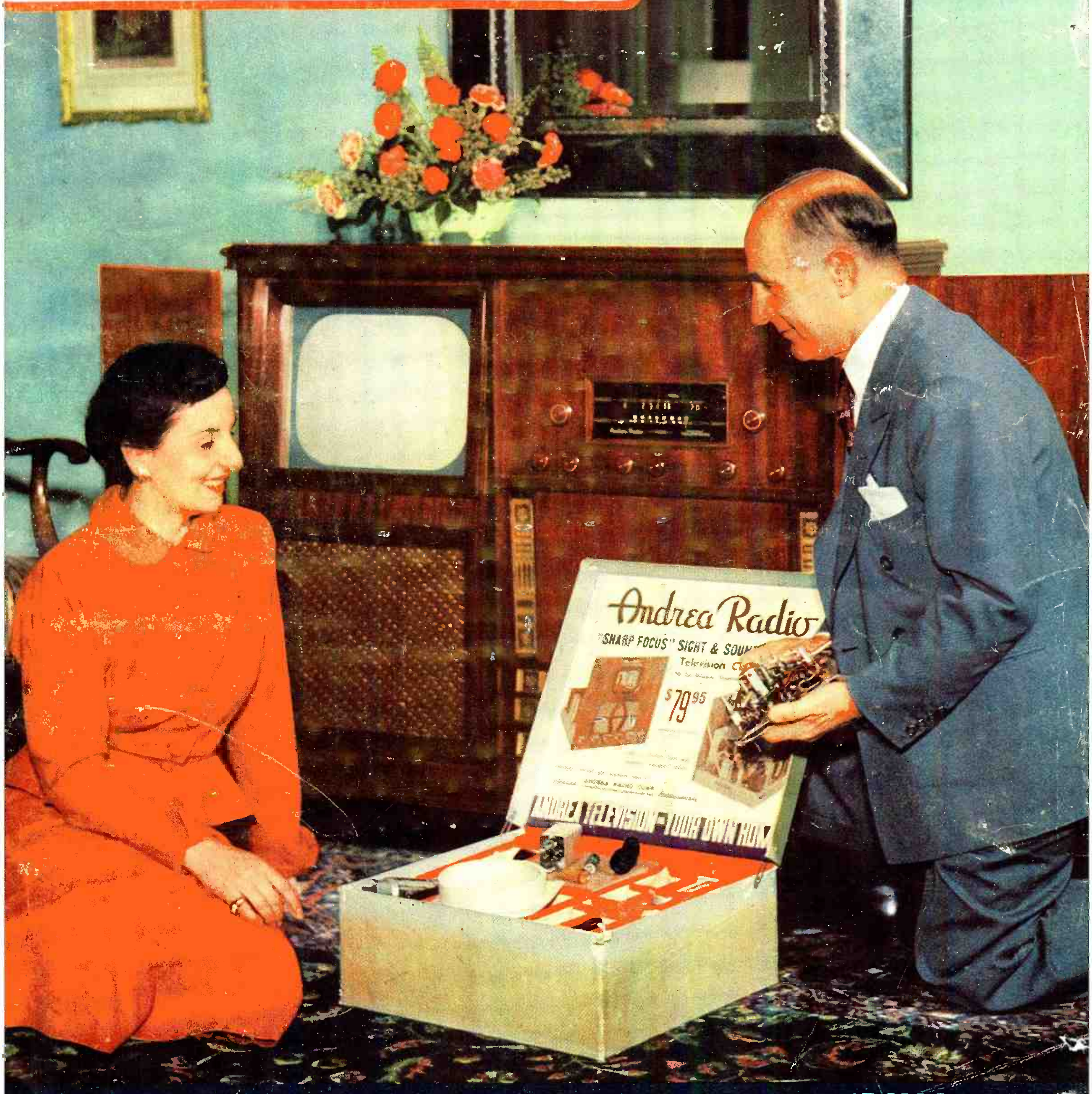
RADIO & TELEVISION NEWS

MAY 1950

RADIO-ELECTRONIC ENGINEERING EDITION



30 YEARS OF RADIO-TELEVISION PIONEERING

PAGE 40

Higher Quality Standards

for TV, FM and AM

THE *QUALITY LEVEL* of RCA miniatures has been continually advanced in step with circuit progress. Improved design . . . more rigid control over manufacture and inspection . . . and more exacting tests, including rigid re-test before shipment, are the reasons why RCA miniatures have unusually uniform characteristics, so important to tubes for television receivers in particular, and also for FM and AM receivers. Their dependability in critical circuits cuts down costly service call-backs.

And now . . . this *extra* quality of RCA miniatures is "packed in so it can't be shaken out." A new type "snug-fit" carton protects tubes against damage by holding them securely in place during transit.

RCA's engineering leadership adds *value beyond price* to the RCA tubes you sell. Your customers know about this advantage too.

Always keep in touch with your RCA Tube Distributor

RADIO CORPORATION of AMERICA
ELECTRON TUBES — HARRISON, N. J.

COVER PHOTO: Frank A. D. Andrea and his daughter inspect one of his early "Neutrodyne" kits in front of a present-day Andrea television set. (Kodachrome by Nick Desmond)

First in radio-television-electronics

RADIO & TELEVISION NEWS

Average Paid Circulation over 200,000

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BE A SUCCESS AS A RADIO-TELEVISION TECHNICIAN

TWO FREE BOOKS SHOW HOW MAIL COUPON

America's Fast Growing Industry Offers You All Three

I TRAINED THESE MEN AT HOME

OWNS SUCCESSFUL BUSINESS
"Today I am considered an expert Radio-Television Technician. I have four employees working in my shop. Repair business has doubled."—PAUL MILLER, Toledo, Ohio.

RADIO ENGINEER ABC NETWORK
"4 years ago, I was a bookkeeper with a hand-to-mouth salary. Now I am a Radio Engineer with key station of the ABC network."—NORMAN H. WARD, Ridgefield Park, New Jersey.

$5 TO $10 WEEK IN SPARE TIME
"While learning, made $5 to $10 a week in spare time. Now have a spare time shop in my home and earn as high as $25 a week."—LEANDER ARNOLD, Pontiac, Michigan.

SERVICING BUSINESS PROFITABLE
"For the past two years, I have been operating my own Servicing business. Net profit, $6,850. N.R.I. training made it possible."—PHILIP G. BROGAN, Louisville, Kentucky.

GETS FIRST JOB THROUGH N.R.I.
"My first job, with KDLR, was obtained for me by your Graduate Service Dept. Am now Chief Engineer, Police Radio Station WQOX."—T. S. NORTON, Hamilton, Ohio.

SEES PROFIT IN RADIO-TELEVISION
"I am operating my own Radio Sales and Service business. With FM and Television, we are looking forward to a very profitable future."—ALBERT PATRICK, Tampa, Florida.

SPARE TIME SERVICE PAYS WELL
"Work only in spare time at Radio and average about $40 a month. Knew nothing about Radio before enrolling with N.R.I."—SAMUEL T. DEWALD, St. Clair, Pennsylvania.

1. EXTRA MONEY IN SPARE TIME

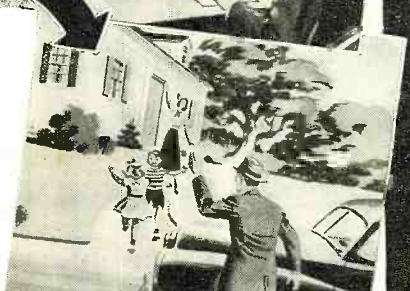
As part of my servicing course, I send you SPECIAL BOOKLETS starting the day you enroll that show how you can make $5, $10 or more a week EXTRA fixing neighbors' Radios in spare time while learning. Tester you build with parts I send helps.

2. GOOD PAY JOB

Your next step is a good job installing and servicing Radio-Television sets, or becoming boss of your own Radio-Television Sales and Service Shop, or getting a good job in a Broadcasting Station. In 1945, there were 943 Radio Stations. Today, about 2,700 are on the air! Result—thousands of qualified men stepped into good jobs. Then add developments in FM, Two-Way Radio, Police, Aviation, Marine, Micro-wave Relay Radio. Think what this means! New jobs, more jobs, good pay for qualified men.

3. BRIGHT FUTURE

And think of the opportunities in Television. Only 19 Stations were on the air in 1947. Today, more than fifty. And the experts say there will be over 1,000 within three years. Manufacturers are producing over 100,000 Television sets a month. Be a successful Radio-Television Operator or Technician . . . get in line for success and a bright future in America's fastest-growing industry!



I Will Train You at Home

You Practice Servicing or Communications with MANY KITS

I've trained hundreds of men with no previous experience to be successful TECHNICIANS. I will train you, too. Or now you can enroll for my NEW practical course in Radio-Television Communications. Train for your FCC operator's or technician's license. You learn Radio-Television theory from clear, illustrated lessons in my tested home study courses.

As part of both my Servicing and Communications course, I send you MANY KITS of modern equipment that "bring to life" theory you learn. Building circuits, conducting experiments with them, introducing and repairing defects, gives you valuable, practical experience. (Some of the equipment you get is shown below.) Everything I send is yours to keep.

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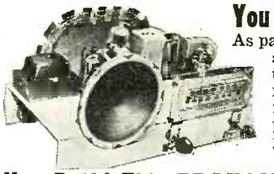
Coupon entitles you to ACTUAL LESSON on Radio Servicing with many pictures and diagrams plus my 64-page book, "HOW TO BE A SUCCESS IN RADIO-TELEVISION" . . . both FREE. See what my graduates are doing and earning. Send coupon today. J. E. SMITH, President, Dept. OER, National Radio Institute, Pioneer Home Study Radio School, Washington 9, D. C.

VETERANS

GET THIS TRAINING UNDER G. I. BILL. MAIL COUPON NOW.

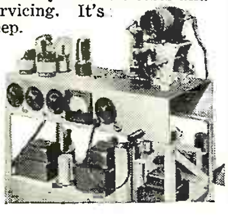
You Build This MODERN RADIO

As part of my Servicing course, I send you speaker, tubes, chassis, loop antenna, transformer, EVERYTHING you need to build this modern Radio. Use it to conduct many valuable tests and practice servicing. It's yours to keep.



You Build This TRANSMITTER

As part of my New Communications course, I send parts to build this low-power broadcasting Transmitter that shows how to put a station "on the air." Perform procedures demanded of Broadcast Station operators, conduct many tests, experiments. It's yours to keep.



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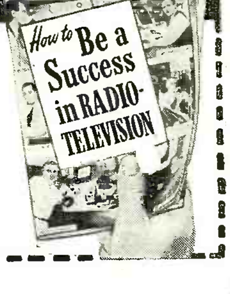

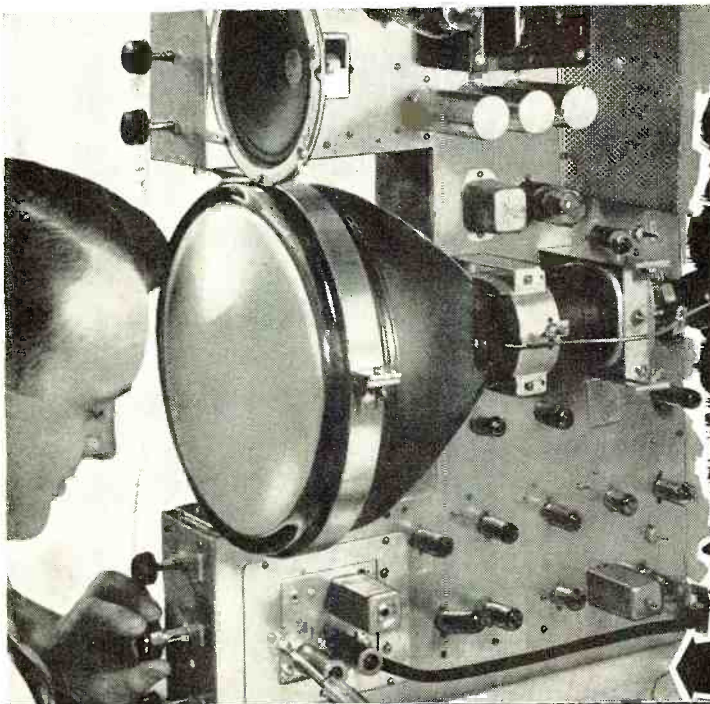

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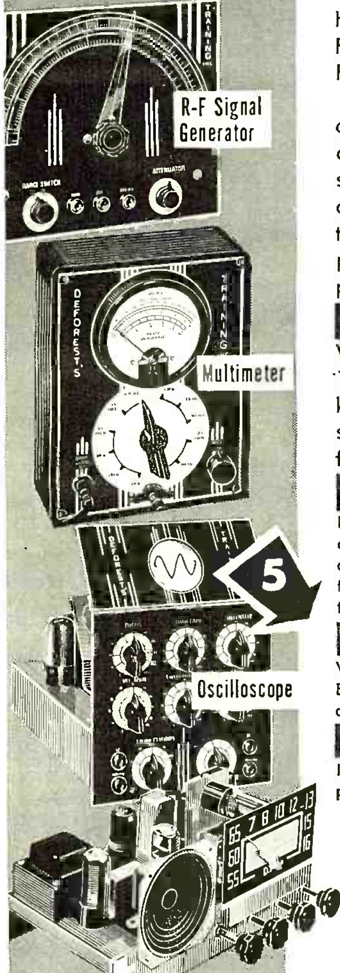

Here is *everything you* need to prepare you at home for FASCINATING WORK, GOOD MONEY and a THRILLING FUTURE in one of America's most promising fields.

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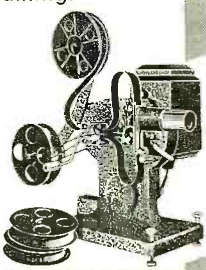

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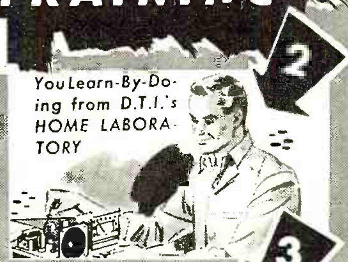

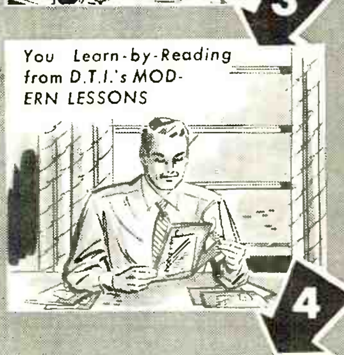

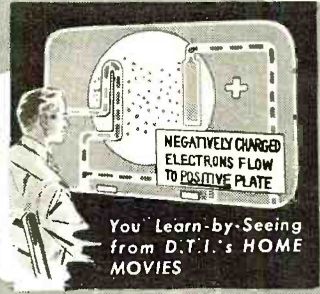

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For the RECORD

BY THE EDITOR

RADIO-TELEVISION SHOPS NEED SHOWMANSHIP

THE past few weeks have been spent by this editor on an extensive field trip in order to gather ideas from radio and television dealers and technicians and to discuss problems of sales and maintenance. We have had the opportunity to "spot check" cities and towns, both large and small.

Eleven states were included in order to make visits in both TV and non-TV areas. We wanted to find out what radio and television dealers were doing to increase sales, what promotion they used, what test equipment was doing to speed the repair of sets, and what we, as publishers, could do to help make their businesses more profitable.

It didn't take many stops to discover that, in comparison to other merchandisers, radio and television shops were far behind in the matter of display of sets and components and that the average service shop presented an unsightly mess to its customers.

The trend in automobile dealer service departments has been toward neatness, cleanliness, and "showmanship." It was only a short time back that such service to automobiles was rendered in space cluttered with old parts, with greasy floors, inadequate lighting, and without specialized equipment.

Today the aggressive auto dealer takes great pride in the appearance and efficiency of his repair department. He knows, from experience, that customers—especially women—won't hesitate to bring in their cars to a well-equipped shop where cleanliness, efficiency, and courtesy prevail.

And so it is in the case of radio or television service shops. We technicians can learn much of specific value by observing methods and techniques employed successfully by other businessmen that cater to the same public.

We can, and economically, tidy up our service benches and rearrange our test equipment to be both workable and presentable. We can clean up the messy (and dangerous) wiring of the line supply on the bench. We can do a bit of painting and arrange our parts cartons to good display advantage. These things come under the heading of "showmanship."

The wearing of a neat shop coat does much to impress the customers. They cost but little and can pay real dividends to the technician.

Many of the dealers we visited actually featured and pointed with pride to their service departments. These, in most instances, were situated at the front of the store by the window for all to see. We were impressed by this method of "showmanship" and can readily see its advantages.

In other establishments, however, the service bench was back in a dark corner and was cluttered with old chassis and dust laden cabinets from as far back as 1930. Visible to customers, these shops certainly couldn't expect to make a good impression with those who had occasion to bring their sets in for repair.

It is particularly important that service technicians who own and use modern, up-to-date service equipment bring it out into the open and give their customers a true appreciation of the "professional" character of the work involved in servicing radio and television receivers.

Good commercial test equipment represents a large investment on the part of the shop owner. Failure to exploit its "showmanship" value is simply missing a good and no-investment possibility.

Conversely, if the test equipment being used is of the type casually thrown together by the service technician, cabinetless, or hopelessly outdated, the shop owner would do well to bury this equipment on the service bench in some remote part of the store. This type of equipment lends no prestige and often might shake the customer's confidence in the service technician to whom he had planned to entrust his radio or video set.

Don't misunderstand us—the amount of beautifully-matched test equipment on a service bench is no infallible criterion of the work capable of being performed in that particular repair shop, but often the customer is far more impressed with such a display of equipment than conditions warrant. It seems to be human nature to seek the external trappings of a successful business and then assume from the visual evidence that here indeed is an A-1 establishment.

There are many service technicians who can perform miracles with a v.t.v.m. and those good little grey cells and more power to him! The point we are trying to make is that if you have invested large sums in modern test equipment don't relegate it to the bench located in the recesses of the shop but have it visible where it can do its bit in promoting "showmanship."

Yes—we radio and TV technicians can learn much by visiting other shops which use "showmanship" and use it to good advantage. Let's give it a try.

. . . . O. R.

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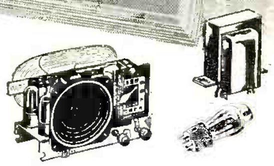

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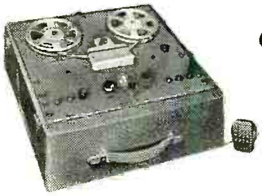

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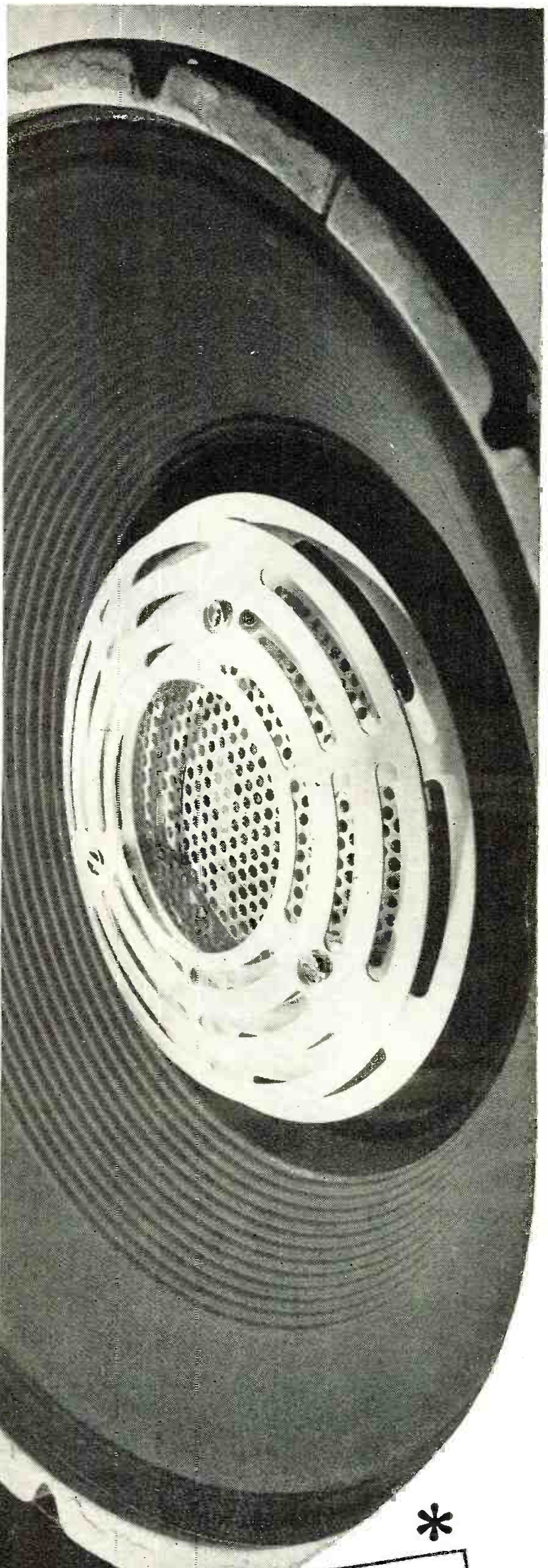

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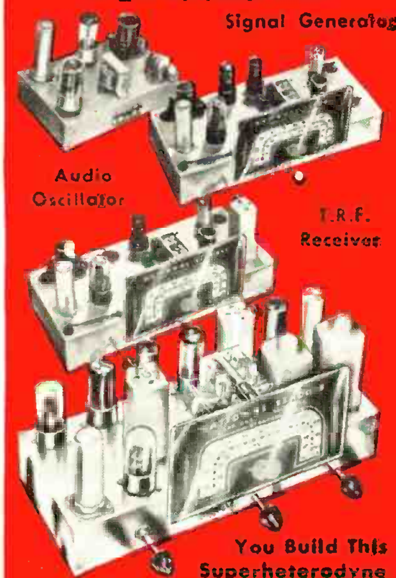

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world's first dual-purpose TV offers 3' x 4' picture—$199.50 list*

NEW! PROTELGRAM "CONVERSION PACKAGE"

makes possible huge 234 sq. in. picture for trade-in buyers

This 2½" 3NP4 is smallest projection tube on market, is lowest in cost ($19.50 retail), produces largest home picture (3'x4').

North American Philips has really BIG PROFIT NEWS for you—and BIGGER, BETTER PROTELGRAM TV pictures for your customers, up to 3' x 4' in the sensational NORELCO DUO-VUE now making its world premiere at $199.50 — more television picture for less money than ever before offered!

What is there in it for you? PROFITS from PROTELGRAM'S Four-Way Plan described on the right.

Philips makes it easy and profitable for you to—

1. Sell PROTELGRAM to set builders interested in bigger pictures — 13½" x 18".

2. Sell PROTELGRAM for custom-built, large-screen installation, up to 3' x 4' for homes, clubs, bars, hotels, etc.

3. Sell NORELCO DUO-VUE, television's newest, finest and biggest picture used with the customer's direct-view table set to produce 3' x 4' pictures on a home-movie screen. A flip of a switch selects either picture, and you can connect DUO-VUE to almost any table-model receiver in less than an hour.

4. Sell PROTELGRAM in a conversion cabinet to customers wanting to convert their 10 or 12½" direct-view receivers to a picture larger than a 20" tube gives. And you can make the conversion in less than one hour following the simple, straightforward instructions provided.

Right NOW is the time to make extra profits with PROTELGRAM. Read every word of this ad. Then get in touch with your distributor or send the coupon now for all the facts.

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Norelco

PROTELGRAM

**Prices slightly higher west of Rockies. Connection charges extra.*

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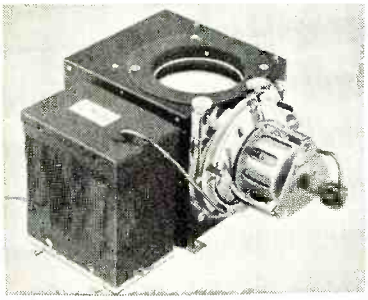
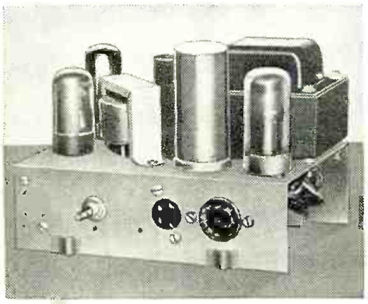
PROTELGRAM



PROTELGRAM UNIT

Projection box measures only 8½"x9"x13", contains optical system and alignment assembly, is designed for quick easy service and adjustment. The 2½" 3NP4 projection tube is long-lived, extremely low in cost. Compact 25KV high-voltage unit is only 8½" x 4½" x 7".

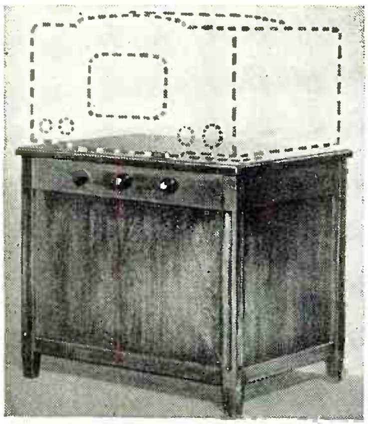


AUXILIARY CHASSIS

New auxiliary chassis fills additional electrical requirements essential to adaption of TV chassis to PROTELGRAM; makes change-over quick and easy. Measures only 8" x 12" x 4".

CONVERSION CABINET

Console cabinet measuring 22" x 27¾" x 46½" provides space for installation of customer's 630 Type TV chassis, comes equipped with complete PROTELGRAM system, auxiliary chassis, cabinet mirror and viewing screen.



NORELCO DUO-VUE

Beautiful cabinet contains PROTELGRAM unit. Only 23½" high. 20" x 26" top holds most any 10" or larger direct-view table model. Concealed ball-bearing casters make it easy to pull out from wall for 3' x 4' viewing on external screen. Offers customers choice of two picture sizes for small and large group viewing.

FOUR-WAY Profit Plan

Sell PROTELGRAM to the man who builds his own!

Thousands of TV kits have been sold to the man who likes to build his own equipment. These handymen are ripe for PROTELGRAM, because they can combine it with a TV chassis, get life-size TV at a reasonable cost.

Sell PROTELGRAM to custom set buyers

Clients who want built-in installations in walls or cabinets are perfect prospects for PROTELGRAM. Huge picture size, plus compactness and flexibility, makes it the answer for this type of user.

Sell PROTELGRAM to trade-in customers

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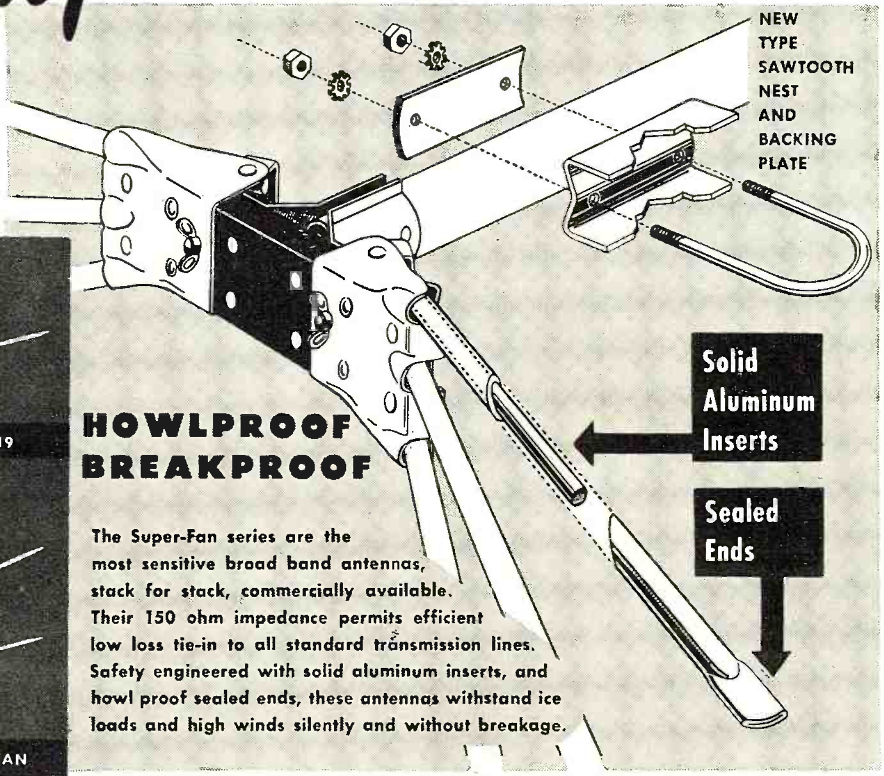

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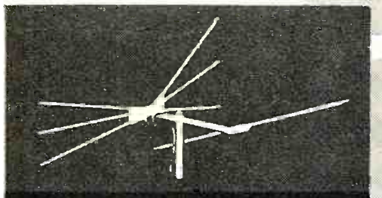

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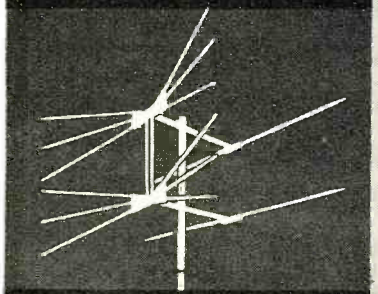

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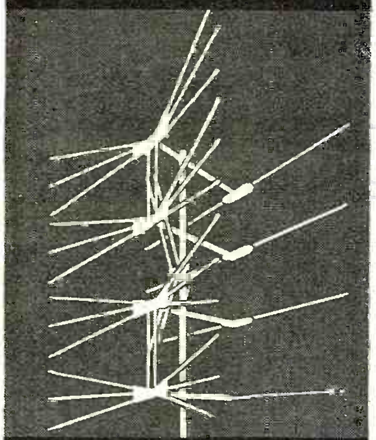

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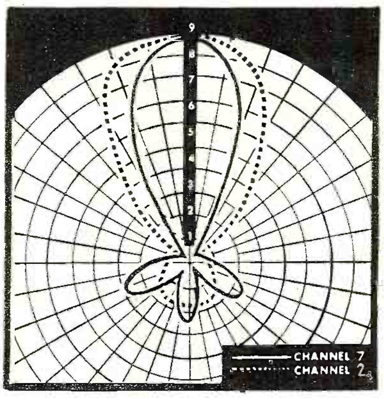

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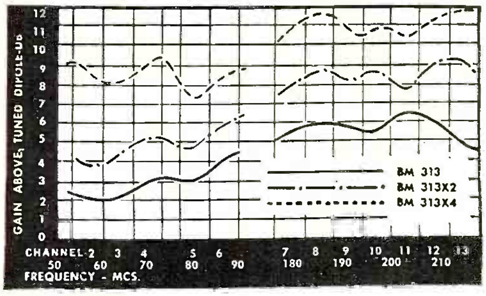

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313X2	4.8	5.0	6.1	5.7	6.8		9.0	9.7	9.3	9.4	8.8	9.8	10.0
313X4	9.0	8.2	9.0	7.5	8.5		11.0	11.4	10.6	10.8	10.3	11.3	11.9

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Spot Radio News

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By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

TV COLOR activity zoomed on famed Constitution Avenue, in the electronic labs of the Commission at Laurel, Maryland, and in the labs at Princeton, New Jersey, Madison Avenue, New York City, and San Francisco, California, as the furiously-paced renewed hearing and test sessions began in the nation's capital in the early days of spring.

The second comparative-test session roared in as the curtain raiser for the three-colored event, with both the audience and performers, throbbing with first-night jitters. With a room about twenty-five by thirty feet as the theater, twenty-one receivers as the equipment, and about 125 persons looking, listening, and adjusting, the scene was quite a hectic one. There were miles of overhead cables, crowded folding chairs and swaying viewing heads to add to the confusion and audio bursts from different programs which caused many a flushed face. Reaction to the tests ran from very good to completely inconclusive. From the data that was collected, it did appear, however, as if the technical group was able to gather information that would be very helpful in evaluating the systems demonstrated.

Receivers in the room and also installed in a balcony, included ten-inch, twelve-inch, sixteen-inch and fifteen-by-twenty and eleven-by-fourteen inch projection models, all of which were operated simultaneously from antenna setups installed by the color proponents. Signals came from WNBW, operating on Channel 4, for the *RCA* sets; from WOIC, telecasting on Channel 9, for the *CBS* receivers; and from WMAL, using Channel 7, for the *CTI* models. Program material included wedge test patterns, moving horizontally and vertically to simulate camera movements, rotating paddles of various colors moving at varying speeds, keyboard color and black and white patterns, and fixed and live copy. In the fixed setups were cereal boxes, toweling, canned good containers, while the live portions featured dancers, models, and singers attired in bright costumes.

Laboratory signals were also aired to enable the specialists to study such problems as fringing, interference, and ghost reception.

That the test period was a momentous one became strikingly obvious when the audience was surveyed. For among those in the lab room were David Sarnoff, Dr. C. B. Jolliffe and D. F. Schmit of *RCA;* Dr. Frank Stanton and Dr. Peter C. Goldmark of *CBS;* Dr. Allen B. Du Mont and Dr. Thomas T. Goldsmith, Jr., of *Du Mont Labs;* Kenneth Norton of the Bureau of Standards; Raymond C. Cosgrove, RMA prexy, and Jack Poppele, prexy of TBA. Canada was also represented with C. W. Browne and W. A. Caton, controller of radio and chief inspector of radio, respectively, of the Department of Transport, as well as W. B. Smith, engineer in charge of the department's broadcast division and W. Hayes of the *Canadian Broadcasting Company.*

During informal interviews, it was learned that some of the FCC representatives were quite impressed with the demonstrations. Madame Commissioner Frieda Hennock indicated that she felt that the *RCA* system had displayed significant improvement over the setup shown during the first series of comparisons.

AN OFFICIAL VERSION of what the Commission, as a whole perhaps, thought of the tests appeared in quite a frank talk by FCC Headman Wayne Coy, at a conference at the University of Oklahoma. Commenting on the *CBS* system, for instance, Coy said: "The system proposed by *CBS* has been in development longer than any of the other two systems and has progressed farther than any of the other two systems. The system has worked well and produces pleasing color pictures of good quality and good color fidelity. At the present stage of development the system must necessarily use a mechanical rotating filter as the means of producing color. Since the mechanical filter must be more than twice the size of the tube, it is obvious that direct view tubes under this system, as a practical matter, can be no larger than ten to twelve inches . . . the larger sixteen to twenty-inch tubes cannot be used with the color wheel. . . . In addition, the *CBS* system involves a change of transmission standards in two important respects. First, the number of

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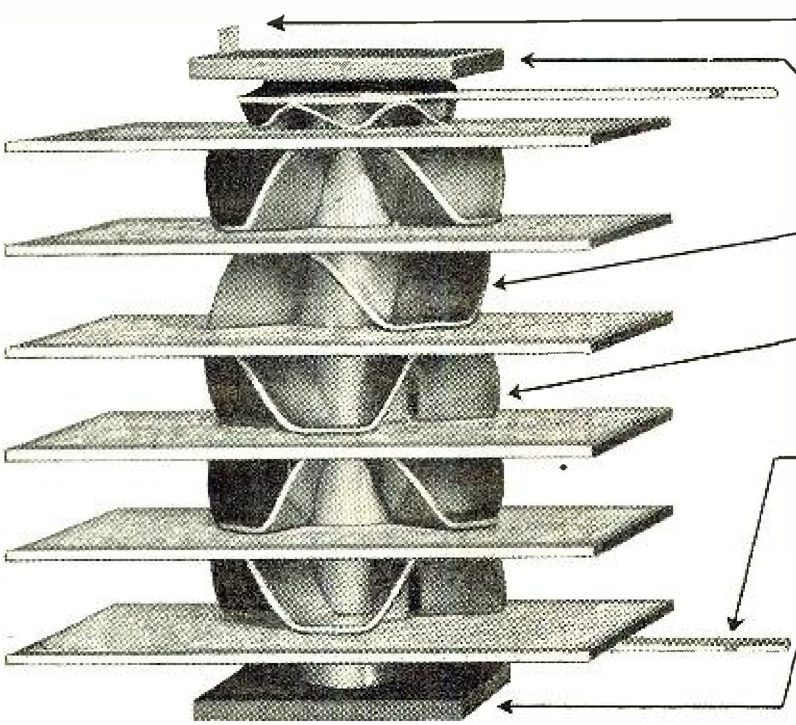

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lines is reduced from 525 to 405. Secondly, the number of fields is changed from the 60 of black and white television, to 144 for color. *CBS* urges that the additional intelligence which results from color more than compensates for the loss in geometric resolution which results. However, when a station is broadcasting color programs, in accordance with *CBS* standards, an ordinary black and white receiver will not be able to receive the program in black and white, unless either a manual or automatic adapter is incorporated into the black and white sets. *But that is not color television.*"

Then the FCC spokesman went on to describe the *RCA* system, which he recalled was very unsatisfactory in the early demonstrations, but displayed improvement as the recent tests revealed.

"However," he added, "at the present time, the system relies on three tubes to produce the color image. This is costly and a cumbersome procedure, and involves fundamental problems of registration. If the system works out, present black and white receivers will be able to receive color broadcasts in black and white, with no change in the receiver."

"But," he emphasized, "that is not color television either. . . . Getting black and white reception on present receivers from color broadcasts deals only with an economic aspect of the problem; namely, obsolescence of present-day receivers or lack of obsolescence or the cost of preventing such obsolescence as occurs when television programs, which one wants to see, are broadcast in color. . . . One additional fact about the *RCA* system is that at the present time a color signal will not pass through the coax presently available. The cable width used at present is about 2.7 megacycles and the *RCA* system requires about 4 megacycles. An *RCA* signal passing through the 2.7 megacycle coax emerges as a black and white signal."

In commenting on the third system, the *CTI*, the Commissioner noted that during two attempts demonstrations before the Commission were not successful and that a third was in prospect.

Reviewing the advantages of the six megacycle systems, unveiled during the hearings and recent comparison tests, Coy said that . . . "Certainly a system that would allow black and white reception on present-day receivers would be most desirable. . . . At the present time *we do not have such a fully developed system.* On the other hand, we do have a workable color system with good picture quality, but it is handicapped by limitations on tube size and the fact that it cannot be received by present black and white receivers without a change."

The answers to these puzzling problems involve many factors, Coy emphasized. He pointed out that the Commission must decide whether it's wise to choose an undeveloped system because its color transmission can be received in black and white on existing receivers, or choose a workable system whose color transmissions cannot be received on existing receivers in black and white, or permit all of the systems to have more time for experimentation and development.

Then Coy added: "If more time were to be allowed for experimentation and development of all color systems, could the freeze be lifted and permit black and white television to go ahead? Or should the freeze be kept on until it is possible to write engineering standards for color television?"

The FCC chairman then posed several more key questions. He asked: "If there were to be time for further experimental and developmental work, is there any action, which, taken now, would protect the public presently buying television receivers in a manner which would reduce the obsolescence factor, in the event the Commission decision favored a color system incompatible with present black and white standards? . . . Given the assumptions I have just stated, could it be expected that the industry would immediately build manual or automatic adapters in all receivers? Would the relative small cost for such an addition to a set be worth it, in terms of giving the widest possible latitude for decision, after further experimentation extending perhaps a year or more? . . . Or must we write multiple standards and let the public decide in the market place which is the better system? And is there any way to assure the future use of all color sets if such a proposal is followed?"

The Commissioner then placed these questions before the audience: "Is it a proposal (the multiple-standard proposal) in which the public will willingly accept the risks and costs involved? Or must we reject all of the systems and say that we will proceed immediately with black and white television in both bands and let color wait until another generation or two, and in another, and now unexplored, portion of the spectrum?"

"These are the very difficult questions which the Commission has to face and resolve before it can decide the color television issue," Coy declared. "And," he added, "I am not prepared to answer these questions now."

Commenting on queries as to the hearing's end, in which everyone is so interested, Coy said: "I make no prediction when the hearings will end, or when a decision will be made. I wish the decision could be made tomorrow, but it won't be."

He said that he hoped, but would not predict, that the Commission would be able to resume the processing of applications before the year is out.

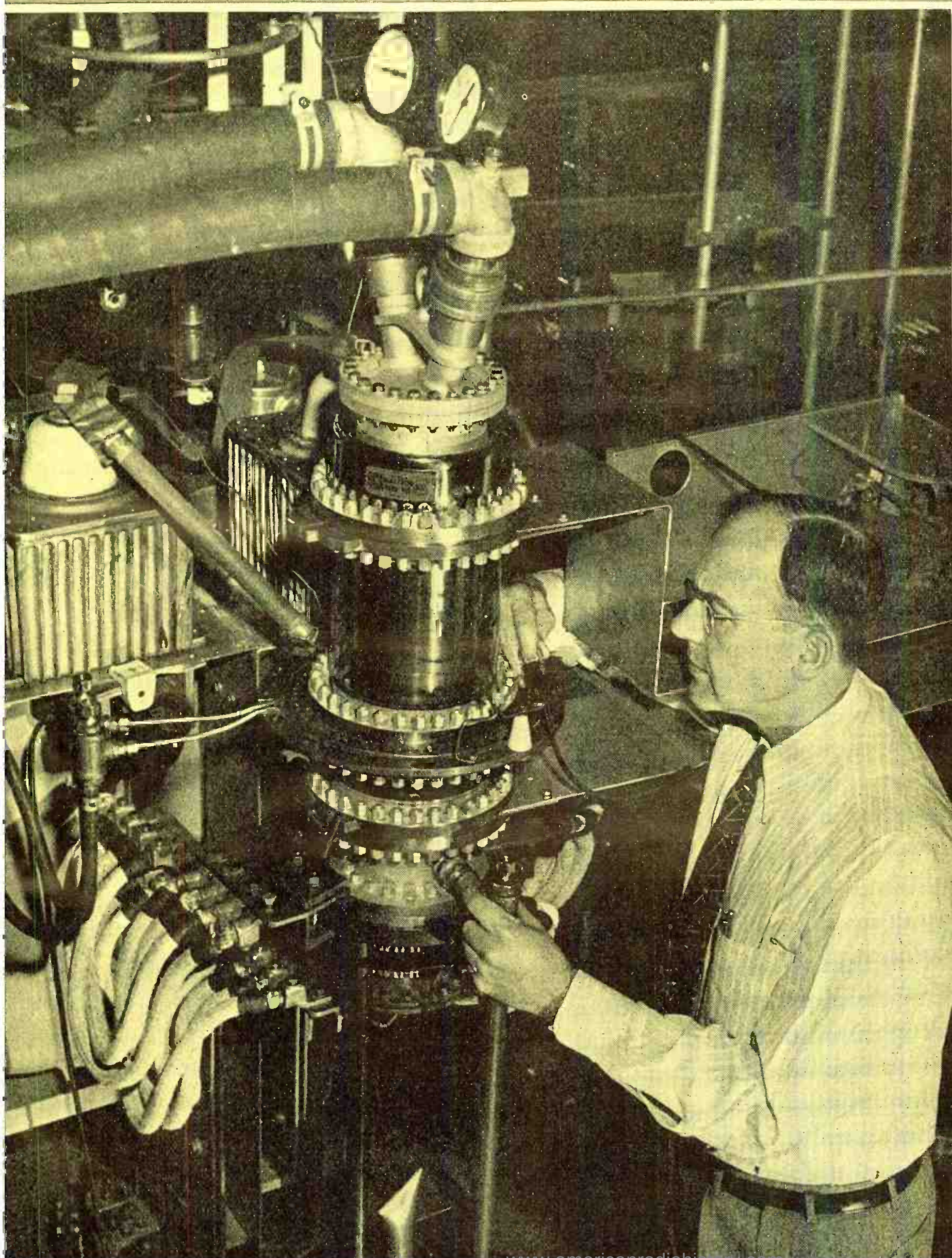
CTI, the wallflower contestant in the color race, came to life a few weeks after the official tests, with its own

(*Continued on page* 112)

MAY, 1950

RADIO & TELEVISION NEWS

RADIO-ELECTRONIC Engineering



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DEPARTMENTS

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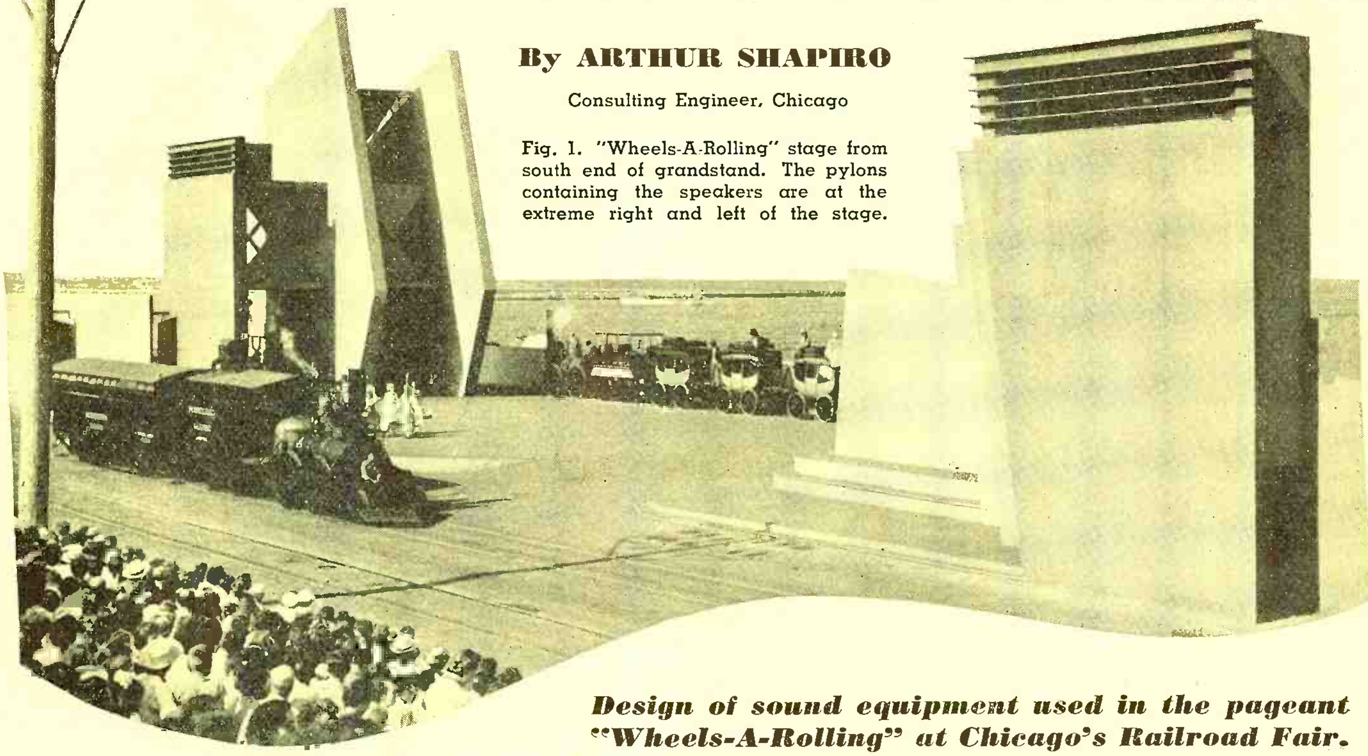
COVER PHOTO—Courtesy of RCA

RCA's new "Super-Power Beam Triode" 5831, mounted for testing, is examined by Dr. L. P. Garner, head of the Advance Development Lab of the RCA Lancaster tube plant. The new tube, which can be operated with maximum rated plate voltage and plate input at frequencies up through the "Standard Broadcast Band" and much higher, is being tested at 1,000,000 watts input.

CUSTOM SOUND INSTALLATION



By ARTHUR SHAPIRO

Consulting Engineer, Chicago

Fig. 1. "Wheels-A-Rolling" stage from south end of grandstand. The pylons containing the speakers are at the extreme right and left of the stage.

Design of sound equipment used in the pageant "Wheels-A-Rolling" at Chicago's Railroad Fair.

IN designing the sound installation for the great pageant, "Wheels-A-Rolling," presented at the Chicago Railroad Fair of 1948-49, many unusual conditions had to be met. The tremendous scope of this show can be realized by the great numbers of people and equipment placed on the stage during the one hour and eight minutes of pageantry that told the complete story of transportation in America from early Indian times to the present day. To present this show required a cast of over one hundred actors, 40 engineers, 25 stagehands, stablehands, orchestra, singers and production staff—a total of 250 people who, together with the 94 horses, 35 locomotives and their trains, 32 old automobiles and 100 pieces of horse-drawn equipment, were all controlled from a central point by means of sound, intercommunication, buzzer, light and railroad signal equipment which had to be designed especially for this show.

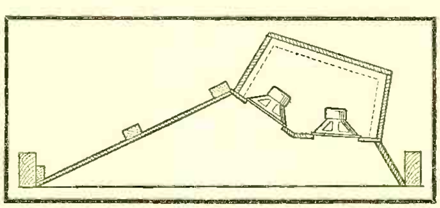
The audience of 6200 that witnessed this spectacle four times daily was housed in a grandstand that measured 318 feet from stage right to left and 80 feet deep starting at ground level at the stage and rising to 30 feet at the rear of the stands. The grandstand had a metal roof extending from end to end and covered approximately two-thirds of the seats. The stage proper was over two hundred feet wide and 100 feet deep with its wings extending either end to make a total play area 500 feet long.

The pageant was historical in tenor with variety and comedy that made for a complete and enjoyable show. Music, especially arranged by Isaac VanGrove, was played throughout the show by an orchestra housed in a special band shell at the south end of the grandstand. The offstage singers were also in the orchestra shell as was the control keyboard for the *Deagan* Celesta-Chime, an electronically amplified chime which will be noted later.

Two narrators, located in a booth at the top of the grandstand, told the story of transportation and gave descriptions and comments of the events as they were enacted on stage. Actors' speaking parts and group singing were picked up on stage by means of concealed microphones which were plugged in under cover of stage action.

The pageant was scheduled for presentation four times daily for the one-hundred days from June 25 to October 2nd with performances at 2, 4, 7, and 9 P.M. From this schedule it can be seen that the equipment would be in almost constant service from early afternoon through ten at night. Before the actual show started, there was recorded music to fill the time while the audience found their places. This music was presented for one hour before the 2 and 7 o'clock performances and one-half hour before the other shows. In case of power failure on the grounds, there was a gasoline powered generator as a stand-by to operate the sound system only, so that the show could be presented during the day and to keep the sound operating to avoid panic in the event of power failure during the night shows.

Fig. 2. Cross-section of the baffles, showing orientation of the speakers.



Heavy-duty and trouble-free equipment was a definite requirement. Such items as weatherproof "Twist-Lock" microphone connectors, instant metering of circuits, duplicate wiring and stand-by units were all provided to obviate the possibility of breakdown of the equipment. Since the stage was located on the lake front, the weatherproofing of the equipment was a definite factor to be considered. The high humidity made it necessary to take special care that no space was imperfectly sealed in the equipment that would allow the formation of condensation. On open equipment, sufficient ventilation was required to prevent condensation even when the humidity hovered around 98 per-cent. As an indication of the severe humidity, it was not unusual to pick up a tool that had been perfect the night before and find it covered with rust the next morning.

As can be seen from the accompanying drawing, Fig. 7, eleven microphone receptacles were installed, four in the orchestra, one in the room below the orchestra (used for the Celesta-Chime), four on stage and two in the narrators' booth. These receptacles were of the heavy-duty, three wire "Twist Lock" type mounted in weatherproof condulets with spring loaded lift covers. *Shure* Model 556 Super-Cardioid microphones, set at 250 ohms, were used in all locations except at stage right where a lapel microphone was used in front of the speakers by the actor portraying Abraham Lincoln. This microphone, a high-impedance crystal, required a transformer at the point where it was plugged in to feed the 250 ohm balanced input line.

All microphone lines in the stage area were run underground in steel conduit to a junction box set in the center of the stage apron and then through a two inch conduit under the railroad tracks at the front of the stage to the front of the grandstand where they joined the lines from the orchestra pit. The eleven microphone lines were then brought up to the operating position near the top of the grandstand to a 24 jack patch panel. This panel terminated all the microphone lines and normalled them through to the ten console inputs. The patch panel was installed to permit the instantaneous substitution of an unused console preamp in case of failure of one in use. Inserting a patch cord in the top, or microphone, row of the panel automatically disconnected both sides of the line and transferred the incoming signal to the plug which could then be inserted into the bottom, or console input, row. The eleventh microphone line terminated in a fixed "H" pad. This line was used for the electronically amplified Celesta-Chime. The chime preamplifier fed the signal to the line at 500 ohms and zero level. The front side of the pad fed the signal at 500 ohms direct to either of the loudspeaker systems described below, and the back side of the pad fed through a patch cord to one of the console inputs at 250 ohms and -55 db. Normally the patch panel operated with only one cord in use as all other circuits were normalled through.

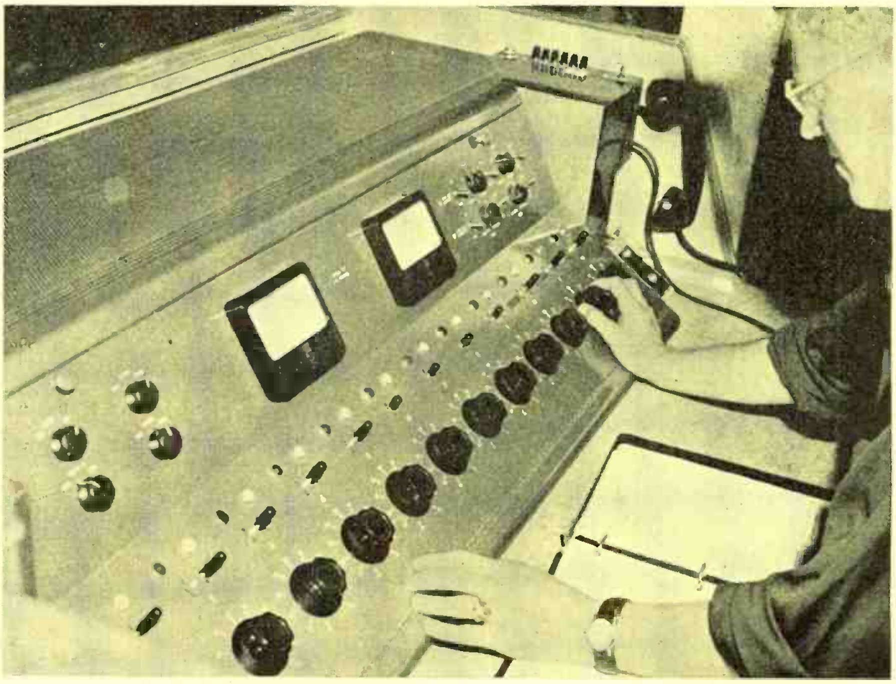
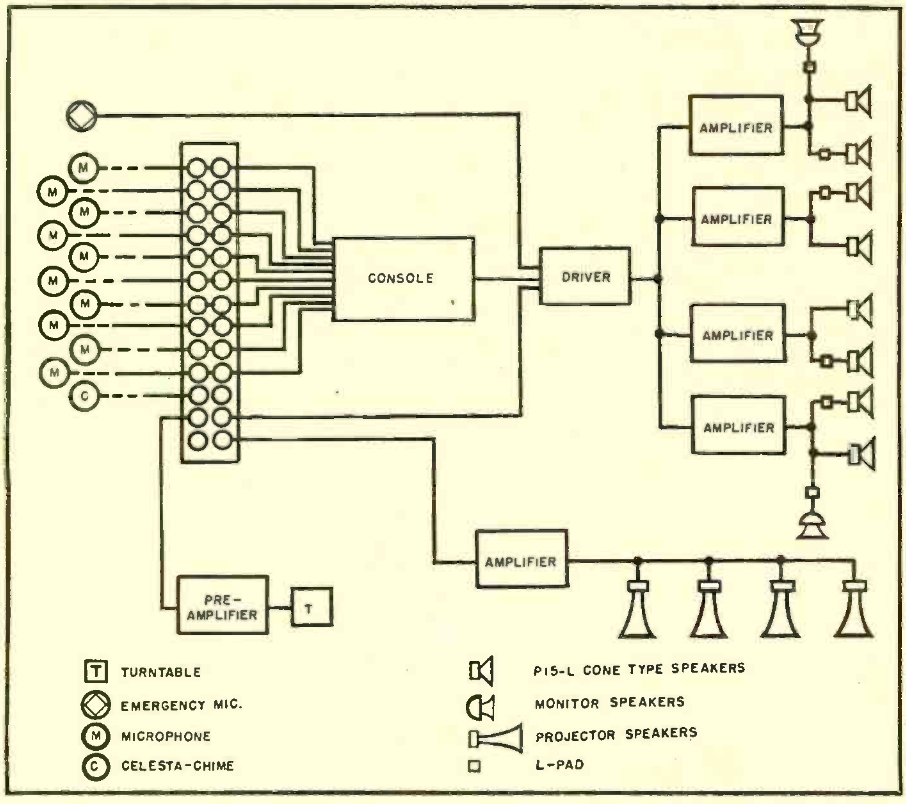


Fig. 3. Ten position, dual channel custom-built control panel in operation. One of the telephone-type intercom masters is visible at the extreme right.

Fig. 4. Block diagram showing essential components of the complete system.



The custom-built console, Fig. 3, contained ten independent preamplifiers feeding through a fader and switch to either of two outgoing channels. Each channel featured independent VU meters, *UTC* tone equalizers and amplifiers, master faders and output switches. Each preamp position had red and white indicator lights to show which channel was being fed. In operation, the "Red" channel was used for music and the "White" channel was used for speech. This enabled the operator to control the fading of several microphones with a single control. In all there were 37 tubes in the console, three in each preamp and the balance in the equalizer and output section. To eliminate any possibility of hum pickup, all filaments and also all indicator lights were operated on 12 volts d.c. The power supply, mounted within the special weatherproof cabinet, consisted of a heavy duty selenium rectifier for the low voltage and a 5U4G for the plate voltage rectifier. The output of the console was fed through the patch panel to the line amplifier-driver located in the main amplifier racks in the director's booth. This driver amplifier had provisions for additional high-impedance microphone inputs as well as the 500 ohm low level input. One of these high-impedance inputs was utilized for the director's break-in microphone for use in case of serious accident or emergency on stage. This microphone could break into the system regardless of the status of any other microphones.

The output of the driver amplifier fed four 80 watt booster amplifiers which were limited to approximately 50 watts output each. These boosters were mounted in one rack and were plug connected so that, in case of a failure, a spare could be quickly interchanged. The need for instant changeover was not deemed necessary as each amplifier fed only one-half of the right or left side of the stage, and failure meant only a slight reduction of volume and would not interrupt the show.

The loudspeakers, by far the most important pieces of equipment in the installation, consisted of eight *Jensen* P15-L cone type speakers specially weatherproofed and treated. These speakers were mounted in special baffles, Fig. 6, and connected two to an amplifier. There are several unique features in the design of these baffles and a study of Fig. 2 will show how each individual motor was oriented to a specific coverage area relative to the grandstand. The pylons in which these units were mounted were not equally spaced and were different distances from the grandstand. This required that the speaker coverage areas be accurately plotted.

Due to the comparatively small difference in angle of each pair of speakers, it was decided that two speakers would be mounted in a common horn and rear enclosure. The loudspeakers had a downward tilt of approximately 10 degrees and the "floor" of the baffles sloped 15 degrees. This angle placed the aural center of the unit at the middle row of the grandstand. These horns were made of three-quarter inch marine grade plywood and finished with flat black paint on the inside so that the speakers were not visible from the audience. The tops of the pylons which supported these large baffles were built with an opening sixteen feet long and four feet high faced with one-quarter inch square mesh screening and treated architecturally with horizontal two by six planks as shown in Fig. 1.

It was evident that with the great variation of distance that the sound had to travel to reach various parts of the grandstand, some control was necessary to drop the level of those speakers operating with the shortest "throw". This was accomplished by inserting a heavy

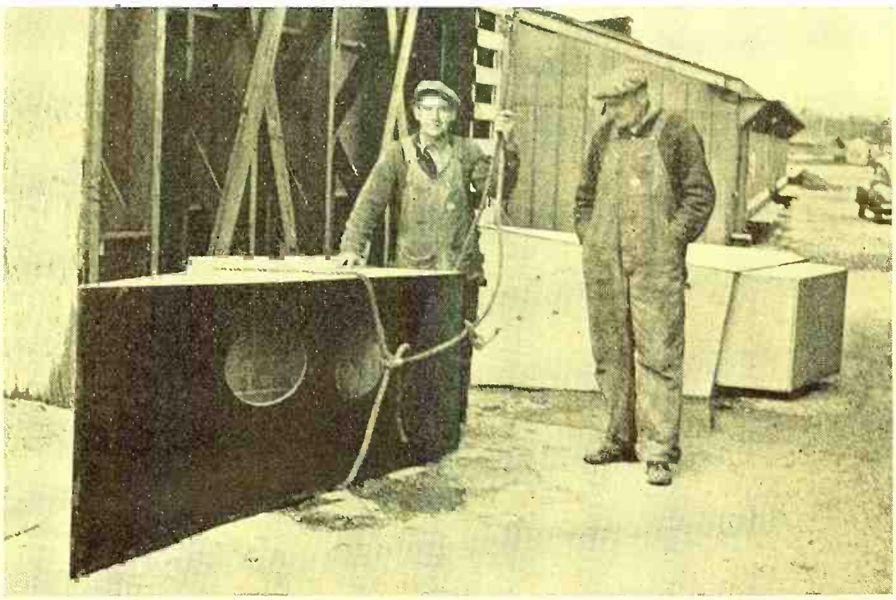


Fig. 5. Two of the special dual loudspeaker housings before being hoisted into place. Flare of horn and mounting of speaker enclosure can be noted on rear horn.

25 watt "L" pad in the line of each of the two inside speakers of each pylon. In the case of the north pylon, where there was a ladder and platform, these controls were mounted on the speaker enclosures. In the south pylon where the speakers were inaccessable, these controls had to be mounted in a weatherproof box remote from the speakers. Once these controls were set by experimentation and measurement after the installation was completed, they were not changed for the rest of the season. Referring to the block diagram, Fig. 4, it can be seen how these controls were installed. The entire grandstand was covered with a variation of not more than 6 db. This was accomplished by sound pressure measurement and setting each booster amplifier separately and then setting the "L" pads on the individual speakers.

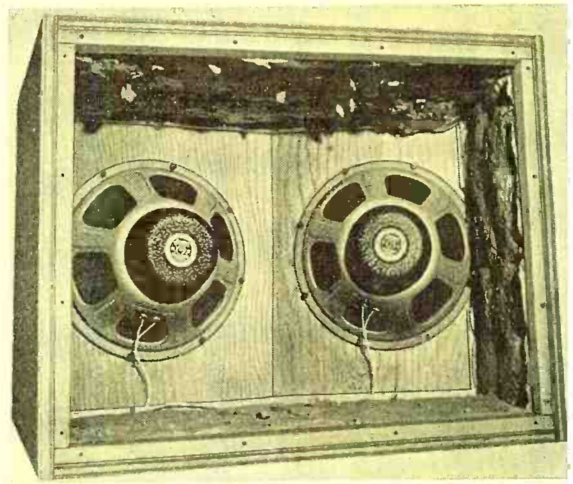
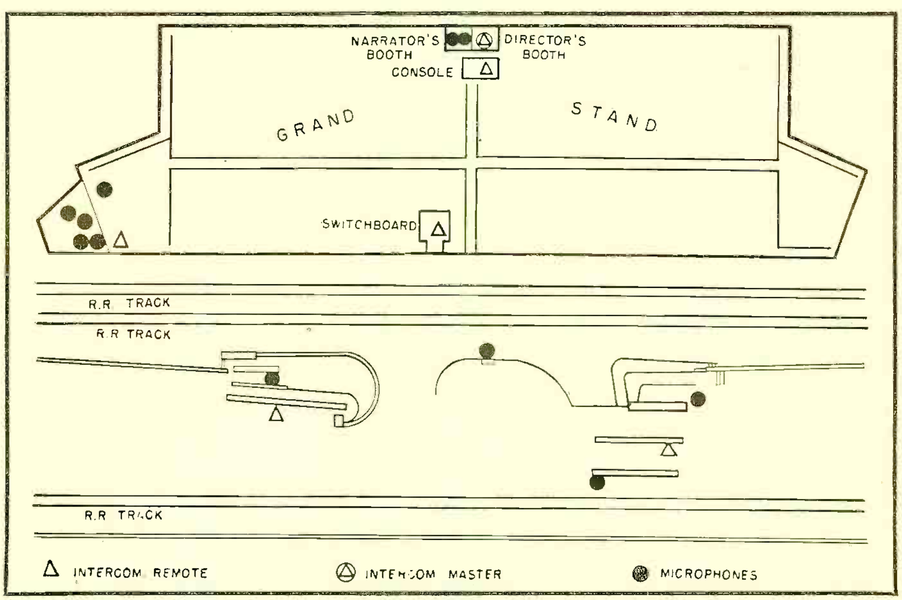


Fig. 6. Dual speaker enclosure showing speakers mounted on individual sections. Note lining of sound absorbent material.

This may seem to be adjusting rather

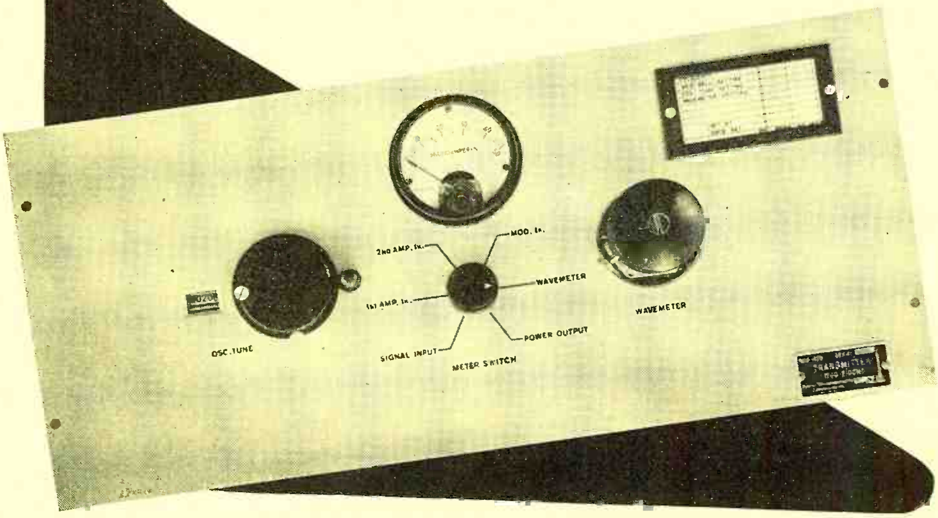
(*Continued on page* 31)

Fig. 7. Drawing showing the location of various components of the system.



MICROWAVE TRANSMITTERS

By J. RACKER
Federal Telecommunication Labs.



Typical microwave transmitter using a lighthouse oscillator.

First of two articles discussing the generation, modulation, and frequency control of microwaves.

THE compactness and simplicity of microwave transmitters is of great interest to all engineers, particularly so to most "low frequency" engineers accustomed to regarding point-to-point transmitters in terms of large size. The main reason for the reduction in size—for equivalent service—is the large power gain obtained by microwave antennas. It is generally true that the higher the frequency, the more expensive and inefficient the generation of power but, due to the increase in antenna gain, less transmitter power is required. It is therefore possible to operate at higher frequencies—all other factors remaining equal—without too much loss in over-all system efficiency, provided directional point-to-point transmission is desired.

Since it is more expensive to operate at microwave frequencies (for a given power output), virtually all transmitters operating in this band employ high level modulation, i.e. one r.f. stage is used with the modulating voltage amplified to a sufficient degree to modulate the final at the desired power output level. Thus in considering the design of a microwave transmitter, we are primarily interested in the final stage—all other stages employing conventional techniques.

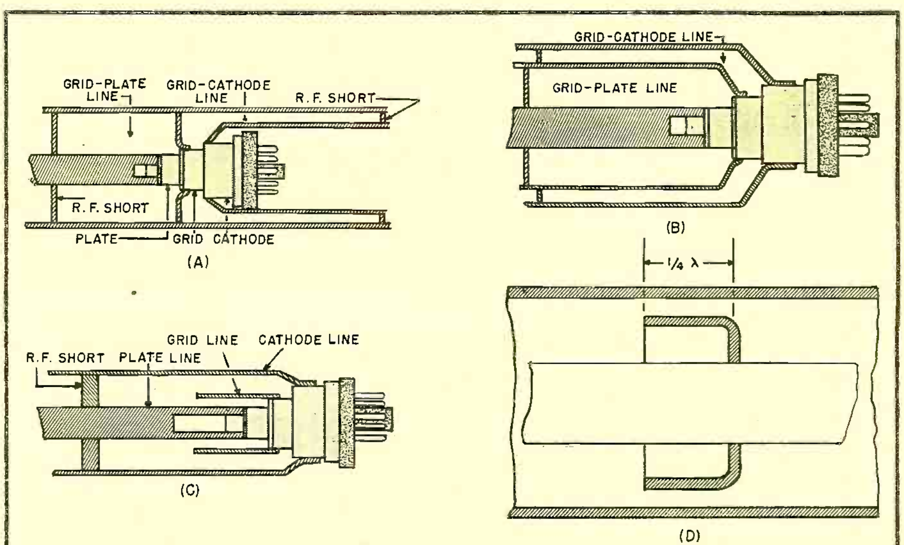
Microwaves can be generated in a number of ways. The most important of these are the lighthouse triode oscillators, klystrons, magnetrons, and traveling wave tubes. With the exception of the lighthouse triodes, the tubes used at these frequencies are as different in concept and design from conventional tubes as amplitude modulation differs from frequency modulation. The important characteristics of these four methods of microwave generators are:

1. *Lighthouse Triodes*. Operating range: up to about 3300 mc.; peak power of the order of kilowatts depending upon frequency and duty cycle; average power of the order of watts. This tube requires an external cavity designed by an engineer. This cavity is permanent and only the tube must be replaced when it burns out (in contrast to other tubes as will be noted), therefore from a long term viewpoint it is the most economical method. Requires relatively elaborate automatic frequency control systems when a high degree of stability is required, can be pulsed, operated c.w. or amplitude modulated. Difficult to frequency modulate.

2. *Klystrons*. Frequency range: 900 to 21,000 mc.; power (peak and average) of the order of 5 watts depending upon frequency; efficiency is poor—less than 10%. Cavity is built right into tube and therefore no special cavity design is necessary unless other design problems are involved. Entire assembly must be replaced if tube goes bad. Can readily be frequency modulated, electronically tuned and frequency controlled (a.f.c.). Requires multiple, well regulated power supplies which are relatively expensive and bulky. Cannot readily be amplitude modulated.

3. *Magnetrons*. Frequency range: 900 to 30,000 mc.; peak power of the order of megawatts depending upon frequency and duty cycle; average power of the order of kilowatts depending on frequency; efficiency is very good—better than 50% depending on frequency. Cavity built right in and entire assembly must be replaced if tube goes bad. Good frequency stability—depends only on expansion of copper. Not easy to

Fig. 1. (A) and (B) Two types of double coaxial resonator circuits. (C) Re-entrant cavity circuit. (D) Quarter-wave choke used as r.f. shorting plug.



a.f.c., amplitude or frequency modulate. Usually used for c.w. or pulsed applications.

4. *Traveling Wave Tubes.* Frequency range: 500 to 10,000 mc. (and higher); power, c.w., is of the order of hundred watts depending upon frequency; efficiency may be as high as 60%. These tubes are particularly noted for their broad bandwidth. At the present time they are largely experimental and show great promise for the future.

This brief summary of the characteristics of the four major methods of generating microwaves indicates the primary considerations confronting the engineer in designing the transmitter. When the power output, carrier frequency, and method of modulation are specified, the choice of the optimum method of generation is usually apparent though other system characteristics such as bandwidth, frequency stability, and equipment size should also be evaluated before the final selection is made.

Transit Time Effect

It is known that a finite period of time is required for an electron to travel from the cathode to the plate of a tube. This period of time is called the transit time and at low frequency ranges it is negligible compared to time required to evolve one cycle. However, starting at about 500 mc., the time required for one cycle of operation is less than 0.002 microseconds which is comparable to the transit time in most conventional tubes.

This fact invalidates many of the characteristics and design principles governing these tubes since the assumption had been made that the electron stream flowing from cathode to grid traveled under essentially static conditions, i.e., transit time small compared to time variation of tube potentials. However, when the transit time becomes comparable to the period time, then the tube conductance is increased and tube efficiency and output decreased.

This can be best understood by considering the action in a triode with an alternating current applied to its grid. When the grid is at zero (a.c.) potential, the electrons travel from cathode to plate at the quiescent velocity. With the grid at a positive a.c. potential, the electrons are accelerated and pick up energy from the grid in the cathode-to-grid path and are retarded and lose energy in the grid-to-plate path. The reverse occurs when the grid is at a negative a.c. potential so that there is no net energy transfer from the a.c. grid potential source to the electrons.

At frequencies where the period is comparable to the transit time, it is possible for the a.c. grid potential to reverse its phase before the electrons reach the plate so that, in the positive grid case, the electrons are accelerated and gain energy in both the cathode-to-grid and grid-to-plate regions. Under these conditions, there is a net energy transfer from a.c. grid potential to electrons, resulting in an increase in input conductance. In a similar manner it can be shown that energy can be transferred from the source of a.c. plate potential to the electrons during a portion of the cycle resulting in a decrease in power output and efficiency.

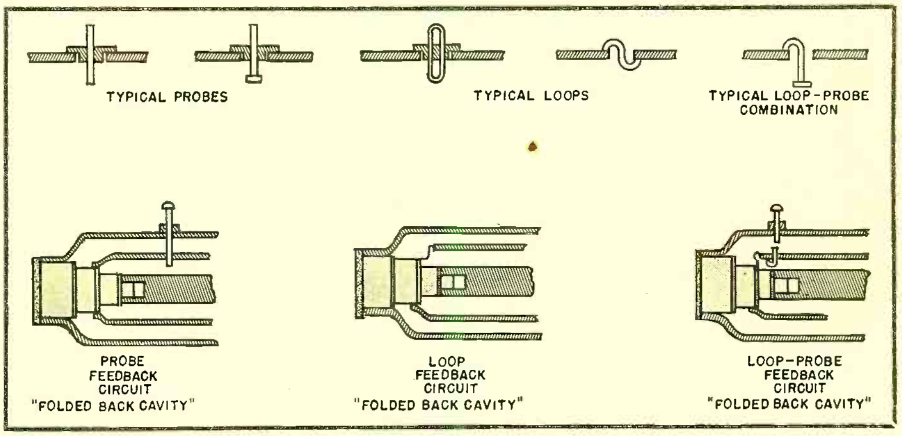


Fig. 2. Typical loops, probes, feedback circuits, and combinations.

Another factor influencing the operation of tubes at microwave frequencies is the lead inductance of the tube elements (plate and cathode) and the tube interelectrode capacitance. In many cases the resonant frequency of these *L-C* networks falls below or within the range of operation. Hence, microwave tubes must be designed with a minimum of lead inductance and interelectrode capacitance.

The requirements of reducing transit-time and interelectrode capacitance are conflicting, necessitating design compromises. Interelectrode capacitance may be reduced by decreasing the physical size of electrodes and increasing the spacing.

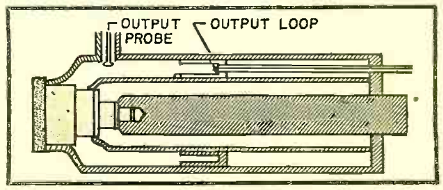
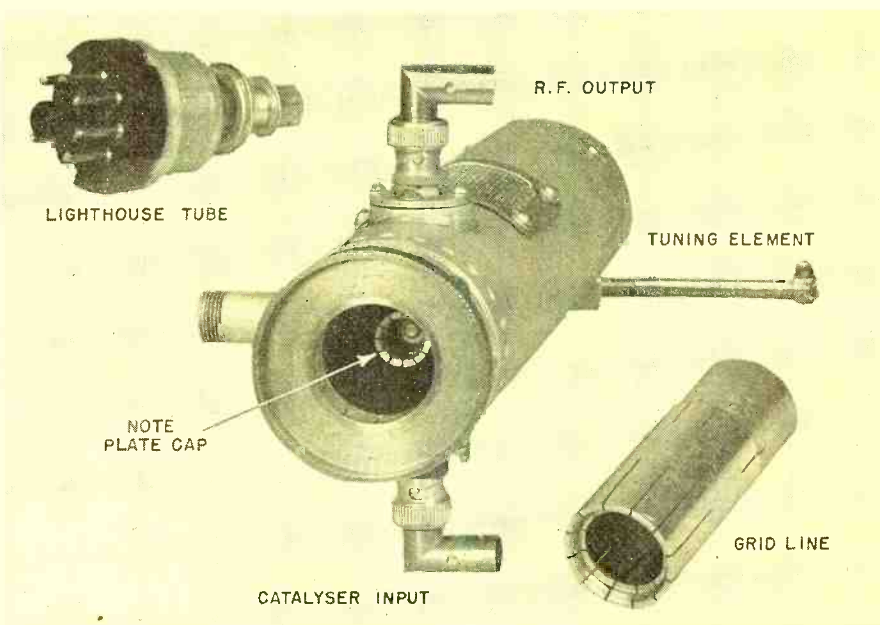


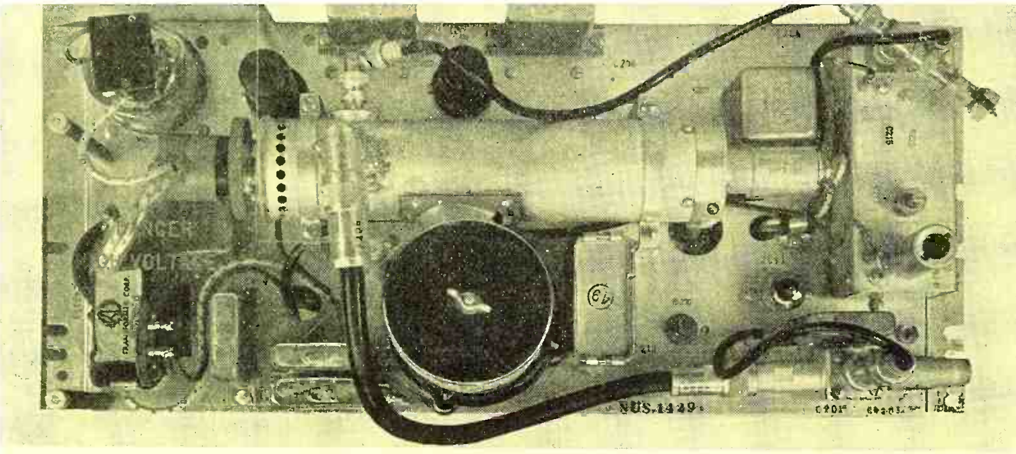
Fig. 3. Alternate methods of output coupling—probe or loop circuit.

However, increasing the spacing increases the transit time, while reducing element size decreases maximum safe power dissipation. Transit time may be reduced by increasing the plate potential, but increased plate potential means greater power dissipation.

It is therefore readily seen that special tubes must be used for microwave frequencies which overcome the limita-

Breakdown of a typical lighthouse tube oscillator.





Microwave transmitter—rear view—showing lighthouse oscillator.

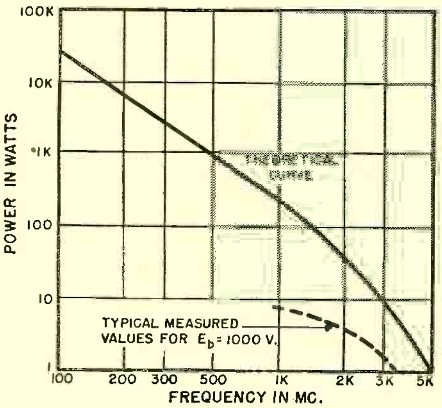


Fig. 4. Theoretical and typical power output versus frequency for a simple triode oscillator.

tion of transit time and capacitance noted above or employ entirely different techniques than conventional tubes. Lighthouse tubes fall in the former category, while klystrons, magnetrons, and traveling wave tubes are examples of the latter category.

Lighthouse tubes are designed for operation in the frequency range of 200 to 3370 megacycles in which coaxial line resonators and elements are used. A typical lighthouse tube is shown on page 7 and as indicated in this picture it has the over-all appearance of a lighthouse—hence its name. These tubes are constructed in this way to permit the use of coaxial elements which fit right over the cathode, grid and plate leads.

This tube has effected reduction in lead inductances by use of disk seals, and employs a parallel plane structure which permits the use of relatively small electrode areas; thereby making possible low interelectrode capacitances while reducing the spacing between electrodes to the point where the transit time is small in comparison with the period at the frequencies indicated.

Design of Lighthouse Oscillators

There are two types of resonator circuits used in conjunction with the lighthouse tube, one is known as the double coaxial resonator, shown in Figs. 1-A and B, and the other a re-entrant cavity, shown in Fig. 1-C. As indicated in Figs. 1-A and B, there are two variations of the double coaxial resonator. In one case, the grid to cathode line is completely independent from the grid to plate line. In the second case, in order to conserve space, the grid to cathode line is folded back over the grid to plate line. This does not alter the fundamental principles of the two resonant circuits inasmuch as the inner surface of the grid cylinder acts as the grid side of the grid-anode line while the outer surface forms the grid side of the grid-cathode line. There is no coupling between these two lines through the common conductor since, as indicated in a previous article[1], the depth of penetration of the electromagnetic field at these frequencies is much less than the thickness of the metal.

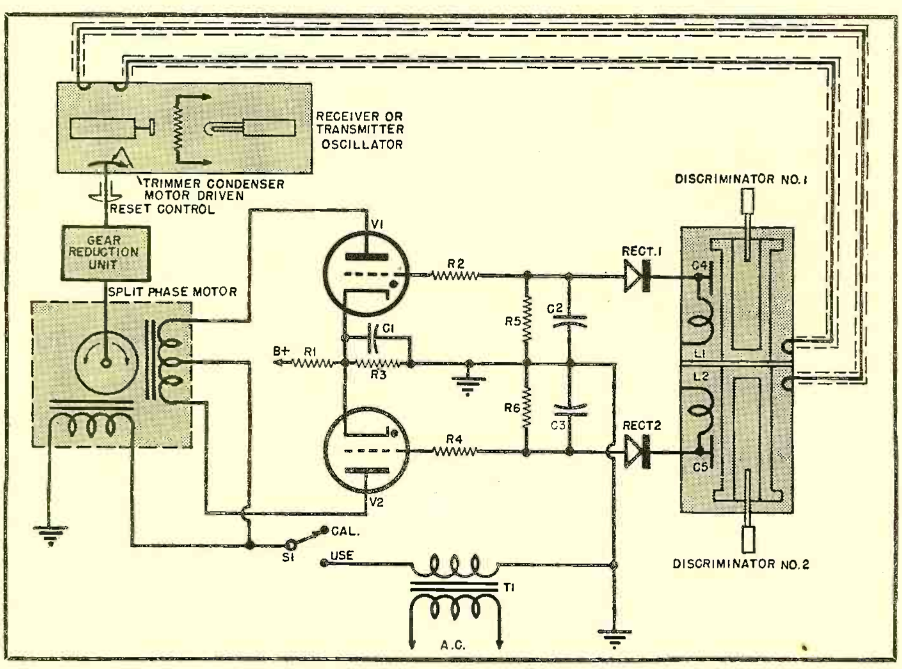
The shorting plugs, shown in Figs. 1-A, B, and C, are actually r.f. shorts and not d.c. shorts. This is done by using a quarter-wave "choke" shown in Fig. 1-D. Since this element is a quarter wave long and open circuited, it presents a short circuit to the r.f. energy. The spacing between the choke and the wall of the tube is determined by the amount of d.c. voltage applied to the plate of the tube. The smaller the spacing the more effective the "choking" or "shorting" action, since Z_o will be small.

In the double coax circuits shown in Figs. 1-A and B, both grid-cathode and plate-grid lines have shorting plugs which can be varied to tune over the desired frequency range. The re-entrant cavity circuit, shown in Fig. 1-C, is similar to the "folded back" grid-cathode line. However, this circuit is not tuned in the same manner that is used in the double coax resonator. Instead of terminating the tuned circuits in "shorting plugs," the grid line is made one half wavelength long and mounted directly on the flange of the tube. The length of the grid line is fixed for any given setup, and thus becomes the frequency determining factor in the circuit.

The shorting plug in the re-entrant cavity, which is mounted on the plate line, does not affect the resonant frequency of the circuit, but functions primarily to optimize conditions for oscillation with a given grid cylinder rather than to change the frequency.

The double coax and re-entrant cavity circuits are basically degenerative and the amount of feedback provided by the interelectrode capacity is insufficient for oscillation, if care is used in shielding the resonant lines from one another. Probably the most frequent cause of insufficient shielding is poor grid contact design. These lines should be slotted to permit a spring contact. Similarly

Fig. 5. Typical automatic frequency control circuit for a microwave oscillator.



the plate line should be machined and slotted so that it grips the plate cap of the lighthouse tube firmly.

There are a number of feedback loop or probe arrangements that can be used to sustain oscillations. Some of these are shown in Fig. 2. A loop is usually placed at a voltage minimum and a probe at a voltage maximum. When broad tuning is desired, a combination of probe and loop feedback elements may be used to cover the entire frequency range.

It will be found that the frequency and efficiency of the oscillator will depend to some degree upon the position (determining phase of feedback) and size (determining the amplitude of feedback) of the probe or loop. A trial and error procedure is used to determine the optimum feedback circuit that provides maximum output and efficiency.

The output of the oscillator is picked up by either a probe or loop as shown in Fig. 3. The exact position of the probe or loop will depend upon the impedance of the load. Again the best procedure is to vary the position until maximum output is obtained across the load. This effect is similar to tapping the coil of a tank circuit to match a given impedance.

The diameters of the lines are determined by the requirements of the oscillator. Using standard theory, the desired Q of the tank circuit is determined considering both the effects of the tube and the load. The Q of a resonant length of coaxial line was given[3] in a previous article as:

$$Q = \frac{2\pi f_o \sqrt{LC}}{2\alpha_T} \quad . \ . \ . \ . \ . \ . \ . \quad (1)$$

This equation can be simplified by assuming that the attenuation due to the dielectric, α_d, is negligible, in which case $\alpha_T = R_f/2Z_o$, and Eqt. (1) becomes:

$$Q = \frac{2\pi f_o Z_o}{R_f V_T} \quad . \ . \ . \ . \ . \ . \quad (2)$$

since $V_T = 1/\sqrt{LC} = 3 \times 10^{10}$ cm./sec. for air. Further simplification of this equation can be obtained[3] by writing Z_0 in terms of D/d and the r.f. resistance[2] in terms of D, d, and f. Doing this we obtain:

$$Q = 8.39\sqrt{f}\, DHR_1 \times 10^{-2} \quad . \ . \ . \quad (3)$$

where D is in cm., f in mc., R_1 is the ratio of the d.c. resistance of the conductor used to the d.c. resistance of copper, and H is defined as:

$$H = 3.6\left(\frac{D+d}{d}\right) \log_e \frac{D}{d} \quad . \ . \ . \quad (4)$$

Eqt. (4) is plotted in Fig. 7. With the help of this figure and Eqt. (3), the Q of a coaxial line for a given D/d ratio can readily be determined.

For the purpose of mechanical simplicity, the plate line diameter is usually made so that it will just slip over the plate cap. The diameters of the grid and cathode rods are then calculated based on this parameter and the Q required. Of course it is desirable to use rods that are of the same diameters as the caps provided or slightly larger.

Earlier in this article it was noted that there is a definite relationship between interelectrode capacitance, electron transit time, and maximum plate dissipation in a tube design, i.e., reducing interelectrode capacitance and transit time also causes a reduction in maximum plate dissipation. Due to the various mechanical factors involved, there is a maximum theoretical (at least at the present time) continuous power output than can be obtained from a single triode employed in the conventional manner. This maximum value has been plotted in Fig. 4 as a function of frequency.

The continuous power output obtained from commercially available tubes is less than this theoretical value. Fig. 4 plots a typical power output versus frequency curve of a 2C43 lighthouse tube operating in a re-entrant cavity. The outputs obtained from other tubes operating with different potentials can be obtained from the tube manufacturers.

At microwaves, where considerable spectrum is available, it is frequently convenient to use greater r.f. bandwidth for greater efficiency and power. This can be done by using one of the several pulse modulation techniques available such as pulse time modulation (PTM), pulse amplitude modulation (PAM), or pulse frequency modulation (PFM)[4]. When the transmitter is pulsed, a much higher peak power can be emitted for a given maximum average power.

It is known that the average value of a pulse series is equal to[5]:

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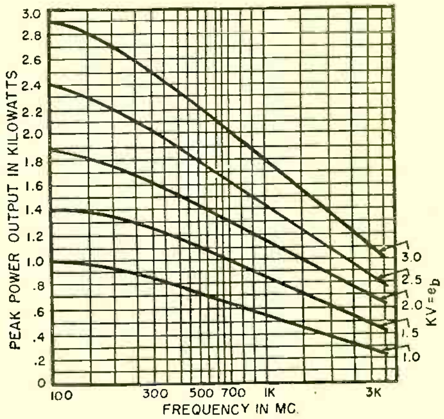


Fig. 6. Plate-pulsed oscillator performance, power output vs. frequency. Pulse rate, 1000 per second; duration, 1 microsecond.

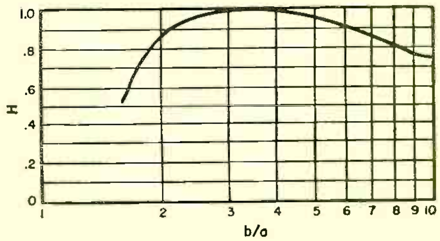
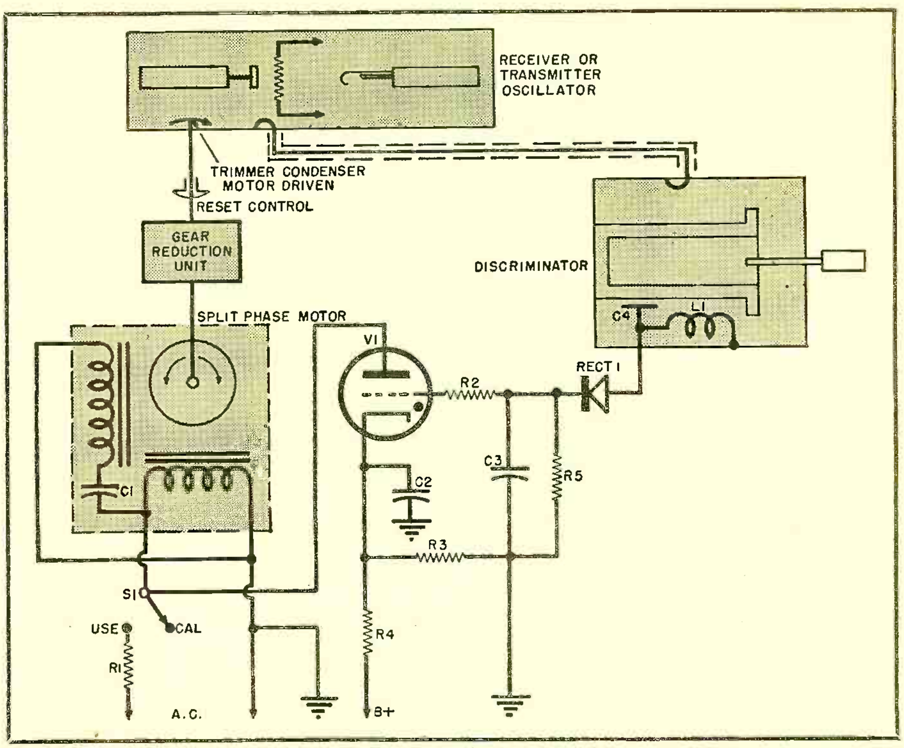
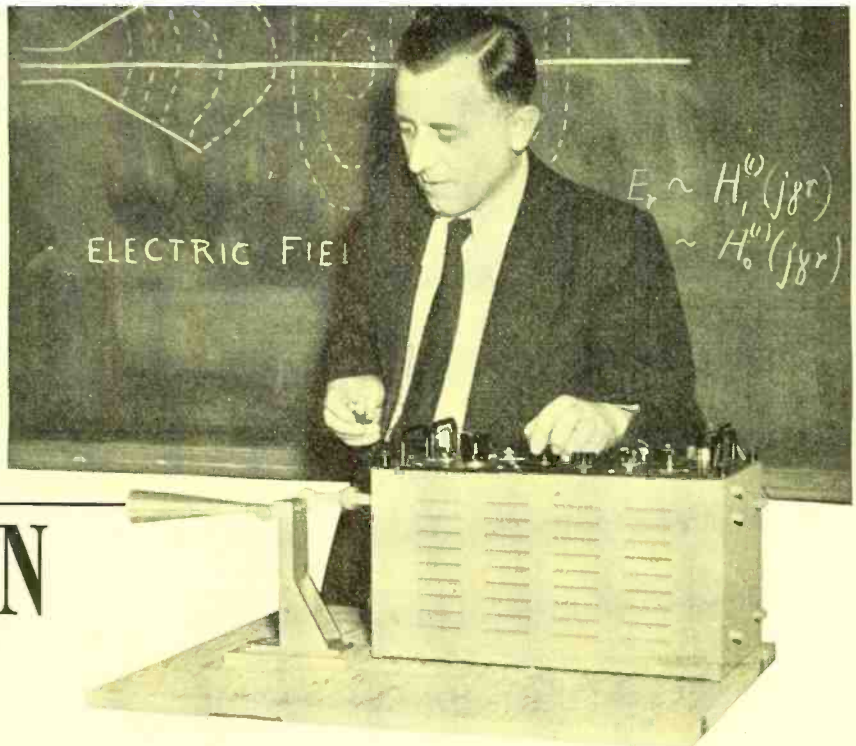


Fig. 7. Variation of H with b/a.

Fig. 8. Another type of microwave automatic frequency control circuit.



Dr. Goubau at the Signal Corps Engineering Laboratories with a model of the simplified "G-String" transmission line which he invented.



SURFACE WAVE TRANSMISSION LINE

By GEORG GOUBAU
Signal Corps Engineering Labs.

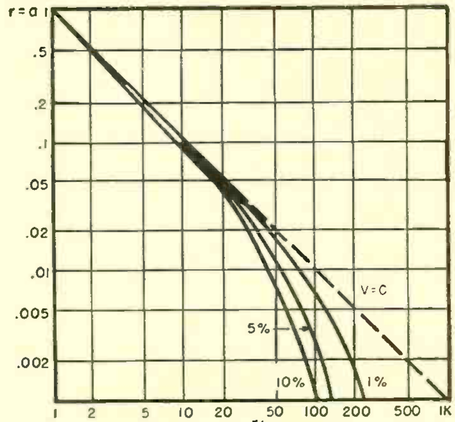
A single insulated wire with special funnel-shaped terminals provides very efficient h.f. transmission.

A PAPER published by Sommerfeld in the year 1899 describes a surface wave guided by a cylindrical conductor of finite conductivity. This wave differs from the wave mode usually excited on long wire antennas in two respects: first, it suffers no radiation loss along its path and second, the field distribution depends to a high degree upon the conductivity of the wire material; and the wave would not exist at all if the conductivity were infinite. Though there is a solution of Maxwell's equations in that case, the solution lacks physical reality since the power transmitted by the wave is infinite if the current in the wire is finite.

Sommerfeld's paper has seen little consideration in the modern literature and there are only a few books in which it is quoted. One of these books is Stratton's well-known "Electromagnetic Theory". It may have been doubtful to many a physicist whether this surface wave can be excited, because not every special solution of Maxwell's equations is realizable. Sommerfeld's wave is a plane wave and therefore the wave could be part of an asymptotic solution, which is valid at a large distance from the power source. In that case, only an infinitesimally small amount of the total power would be converted into the surface wave. To our knowledge nobody has proven as yet that Sommerfeld's surface wave can be excited with finite amplitude. Though we are convinced that this can be done, there are two facts which will make it difficult to obtain good efficiency. The field extends very far from the wire and has a rather complicated shape. An effective launching device would have to be very large, otherwise the radiating wave mode would become predominant.

The reason we were interested in Sommerfeld's wave for a long time is the theoretically low attenuation of this wave. Transmission lines using this wave mode should have less insertion loss than coaxial cables and—provided the diameter of the wire is sufficiently large—even smaller loss than rigid wave guides. This fact made us think about the possibility of concentrating the field closer to the wire; thus, the excitation of the wave would become simpler and besides, the clearance around the wire required for an undisturbed propagation could be kept smaller. A study of cylindrical surface waves showed that the extension of the field of a surface wave depends upon the phase velocity. The more the wave is urged to travel with lower speed, the more the diameter of the field shrinks. A reduction in phase velocity of less than one per-cent is in general sufficient for obtaining reasonable dimensions of the field. Such a reduction can be achieved by a dielectric coat on the wire or by other modifications of the conductor surface like the application of a thread on the wire. The wave mode guided by a conductor, the surface of which is modified as mentioned, differs from Sommerfeld's wave not only in the extension but also in the structure of the field. Both wave modes are mathematically described by Hankel functions; however, in the case of the plain wire, the argument of these functions is complex, while it is purely imaginary in the other case, at least if the losses are disregarded. And here we have an important difference: the finite conductivity is no longer an essential provision for the existence of the non-radiating wave mode.

Fig. 1. Distribution of magnetic field for various reductions in phase velocity λ/(wire radius) a is 100.



Last summer we started experiments with this wave mode on dielectric coated and threaded wires. From the very beginning we observed that this wave mode can be easily excited with an efficiency up to 90%. Furthermore, the experiments showed that the wave mode is very stable with regard to a sag of the wire or to small bends. The measured loss of transmission lines based on this wave mode was in very good agreement with the theoretical expectations.

Before discussing the setup and the results we would like to say a little bit more about the wave mode. The wave mode is a radially symmetrical transverse magnetic mode with a small longitudinal electric component. Fig. 2 shows the electric field lines for a case in which the wavelength is 100 times the wire radius and the phase velocity is reduced by 10%. In general a much smaller reduction of phase velocity is used. We assumed here a large reduction in order to get more field lines on the drawing. All electric field lines start on the wire and return to the wire. The magnetic field lines are circles around the wire.

Fig. 1 shows how the field decreases with the distance from the wire. The ratio of the magnetic field strength at a distance from the wire to the magnetic field strength at the surface of the wire is plotted versus the distance, measured in multiples of the wire radius. Both scales are logarithmic. The broken line indicates a $1/r$ decrease as it would be present in the case of a plain wire with infinite conductivity. In this case the phase velocity would be equal to the velocity of light, and as mentioned before the power would be infinite if the field strength were finite. The unbroken curves show how the field decreases if the phase velocity is reduced by 1, 2, 5 and 10%. The curves follow first the $1/r$ decrease and approach at larger distances an exponential decrease. The smaller the phase velocity is, the earlier the exponential decrease begins.

Fig. 3 is a schematic sketch of a surface wave transmission line. The launching device used in the experimental work consisted of a metal horn connected to the outside conductor of the coaxial feed lines. The inner conductor of that line is connected to the surface wave guide consisting in most of the experiments of a normal enameled wire. The transmitting and receiving ends of the line are alike. The dimensions given in Fig. 3 refer to the curves of Figs. 5 and 6.

The loss of such a surface wave transmission line consists of three parts: the conductivity loss in the wire, the loss in the dielectric coat and the loss, effected by the launching device, due to a partial excitation of the radiating mode. The first two parts, conductivity loss and dielectric loss, can be calculated from the field distribution of the wave. They are proportional to the length. The launching loss is independent of the length of the line and can be determined with fair accuracy by the following consideration. At the receiving end that portion of the wave energy will be received which travels within the area of the aperture of the horn. The wave energy outside this area will be lost. The ratio between received energy and the total energy determines the efficiency of the receiving horn. Because of the reciprocity theorem the efficiency of the transmitting horn must be the same as the efficiency of the receiving horn.

The loss of the transmission line shown in Fig. 3 was calculated for various frequencies and Fig. 5 is a plot of the results. The length of the line is 120 ft., the diameter of the wire 0.2 cm., and the thickness of the enamel layer 5.0×10^{-3} cm. The dielectric constant is assumed to be 3 and the power factor 8×10^{-3}. The opening of the horns is 13″. The conductivity loss L_c and the dielectric loss L_i increase with frequency while the launching loss L_h decreases. The total loss L_{tot} which is the sum of the three components L_c, L_i and L_h has a flat minimum of about 2 db. The loss was measured for three frequencies. For 1600 mc. it measured 2.2 db.; for 3300 mc., 2.3 db.; and for 4700 mc., 4.5 db. While the deviation between theory and measurement for the lower frequency is comparatively small, it is pretty large for the high frequency. The main reason for this deviation lies in the fact that the angle of the horns was too large for the high frequency and thus the efficiency of the horns was much smaller than expected. For comparison, the approximate loss of 120 ft. of RG-8/U cable is 13 db. for 1600 mc., 22 db. for 3300 mc. and 30 db. for 4700 mc. Though these data refer to a very good cable the losses are about 6 to 10 times as high as the losses of the surface wave transmission line.

The effect of the thickness of the dielectric coat on the efficiency of such a transmission line is demonstrated by curves shown in Fig. 6. Length of the line, diameter of the wire and dimensions of the horns are the same. Only the thickness of the dielectric coat is assumed to vary. The curves refer to a frequency of 3000 mc. For a very thin dielectric coat the insertion loss is large because of the low efficiency of the horns. There is an optimum thickness for which the loss is a minimum. For larger thickness of the dielectric coat the loss rises slowly because of the increasing conductivity and dielectric losses. A curve like this has been verified. The same horns and the same wire length (120′), but a wire of 0.26 cm. thickness were used (this was the only available bare copper wire). The measurements were made at a frequency of 2600 mc. The wire was outdoors for

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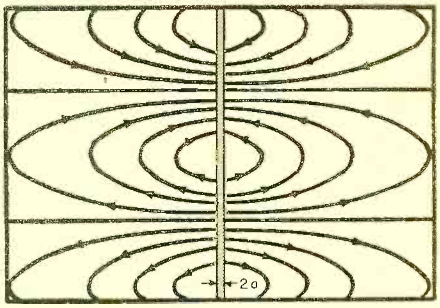


Fig. 2. Electric field lines where $\lambda = 100\ a$ and $v/c = 0.9$

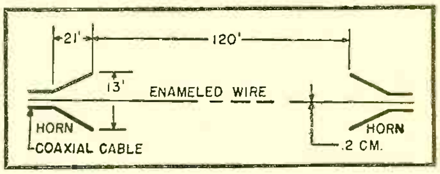


Fig. 3. Schematic sketch of a surface wave transmission line.

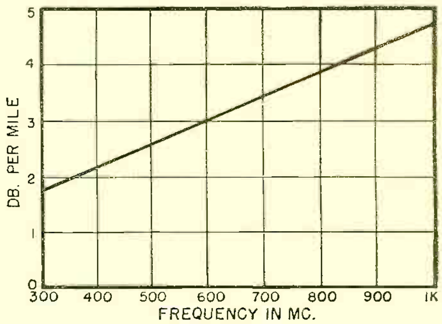


Fig. 4. Calculated attenuation for 2 cm. wire with ½ mm. polystyrene coating.

Fig. 5. Losses for the transmission line of Fig. 3 as a function of frequency.

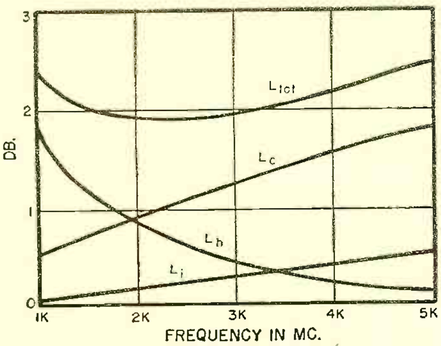
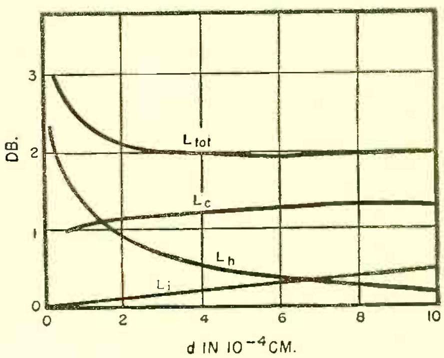
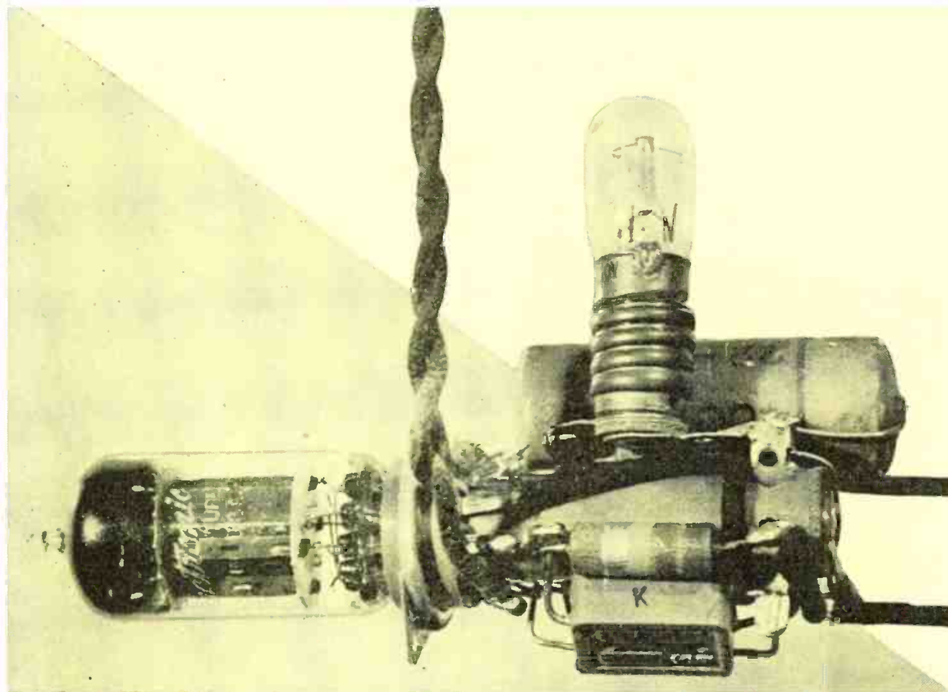


Fig. 6. Losses for the line of Fig. 3 for varying thicknesses of dielectric coating.





A NEW R-C OSCILLATOR CIRCUIT

By MILTON H. CROTHERS
Electrical Engineering Dept., U. of Illinois*

Oscillator using a 12AU7 and operating near 9 kc. Note compactness of unit.

Development of an R-C oscillator having greater stability and fewer parts than conventional units.

VACUUM tube oscillators are truly fundamental to the art of modern communications. Vacuum tube oscillators may be grouped in two general classes depending upon the class of operation of the amplifier stage, that is, linear or nonlinear. The first vacuum tube oscillators depended upon nonlinear operation of the vacuum tube to locate and determine the steady state amplitude of oscillation. Nonlinear operation of the amplifier tube must introduce distortion components of the fundamental signal frequency. These distortion components are attenuated by a highly selective tuned circuit.

Resistance-capacitance oscillators have become very popular within the last decade. This paper will introduce a novel form of this oscillator, making use of the standard *R-C* network and a new amplifier, and having several marked advantages over circuits which have been used to date.

Need for Nonlinearity in an Oscillator

Let the general oscillator be described as an amplifier section and a feedback section. The gain of the amplifier will be represented by the symbol K and the transmission of the feedback section will be represented by the symbol β. Either one or both of these sections will include some form of a selective circuit so the gain through the sections will be a maximum at only one frequency, as indicated in Fig. 1.

When the input signal (E_1) and the output signal (E_3) are identical the loop may be closed to form an oscillator. If the net gain around this loop is greater than unity the oscillations will build up in amplitude with each succeeding cycle. The gain around the loop must be self adjusting in order that the oscillator maintains some particular value of oscillation amplitude. The steady state amplitude in an oscillator is defined as that signal level which just makes the loop gain unity. An amplifier operating in a nonlinear region varies its effective gain somewhat inversely with signal amplitude and thereby controls the oscillation amplitude.

Nonlinearity and Circuit Selectivity

An oscillator using any nonlinear element which is instantaneous in nature generates distortion components. The relative distortion depends upon the degree of nonlinearity over the operating range. Attenuation of these distortion components depends upon the selectivity of the circuit. Highly selective circuits permit highly nonlinear operating regions in the amplifier.

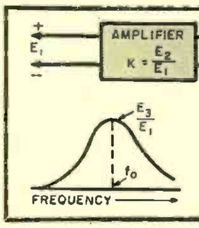
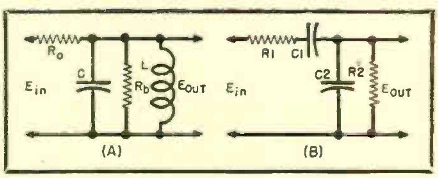


Fig. 1. Block diagram of general oscillator showing selectivity of over-all system.

Fig. 2. (A) Tuned L-C circuit. (B) Tuned R-C network.



The resistance-capacitance network shown in Fig. 2 may be used as a selective network. The Q of the *R-C* network is only ⅓ when equal values of resistance and capacitance are used. A highly selective tuned circuit is compared with the *R-C* network in Figs. 3 and 4.

Very little attenuation is offered to distortion components by the poorer selectivity of the *R-C* network. For this reason there must be control of the loop gain by a method which is not an instantaneous nonlinear element.

Nonlinear Elements Which Are Not Instantaneous

Most of the resistance-capacitance oscillator circuits use thermally responsive nonlinear devices. Generally these elements are low current 115 volt tungsten lamps. Low current fuses are also suitable for higher frequency signals. These devices have a positive temperature-resistance coefficient. Typical characteristics of a number of common nonlinear elements are given in Figs. 5 and 6.

The lamps show linear operation within each cycle for frequencies as low as ten cycles per second. They will not introduce distortion components when operated over the audio range. The small fuses show some instantaneous nonlinearity at frequencies below 100 cycles and therefore are not suitable for use at frequencies lower than 1000 cycles.

A fundamental and useful oscillator circuit using class 'A_1' amplifiers with an *R-C* feedback network is shown in

* *From the thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Electrical Engineering to the Graduate College of the University of Illinois 1949. 'A Study of Nonlinear Circuit Elements'.*

Fig. 7A. Pentodes are normally used but triodes are shown to illustrate the basic circuit.

A great amount of inverse feedback is included to stabilize the circuit. The inverse feedback circuit includes a nonlinear element R_x which controls the gain inversely as the signal amplitude varies. The gain of this amplifier is indicated in Fig. 13.

The condition required for steady state oscillation is that the loop gain is unity, that is, E_1 and E_3 are identical. This will lead to two general expressions:

$$K = 1 + \frac{R_1}{R_2} + \frac{C_2}{C_1}. \quad \ldots \ldots \quad (1)$$

$$\text{Freq.} = \frac{1}{2\pi\sqrt{R_1 C_1 R_2 C_2}}. \quad \ldots \quad (2)$$

Adjustment and selection of circuit elements and tube coefficients should be made so the action of R_x limits the oscillation amplitude to class A_1 operation. The nature of control obtained from R_x depends upon the heating by the a.c. signal current. It is to be noted that d.c. quiescent current must also pass through R_x and thus hinders the control action. Oscillator circuits of this general type have been used with great success in a large number of applications over frequency ranges of 1 to 200,000 cycles. The distortion in most cases is of the order of 2 per-cent or less.

These are the general characteristics desired of the amplifier section selected for this oscillator circuit:

1—Gain is stable and constant as a function of supply voltages, component values (in general) and tube changes.

2—Wideband frequency response and minimum phase shift over the working frequency range.

3—Low output impedance compared to values of elements used in the feedback network.

4—Nonlinear element controlling the gain inversely with signal amplitude. This element must not introduce distortion and the signal level must be within the class A_1 region.

The New Amplifier Circuit

The circuit devised by the author and shown in Fig. 7B complies in general with the specifications listed above and offers a number of advantages. A fewer number of circuit components are required with this new "π coupled" amplifier circuit. There is also one fundamental advantage in the manner in which the nonlinear element operates and responds to the signal level. These items will be discussed in detail.

The "π coupled" amplifier is that part of the circuit within the dotted lines and uses one dual triode tube, three resistors and one nonlinear element. This is a total of four circuit elements

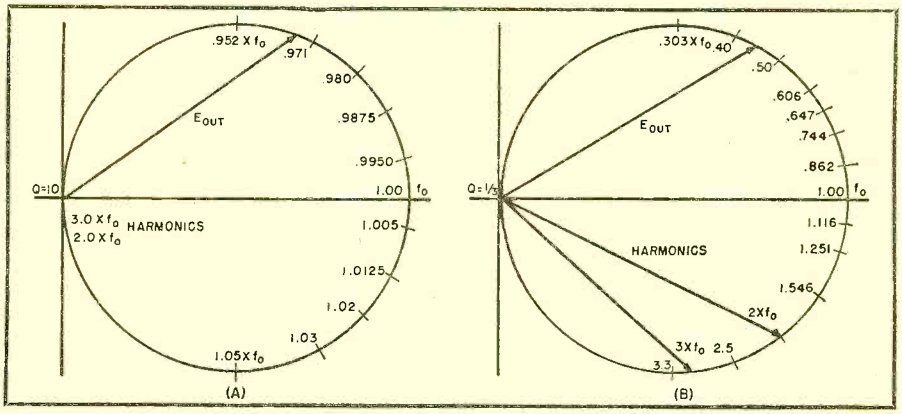


Fig. 3. Frequency response of networks for a Q of 1/3 and a Q of 10.

as compared to the nine components required by the amplifier in Fig. 7A. This smaller number of elements offers decided advantages where cost, space, and weight are to be considered. This is the major reason for advancing this new circuit.

The second advantage results because the nonlinear element R_x does not carry quiescent current in this new circuit. The element can respond more readily to the a.c. signal component in the circuit and offers a greater sensitivity to signal amplitude. This greater sensitivity offers some compensation for the less stable amplifier characteristics. It is true that any of these circuits could be arranged to impress only the a.c. signal across the element R_x but this new circuit provides such isolation within the basic form. A total of three variations will be given for this circuit. These variations differ only in the manner of balancing out d.c. from the nonlinear element.

The amplifier shown in Fig. 7A has low output impedance because the inverse voltage feedback reduces the output impedance below the value of the amplifier without this inverse feedback. The output impedance of the new amplifier is higher because there is no inverse feedback applied. A value of 5-10 k. ohms is typical of this output imped-

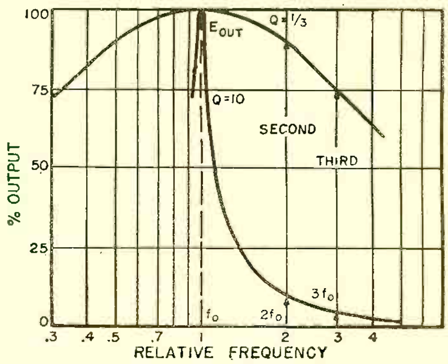


Fig. 4. Selectivity of a network for a Q of 1/3 and a Q of 10.

ance. The value of R_1 in the feedback section might be corrected to allow for this impedance.

Examination of the circuit for the "π coupled" amplifier reveals that the first stage is operating as a grounded plate amplifier and the gain is therefore less than unity:

$$K_1 = \frac{\mu_1 R_{k1}}{R_{p1} + R_{k1} + \mu R_{k1}} \quad \ldots \quad (3)$$

The gain of this stage is reasonably constant with respect to changes in supply voltages.

Fig. 5. Characteristics of fuses.

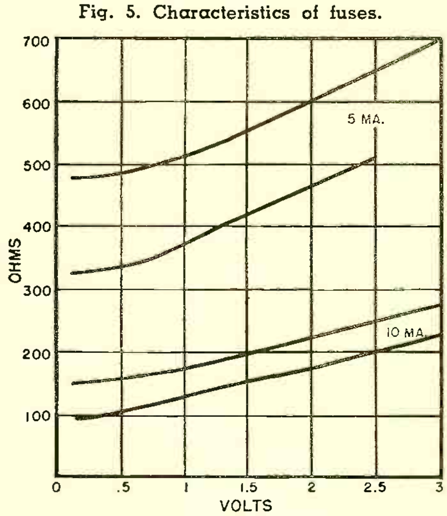
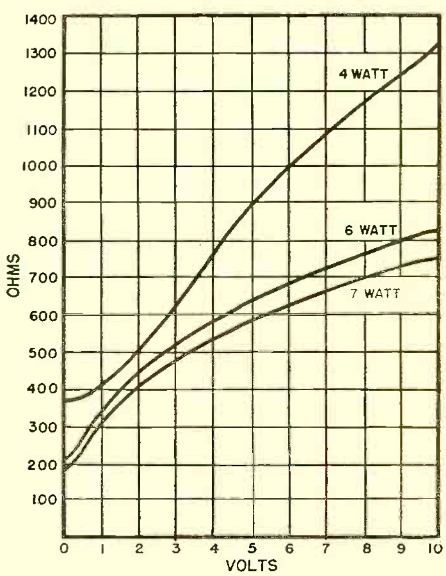


Fig. 6. Characteristics of lamps.



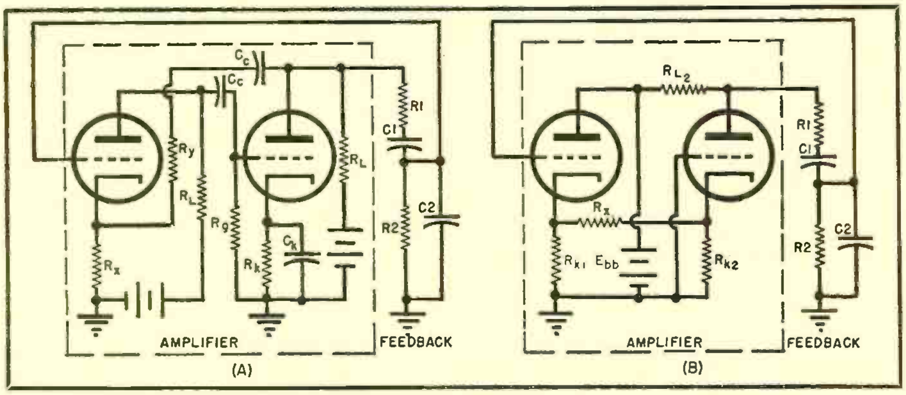


Fig. 7. (A) Fundamental circuit using class A_1 amplifiers with an R-C feedback network. (B) New "π coupled" circuit has advantages over (A).

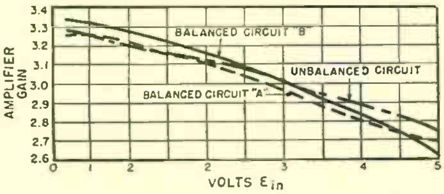


Fig. 8. Variation in amplifier gain with respect to signal level.

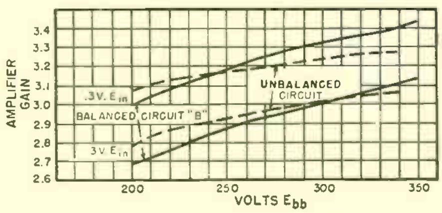


Fig. 9. Variation in amplifier gain with respect to plate voltage.

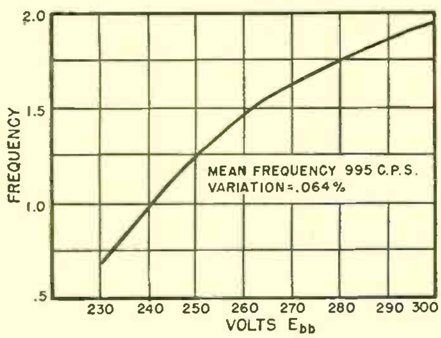
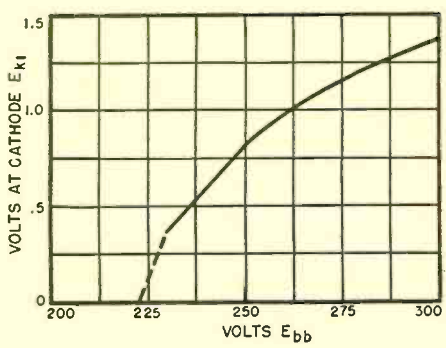


Fig. 10. Frequency stability of typical oscillator plotted against variations in plate voltage.

Fig. 11. Amplitude stability vs. plate voltage using a 115 volt, 4 w. tungsten lamp as R_x. Frequency is 400 c.p.s.



This first stage is coupled to the second stage by means of the π type network between the cathodes. For this reason the name of "π coupled" amplifier has been coined for the circuit. The second stage operates as a grounded grid amplifier, the gain of which is given as:

$$K_2 = \frac{(\mu_2 + 1)\, R_{L2}}{r_{p2} + R_{L2}}. \quad \ldots \ldots \quad (4)$$

Interaction between these stages through the π coupling network gives a net gain different than that of the product of K_1 and K_2 above. The net over-all gain has been calculated and is given in this form:

$$K = \frac{A}{B + CR_x}. \quad \ldots \ldots \quad (5)$$

where A, B and C are:

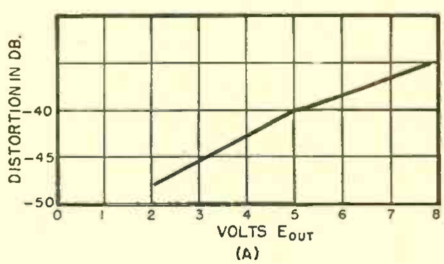
$$A = \mu_1\ (\mu_2 + 1)\ R_{L2}\, R_{k1}\, R_{k2} \quad \ldots \quad (6)$$

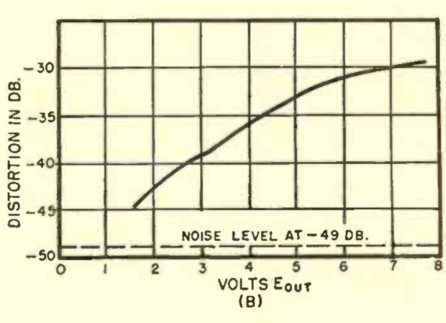
$$B = (R_L + r_p)\,[r_p R_{k1} + r_p R_{k2} + (\mu + 1) R_{k1} R_{k2}] + r_p R_{k1} R_{k2} (\mu_2 + 1) \quad . \quad (7)$$

$$C = [r_p + R_{k1}(\mu_1 + 1)] \times [r_p + R_L + R_{k2}(\mu_2 + 1)] \quad \ldots \quad (8)$$

Loading of the amplifier by the feedback network has not been considered in the calculation of amplifier gain. It is assumed that this may be neglected in most cases by proper selection of the elements in the feedback network.

Fig. 12. Distortion in 400 cycle 6SN7 R-C oscillator with (A) R_x a 4 w. lamp and E_{bb} = 200 v., (B) R_x a 5 ma. fuse and E_{bb} = 250 v.





Typical Operation

Most of these oscillator circuits are used with equal values for the resistances in the feedback network. The gain which is required is then found to be three. The dual section triodes 6SN7 and 12AU7 may be used with these approximate circuit values:

$R_{k1} = R_{k2} =$ 2,000 ohms.

$R_{L2} =$ 10,000 to 15,000 ohms selected for oscillation level.

$R_x =$ one 115 volt, 6 or 7 watt tungsten lamp.

The feedback network values are selected for the frequency desired with these general limits suggested:

$R_1 = R_2 =$ values ranging from 50k ohms to 10 megohms.

$C_1 = C_2 =$ minimum values of 100 $\mu\mu$fd.

These feedback network values will permit operation over and slightly beyond the audio frequency range.

A number of oscillators have been constructed using the basic circuit with fixed elements in the feedback network. These oscillators have been built within the general circuit of some projects to provide various signals at one frequency. Another oscillator has been constructed using a pair of switches to select any one of a number of fixed frequencies. Continuously variable oscillators have also been constructed using either variable resistors or variable condensers in the feedback circuit.

From a number of these different oscillators the curves given in Figs. 10, 11 and 12 have been recorded to illustrate the general operation of this circuit.

Long time measurements are not indicated for frequency stability for this oscillator does not seem to fit in this general class. The variation in frequency with respect to supply voltage is favorable on a short time test. The frequency will be sufficiently constant for most applications in mind for the circuit.

Measurements on a number of different oscillators indicated that an output voltage with 1 per-cent or less total distortion can be obtained operating near the oscillation threshold. Additional measurements indicate that lower distortion was obtained, for any given output voltage level, when the plate supply voltage is increased and the amplifier gain readjusted for the same output level. In making the observation the gain was adjusted by varying the value of R_{k2}. In other circuits the

(*Continued on page* 24)

VIDEO AMPLIFIER DESIGN

By ROBERT C. MOSES
Sylvania Electric Products Inc.

Various types of compensation may be used to give an amplifier with essentially flat amplitude and phase characteristics over the entire video band.

HIGH definition television systems are required to convey information transmitted at rates up to 8,700,000 picture elements per second. The ultimate resolution obtainable in the reproduced image is determined by the ability of the equipment as a whole to respond to the maximum rate of transmission. The latter, in turn, is directly proportional to the bandwidth of the circuits through which the video signal must pass. With the present 525 line, 30 frame transmission standards, it can be shown that adequate response up to a maximum frequency of 4.35 megacycles is necessary for faithful reproduction of the finest detail in the picture. On the other hand, satisfactory rendition of backgrounds and of very large objects requires that the system be capable of reproducing one picture element having dimensions approaching those of the entire scanned area. Proper response of the system down to d.c. is therefore indicated. Since transmission of d.c. in the system is a subject beyond the scope of this article, the following discussion will be limited to amplifiers responding to frequencies down to about 30 cycles.

The necessity for handling such a wide spread in rates of transmission imposes severe requirements upon the video amplifier channel. Not only must the amplifier be capable of passing the entire frequency range from 30 cycles to over 4.0 megacycles with a minimum of amplitude discrimination, but also the transmission time through the system must be as nearly constant as possible for all frequency components within these limits. The latter requires that the curve of amplifier phase shift versus frequency be essentially linear up to the maximum frequency present in the video signal.

The usual resistance-coupled audio amplifier falls far short of these requirements, since both the amplitude and phase characteristics deteriorate rapidly above about 10,000 cycles and below 70 cycles. Some form of compensation for both amplitude response and phase shift is obviously necessary. There are several methods by which such compensation may be accomplished, and for purposes of discussion, the low and high frequency considerations will be treated separately.

Even if the amplitude response of the conventional pentode resistance coupled amplifier were satisfactory at low frequencies, the phase characteristics below 60 cycles would be troublesome. Excessive phase shifts at low frequencies may be attributed to three sources:

1. The time constant of the grid coupling network
2. The screen circuit time constant
3. The cathode biasing network

These factors are indicated in the equivalent circuit of Fig. 2A. The plate supply terminals and d.c. connections are omitted for clarity.

The reactance of the coupling capacitor C_c at low frequencies introduces a leading phase shift and a drop in amplitude in the component E_o of output voltage across the grid resistor of the following stage. These effects become serious below the frequency at which the reactance of C_c exceeds about ⅛ the resistance of R_g, and may be sufficiently great to prevent proper reproduction of square waves of 60 cycles base frequency unless large values of C_c and R_g are used. The magnitude of the phase angle is given by:

$$\varphi = -\tan^{-1} \frac{1}{2\pi f\, C_c\, R_g}$$

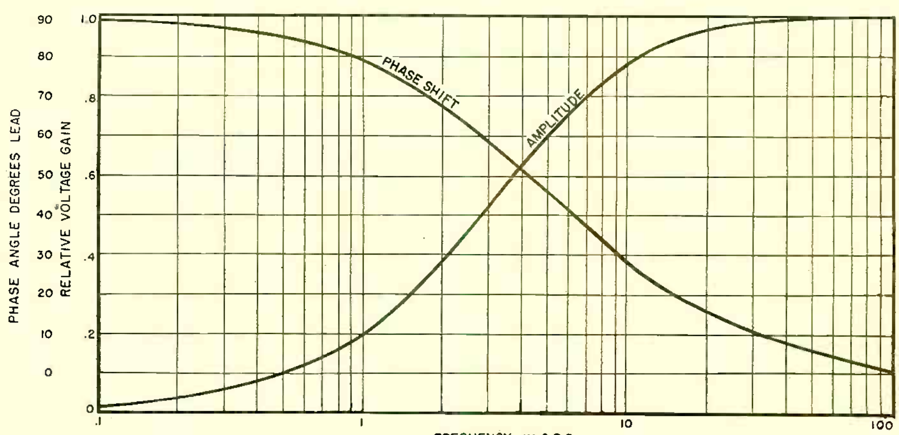
and the relative amplitude characteristic by:

$$\frac{E_o}{E_i} = \cos \varphi$$

where E_o and E_i are the output and input voltage respectively.

While it is theoretically possible to obtain values of C_c and R_g which will keep the frequency of negligible phase shift below 30 cycles, large values of coupling capacitors introduce additional stray capacitances which may affect the high frequency characteristics of the amplifier. At the same time, the maximum value of the grid resistor R_g is usually limited by gas and grid current considerations in the following tube. It is therefore customary to assign reasonable values to C_c and R_g, and

Fig. 1. Low frequency phase and amplitude characteristics of a typical two-stage video amplifier with compensation.



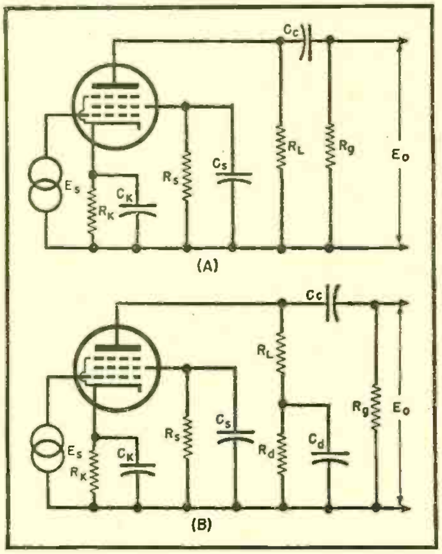


Fig. 2. (A) Low frequency equivalent circuit. (B) Equivalent circuit with low frequency compensation.

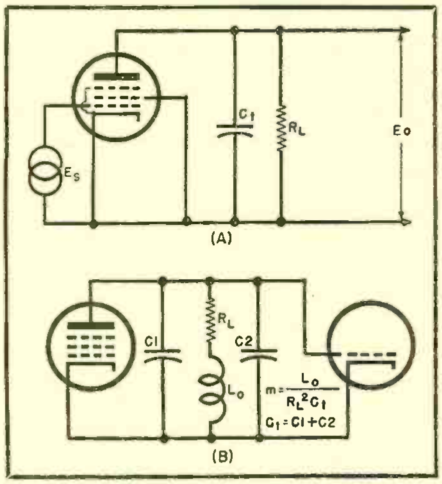


Fig. 3. (A) High frequency equivalent circuit. (B) Shunt peaking network.

provide compensation for the resulting phase shift at some point in the system.

The finite time constant of the screen resistor-capacitor combination R_sC_s causes a shift in phase and a drop in amplitude at low frequencies in exactly the same way as the grid coupling network, and the extent of these deficiencies may be specified in the same manner. However, the phase angle and departure from flat amplitude response introduced by R_sC_s can be kept small with practical component values, and their effect need not be compensated if:

$$R_s\,C_s \geqq 0.077$$

where R_s is in megohms and C_s is in microfarads, a condition readily achieved in most cases. If the above holds, the phase angle due to R_sC_s will not exceed 4° at 30 cycles.

The impedance of the cathode bias network C_kR_k results in degenerative effects and excessive phase shifts at frequencies below that at which the reactance of C_k exceeds about 1/10 the resistance of R_k. In many cases, prohibitively large values of C_k are required if the frequency of near-zero phase shift is to be comparable with the frame repetition frequency. Compensation for low-frequency discrepancies due to C_kR_k can be provided in much the same manner as for the grid coupling network; however, the design constants for cathode-bias impedance compensation are different.

Despite the fact that there are several arrangements for compensating the effects of the grid coupling and cathode biasing networks, one simple form of correction circuit has been widely used. This consists of a parallel resistor and capacitor in the plate circuit of the stage to be compensated, as shown in Fig. 2B.

In this circuit, the additional components C_dR_d in series with the plate load of the tube introduces a compensating phase shift which causes the output voltage E_o to lag in phase by the same amount as the leading phase angle produced by either C_cR_g or C_kR_k. At the same time, the reactance of C_d causes a rise at low frequencies in the effective load impedance presented to the tube. The resulting increase in gain counteracts deficiencies in amplitude response. It is usually not possible to satisfy the conditions for correction of both grid coupling and cathode biasing network effects in one such correction circuit. An entirely satisfactory degree of compensation for either can, however, be achieved through a suitable choice of correction parameters.

Compensation for Grid Coupling Network

For a satisfactory degree of compensation for phase shifts produced by the grid coupling network, the following relations must hold:

1. The time constant of the plate load resistor and compensating capacitor must equal the time constant of the grid coupling network.

$$C_d\,R_L = C_c\,R_g$$

2. The resistance of the decoupling resistor must be at least ten times the reactance of the compensating capacitor at the lowest frequency for which correction is required.

$$R_d \geqq 10/\omega\,C_d$$

It should be noted that this type of compensation for deficiencies in the grid coupling network will not give perfect correction to very low frequencies or to d.c. except in the theoretical and practically unattainable condition of infinite decoupling resistance R_d. For a fixed value of C_d, the lowest frequency for which compensation is exact is inversely proportional to the value of R_d.

The usual procedure in compensating a stage for the effects of the grid coupling network is to select a suitable value for C_d, say 10 microfarads. This, in combination with the plate load resistor as determined from high frequency considerations, gives the time constant to be obtained in the following grid circuit. The decoupling resistor R_d is then made as large as possible consistent with obtaining the required plate voltage at the tube.

Compensation for Cathode Bias Network

Correction for phase shifts and amplitude discrimination due to the cathode biasing network can be effected in a similar manner to the above, except in this case, exact compensation can be achieved down to d.c. with practical circuit values. Perfect correction will be obtained if:

1. The time constant of the compensating network is made equal to that of the cathode bias network.

$$C_d\,R_d = C_k\,R_k$$

2. The decoupling resistor is made equal to the product of the midband stage gain and the value of the biasing resistor.

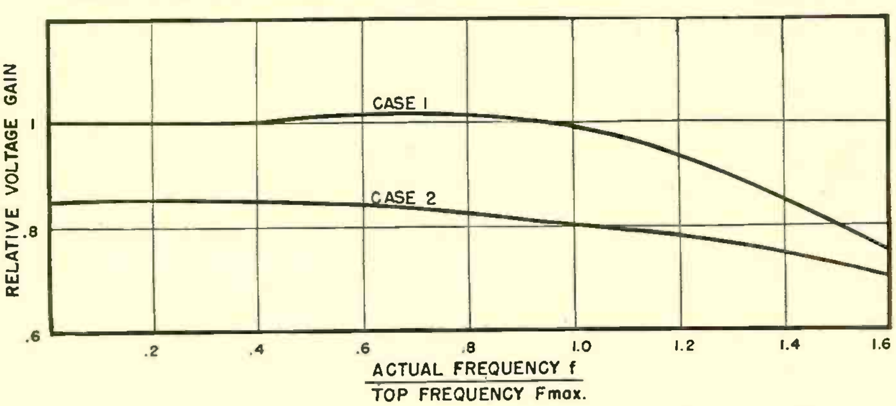
$$R_d = \overline{A}\,R_k = G_m\,R_L\,R_k$$

where G_m is the tube transconductance.

Compensation for All Low-Frequency Effects

It will not usually be possible to obtain values for the correction circuit, such that the requirements for phase

Fig. 4. Amplitude characteristic of the two shunt peaking networks (Fig. 3B).



and amplitude compensation of both grid coupling and cathode bias networks are simultaneously satisfied. For correction of all low-frequency effects in a multistage amplifier, the preferred procedure is to make the grid circuit time constants as large as possible in stages having a cathode bias network, and compensate the latter in each plate circuit. Then, for every two or three such stages, a stage having no cathode bias network is provided, and the combined phase shifts of all grid couplings compensated in the plate circuit of this stage. This arrangement operates quite satisfactorily provided the total phase shift to be corrected is smaller than about 20° at 60 cycles. This figure is readily achieved if the time constants of the uncompensated grid coupling networks are from 8 to 15 times greater than the period of the lowest frequency to be passed.

For adequate vertical resolution of a 525 line picture, the maximum delay time $\left(\frac{1}{\text{phase shift} \times \text{frequency}}\right)$ variation tolerable at the low end of the video band is on the order of 850 microseconds. With two video stages involved, a phase shift of 4 or 5 degrees per stage at 30 cycles can be considered allowable for design purposes. The amplitude response should be flat within a few tenths of a decibel to well below 30 cycles if the above requirement is to be met. Low frequency phase and amplitude characteristics of a typical two-stage video amplifier with compensation are shown in Fig. 1.

Tube interelectrode capacitances and stray capacitances associated with circuit components and wiring have a shunting effect which produces excessive phase shifts and departure from linear amplitude characteristics at the higher video frequencies. For a fixed value of plate load resistance, the absolute magnitude of these capacitances becomes the limiting factor on the top frequency f_o, at which satisfactory performance can be obtained. Referring to the high-frequency equivalent circuit of Fig. 3A, it can be shown that a phase shift of 45° together with an amplitude drop of 3 decibels will occur when:

$$f_o = \frac{1}{2\pi C_t R_L}$$

where C_t is the total shunting capacitance, and R_L is the plate load resistance (Fig. 3A). For half-power (3 db.) response to 4.5 megacycles, and a total shunt capacitance of 25 $\mu\mu$fd., (a reasonable figure for a two-terminal interstage) the above equation indicates that the load resistor must be 1400 ohms. The stage gain is given by:

$$\overline{A} = G_m R_L$$

For a tube with a transconductance of 9000 ohms the stage gain will be 12.6.

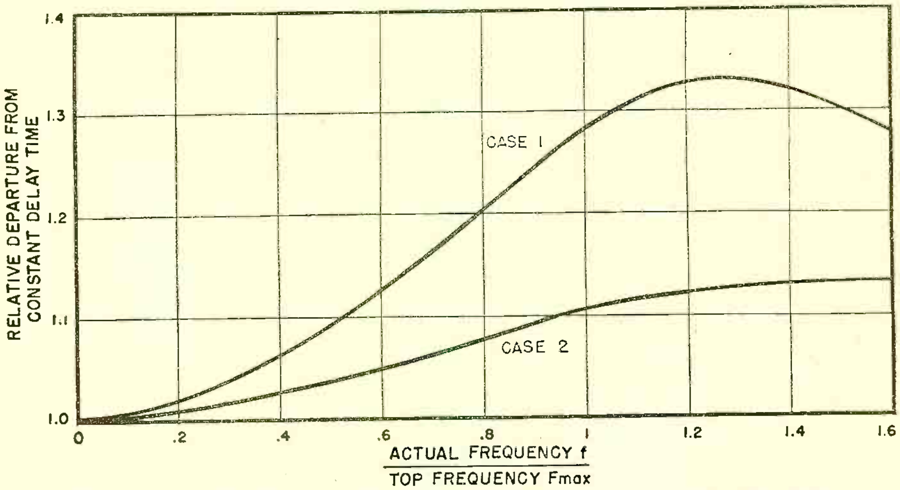


Fig. 5. Time delay characteristics of the two shunt peaking networks (Fig. 3B).

The above considerations lead to a "gain bandwidth" (hereafter abbreviated G.B.) rating for video amplifier tubes, in which the input and output capacitances are compared with the transconductance. For tubes of the same type, coupled by a two terminal network, the input and output capacitances add directly, and the G.B. factor F' is:

$$F' = \frac{G_m}{2\pi\,(C_1 + C_2)}$$

where C_1 and C_2 are input and output capacitances respectively.

With four terminal and certain filter couplings, the input and output capacitances are isolated from each other. The G.B. factor F'' in this case is:

$$F'' = \frac{G_m}{2\pi\,\sqrt{C_1\,C_2}}$$

Gain-bandwidth factors for several common tube types are given in Table I.

The G.B. factor has the dimensions of frequency, and denotes the bandwidth at which the voltage gain of an ideal stage becomes unity. Thus, a type 6AC7 with a two-terminal interstage coupling would have a gain of 1 at a half-power bandwidth of 90 megacycles; conversely, with a 1 megacycle bandwidth, the stage gain would be 90 times. These figures take into account the tube capacitances only, and do not include the unavoidable strays.

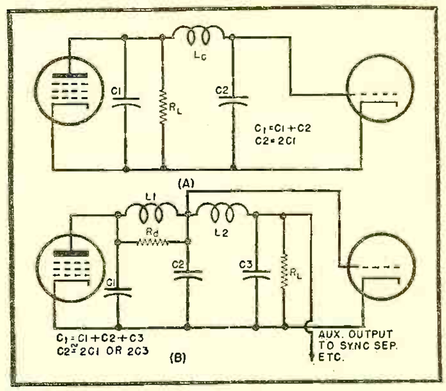
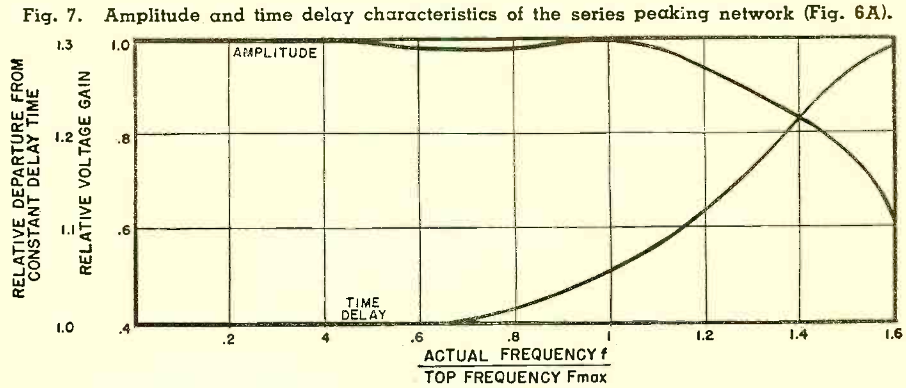


Fig. 6. (A) Series peaking network. (B) Two section filter coupling.

From the above discussion, it is apparent that a tube having high G_m and low interelectrode capacitances (largest G.B. factor) is the most desirable for video amplification. At the same time, the figures given represent the ultimate performance of which the tube is capable, and will not be realized in practice because of the presence of external circuit capacitances which tend to restrict the bandwidth. Furthermore, the G.B. factor is based on half-power bandwidths, and for television video applications, which may involve several amplifier stages, a much more linear phase and amplitude characteristic in each stage is necessary. The G.B. factor does, however, serve to indicate the rel-

Fig. 7. Amplitude and time delay characteristics of the series peaking network (Fig. 6A).



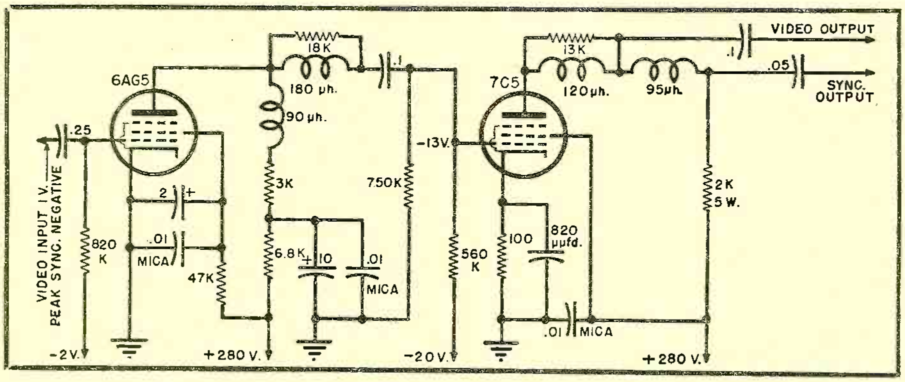


Fig. 8 Typical two-stage video amplifier incorporating high and low frequency compensation. Over-all gain is 90, and bandwidth is 4.35 mc.

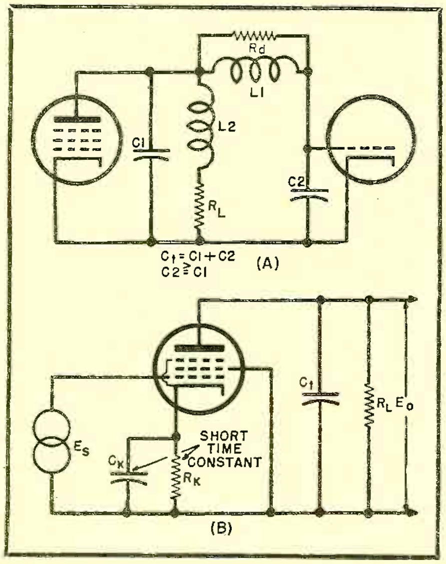


Fig. 9. (A) Modified shunt-series peaking. (B) Cathode peaking.

ative merit of the various tube types in wide-band amplifier applications.

High Frequency Compensation

It is possible to approach more nearly the theoretical performance indicated by the G.B. factor for any tube type through the use of one of a number of two or four terminal interstage coupling networks. Such networks may provide nearly complete phase and amplitude compensation up to a top frequency F_{max} which equals or exceeds

$$\frac{1}{2\pi C_t R_L}$$

This is to be contrasted with the uncompensated case where the departure from ideal phase and amplitude characteristics at the top frequency is very much greater than can be tolerated. In the following discussion of several such coupling networks, the basic circuit parameter for design purposes is the reactance of the total shunting capacitance C_t at the top frequency F_{max}. The figures of merit given in each case apply to the network itself, and indicate its midband voltage gain in relation to the uncompensated case.

Two Terminal Networks

Shunt Peaking, case 1 (Fig. 3B):

$m = 0.50$

$C_t = C_1 + C_2$

$R_L = \dfrac{1}{2\pi F_{max} C_t}$

$L_o = 0.5\, R_L^2\, C_t$

Figure of merit 1.0

Shunt Peaking, case 2

$m = 0.41$

$C_t = C_1 + C_2$

$R_L = \dfrac{.85}{2\pi F_{max} C_t}$

$L_o = 0.41\, R_L^2\, C_t$

Figure of merit 0.85

The shunt peaking circuit of Fig. 3B is the simplest type as it involves only one inductance. It has the lowest figure of merit of any coupling network, but has the advantage of permitting relatively wide tolerances in circuit values with little change in performance. The design coefficient m relates the reactance of the peaking inductor L_o to that of the total shunt capacitance C_t at the frequency of correction, and determines the linearity of the phase characteristic up to the top frequency F_{max}. In case 2, improved phase response is obtained at the expense of gain factor. Figs. 4 and 5 show amplitude and time delay characteristics of the two shunt peaking networks, as a function of the ratio of actual to top frequency.

Four Terminal Networks

Four terminal networks give improved figures of merit, since the tube input and output capacitances are effectively isolated from each other. On the other hand, four terminal networks are more difficult to adjust, and frequently require certain specified ratios between the capacitances at each end. In general, both the figure of merit and the linearity of phase and amplitude response will be determined by the manner in which the capacitances are distributed; this is particularly true of the more complicated structures.

Case 1 Series Peaking (Fig. 6A).

$C_t = C_1 + C_2$

$C_2 = 2C_1$

$R_L = \dfrac{1.5}{2\pi F_{max} C_t}$

$L_c = 0.67\, R_L^2\, C_t$

Figure of merit 1.5

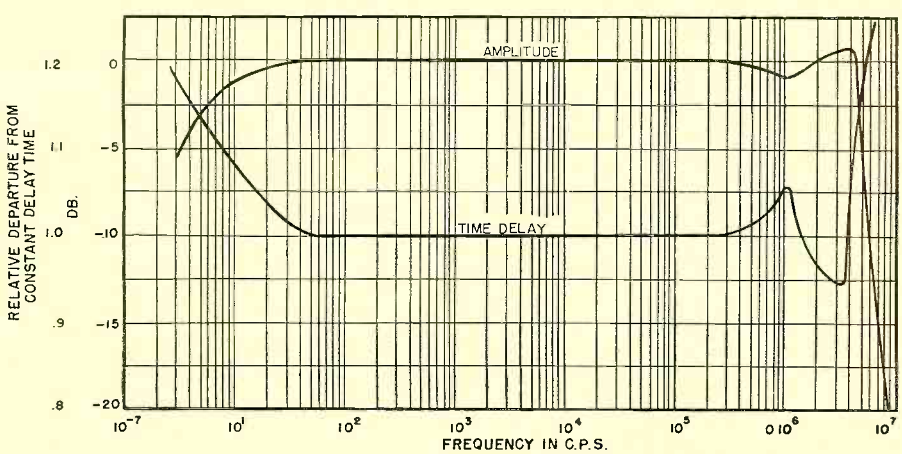
The series peaking network of Fig. 6A provides a gain of 1.5 over the uncompensated case, at the same time permitting a moderate tolerance with respect to capacitance distribution and circuit values. It is sometimes possible to achieve a slightly greater figure of merit than the above figure would indicate by using higher values of inductance and load resistance, but this procedure may require resistive damping of L_c in order to obtain sufficiently uniform response.

It might be noted that the positions of the source and load may be interchanged so that R_L is at the output end, with no change in network characteristics. This may be found necessary in certain cases where the terminating capacitance C_2 is less than the input capacitance C_1. In any case, the load resistor R_L should be on the low capacitance side of the peaking inductor L_c.

Capacitance ratios other than 2 to 1 or 0.5 to 1 may be accommodated at the expense of uniformity of phase and amplitude response. If, in Fig. 6A, the

(*Continued on page 27*)

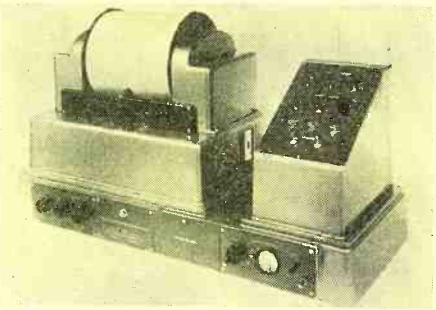
Fig. 10. Time delay and amplitude characteristics of amplifier of Fig. 8.



NEW PRODUCTS

INFRARED SPECTROPHOTOMETER

A double beam infrared spectrophotometer which will meet the demands of the structural chemist for high resolu-



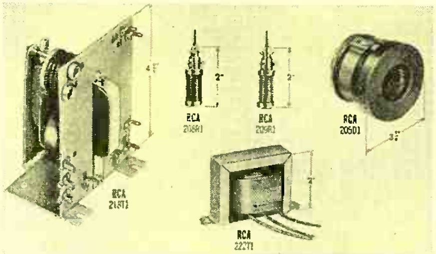
tion and sensitivity, and the analytical chemist for speed and accuracy, is now in production at the plant of the *Perkin-Elmer Corporation,* Glenbrook, Conn.

Designated Model 21, the instrument records directly in percent transmission against a linear wavelength scale on large, easily read charts. The instrument's resolution is up to the limitations imposed by the Raleigh criterion and Johnson noise. Its speed of scanning ranges from 3 minutes to 100 hours for the rock salt region, and the wavelength drive speed can be suppressed automatically when desired. The over-all range of the instrument is from less than 2 microns to 15 microns in the rock salt region.

Chart scales of the *Perkin-Elmer* Model 21 are uniform from 1 to 50 inches per micron by integral factors. The amplifiers and power supplies are external.

PICTURE TUBE COMPONENTS

The Tube Department of *RCA*, Harrison, N. J., recently offered to equipment manufacturers five new components for the RCA 16GP4 deflection sys-



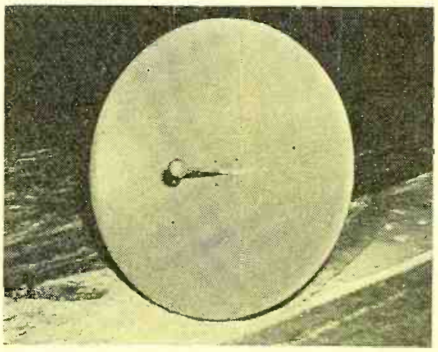
tems designed to use the horizontal-deflection amplifier tube 6CD6-G and the vertical-deflection amplifier tube 6S4.

These new components are as follows: Deflecting Yoke, Type 206D1; Width Control, Type 208R1; Horizontal-Linearity Control, Type 209R1; Horizontal-Deflection-Output and High-Voltage Transformer, Type 218T1; and Vertical-Deflection-Output Transformer, Type 222T1.

PARABOLIC ANTENNAS

Five new parabolic antennas to cover the 5929-7125 mc. frequency band are now available from the *Workshop Associates, Inc.*, 66 Needham St., Newton Highlands 62, Mass.

Each parabola is available in two, four, six, and eight foot diameters, and



mounts are available for all types of installations. The antennas have gains up to 44.9 db., and can be supplied with complete de-icing equipment and junction boxes.

A free booklet giving complete descriptions of these antennas may be obtained upon request.

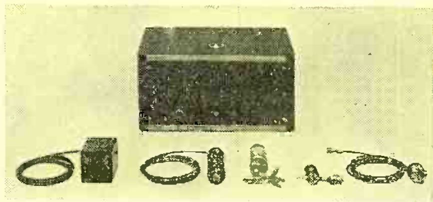
TEST EQUIPMENT

A new instrument which indicates on the screen of an oscilloscope instantaneous speed vs. time is announced by *Kay Electric Co.*, Maple Avenue, Pine Brook, New Jersey. The Rotalyzer uses a properly magnetized disc and a pick-up to provide a signal whose frequency is proportional to instantaneous speed. An accurate determination of this frequency is made and indicated on the cathode-ray oscilloscope screen. Average speed is read on a panel meter.

This instrument may be used in the study of torsional vibrations in rotating shafts, in the study of "wow" in phonograph equipment, and in the measurement of shaft rotational changes in computer systems. The r.p.m. range of 900 to 7200 r.p.m. may be extended down to 33-1/3 r.p.m. and upward to 50,000 r.p.m. Speed variation is up to 200 c.p.s.

ELECTRONIC TILE SORTER

An electronic tile sorter designed primarily to detect flaws in 4¼" x 4¼"



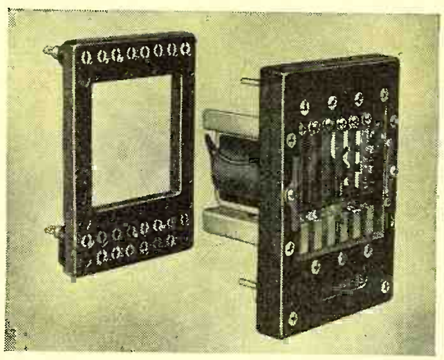
x ¼" double-fired tile when it is in the bisque state has been announced by *Electronic Associates Incorporated,* Long Branch, N. J.

The Model 203 Tile Sorter is adjustable to meet any possible conditions of mixture or firing. Adjustment to any level desired by the tile manufacturer is dependent on the following ratios: 1) When set to reject 100% of the tiles with objectionable air pockets, it will also reject 100% of the cracked tile and will reject all tiles under 200 lbs. on the 3-point break test; 2) When set to reject 95% of the tiles with objectionable air pockets, it will reject 87% of the cracked tiles and will reduce the break test to 110 lbs; and 3) When set to reject 90% of the air pocket tiles, it will reject 80% of the cracked tiles and the break test is reduced to 80 lbs.

This sorter is capable of sorting tiles at any rate up to 10 tiles per second, which is much faster than the tiles can be brought to the machine using present conveyor methods.

HIGH SPEED RELAY

The Autocall Company, Shelby, Ohio, has released for general use their ultra high-speed "HHA" relays which were originally designed and built as a basic component of the Harvard University's



Mark II Calculator for the Navy Department.

These relays, according to the manufacturer, are built for long life with 100 million operations, minimum, at high speed of 6 to 8 milliseconds and incorporate many features including six single-pole double-throw contacts arranged side-by-side to provide 28 different contact combinations; individual contacts and prongs are of one-piece construction, and each contact provides its own prong for jack-connecting to the circuit.

Coils can be furnished for 24 to 150 volts, d.c., with no increase in price for the various voltages.

SOLDERING UNIT

A soldering unit, operating on the conduction principle, and suitable for all types of soldering operations including silver soldering and brazing, is now

available from *Wasserlein Mfg. Co., Inc.*, 7400 3rd Ave., No., St. Petersburg 6, Florida.

The Wassco Glo-Melt has a 24 heat selector to handle lightest up to heaviest work. With capacity equal to a 450 watt heavy electric iron, Glo-Melt soldering is done with a light handpiece weighing only 5 oz., which is said to be as easily and accurately handled as a pencil. According to the manufacturer, this unit is faster and more accurate, consumes less power, and uses solder and flux.

Glo-Melt literature and a use-manual are available from the manufacturer.

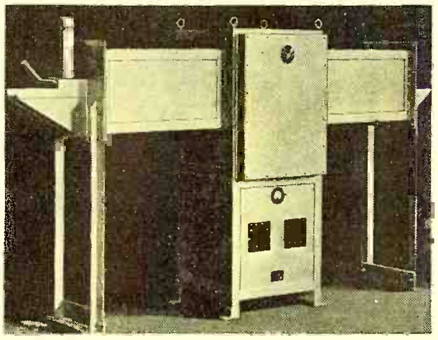
TIME INDICATOR

Electronic Systems Co., 555 East Tremont Avenue, New York 57, N. Y., has announced its Model 632-B Pulse Rise Time Indicator for the accurate plotting of the rise time of rapidly rising positive voltage pulses. The device employs a specially designed delay line of variable length and a vacuum tube voltmeter.

The 632-B features a radical change in the method of analyzing the build-up time of a pulse. However, the most important factor is the range available: .005 to .1 microseconds in 20 steps. Other ranges are available upon request.

PILOT TUNNEL KILN

Harper Electric Furnace Corporation, Niagara Falls, N. Y., has announced a small tunnel kiln for speeding up pro-



duction test runs. Its versatile design permits variations in firing cycles to allow duplication of most firing schedules.

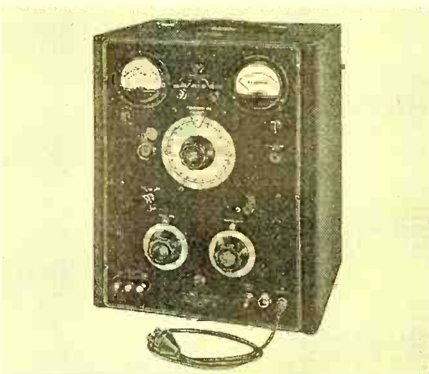
These units are being used in test firing of ceramic powders, steatite, electrical porcelain, insulators, resistors, spark plugs, grinding wheels, newly developed electronic components, and other ceramic products.

Further information may be obtained by writing the company direct.

FM SIGNAL GENERATOR

Boonton Radio Corporation, Boonton, N. J., has announced the Type 202-D frequency modulated signal generator designed for use with telemetering receiver equipment and in other associated applications.

This instrument covers the frequency range from 175 to 250 megacycles and is provided with three continuously adjustable deviation ranges: 0-24 kc., 0-80 kc., and 0-240 kc. In addition, amplitude modulation up to 50% may be obtained using the internal audio oscillator and



modulation to 100% using an external audio oscillator.

The deviation sensitivity of the frequency modulation system is within ± 0.5 db. from d.c. to 200 kc. The ampli-

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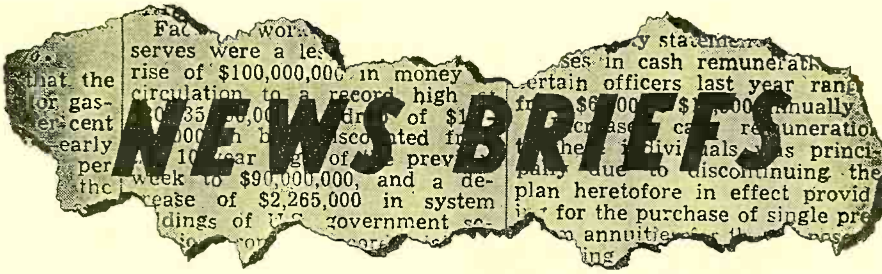


DR. LANGMUIR RETIRES

Dr. Irving Langmuir, regarded as one of the greatest scientists of modern

times, has retired as associate director of *General Electric Company's* Research Laboratory. Dr. Langmuir will continue work in the laboratory in a consulting capacity, but will engage primarily in activities of Project Cirrus, joint weather research program of the U. S. Army Signal Corps and the Office of Naval Research in consultation with *General Electric.*

Dr. Langmuir, who has received the world's top-ranking scientific awards, including the Nobel Prize in chemistry in 1932, was responsible for the development of the gas-filled incandescent lamp, the high-vacuum power tube, atomic hydrogen welding, screening-smoke generator for the military, and methods for artificial production of snow and rain from clouds.

MICROWAVE REPEATER IN PRODUCTION

The *Philco* feedback-type microwave repeater announced at the recent annual session of the Communications Section of the Association of American Railroads is now being manufactured on a production basis.

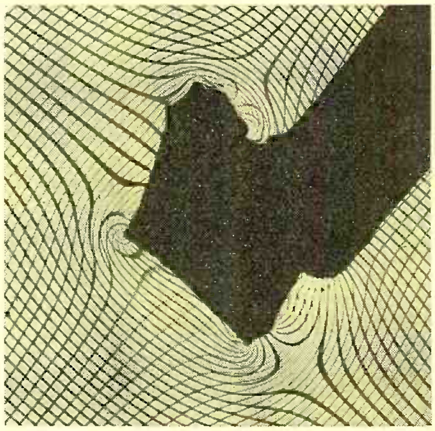
Capable of handling up to 32 two-way voice channels or combinations of voice and coded intelligence, the *Philco* CLR-5 microwave repeater is designed for operation in the 6575-6875 megacycle band, which is available to railroads. This feedback repeater circuit permits multiple chain repeats with very little distortion and makes possible the use of only one microwave oscillator tube for both transmitting and receiving functions of a single-direction repeater.

The Industrial Division of *Philco Corporation,* Philadelphia 34, Pa., will give further information and detailed technical specifications upon request.

ELECTRIC FIELD

A shadow technique, developed by Dr. L. L. Marton and associates of the National Bureau of Standards, now makes it possible to photograph and study quantitatively electrostatic and magnetic fields of extremely small dimensions.

The striking pattern shown is the result of an electric field about a charged crystal of barium titanate when studied by the electron-optical shadow



method. This method offers a powerful tool for exploring fields that have not been susceptible to other methods of investigations.

An electron lens system is used to produce a shadow image of a fine wire mesh placed in the path of an electron beam. From the distortion in the shadow network caused by deflection of the electrons as they pass through the field under study, accurate values of field strength are computed. In the photograph, the distorted shadow image of the wire mesh is superposed on the image of the crystal (center) and its 0.010-inch tungsten-wire support.

NEW SITE FOR NBS LABORATORY

Approval has been given for the development of a site at Boulder, Colorado, for additional Bureau laboratory facilities. To be used initially by the Bureau's Central Radio Propagation Laboratory, the site consists of about 210 acres directly south of the city.

Laboratory facilities at Boulder for research in radio propagation at a cost of about $4,500,000 have been authorized by Public Law 366 of the 81st Congress. Actual construction is expected to start in the summer of 1951 and when completed will maintain a research staff of about 300 people.

NBS TO USE MEMORY UNITS

The first of three *Technitrol* memory units has been obtained by the National Bureau of Standards for use in the latest type of large scale electronic computer developed jointly by funds of the Air Comptroller Department of the Army and NBS.

The memory unit, based on the principle of the mercury delay line originally conceived at the University of Pennsylvania and manufactured by the *Technitrol Engineering Co.,* is an automatic brain which will remember for later recall any sequence of facts or figures once placed on it. It has reached its latest development in the computer to be known as the NBS Interim Computer.

In addition to contemplated work in processing the 1950 census figures, the Interim Computer will be studied in an effort to develop new and better computers for Government and commercial use. It will also be utilized for solving many of the scientific problems that arise in the normal work of the Bureau.

ULTRASONIC GENERATOR

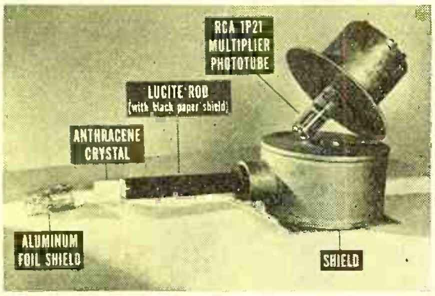
One of the many electronic developments described in "Electrical and Allied Developments of 1949" published in the *General Electric Review* was an ultrasonic generator having a quartz

transducer on top of the power supply and operating in an oil-filled well.

Power at 300, 500, 750, or 1000 kc. is supplied by the equipment. Applications of this ultrasonic generator include assistance to chemical reactions, bacteria control, and the mixing of immiscible liquids such as mercury into water.

IMPROVED MULTIPLIER PHOTOTUBE

Important advances in nuclear research, astronomy, photoelectric spectrometry, and other fields involving work with light at extremely low levels

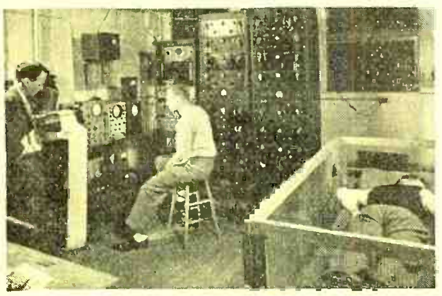


is expected with the announcement of a greatly improved 1P21 multiplier phototube by *RCA's* Tube Department. Heart of the cyclotron used in radiation research at the University of Rochester is an *RCA* 1P21 multipler phototube shown partially disassembled. The "equivalent noise input" of the improved 1P21 has been reduced to $5x10^{-13}$ lumen at room temperature. This value represents a six-fold reduction in operational noise and permits a corresponding reduction in the lower limit of measurable light intensities.

This extension in the range of the 1P21 makes it an even more valuable aid for astronomers studying light from distant stars, for nuclear scientists studying atomic radiation, and for other laboratory research work requiring measurement of light of extremely low intensity.

INSTRUMENT TO RECORD BRAIN AND HEART ACTION

Equipment for making radar-like pictures of the heart and brain in action was described by Dr. Stanford Goldman, professor of electrical en-



gineering at Syracuse University and former research associate in the M.I.T. Research Laboratory of Electronics, at the recent IRE Convention. Results already obtained indicate that the pictures will be useful for the diagnosis of disease in the heart and brain and in studying the physiology of these vital organs.

The equipment, first conceived and developed at M.I.T., picks up tiny electrical impulses which flow through nerves in the body. These impulses are then converted into a constantly moving map-like picture similar to those made by World War II radar sets.

Equipment shown in the center of the photograph amplifies signals from electrical pick-ups on the patient at the right. Dr. Goldman at the left is shown examining a printed record of these signals while William F. Bantelmann, Jr., M.I.T. Research Assistant in electrical engineering, watches the visional pattern.

NEW LITERATURE

Handling of Radioactive Isotopes

The National Committee on Radiation Protection, established by the National Bureau of Standards, has prepared a handbook giving recommendations for the safe handling of artificially-produced radioactive isotopes in the typical laboratory or small industrial operation.

Handbook H42, Safe Handling of Radioactive Isotopes, gives general safety recommendations which may be modified to suit the control requirements of different types of operations. Specific problems discussed are those of personnel, laboratory design and equipment, hazard instrumentation, hazard monitoring, and transportation of isotopes. The increasing use of radioactive isotopes by industry, the medical profession and research laboratories has made it essential that certain minimal precautions be taken.

This handbook is priced at 15 cents a copy and is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Paper Laminates

A report prepared by the Plastics Laboratory of Princeton University under joint sponsorship of the National Defense agencies describes the development of a low-loss, arc-resistant paper laminate for high frequency applications.

The report, released to the public by the Office of Technical Services of the U. S. Department of Commerce, deals with modifying standard melamine-formaldehyde impregnating resin with varying amounts of hexamethylenediamine to produce a laminated material with high dielectric strength,

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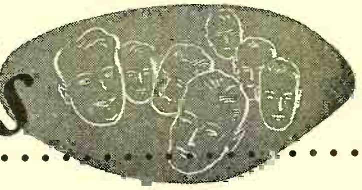
Personals



DR. MERLE M. ANDREW has joined the staff of the machine development section of the National Bureau of Standards applied mathematics laboratories. Before coming to the Bureau, Dr. Andrew was engaged in operational research with the Naval Operations Evaluation Group and prior to that time conducted radar research at the Radiation Laboratory of MIT. He is a member of the American Mathematical Society and the American Physical Society.

ARTHUR L. CHAPMAN has been named general manager of the *Colonial Radio and Television Division* of *Sylvania Electric Products Inc.* With headquarters in Buffalo, N. Y., Mr. Chapman will be responsible for production and sales of the division in addition to his duties as general manager of *Sylvania's* newly formed Parts, Wire and Plastics Division at Warren, Pa. Mr. Chapman has been associated with *Sylvania* since 1933.

CURTIS R. HAMMOND has been appointed equipment sales manager of the Receiving Tube Division of *Raytheon Manufacturing Company.* He will be responsible for the sale of radio receiving tubes and cathode-ray picture tubes and will direct activities from *Raytheon's* Chicago warehouse. Mr. Hammond joined *Raytheon* five years ago after many years in sales and sales engineering work with *Ken-Rad Tube and Lamp Corporation.*

DELMAN E. ROWE has been appointed senior test director in the guided missiles research laboratory of the National Bureau of Standards. Mr. Rowe, who received the Naval Ordnance Development Award with Certificate by the Naval Bureau of Ordnance in 1945, is a member of the Institute of Radio Engineers, is the inventor of a microwave switch and attenuator, and has published several technical papers in the electronics field.

ROBERT A. STAREK has been appointed field engineer for the Radio Tube Division of *Sylvania Electric Products* at Emporium, Pa. Formerly commercial engineer, Mr. Starek joined the Engineering staff of *Sylvania* immediately after receiving his B.S. degree in electrical engineering from Iowa State College. He is a member of the American Institute of Electrical Engineers and the IRE and will make his headquarters in the Cincinnati office.

JEROME R. STEEN, director of quality control for *Sylvania Electric Products, Inc.,* New York, has been elected to grade of Fellow by the board of directors of the Institute of Radio Engineers. Mr. Steen joined the engineering staff of the Radio Division of *Sylvania* at Emporium, Pa., in 1931 and since that time has been active in the application of quality control and standardization methods in radio tube manufacture.

New R-C Osc.

(*Continued from page* 14)

plate load resistor R_{L2} or the alternate cathode resistor R_{k1} may be varied for manual adjustment of amplifier gain. The higher supply voltages give a more linear operating region for the amplifier tubes.

Oscillators of this type have been adjusted to operate with various supply voltages ranging from 100 to 350 volts. When distortion is considered important the circuit should be supplied with higher voltages and adjusted to as near the oscillation threshold as is deemed advisable. The supply should be regulated if possible but satisfactory results can be obtained over quite a range of voltages.

The amplitude of oscillation is a marked function of these supply voltages; therefore, the relative distortion will also vary. Some compensation is possible by using one of the circuit variations.

Circuit Variations

There will be some quiescent current flowing in the nonlinear element if two equal resistors are used in the cathodes. These tubes are not balanced because the load resistor appears only in the plate circuit of stage two. This condition will be known as the unbalanced circuit.

If the cathode resistor R_{k2} is increased in value the d.c. voltages on the cathodes may be made equal and the nonlinear element will not carry d.c. current. This will be known as balanced circuit A and does not require any additional circuit components.

When the circuit is made symmetrical by using a dummy load resistor in the plate circuit of the first stage the quiescent current may be removed from the nonlinear element. This will be known as balanced circuit B. If this dummy load is bypassed for a.c. signals the gain is given by the first expression. If the dummy load is not bypassed the element R_{L1} must be included in calculation of the net amplifier gain in this manner:

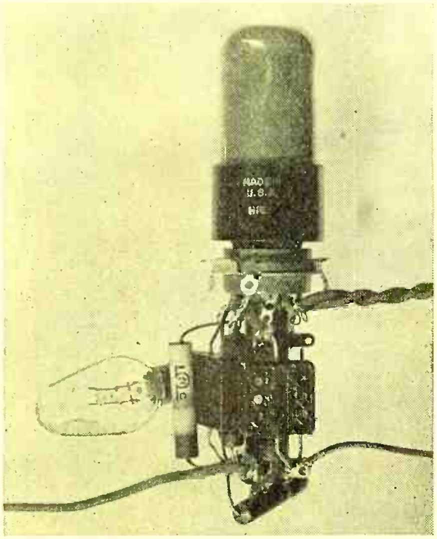
$$K' = \frac{A}{B + CR_x} \qquad (9)$$

where the constant A is the same as Eqt. (6), and B and C are given by:

$$B = (r_p + R_{L2})[r_p(R_{k1} + R_{k2}) + (\mu+1)R_{k1}R_{k2}] + r_pR_{k1}R_{k2}(\mu_2+1) + R_{L1}\{R_{k2}(r_p + R_{L2}) + R_{k1}[r_p + R_{L2} + (\mu_2+1)R_{k2}]\} \qquad (10)$$

$$C = [r_p + (\mu_1+1)R_{k1}][r_p + R_{L2} + (\mu_2+1)R_{k2}] + R_{L1}[r_p + R_{L2} + (\mu_2+1)R_{k2}] \qquad (11)$$

The basic unbalanced circuit causes the attenuation in the "π coupling" network to increase with increasing supply voltages. This tends to counteract



A 6SN7 oscillator of the unbalanced circuit form operating at 995 to 997 c.p.s.

the increase in tube amplification at higher supply voltages in much the same manner as the circuit of Fig. 7A. This unbalanced circuit offers this inherent compensation; however, where the greatest a.c. sensitivity is desired the amplifier should be balanced for equal d.c. voltages on the cathodes.

The variation of amplifier gain with respect to signal level has been examined for the unbalanced and two balanced circuit variations. Typical results are indicated in Fig. 8.

The basic unbalanced circuit is shown to be less responsive to supply voltage variations in the results given in Fig. 9.

The circuit presented is well suited to fixed frequency oscillators. The values required may first be calculated and then trimmed on a trial and error basis. A great deal of care is required to locate the frequency to less than 1 per-cent using fixed elements. These rules may prove helpful:

1—To raise the frequency pad additional resistance across R_1 or R_2 in the feedback circuit.

2—To lower the frequency pad additional capacitance across C_1 or C_2 in the feedback circuit.

3—The choice between the two resistors (or the two condensers) is made considering the present level of oscillation. When additional resistance is placed across R_1 or additional capacitance is placed across C_1 the signal level of steady oscillation will increase. If some adjustment of amplifier gain is provided this need not be considered.

A number of fixed frequencies may be obtained by suitable switching of fixed components in the feedback network. Both the resistance and the capacitance elements may be switched for frequency ranges greater than one decade. There is a relationship between the values selected; these general rules may help in adjusting these values.

1—Begin with the larger values of resistance and capacitance first.

2—Complete the selection of the set of elements (R's or C's) which are greater in number. Attempt to maintain nearly constant output signal amplitude for these values.

3—Complete the selection of the remaining set of elements. This set will generally be used as multipliers of the frequencies given by the first set.

A very useful audio oscillator may be constructed using two sets of element values for the feedback network. An example of the different frequencies which might be obtained is as follows:

The resistor elements are selected with a two pole, nine point switch to give these base frequencies: 10, 15, 20, 25, 30, 40, 50, 60 and 80 cycles per second. The condenser elements are selected with a two pole, three point switch to give these multiplier factors: Times 1, Times 10 and Times 100.

Continuously variable frequency oscillators may use ganged resistance or capacitance pairs with the alternate elements switched for different multiplier factors times the basic frequency range. Ganged resistors may be used in series with fixed resistors to minimize tracking errors—a frequency range of 3:1 may be suggested here. Variable resistor elements will cause the loading of the feedback network upon the amplifier to vary as the oscillator is tuned to different frequencies. Ganged condensers may be used for a range of 10:1 as tracking is much easier and the loading upon the amplifier is constant. If the minimum capacitance is to be 100 $\mu\mu$fd. the condenser pair would require a maximum of 1000 $\mu\mu$fd. per section for a decade of frequency variation. With care a smaller minimum capacitance might be used.

Advantages of this new oscillator are primarily in design and economics,

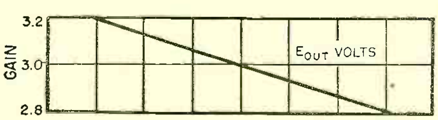


Fig. 13. Gain characteristics of the amplifier shown in Fig. 7A.

where cost, weight and space are important. Fixed frequency applications include bridge test sets, intermodulation test sets, modulation signals for signal generators, telemetering systems, tone generators, and simple musical instruments.

Semi-variable and continuously variable frequency oscillator applications are many and varied. This oscillator will best serve in those applications where it has not been possible to use other circuits because of the cost, space and weight factors.

News Briefs

(*Continued from page* 23)

very low dielectric loss and good punching characteristics.

PB 99220, Low-loss Arc-resistant Paper Laminates, sells for 50¢ a copy. Orders should be addressed to the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., and should be accompanied by check or money order payable to the Treasurer of the United States.

Welding Control Equipment

Westinghouse Electric Corporation now has a booklet describing in detail its electronic resistance welding control equipment, both synchronous and non-synchronous.

Basic equipment in the control circuit includes a sequence-weld-timer panel and a means to fire the ignition tubes in the power circuit. Auxiliary control panels can be readily added to meet specific job requirements.

A copy of this booklet, B-4309, may be obtained by writing *Westinghouse Electric Corporation*, P. O. Box 2099, Pittsburgh 30, Pa.

TV Tube Booklet

The Radio Tube Division of *Sylvania Electric Products Inc.*, Emporium, Pa., is offering a new 20-page booklet providing television picture tube and general purpose cathode ray tube characteristics; replacement tube data; base diagrams; suggestions for tube handling; and a concise description of cathode-ray oscilloscope use in television servicing.

Information contained covers 165 tube types with faces ranging from two to twenty inches maximum dimension utilizing electrostatic or magnetic deflection systems. A nomenclature chart explains the meaning of type number letters and figures and applications for different types of tube screens.

The booklet is available through Authorized *Sylvania* Distributors.

Geiger-Muller Counter

The nature, construction, and use of the Geiger-Muller Counter is presented in a new booklet just published by the National Bureau of Standards.

In addition to the treatment of the counter itself, the booklet discusses methods of detecting counter pulses, applications of counters to quantitative measurements, proportional counters, and the preparation and filling of Geiger-Muller Counters.

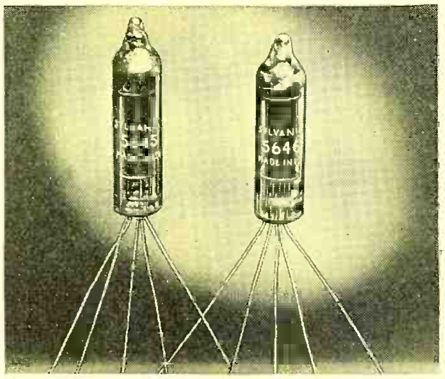
Circular 490, The Geiger-Muller Counter, may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., 20¢ a copy.

NEW TUBES

SYLVANIA TUBES

Subminiature Tubes

Two additional *Sylvania* subminiature tube types, a medium-mu triode



and a high-mu triode, are now available. Type 5645 medium-mu triode is a T-2 suitable for Class A amplifier applications. Under typical operating conditions the tube will have a transconductance of 2700 micromhos and an amplification factor of 20. Maximum rated plate dissipation is 1 watt and plate resistance is 7400 ohms.

Type 5646 high-mu triode is a T-2 suitable for Class A amplifier or resistance coupled amplifier applications. Under typical operating conditions the tube will have a transconductance of 2400 micromhos, an amplification factor of 70, and a plate resistance of 29,000 ohms. Maximum rated plate dissipation is 0.3 watt.

Both subminiature types have 6.3 volt, 150 milliampere heaters, and flexible leads for direct wiring to circuit.

Beam Power Amplifier

A high-perveance beam power amplifier designed for use as a horizontal

deflection amplifier in high efficiency deflection circuits for television receivers is another of the many new tubes announced by *Sylvania.*

Features of type 6AU5GT include: low-mu, high plate current at low plate voltage and high operating ratio of plate current to number 2 grid current. The tube has a 6.3 volt, 1.25 ampere heater. Under typical operating conditions, it will have trans-conductance of approximately 6000 micromhos; mu approximately 5.9. The maximum plate dissipation is 8 watts; peak positive pulse plate voltage is 4500 volts; and maximum d.c. plate voltage is 450 volts.

Picture Tubes

An 8½-inch, all-glass, direct-view television tube with electrostatic focus and deflection for use in television sets designed for 7-inch viewing tubes is now available through authorized *Sylvania* distributors.

The tube, type 8BP4, is interchangeable with type 7JP4 and offers the advantages of 50% increase in useful area. Deflection sensitivity is provided for full scan in circuits designed for full scan

with 7-inch tube types. Operating voltages include: 6000 on number two anode; 1620 to 2400 on number one anode; and zero to —72 to —168 volts on number one grid.

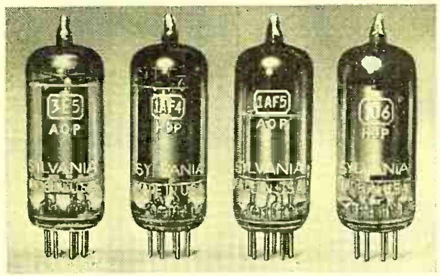
Type 16LP4 is a 16-inch, all-glass, direct-view television tube supplied with an external conductive coating which acts as a filter capacitance when grounded. The tube is supplied with neutral or clear face plates and employs an ion trap gun for use with external magnet.

Typical 16LP4 picture tube operating conditions include: maximum usable face diameter, 15⅞ inches; heater volts, 6.3; heater current, 0.6 amperes; focus coil current, 110 milliamperes; ion trap magnet current, 120 milliamperes; number 1 grid volts (for cut-off) -33 to -77; number 2 grid volts, 300; and anode volts, 12,000.

Miniature Portable Radio Tubes

A new line of miniature radio tubes for portable radio receivers, said to be the first announced in this country in more than ten years in which filament current has been reduced below 40 milliamperes per tube, is now being offered by *Sylvania.*

The new tubes require only 25 milliamperes per tube which means that "A"



batteries used in portable receivers will last approximately three times as long as with previous tubes. All are supplied with 7-pin miniature button bases.

Types included are: 1U6, a heptode converter with oscillator anode as a separate element; type 1AF5, a diode pentode; type 1AF4, a sharp cutoff r.f. pentode; and type 3E5, a beam power output tube. Power required for a complement of the new tubes in a typical battery-operated superheterodyne is only 2.1 watts. They will also operate satisfactorily over a range of 1.4 volts to 1.1 volts.

Miniature Rectifier Tubes

The Radio Tube Division, *Sylvania Electric Products Inc.*, 500 Fifth Ave., New York 18, N. Y., has announced a miniature high voltage half wave rectifier designed for television receiver pulse rectifying systems and voltage doubler circuits for magnetically deflected 10 and 12-inch viewing tubes.

The tube, type 1V2, has a peak inverse plate voltage of 7500, a peak plate current of 10 milliamperes, and an av-

erage plate current of .5 milliamperes.

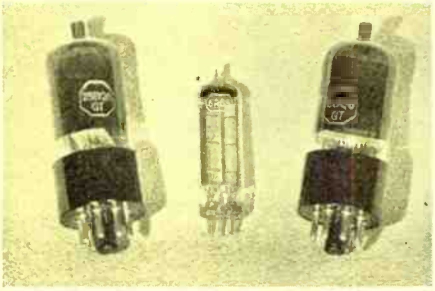
Type 1X2 is a double ended miniature high voltage rectifier tube designed for use with r.f., fly-back, and 60-cycle types of power supply for television picture tube anodes. This type is for use in power supplies where voltages up to

15,000 volts d.c. are required. The 1X2 is mounted in a T-6½ bulb and has an over-all height of 2¹¹⁄₁₆ inches.

RECEIVING TUBES

Three new receiving tubes designed mainly for television receivers have been added to *General Electric's* tube production lines.

The 6AS5 is a beam-power amplifier of miniature construction intended for use as the audio power-output tube in television receivers and small radio receivers. When operating Class A1, with



a plate voltage of 150 volts and an input signal of 8.5 volts peak, 2.2 watts of output power can be realized with 10 per-cent distortion.

The 6BA6-GT and 25BQ6-GT are beam-power amplifier tubes designed to withstand high-surge plate voltages for short periods of time. These tubes are intended for use as horizontal-deflection amplifiers in television receivers. Maximum ratings of the tubes include a plate dissipation of 10.9 watts, a plate current of 100 milliamperes, and a peak positive surge plate voltage of 5000 volts.

Further information may be obtained from the Tube Divisions, Schenectady, New York.

RCA TUBES

Deflection Amplifier Tubes

Two new deflection amplifier tubes designed particularly for use with the

new 16-inch "metal" picture tube 16GP4 have been announced by the Tube Department of *RCA*, Harrison, N. J.

The 6CD6-G shown is a high-perve-

(*Continued on page* 29)

Video Amp. Design

(*Continued from page* 18)

ratio C_2/C_1 is designated by M, the values of R_L and L_c will be modified by:

$$R_L' = \sqrt{MR_L/2}\ ;\ L_c' = ML_c/2$$

where R_L' and L_c' are the new values of load resistance and peaking inductance respectively. The curves of Fig. 7 show amplitude and time delay characteristics of the series peaking network, for the case where $C_2 = 2C_1$.

Two Section Filter Coupling

It is frequently possible to secure uniform response and an improved figure of merit with a four terminal coupling network designed on the basis of a low-pass filter. Although such a network requires rather carefully controlled distribution of capacitances for best results, it does provide a gain factor approaching 2 over the uncompensated case, and has the further advantage that two output terminals are available (Fig. 6B).

The filter structure consists of a T type constant K full section, with mid-shunt terminated half-sections at each end. The full T section is composed of C_2 and the two series impedances $L_1/2$ and $L_2/2$. The load resistance and the cut-off frequency of the filter as a whole is determined by the capacitance C_2. The cut-off frequencies of the end half-sections are determined by capacitances C_1 and C_3. In order to prevent an unwanted rise in the image impedance of the input half-section, it is usually necessary to add resistive damping across L_1. The value of the damping resistor R_d is best determined by experiment, and will generally lie in the vicinity of 5 to 6 times the load resistance.

Due to the larger number of reactive elements, this type of coupling network shows a somewhat greater deterioration of phase characteristics about the top frequency. In order, therefore, to obtain sufficiently uniform response, it is sometimes necessary to design for a higher top frequency than would otherwise be the case. For optimum results, the terminating capacitances C_1 and C_3 should be nearly equal to one half the center capacitance C_2.

$$C_t = C_1 + C_2 + C_3 \quad ; \quad C_2 \cong 2C_1 \text{ or } 2C_3$$

$$R_1 = 1/\pi F_{max} C_t$$

$$L_1 = \left(\frac{1}{2} + \frac{C_1}{C_2}\right)\left(\frac{R_1}{2\pi F_{max}}\right)$$

$$L_2 = \left(\frac{1}{2} + \frac{C_3}{C_2}\right)\left(\frac{R_1}{2\pi F_{max}}\right)$$

Figure of merit $\cong 2.0$

Case 3. Modified Shunt-Series Peaking

This type of coupling network provides a large figure of merit and at the same time quite uniform phase and amplitude characteristics. It is similar to the two section filter coupling described above, except that the terminating half-section is of the mid-series type. C_3 of Fig. 10 is therefore missing. The shunt-series network may afford a slightly better gain factor than the network of Fig. 6B, and the deterioration of phase response about the top frequency is not so great (Fig. 9A).

The accompanying Table II, taken from a report by O. H. Schade of *RCA* Laboratories gives the information necessary to design a shunt-series peaking network for capacitance ratios of 0.3, 0.5, and 1.0. Since the characteristics of the network are comparatively insensitive to this ratio, it is possible to interpolate between the values given with a fair assurance of success.

Of the six circuit values in the network, only two need be determined in order to completely design the interstage for a given bandwidth or gain. As the capacitances C_1 and C_2 are presumed fixed and reduced to their practical minimums, either the bandwidth or the gain may be used as a design parameter. Once the capacitances have been evaluated, the remaining parameters may be determined as a function of the chosen parameter directly from the table. The necessary design equations are:

$$C_t = C_1 + C_2 \; ; \; R_0 = 1/\pi F_c C_t$$

$$L_1 = R_1^2 \, C_t \; ; \; L_2 = 0.5 \; L_1$$

where F_c is the cutoff frequency of the network and R_o is the load resistance design constant.

The general procedure in designing a network of this type is to determine first the capacitances C_1 and C_2, the capacitance ratio C_1/C_2 and the total capacitance C_t. The ratio of the network cut-off frequency F_c to the top frequency of correction F_{max} for the existing capacitance ratio is determined from Table II (col. 4). The resulting value of F_c is then used to calculate the load resistance design constant R_o. The actual load resistance R_L can then be obtained from column 3 and the values of L_1, L_2, and R_d determined.

Where the video amplifier provides a fairly large gain reserve, it is sometimes possible to make use of selective degenerative feedback to compensate for discrepancies in the over-all high frequency characteristic. One simple method of accomplishing this is shown in Fig. 9B.

The resistance-capacitance network in the cathode circuit of the tube has a short time constant, and provides selective degeneration. C_k is a small mica capacitor, seldom larger than 1000 $\mu\mu$fd.

The voltage gain of the stage at low and medium frequencies where C_k is not effective is given by:

$$\overline{A_L} = \frac{G_m \, R_L}{1 + G_m \, R_k}$$

and is, of course, always smaller than the stage gain were R_k omitted. The gain reduction due to R_k is:

$$20 \log \; (1 + G_m \, R_k) \text{ decibels}$$

This equation indicates the maximum degree of amplitude compensation obtainable with cathode peaking for a fixed value of R_k.

Table II. Table for determining the ratio of the network cut-off frequency to the top frequency of correction for the existing capacitance ratio.

1 C_1/C_2	2 R_d/R_1	3 R_1/R_o	4 F_{max}/F_c	5 *Figure of merit*
0.3	5.66	1.088	0.96	2.1
0.5	5.66	1.075	0.85	1.8
1.0	18.90	1.00	0.76	1.5

Tube Type	G_m	F'	F''
6AG5	5000	98	232
6AH6	9000	117	238
6AK5	5100	119	242
6AU6	5200	79	157
6AC7	9000	90	184
6AG7	11000	85	177
7B5 (6K6GT)	2300	24	47
7C5 (6V6GT)	4100	35	71
6L6G	6000	40	84

Table I. The gain-bandwidth factor for some of the more common tubes.

At the high frequency end of the video band, the shunting reactance of C_k causes a decrease in the effective cathode circuit impedance, and results in an increased voltage gain. At the same time, the a.c. plate-cathode voltage is shifted in phase in a direction such as to partially counteract the phase shift produced by the plate circuit time constant $C_t \, R_L$. The gain at high frequencies is given by:

$$A_h = \frac{G_m \, R_L}{1 + (G_m \, R_k/y)}$$

where $y = [(2\pi \, f \, C_k \, R_k)^2 + 1]^{1/2}$
and the added phase shift by:

$$-\tan^{-1}\left(\frac{1}{2\pi f \;\, C_k R_k}\right)$$

It is possible to effect nearly complete high frequency phase and amplitude correction with cathode peaking by making the plate circuit and cathode circuit time constants equal, that is:

$$R_L \, C_t = R_k \, C_k$$

The figure of merit of a stage using cathode peaking only is generally not nearly so good as will be obtained with the two and four terminal networks described. Cathode peaking is, however, useful in small and controlled amounts to supplement compensation obtained by other means.

The high frequency characteristics of a well designed television video amplifier should be such that the maximum variation in over-all delay time at 4.0 megacycles will not exceed about 0.08 microseconds. This requires that the total phase deviation up to the highest frequency of importance be not greater than 57° per stage in a two stage amplifier. The over-all amplitude characteristic should be flat to within ± 1 decibel or so up to the top frequency of correction.

The schematic diagram of Fig. 8 shows a typical two stage television video channel incorporating high and low frequency compensation, while Fig. 10 indicates its time delay and amplitude characteristics.

TECHNICAL BOOKS

"ACOUSTICAL DESIGNING IN ARCHITECTURE" by Vern O. Knudsen and Cyril M. Harris. Published by *John Wiley & Sons, Inc.*, 440 Fourth Ave., New York 16, N. Y. 457 pages. $7.50.

Architects, builders, acoustical engineers, teachers and students of architectural acoustics will find this book extremely valuable as it covers the entire field of acoustical design in architecture. Practical applications are emphasized and includes design of auditoriums, theaters, school buildings, homes, churches, radio, television and sound-recording studios.

The contents is divided into two sections: (1) a consideration of the general principles and procedures which form a basis for all acoustical designing, and (2) a description of specific applications of these principles and procedures.

Complicated mathematical formulas are translated into physical explanations, and charts and nomographs are given for many formulas. Comprehensive tables give pertinent data on sound-absorptive materials and sound-insulative structures.

This volume will serve as a practical guide to good acoustical designing as well as a handbook in the solution of problems encountered.

"ADVANCES IN ELECTRONICS" Volume II, Edited by L. Marton, National Bureau of Standards. Published by *Academic Press Inc.*, 125 East 23rd St., New York, N. Y. 378 pages. $7.60.

Because of the favorable reception given the first volume of "Advances in Electronics," it was decided that a yearbook of this kind would receive wide acclaim. This second volume covering the latest advances in the field of engineering electronics includes a large contribution from European authors, whereas the first volume was written in its entirety by American authors.

Contributors to this second volume are: Donald K. Coles, *Westinghouse Research Labs;* H. Fröhlich, University of Liverpool, G. F. J. Garlick, University of Paris, France; Gunnar Hok, University of Michigan; G. Liebmann, *Associated Electrical Industries*, Ltd., Berkshire, England; Hilary Moss, *Electronic Tubes Ltd.*, Reading, England; George T. Rado, Naval Research Laboratory; and J. H. Simpson, National Research Council of Canada.

The editors and publishers have expressed a hope that this text will be a definite contribution to the free and international exchange of ideas among scientists.

New Products

(*Continued from page* 21)

tude modulation system is substantially flat from 30 cycles to well above 100 kc. A monitoring meter is used to standardize the output level of the signal generator in order to make the mutual inductance r.f. attenuator direct reading over the range from 0.1 microvolts to 0.2 volts.

The instrument is self-contained, with power supply, and is designed for use on 115 volts, 60 cycles. Complete details may be obtained on request.

COIL WINDER

A manually-operated coil winding machine designed for the production of paper-insulated coils in multiple or "stick" form is announced by *Universal Winding Company*, Providence, Rhode Island.

The No. 108 Winder was designed to supplement the automatic type of machine with a low-cost machine suitable for the predominantly "job shop" type of market characteristic of the ever-changing electrical and electronic parts industries. The machine can be adjusted quickly to accommodate changing requirements of wire size, coil length and diameter.

Power is supplied by a ½ h.p. a.c. constant speed motor driving through an adjustable-sheave speed controller to a multiple-disc friction clutch attached directly to the spindle. Speed range is 400 to 2200 r.p.m.

VOLTMETER

A new model of the Mini-Volt Voltmeter manufactured by *Industrial Devices, Inc.*, Edgewater, N. J., which features an expanded scale centered on the common 110 and 220 line voltages, is announced.

The new adaptation of this voltmeter is known as Model 410A and is accurate to within 2 volts at 110 volts a.c. Practically burnout proof operation is assured by the glow-lamp indicator which is guaranteed for 25,000 hours' operation minimum. 12" flexible test leads are tipped with heavily insulated test prods assuring user maximum safety.

The Mini-Volt can check voltage, a.c. or d.c.; check for continuity; check blown fuses; locate grounded components; warn of live wires and scores of other possible troublesome occurrences known to electricians, refrigeration servicemen, maintenance men, and anyone who works with electrical circuits.

PRECISION POTENTIOMETERS

Technology Instrument Corporation, 1058 Main St., Waltham, Mass., is now manufacturing an improved version of their Type RV3 precision potentiometers. Available in two types, the Type RV3-8 (8 watts) and the Type RV3-12 (12 watts), these potentiometers have been redesigned to include bronze bushings for the rotor shaft, tapped mounting inserts, rotor take-off slip ring, dustproof construction with Bakelite cover fastened with screws, and molded parts of low-loss mica-filled Bakelite.

The Type RV3 potentiometers can be supplied with a wide variety of non-standard features to meet special requirements, and the manufacturer has published an established price scale covering such non-standard features. Complete information may be obtained by writing the company direct.

New Tubes

(*Continued from page* 27)

ance, beam power amplifier featuring low mu-factor, high plate current at low plate voltage, and a high operating ratio of plate current to grid No. 2 current. In suitable horizontal-deflecting circuits, only one 6CD6-G is required to deflect fully any directly viewed kinescope having a deflection angle up to 70° and operating at an anode voltage up to 14 kilovolts.

The 6S4 is a high-perveance, medium-mu triode of the 9-pin miniature type. In suitable vertical-deflecting circuits, the 6S4 will deflect fully a 16GP4 or any other similar kinescope having a deflection angle up to 70° and operating at an anode voltage up to 14 kilovolts.

Sharp-Cutoff Pentode

The 6AS6 announced by *RCA* is a sharp-cutoff pentode of the 7-pin miniature type. Designed so that grid No. 1

and grid No. 3 can each be used as independent control electrodes, the 6AS6 is especially useful in gated amplifier circuits, delay circuits, gain-controlled amplifiers, and mixer circuits.

This tube is also suitable for use as an r.f. amplifier at frequencies up to about 400 megacycles per second.

Surface Wave

(*Continued from page* 11)

several months and had a rather thick corrosion layer. In this state the measured loss was 3 db. Most of the corrosion was then removed by sandpaper. The result was an increase of the loss to about 3.6 db. The expected loss for a wire with perfectly clean surface is much higher. Then we applied several coats of polystyrene solution by means of a brush. The loss went down more and more till a minimum of 1.7 db. was reached. Further increase of the dielectric layer gave a slight increase of the loss by about 0.2 db. The thickness of the dielectric coat varied more than 1:10 along the wire, thus it was not possible to measure the average thickness. This test indicated that the wave is not sensitive to inhomogeneities of the guide.

Finally, a test was conducted with a 600 ft. line which showed that the support of the wire is not a serious problem. The horns used were the same as in the other experiments (opening of 13"). The wire was an enameled wire of 3.2 mm. thickness. The enamel coat was 25/100 mm. thick and the frequency was 1600 mc. The line was stretched along the slope of a hill with the distance from the ground varying between 4 and 8 feet. The wire was supported at intervals of about 80 feet by waxed strings. The calculated loss was 4.5 db. and the measured loss 5 db. For comparison, an RG-8/U cable of the same length has an attenuation of 70 db. The supports and the bends in the wire produced by the supports had no measurable effect in the attentuation.

Fig. 4 shows the calculated attentuation in db. per mile for a line with 2 cm. diameter and a polystyrene coat of ½ mm. in the frequency range from 300 to 1000 mc. In addition to this loss which is proportional to the length we get the loss of the launching devices, which could be kept below 2 db. Considering the wide frequency band which could be transmitted by such a line, the loss is very small.

The question of the effect of weather conditions can be answered only partially and only as far as rain is concerned. An increase of the attenuation was observed only if the wire was covered with rows of big raindrops. The maximum increase measured so far for 1600 mc. was less than 1.5 db. A water film did not increase attentuation. It enlarges the thickness of the dielectric layer and behaves like a good dielectric because the ratio of the power factor to $(\varepsilon - 1)$ which determines the losses is very small. The effect of snow and ice will certainly be more serious and it may be necessary to prevent the settling down of snow by shaking the wire or by electric heating.

It is a pleasure to acknowledge the close cooperation in Coles Signal Laboratory which made it possible to obtain the present results in a relatively short time. Thanks are due to Mr. J. Hessel and R. Lacy, Chief and Assistant Chief, Radio Communication Branch, to Mr. J. Egli, Chief, Radio Relay & Microwave Section, and especially to the group who cooperated in the measurements, Mr. C. Sharp and L. Battersby and particularly Mr. A. Meyerhoff, who checked all calculations and improved the English of the paper which otherwise would have been much worse.

Microwave Trans.

(*Continued from page* 9)

$$A_{av} = \frac{1}{T}\int f(t)\,dt \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

where T is the time required for one period (shown in Fig. 9).

The integral is merely equal to the pulse area. For the rectangular pulse shown in Fig. 9, this area is equal to the amplitude times the pulse width. The relation between average power and peak power for a rectangular pulse is therefore equal to:

$$P_{av} = \frac{1}{T} P_p t_d \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

Thus it is seen that if the period is equal to 1000 microseconds, and the pulse width equal to 1 microsecond, the peak power is equal to 1000 times the average power.

In a lighthouse tube the maximum power rating, for a given frequency, is primarily limited by the maximum allowable plate temperature or the average power dissipated. As a result, a peak power thousands of times greater than the maximum average power rating of the tube can be effected. Fig. 6 is a series of typical power output versus frequency curves for different plate voltages for a 2C43 tube modulated by the pulse series shown in Fig. 9.

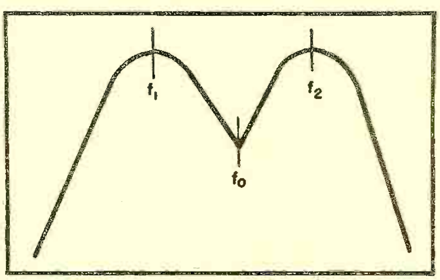
In pulse modulating systems where the timing of the pulse carries the intelligence an effect known as "jitter" may be introduced into the microwave oscillator. The r.f. oscillator is normally keyed "on" at some time during the rise time of the applied pulse — the exact instant of keying depends upon the tube characteristics, circuit constants, and random noise fluctuations. If all of these conditions remained the same, the r.f. oscillation would start at the same relative instant for each succeeding pulse. However, the random fluctuations of the noise signal may cause the tube to fire either slightly before or after the normal repetition rate. Since the timing of the pulse carries the intelligence, this shift in pulse position appears as noise or "jitter" in the demodulator of the system.

This effect can be minimized through the use of a "catalyzer".[6, 7] A "catalyzer", as many readers may remember from their chemistry courses, is an element which aids a reaction but does not react itself. In this case the catalyzer consists of a small oscillator which injects a signal of approximately the same frequency as that of the r.f. oscillator into the microwave cavity. The catalyzer oscillator can be a conventional push-pull oscillator operating in the 300 to 500 megacycle band with a crystal multiplier used to obtain the fifth or sixth harmonic of this signal. The output of the crystal multiplier is then fed to the cavity through a probe or loop. It has been found that the use of a catalyzer appreciably improves the signal to noise ratio of the microwave oscillator. The reason for this effect is probably that the "catalyzer" signal is sufficiently large to "overpower" the noise. Thus random changes in noise have little effect on the oscillator.

There are a number of parameters that affect the frequency of a lighthouse oscillator. Among these effects are the change in cavity length due to a variation in temperature (as a result of expansion and contraction of conductors), change in plate or filament voltage (affecting electron transit time), and cathode to grid interelectrode capacitance (feedback effects). In a typical commercial transmitter, it has been found that the cumulation of all these effects (using "self compensated" temperature conductors in the coaxial lines) results in a frequency stability of about 0.05 per-cent at 2000 mc. In this latter unit no attempt had been made to compensate for the voltage variations through the use of a regulated plate supply.

Where a higher degree of frequency stability is required, some method of automatic frequency control (a.f.c.) must be employed. Heretofore it has been found that the best method of frequency control is an electromechanical system in which a variation in frequency from the desired value is detected by a discriminator, whose output actuates a motor which drives a tuning device until the desired frequency is

Fig. 10. Frequency response of two reference cavities and desired resonant frequency of triode resonant line.



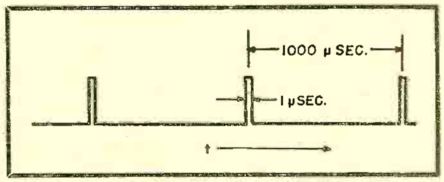


Fig. 9. Typical pulse series.

obtained. Completely electronic systems of control are difficult and expensive to design since the easiest and surest method of tuning involves adjustment of the resonant line length, rather than variation of plate voltage or interelectrode capacitance, which is essentially a mechanical operation.

Two typical a.f.c. circuits are shown in Figs. 5 and 8. The a.f.c. circuit shown in Fig. 5 uses two reference cavities, one resonant at f_1 and the other at f_2. The desired resonant frequency of the triode line, f_o, is equal to $(f_1 + f_2)/2$. These relations are plotted in Fig. 10.

A small amount of energy from the triode line is picked up by loops shown in Fig. 5 and injected into the two reference cavities. When the frequency of this energy is exactly equal to f_o, the outputs of the two cavities are equal and no discriminator voltage is developed across the grids of V_1 and V_2. V_1 and V_2 are thyratrons which are normally cut off. If the energy obtained from the triode line is not equal to f_o, a discriminator voltage will be developed across the grid of V_1 or V_2 (depending upon whether frequency is above or below f_o) causing one to conduct and operate the split phase motor. This motor will operate the reset control in the direction that will correct for the "off frequency" variation. An a.c. voltage is applied to the plates of the thyratrons, so that they will be extinguished when the discriminator voltage reduces to zero. The cavities used can be made highly reliable by using temperature compensated metals such as Invar or using a temperature controlled oven.

The a.f.c. circuit shown in Fig. 8 is a simplified version of the previous circuit. In this case a single cavity and thyratron are used in conjunction with a motor driven trimmer condenser. The effect of a condenser at the end of a line was discussed in the article, "Microwave Components". The action of this circuit is as follows: The existence of a frequency other than the desired value in the cavity provides a discriminator voltage which fires the thyratron. This operates the motor which drives the condenser rotor. The plate of the condenser turns very slowly, first increasing and then decreasing resonant line frequency. The plate will turn until the discriminator voltage drops to zero. The motor speed is made sufficiently low compared to the time required for the discriminator to extinguish the thyratron, that the condenser will not "overshoot" the desired frequency.

Acknowledgement is hereby gratefully made to Mr. Harris Gallay of *Federal Telecommunication Laboratories* for automatic frequency control circuits described in this article.

BIBLIOGRAPHY

1. *Racker, J., "Microwave Techniques"*, RADIO-ELECTRONIC ENGINEERING, *p. 3, February*, 1950.
2. *Racker, J., "Microwave Transmission Lines"*, RADIO-ELECTRONIC ENGINEERING, *March*, 1950.
3. *Racker, J., "Microwave Components"*. RADIO-ELECTRONIC ENGINEERING, *April*, 1950.
4. *Moskowitz and Racker, "Pulse Communication Systems"*, RADIO-EECTRONIC ENGINEERING, *September*, 1948.
5. *Moskowitz and Racker, "Pulse Techniques"*, RADIO-ELECTRONIC ENGINEERING, *January*, 1948.
6. *Young, N. H.*, U. S. Patent 2,416,367.
7. *Hoffman, R. B.*, U. S. Patent 2,418,121.

Custom Sound

(*Continued from page* 5)

finely, but it must be remembered that at certain times there were high levels of noise to overcome on stage due to the locomotives, western style gunplay, and old one-lung autos. If the system were not adjusted so carefully, much of the dialogue and music would be lost in some areas while in other areas the level of the sound would be so high as to be objectionable.

An interesting note is the fact that these speakers and baffles were so efficient in projecting the sound to the grandstand that additional monitor speakers had to be installed backstage in the wings to allow the stage managers and cast to follow the continuity. These were *Jensen* eight inch heavy-duty loudspeakers mounted in weatherproof metal projectors. Each of these monitors had an adjustable "L" pad control to allow the stage managers to set the level to suit their surrounding noise level.

For use before show time and for fill-in in case of rain or accident, a record turntable and its preamplifier was incorporated in the console control cabinet. This unit could be plugged into the patch panel at the output terminal of the console and automatically replace the console program with the recorded program.

In addition to the stage sound system, a second independent amplifier and set of four 24" re-entrant drive unit loudspeakers were installed atop the grandstand roof to cover the outside plaza in front of the grandstand entrances. This system could be fed from the console, the turntable, the Celesta-Chime or from a microphone position located in one of the grandstand entrances. The primary purpose of this system was to advertise the pageant and also to furnish music to the plaza between shows.

The *Deagan* 25 note Celesta-Chime was chosen for this installation because it was found to be the only electronically amplified chime that could be played in tune with an orchestra. The chime rods are tuned harmonically which eliminates the "wow" and "out of tune" effect that is usually associated with chimes and bells. In some instances where the Celesta-Chime was played solo, full chords were used. No other instrument was found that was suitable for such usage. A special low "G" chime was built by *Deagan* to furnish the deep tolling bell effect that was desired for the Lincoln Funeral Train scene. As explained above, these chimes were reproduced through the control console and entire system and could be controlled the same as any microphone.

Since all the sound and control equipment had to be integrated with the entire operation of the show, the design and installation of the intercommunication, buzzer, cue and railroad signal systems was undertaken along with the sound system. The intercommunication system was in two stages; the first stage consisted of an electronically amplified 20 station master unit located in the director's booth connecting with remote stations back stage, ticket booths in the plaza, the orchestra pit, the equipment tents north and south of the stage, the electricians' switchboard room and the sound man. The importance of this intercom system can be realized when it is understood that it was the only two-way communication that the director had with the show from his remote position. It was used to check on equipment, cue in some of the vehicles, instruct the orchestra conductor and deliver the light cues, of which there were 62, to the electricians under the stands. As a supplementary system, there was a battery operated telephone type intercom system with three master stations. One was in the director's booth, one at the sound control console (visible at the extreme end of the control console, Fig. 3), and one in the orchestra pit. This system was used mainly between the orchestra conductor and the sound man.

The buzzers, music cue lights and the railroad signals were all controlled from a small custom-built consolette located in the director's booth. Buzzers were located in all dressing rooms backstage, in the wings and at the extreme ends of the stage extension wings. Each buzzer could be controlled independently or all could be sounded at the same time. The music cue lights were located on the orchestra conductor's stand and consisted of one flashing white warning light and a second steady amber "go" light. The railroad signals were located at the ends of the stage wings and were used to cue the locomotives on stage. These signals had to be visible to engineers on any of the four switch tracks in either the north or south yards both in daylight and dark. The operation of the controls for these buzzers, lights and signals had to be simple and foolproof as a mis-cue during the show could cause a serious accident. Some of the trains that crossed the stage traveled 30 to 40 miles per hour, so it is easy to see that an accident would be hard to prevent in case of a mis-cue.

During the rehearsals before the show opened, a temporary talk-back system was installed in the grandstand to enable the directors to speak to the people on stage and in the equipment and railroad yards. This system utilized the two re-entrant projectors that were on either end of the grandstand roof and additional projectors that were placed in the stands and aimed toward the stage.

Much of the success of the entire installation was due to the intelligent discussion of the entire staging problem by Helen Geraghty, the director of the pageant. By talking over the entire show, and not just the sound system, a clear picture of the entire operation was established before the designing was even undertaken. It must be emphasized here that too many times a sound system of this type will be installed as just a P.A. job and will fail to do the job because "new and unusual" conditions pop up that had not been thought out. One of the reasons that this installation was so successful was that, not only was it a good sound reinforcing system, but a live part of the show. The two operators, who alternated at handling the mixing, worked from a complete technical script that listed all the dialogue, the music cues and the mixing cues. In all they had 260 separate sound cues to handle in one hour and eight minutes.

A good sound installation is noticed and appreciated by those who have to listen to it. Many compliments were received this past summer from musicians, directors and members of the industry who attended the show, and many favorable comments were voiced by members of the audience who had never before paid any attention to the sound systems that they had heard. In every large outdoor amphitheater, stadium or fairgrounds attention should be paid to all the details that contribute to or detract from the coverage and quality of the sound system installation so that high-quality sound systems can become the rule instead of the exception.

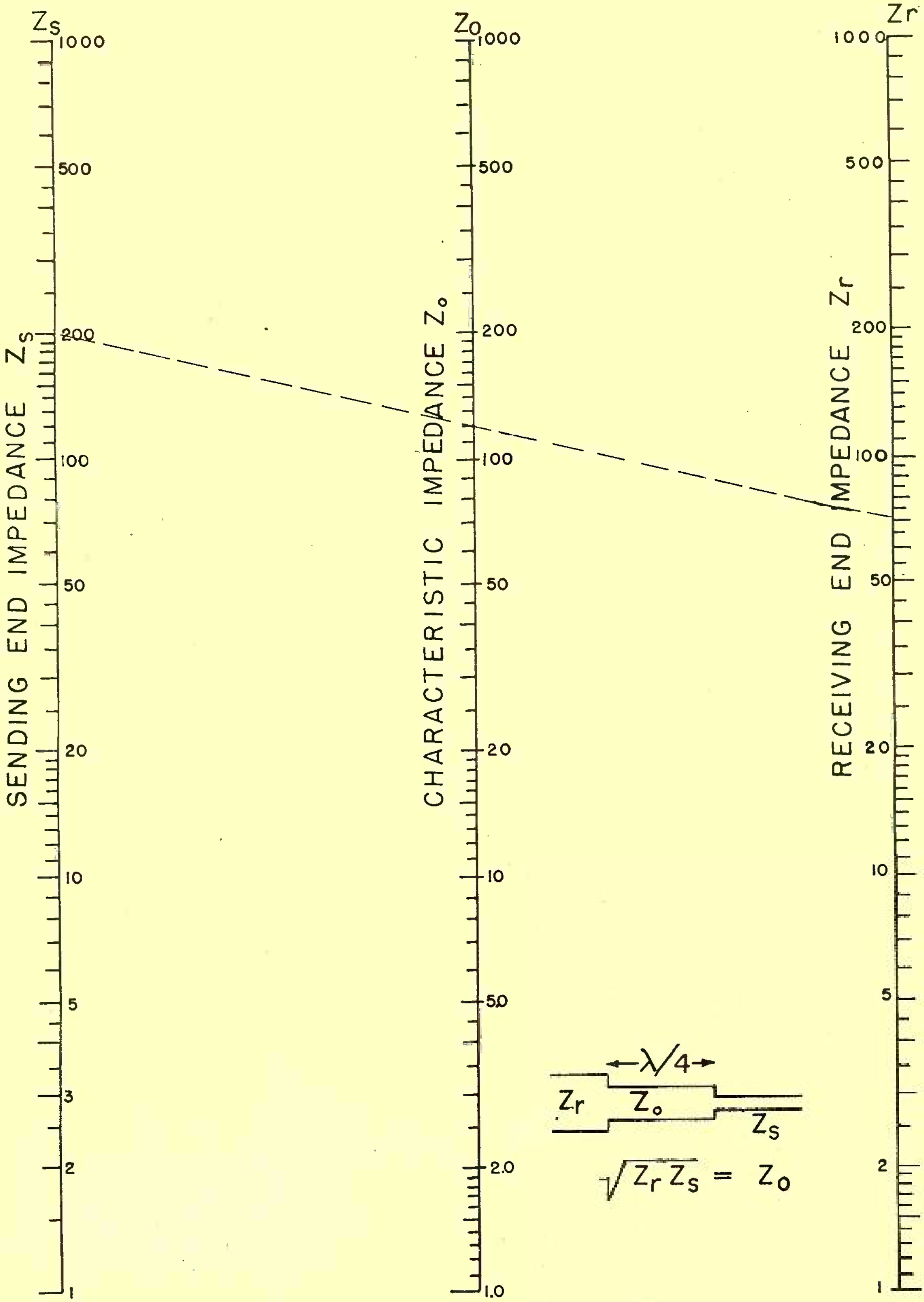
PHOTO CREDITS

6, 7, 8. . Federal Telecommunication Laboratories

10. . Official Department of Defense

QUARTER-WAVE MATCHING SECTION

This chart is used to obtain the surge impedance of a $\frac{1}{4}\lambda$ matching section used as an impedance transformer from one real impedance to another.



Courtesy of Federal Telephone and Radio Corporation

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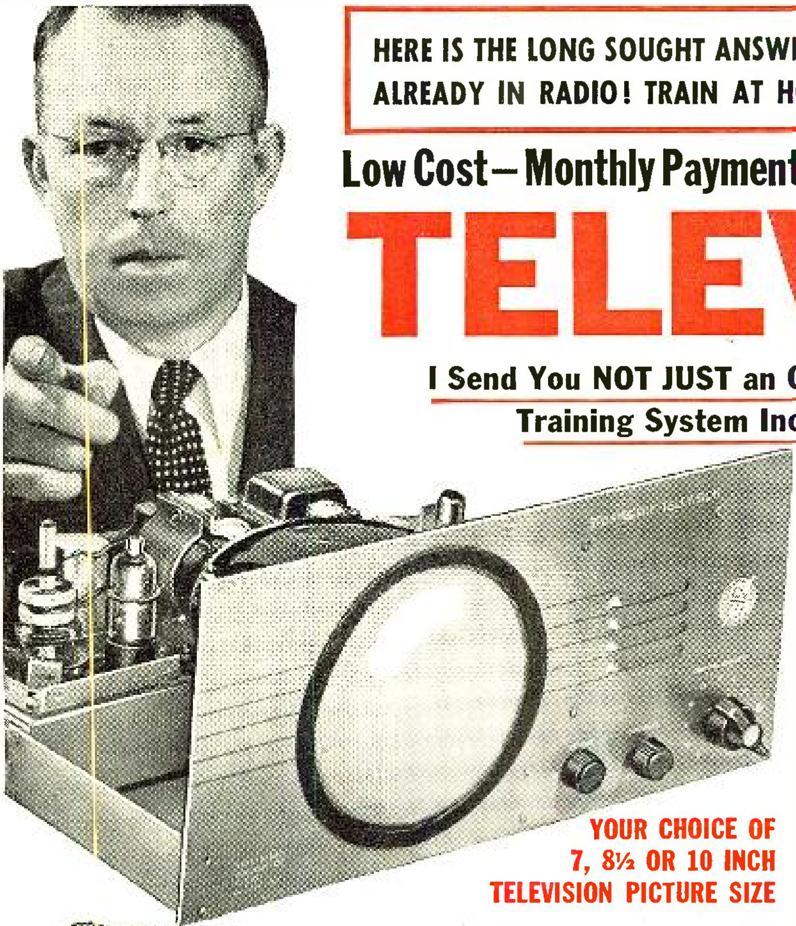

YOUR CHOICE OF 7, 8½ OR 10 INCH TELEVISION PICTURE SIZE

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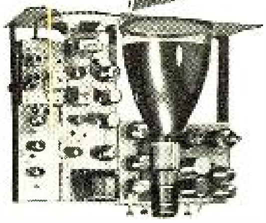
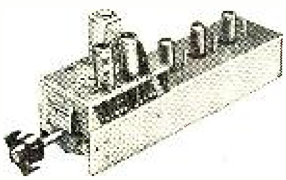
Out of my laboratory has come an entirely new Television Training...cutting months off the time required in old methods. I give all the knowledge and experience you need in weeks instead of months. I start where your present radio experience ends. The same day you enroll with me, I rush the first of many big Television kits that I will send during your training. From the first hour you are experimenting and testing practical TV circuits...and you keep right on from one fascinating experiment to another. You build the remarkable new Television Receiver-Tester illustrated at the left and useful TV Test Equipment. I give you theory, too, but it's 100% practical stuff that will make money for you in Television.



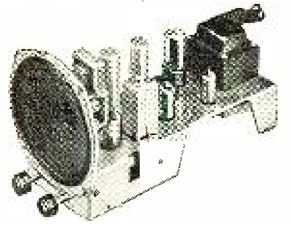
Exclusive THREE-UNIT Construction

You build my Television Receiver-Tester in three separate units—one unit at a time...each complete and self contained within itself. With each unit you perform dozens of important experiments—and each unit may be used in actual Television receiver servicing. In this way my training may save you many dollars by eliminating the need for costly TV Test Equipment. With these three units you can locate most TV Receiver troubles quickly and easily.



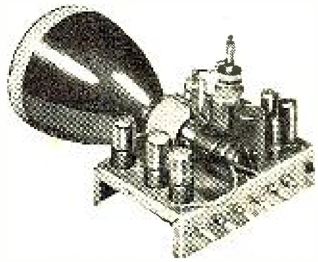
TV Tuner—I. F. Unit

Contains the RF amplified local oscillator, mixer and three stages of broad band IF amplification and the video second dector. The output constitutes the video signal and audio IF signal. For training, it is used to build and test video second detector, and stagger tuned IF amplifier obtaining 4.5 mc band pass. For TV servicing, it becomes a TV calibrator for IF alignment, substitute tuner, IF signal injector and second detector.



Video-Audio Amplifier Unit

Provides 4.5 mc IF ratio detector, low voltage power supply. For TV, it becomes the audio output, including speaker, video output and low voltage power supply for RF and IF stages. For training, it is used to build and test transformer type power supplies, audio, video, IF amplification and FM detection. For TV servicing, it is an audio signal tracer, IF signal tracer, video signal tracer and low voltage power supply.



Video Tube "Scope" Unit

Scope unit contains low and high voltage (6000 V.) power supply for independent operation. For television, it becomes the sync, vertical and horizontal sweep circuits and their power supplies. For training, it is used to build and test most TV power supply, deflection, sweep, oscillator, and sync circuits. For TV servicing, it is a video signal tracer and sweep signal analyzer as well as substitute high and low voltage power supplies.

BE READY FOR TOP PAYING TELEVISION JOBS

If you are a radio-serviceman, experimenter, amateur or advanced student.. YOUR FUTURE IS IN TELEVISION. Depending upon where you live, Television is either in your town now . . . or will be there shortly. This is a vast new industry that needs qualified trained men by the thousand to install and service TV sets. There's really big money in Television, but you MUST know what you are doing to "cash-in" on it. I will train you in a few short weeks if you have had previous radio training or experience.

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If you have no previous experience in Radio work, be sure to mark that fact on the coupon below. I will send you complete information about my Radio-Television training that starts with basic fundamentals and carries you right through my new Radio and Television Training. I will send you my two big Radio-Television books, including an actual lesson selected from my course. I want you to know exactly what this great industry has in store for you. There is no obligation, of course, and NO SALESMAN WILL CALL.

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Every Radio Serviceman today realizes his future is in Television. He knows he MUST have training—*the right kind of practical training* such as I am now offering—to protect his job, his business for the future. This is equally important for the man just starting out. And so I urge you to get the facts I offer you FREE and without obligation. Learn how quickly and easily *you* can get into Television. Fill out and mail the coupon TODAY.

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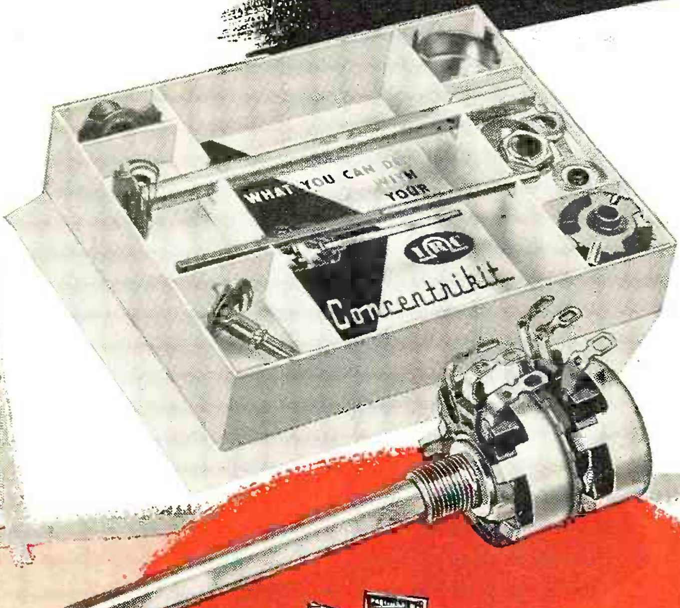
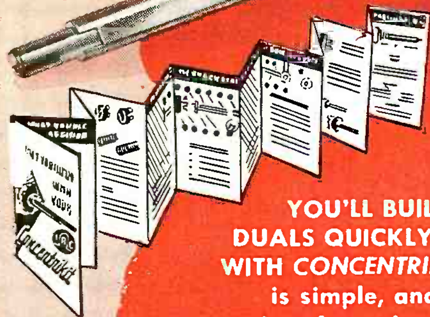


Amazing new IRC Concentrikit is the practical answer to your concentric dual replacement problems. With this set of specially designed parts you can assemble over 90% of all concentric dual types . . . no more long searches and waits for exact duplicates. You save time, worry *and* inventory investment.



YOU'LL BUILD CONCENTRIC DUALS QUICKLY AND EASILY WITH *CONCENTRIKIT*. Assembly is simple, and can be completed in a few minutes. Step-by-step instructions are furnished with every kit.

REPLACEMENT MANUAL AVAILABLE
Full replacement data on concentrics for all applications, from the earliest home and auto radios to television, are contained in a new IRC CONCENTRIC DUAL REPLACEMENT MANUAL. Be sure to get a copy from your IRC Distributor.

STOCK ASSORTMENT

Television has greatly increased your concentric dual requirements . . . be ready with this CONCENTRIKIT Stock Assortment on your bench. Handsome metal cabinet contains all you need to assemble quickly any of 144 different concentric duals. It covers over 500 models . . . RCA, Admiral, Air King, Belmont, Emerson, General Electric, Motorola, Philco, Westinghouse, Zenith and many others. Order from your IRC Distributor now, or send coupon for more information. International Resistance Company, 401 N. Broad St., Philadelphia 8, Pa.

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B11-114	1	B13-137X	1
B11-115	1	B18-137XX	1
B11-116	1	B19-137X	1
B17-116	1	B11-139	2
B11-119	1	B13-139	1
B11-120	1	B13-139X	1
B11-121	1	*Inner Shaft Ends*	
B11-123	2	E-187	3
B11-128	2	E-190	1
B11-130	1	E-202	2
B13-130	2	*Sleeve Bushings*	
B13-130X	1	S-4	1
B18-130X	1	S-5	1
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☐ Enclosed find 25c in stamps or coin for my copy of IRC Concentric Dual Replacement Manual.

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Remember . . . May is Market Month!

"The only all-industry sponsored Conference and Show in Electronics"

MAY 22-25 1950 • STEVENS HOTEL • CHICAGO

PROGRAM OF EVENTS

SUNDAY, MAY 21

9:00 a.m. Exhibition Hall and Display Room Area open for erection of displays

10:00 a.m. Registration Desk Opens—Exhibition Hall Lobby

6:00 p.m. Radio's Old Timers—Cocktail Party for Members—South Ballroom, Stevens Hotel

MONDAY, May 22 "ASSOCIATIONS' MEETING DAY"

9:00 a.m. Erection of Displays

10:00 a.m. Registration Desk Opens—Exhibition Hall Lobby

10:30 a.m. General Meeting—"The Representatives" of Radio Parts Manufacturers, Inc.—Upper Tower Room, Stevens Hotel

12:30 p.m. Luncheon Meeting for General Members—"The Representatives" of Radio Parts Manufacturers, Inc.—Lower Tower Room, Stevens Hotel

2:00 p.m. Joint Meeting of Sales Managers Club, Eastern Division; Association of Electronic Parts & Equipment Manufacturers; and West Coast Electronic Manufacturers' Association—South Ballroom, Stevens Hotel

2:30 p.m. Delegates' Meeting—"The Representatives" of Radio Parts Manufacturers, Inc.—Upper Tower Room, Stevens Hotel

3:30 p.m. Annual Meeting of Member-Exhibitors and General Members of Radio Parts & Electronic Equipment Shows, Inc.—South Ballroom, Stevens Hotel

6:00 p.m. Registration Desk Closes

7:00 p.m. INDUSTRY KEYNOTE DINNER—Grand Ballroom, Stevens Hotel

TUESDAY, May 23

10:00 a.m. Registration Desk Opens—Exhibition Hall Lobby

Exhibition Hall Opens—Attendance confined to exhibitors, their booth attendants, sales representatives, and all distributors

1:00 p.m. Display Room Area Opens

2:00 p.m. Distributors' Educational Session on "Sales and Merchandising"—North Ballroom, Stevens Hotel

6:00 p.m. Registration Desk Closes

Exhibition Hall Closes

WEDNESDAY, May 24

10:00 a.m. Registration Desk Opens—Exhibition Hall Lobby

Exhibition Hall Opens—Attendance confined to exhibitors, their booth attendants, sales representatives and all distributors

1:00 p.m. Display Room Area Opens

2:00 p.m. Distributors' Educational Session on "Inventory Control"—North Ballroom, Stevens Hotel

6:00 p.m. Registration Desk Closes

Exhibition Hall Closes

THURSDAY, May 25

10:00 a.m. Registration Desk Opens—Exhibition Hall Lobby

Exhibition Hall Opens—Attendance confined to exhibitors, their booth attendants, sales representatives, and all distributors

1:00 p.m. Display Room Area Opens

2:00 p.m. Distributors' Educational Session on "Financial Management"—North Ballroom, Stevens Hotel

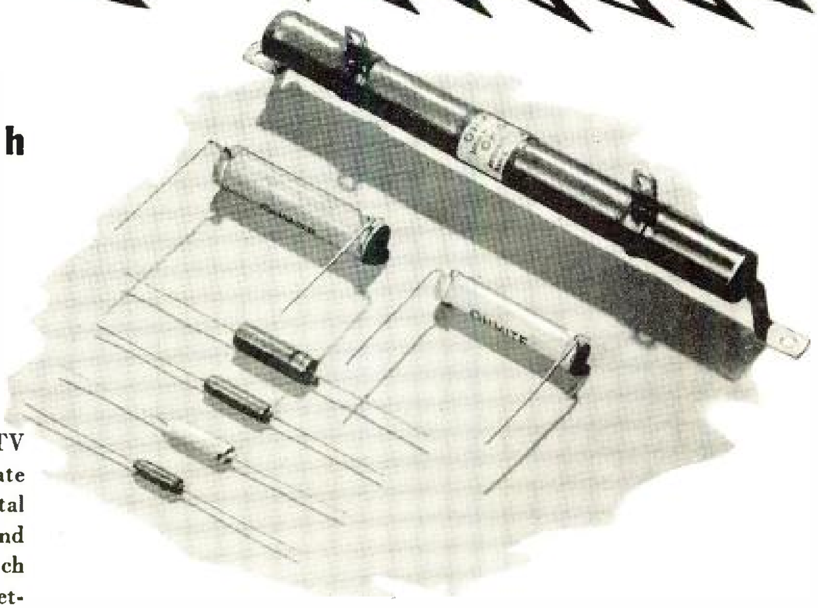
6:00 p.m. Registration Desk Closes

Exhibition Hall Closes

1950 Parts Distributors Conference & Show ends.

HOW TO REDUCE TV INTERFERENCE

Use Wave Traps Made With OHMITE "Frequency-Rated" CHOKES



There are many cases where the front end of a TV receiver lacks the selectivity required to eliminate very strong 14 or 28 Mc signals. These fundamental frequencies jam through the receiver front end and create many kinds of cross-modulation products which affect the viewed picture (not to mention the set-owner's temper). The only solution: each receiver affected must be treated separately, to prevent such fundamental frequencies from getting in and affecting the TV signal.

Tuned wave traps—either series, parallel, or combination types—are most commonly used to eliminate this trouble. They can be made effectively with Ohmite high-Q Chokes, in combination with suitable trimmer capacitors. (See diagrams at the right.)

Since most receivers have 300-ohm input, that type has been treated here. These designs, however, can be adapted to 72-ohm input as well. Series-tuned traps are connected from the receiver terminals to ground. In some cases, however, two parallel-tuned traps may prove equally satisfactory. The chokes and trimmers can be mounted on a small terminal board with binding posts or clips for easy installation.

WRITE FOR BULLETIN 133 AND CATALOGUE 21

OHMITE MANUFACTURING COMPANY
4885 W. Flournoy St., Chicago 44, Ill.

OHMITE CHOKES have accurately predetermined frequency characteristics. High "Q" single-layer wound on low power-factor plastic or steatite cores; insulated and protected by moisture-proof coating. Z-14 and Z-28 rated 600 ma; others 1000 ma. Seven sizes—covering range 3 to 520 megacycles.

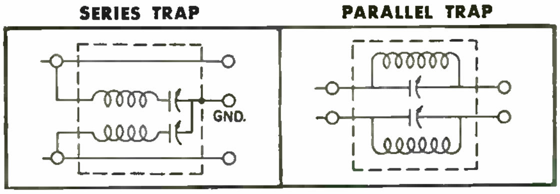
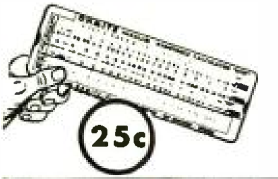


Table below shows approximate capacity necessary to resonate OHMITE Frequency-Rated Chokes at various frequencies:

OHMITE CHOKE	mmf at 3.5 Mc	mmf at 7 Mc	mmf at 14 Mc	mmf at 21 Mc	mmf at 28 Mc	mmf at 50 Mc	mmf at 56 Mc
Z-28	98	25	6.2				
Z-50		74	19	8.2	4.6		
Z-144			72	32	18	5.7	4.5
Z-235				69	39	12	9.7
Z-460						51	40



NEW **OHM'S LAW CALCULATOR**

Quickly solves all Ohm's Law problems—including parallel resistance. Also has standard slide rule.

Be Right with **OHMITE**
Reg. U.S. Pat. Off.

RHEOSTATS • RESISTORS • TAP SWITCHES

The Service Managers of

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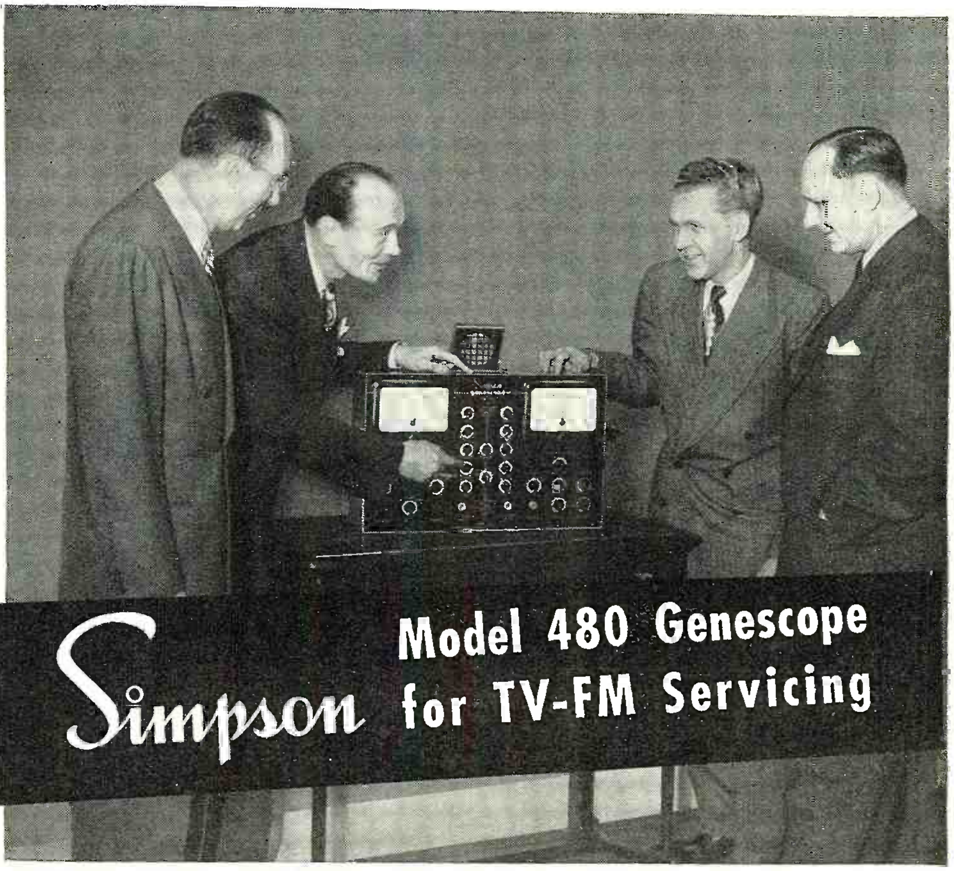
all recommend the



Simpson Model 480 Genescope for TV-FM Servicing

Max Schinke—ADMIRAL Frank Smolek—ZENITH Ed Croxen—HALLICRAFTERS Tim Alexander—MOTOROLA

• These four well known general service managers prefer the Simpson Model 480 Genescope for their FM and TV servicing.

For proper testing, servicing, and alignment of all TV and FM receivers, the Simpson Model 480 Genescope is the ideal instrument, leading general service managers agree.

These service managers know that modern FM and TV development and servicing demands test equipment made to the most exacting standards. They prefer the Simpson Model 480 Genescope because it is the most accurate, flexible, and convenient instrument available.

The Genescope is ruggedly built to give many years of trouble-free, accurate service.

In addition to providing all necessary signal sources, the new Simpson Genescope includes a high sensitivity oscilloscope of unique advanced design, complete in every detail. Equipped with a high frequency crystal probe for signal tracing. AM and FM oscillator sections provided with large, easy to read dials with 20:1 vernier control and 1000 division logging scales. *Revolutionary, ingenious, exclusive* output termination provides for various receiver impedances, either direct or through an isolating condenser. Step attenuator for control of output. Size 22" x 14" x 7½". Weight 45 lbs. Shipping Weight 54 lbs.

DEALER'S NET PRICE complete with Test Leads and Operator's Manual $375.00

THESE RANGES SHOW HOW MUCH THE SIMPSON GENESCOPE CAN DO FOR YOU

FREQUENCY MODULATED OSCILLATOR

Band A: 2-120 megacycles
Band B: 140-260 megacycles

Sweep width variable from zero to 15 megacycles

Sweep rate 60 cycles per second

Specially designed frequency sweep motor

Continuously variable attenuator

Crystal calibrator: 5 megacycles ± .05%

Audio Oscillator 400 cycles

Output Impedance 75 ohms

Step attenuator for control of output

AMPLITUDE MODULATED OSCILLATOR

Band A: 3.3-15.6 megacycles
Band B: 15-75 megacycles
Band C: 75-250 megacycles
30% modulation at 400 cycles or unmodulated
Continuously variable attenuator
Visual method of beat frequency indication

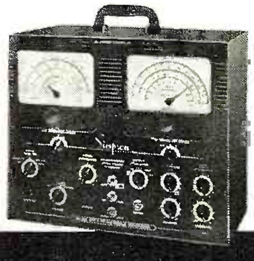
OSCILLOSCOPE

Vertical sensitivity: 35 mv per inch
Horizontal sensitivity: 70 mv per inch
Linear sweep frequency: 3 cycles to 60 kilocycles
60 cycle sine sweep
Frequency essentially flat to 200 KC. usable to over 3 megacycles

THE SIMPSON MODEL 479 TV-FM SIGNAL GENERATOR

Exactly the same circuits, ranges and functions as the Model 480, described above, with the exception of the oscilloscope. Size 17"x14"x7½". Weight 34 lbs. Shipping Weight 40 lbs.

DEALER'S NET PRICE *with Test Leads and Operator's Manual* . . . **$245.00**



Simpson

INSTRUMENTS THAT STAY ACCURATE

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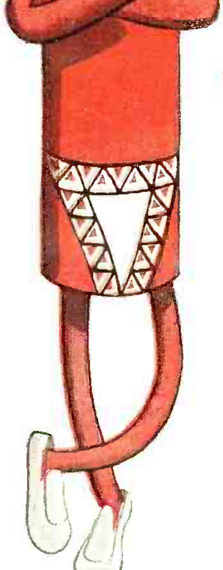
In Canada: Bach-Simpson, Ltd., London, Ont.
Phone: COlumbus 1-1221



The Redskin of course...

SANGAMO'S NEW MOLDED PAPER TUBULAR CAN HELP SOLVE YOUR CAPACITOR PROBLEMS!

The Sangamo Redskin has the "How" it takes to lick paper tubular troubles. The strong, tough plastic casing stands rough handling and the especially designed, flexible leads are troublefree . . . they resist breakage and they can't pull out. It is used extensively by television manufacturers because it gives dependable *long life* operation at 85° C. The thermo-setting plastic case is molded under low pressure—assuring elements undamaged in fabrication, longer life, greater dependability, and the absence of "hot spots."

A trial of these *better* molded tubulars will convince you. See your Jobber for the Redskin and the other capacitors in the Sangamo Tribe.

NEVER FLINCHES IN THE PINCHES!

WATER TEST
Far surpasses any existing specification requirement.

HEAT TEST
Excellent operation under high temperature conditions.

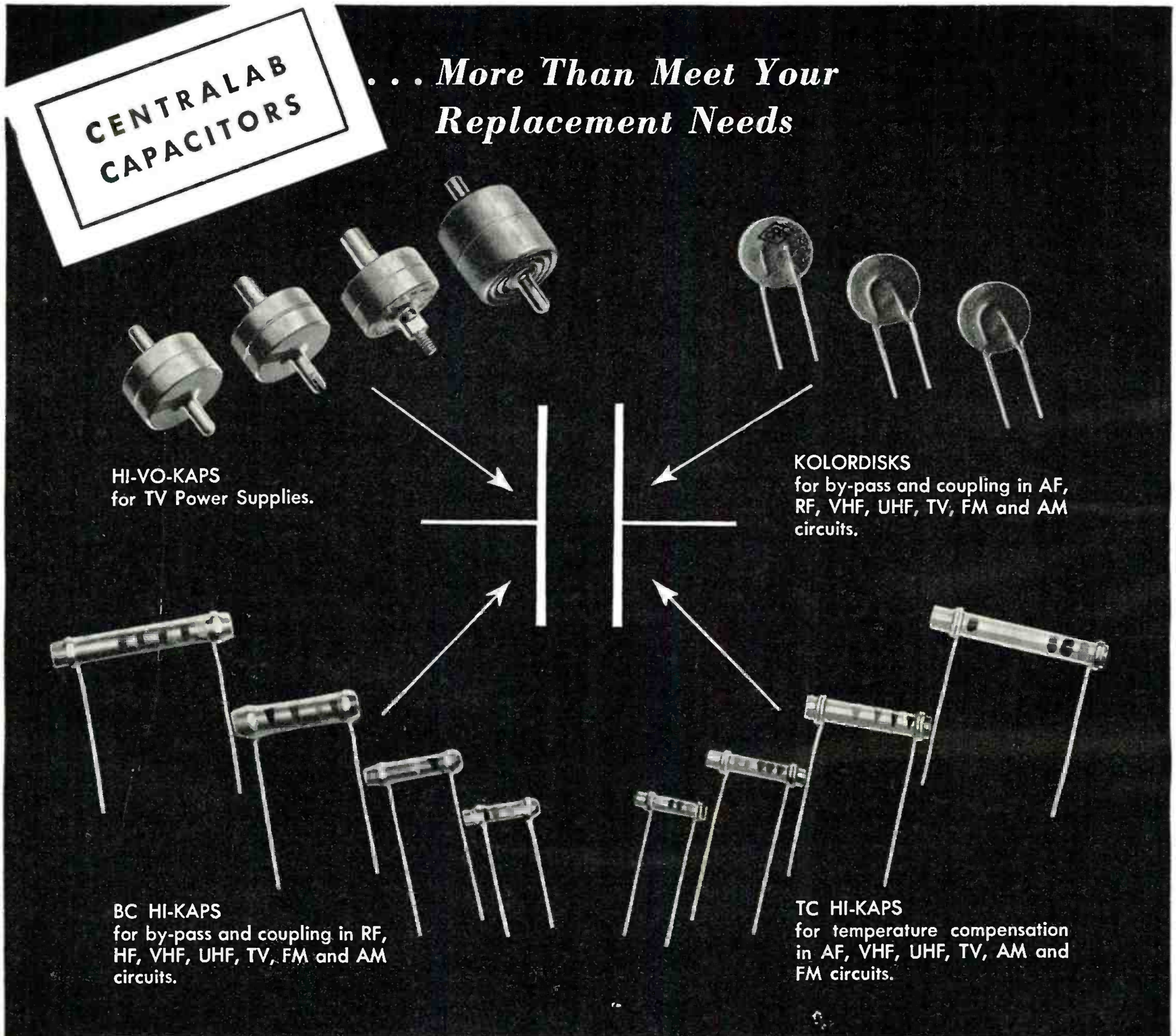
PULL TEST
Leads resist breaking or pulling out. Takes rough handling.

LIFE TEST
Long life even under most severe operating conditions.

SANGAMO ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS
In Canada: Sangamo Electric Company Limited, Leaside, Ont.

SC50-3B

Centralab Components



CRL CAPACITORS MEAN PROFITS FOR YOU!

WHEN YOU use high quality Centralab replacement capacitors in repairing radio sets, television receivers and other electronic equipment, you can be sure of customer satisfaction. You can be sure of new business. What's more, Centralab capacitors — *Hi-Vo-Kaps, Kolordisks, TC* and *BC Hi-Kaps* — make your job easier, save you time. Here's why. They're simple to install . . . easy to stock. Get all the facts on profit-making CRL replacement capacitors from your nearby Centralab distributor.

Within the INDUSTRY

JACK HARRISON has been named to the post of general manager in charge of the custom-built cabinet division of *Mars Television, Inc.* of Corona, Long Island.

Mr. Harrison comes to his new post from *W. & J Sloane* where he served as manager of the radio and television department for the Fifth Avenue department store. Prior to his association with *Sloanes* he was, for many years, the sales engineer for *Scott Radio.*

His new duties will include the creation of individually styled cabinets in addition to handling the sales and distribution of the company's custom line.

* * *

SIMPSON ELECTRIC COMPANY has recently merged with *The American Gage & Machine Company* and will be known as the *Simpson Electric Division.*

Ray Simpson, veteran of 38 years in the industry, will remain as chairman of the new division. Herbert Bernreuter has been elected to the post of vice-president of the parent company and will act as operating head of the *Simpson Division,* with which he has been associated since its inception.

Personnel, operating and sales policies will remain unchanged.

* * *

HAROLD J. NEWTON, vice-president and general sales manager of *National Electric Products Corp.* of Pittsburgh, resigned his post recently because of ill health.

The resignation of Mr. Newton brings to a close a 38-year continuous sales effort for the company. He was first associated with the organization in 1912 and transferred to Pittsburgh in 1929 as eastern district sales manager. He later served as western sales manager and sales manager of the corporation.

He has been vice-president and a director of the firm since June, 1948.

* * *

AUSTIN LESCARBOURA, a well-known figure in the radio industry, has been awarded the French Legion of Honor for technical assistance rendered over many years and more recently to industrial missions sent to the United States in conjunction with the rehabilitation of postwar France.

This is the third French decoration awarded to Mr. Lescarboura. He previously received the Officier d'Academie decoration in 1919, followed by his promotion to Officier de l'Instruction Publique in 1947.

* * *

CONCORD RADIO CORPORATION and *Radio Wire Television, Inc.,* have announced a severance of the joint ownership of stock in the two firms.

Samuel J. Novick has acquired all the stock and is now the sole stockholder of *Concord Radio Corporation* which operates stores in Chicago and Atlanta, Georgia.

Abraham Pletman has acquired all the stock and is now the sole stockholder of *Radio Wire Television, Inc.,* which operates stores in New York City, Newark, New Jersey, and Boston, Mass. Heretofore, the stock in each corporation was owned jointly by the two men. The stores will continue to operate under the same names as before.

* * *

CHARLES L. DAVIS has been named manager of distributor sales to head the new distributor sales setup at *American Transformer Company* of Newark, New Jersey.

Mr. Davis was formerly associated with *Jones Motorola Company* of Stamford as vice-president in charge of sales, service, and advertising. Prior to that association he was assistant to the vice-president of *Central National Bank* of New Rochelle, New York and assistant to the treasurer of the *Delaware, Lackawanna and Western Coal Company* of New York City.

Under the new program headed by Mr. Davis, distributors will be appointed in key locations throughout the country to handle the sale of *AmerTran* transformers.

* * *

INSTRUMENT ASSOCIATES has moved its office and warehouse to 37 East Bayview Avenue, Great Neck, New York . . . **HERMAN H. SMITH, INC.,** manufacturer of radio hardware, electrical components, and TV accessories, has moved to new and larger quarters at 436 18th Street, Brooklyn 15 . . . **POLARAD ELECTRONICS CORPORATION** has increased the size of its manufacturing facilities by moving to 100 Metropolitan Avenue in Brooklyn . . . **W. H. BRADY COMPANY** recently moved to 204 West Washington Street in Milwaukee . . . The increase in television production has forced **HAYDU BROTHERS,** manufacturers of electron

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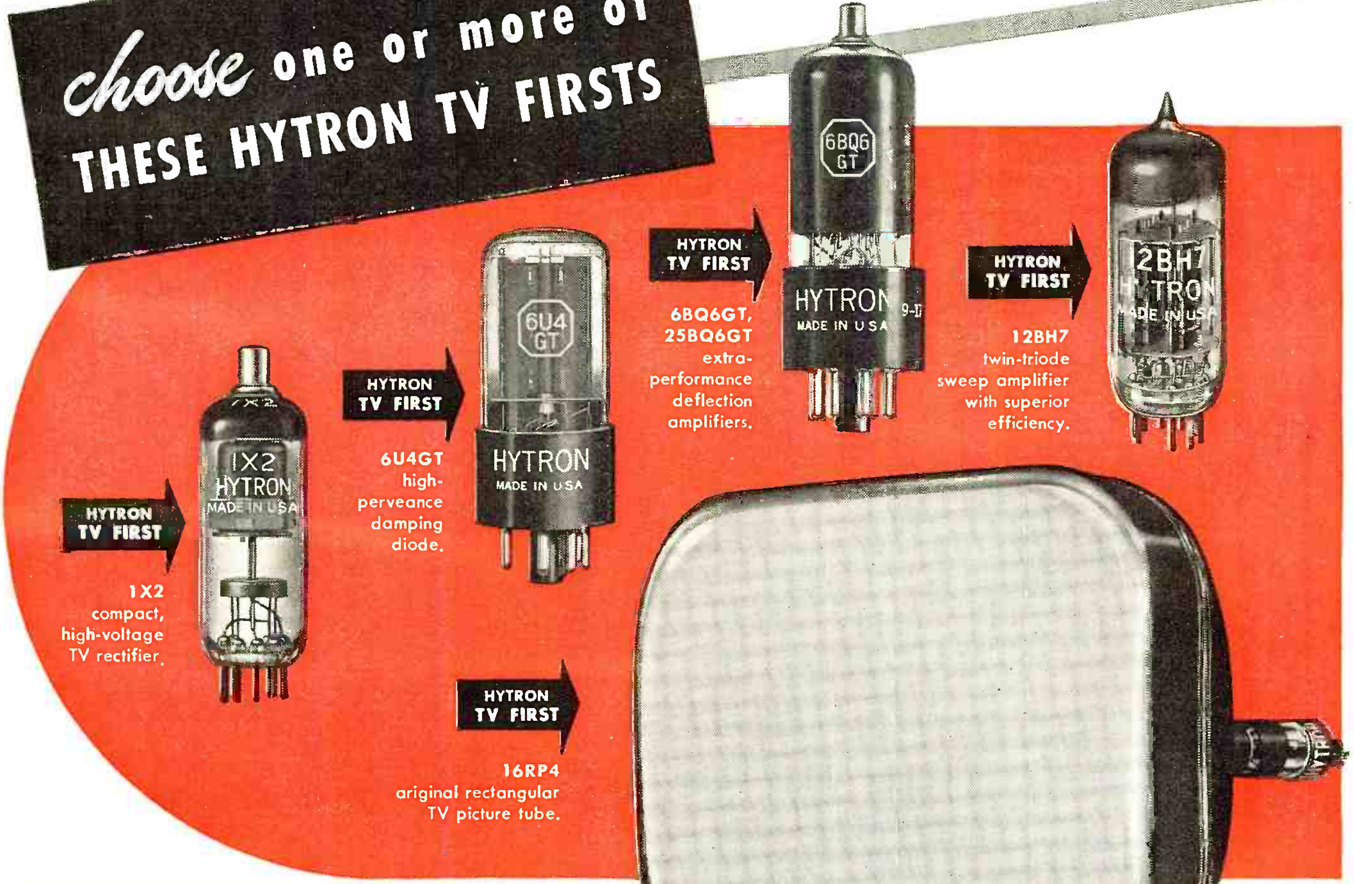
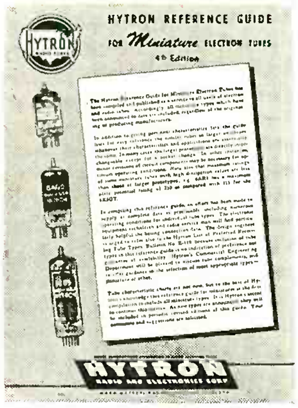
Seen these Hytron firsts in popular new TV sets? The prominent TV set makers shown are using them. And the list is growing. DuMont, for example, now uses the 1X2 and 6BQ6GT. You'll see many more of these famous tubes. And many more new Hytron types designed for low-cost TV for the mass market. When you buy these Hytron firsts, follow the leading set manufacturers. Buy Hytron! the original.

choose one or more of THESE HYTRON TV FIRSTS





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Hytron Reference Guide for Miniature Electron Tubes

Miniature types are multiplying fast. You need this Hytron Reference Guide. Originated by Hytron, it is unique. Lists all miniatures to date, regardless of make. Six pages of pertinent data. 132 miniatures — 41 of them new. 70 basing diagrams. Lists similar larger prototypes. Free from your Hytron jobber. Get your copy of this old friend brought up to date — today.

OLDEST MANUFACTURER OF RECEIVING TUBES

HYTRON

RADIO AND ELECTRONICS CORP.

MAIN OFFICE: SALEM, MASSACHUSETTS

guns for television tubes, to acquire a plant in Mount Bethel, New Jersey, with a 10,000 square foot addition being erected at the present time . . . **SIGHTMASTER CORP.** has moved to 111 Cedar Street in New Rochelle, N. Y. The new plant will enable the company to quadruple production of its television receivers . . . **ACCURATE MANUFACTURING COMPANY,** manufacturers of friction and rubber tapes, has recently completed a new plant in Garfield, New Jersey, which will increase the facilities of its existing factory building in that city . . . Construction has begun on a new 15,000 square foot area building in Cuba, New York, which will house additional production facilities for **ACME ELECTRIC'S** line of television transformers . . . **CORNING GLASS WORKS** is building a new plant in Albion, Michigan, for the manufacture of glass bulbs for television picture tubes . . . **HOFFMAN RADIO CORP.** has added 20,000 square feet of floor space to its plants in Los Angeles . . . **GLOBE-UNION, INC.,** has acquired a new plant in Denville, New Jersey, which will be devoted to the production of a full line of ceramic capacitors manufactured by the *Centralab Division* of the company . . . The new television tube plant of the **RADIO CORPORATION OF AMERICA** was recently dedicated at Marion, Indiana, with local and state dignitaries in attendance.

* * *

GEORGE R. SOMMERS has been appointed assistant general sales manager of the Radio Tube Division of *Sylvania Electric Products Inc.*

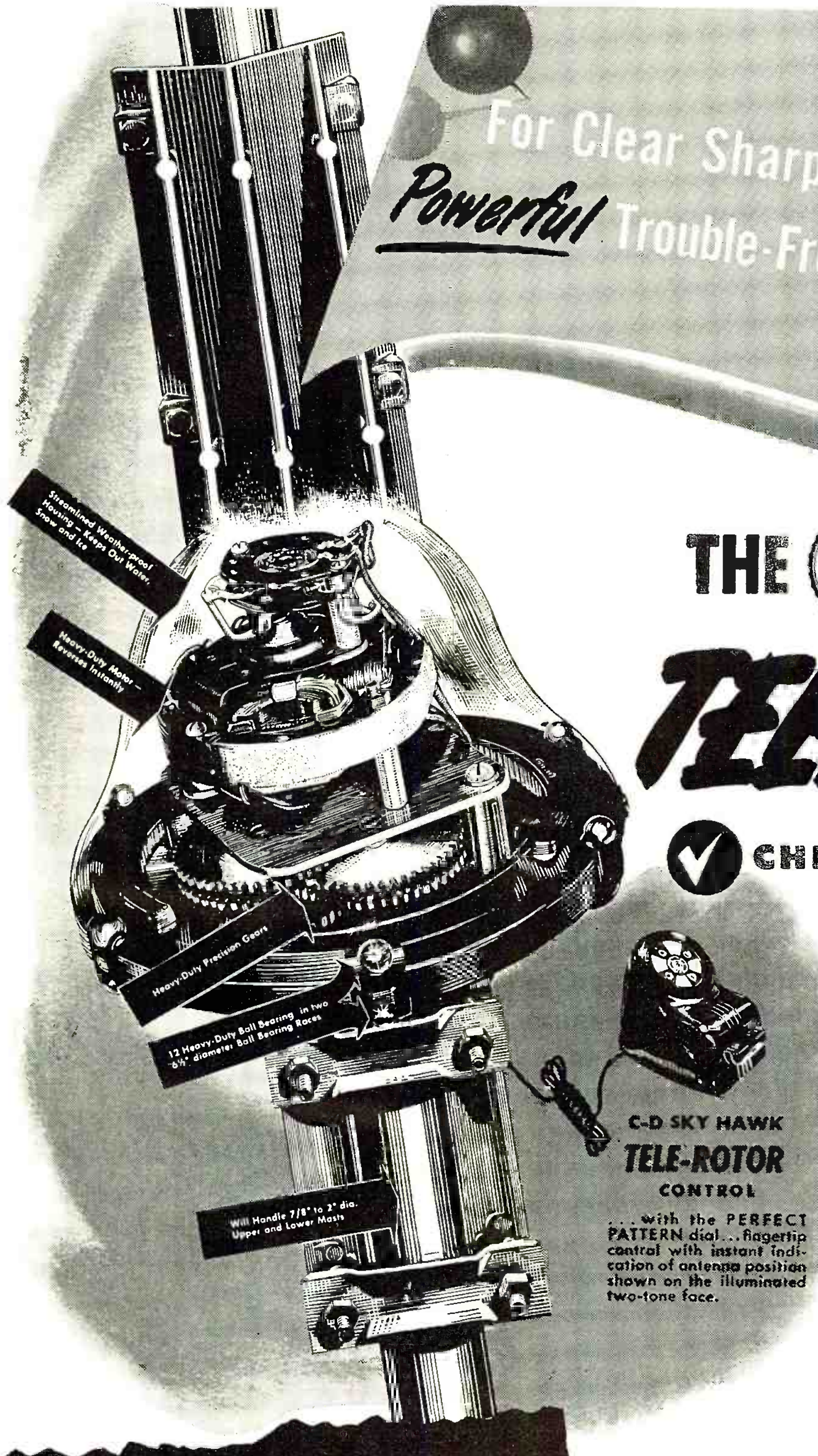
Mr. Sommers joined the company as a lighting fixture specialist in 1940 and early in 1943 was transferred to the Washington, D.C. territory where he instituted a decentralized sales policy which was later adopted for the company's district sales offices. He was appointed director of Pacific Coast sales for *Sylvania* in 1945 and in 1949 was transferred to the New York office to assist the general sales manager of the Radio Tube Division.

* * *

WALTER F. GREENWOOD has been named manager of industrial sales for *Telechron, Inc.*, of Ashland, Mass. . . . **PINCKNEY B. REED** is the new manager of the Industrial Equipment Section of the *RCA* Engineering Products Department . . . *Associated Merchandising Corporation* has named **GEORGE W. SMITH** to the post of merchandise representative for radios, television, and records . . . **D. Y. ROBINSON** will represent *Webster Electric Company's* sound division in the New York area . . . **R. C. DOVE** and **H. V. SOMERVILLE** have been named operating assistant to the vice-president and technical assistant to the vice-president respectively with the distribution division

(*Continued on page* 120)

For Clear Sharp Pictures and *Powerful* Trouble-Free Performance



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TELE-ROTOR
CONTROL

. . . with the PERFECT PATTERN dial . . . fingertip control with instant indication of antenna position shown on the illuminated two-tone face.

THE (CORNELL-DUBILIER ELECTRIC CORP.) SKY HAWK

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CHECK THESE FEATURES

- Will Handle 7/8" to 2" diameter Upper and Lower Masts
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- Handles Heavier Loads With Ease . . . As Much As 150 Pounds
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- 12 Heavy-Duty Ball Bearings in two 6½" diameter Ball Bearing Races
- Heavily Reinforced Die-Cast Housing
- Heavy-Duty Precision Gears
- Positive Stop at End of Rotation

Available in the Following Models:

- **TR-1 . . . rotator with control box $37.45**
- **TR-2 . . . compass control rotator with "Perfect Pattern" dial $44.95**

A Combination You Can't Beat . . . It's a C-D Sky Hawk Antenna with a C-D Sky Hawk Tele-Rotor

The television industry has been looking for something like this . . . and it took CORNELL-DUBILIER to produce it! THIS is the last word in ROTATORS . . . the finest! . . . BECAUSE IT HAS EVERYTHING! It wasn't developed overnight but is the result of fourteen solid months of research and development! BUT . . . it has been worth it! . . . BECAUSE IT MEASURES UP TO CORNELL-DUBILIER STANDARDS

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Simplified HAM TV STATION

By J. R. POPKIN-CLURMAN, W2LNP
Hazeltine Electronics Corporation

Fig. 1. To simplify construction and testing, system is built in separate units.

Part 1. Complete description of a ham TV station that can be built from available parts at relatively low cost. Succeeding articles will present details on constructing entire station.

FROM time to time there have been amateur television systems described in the various radio publications. While these have been of good design in most cases, all lacked the definition and quality that people have been led to expect since the advent of popular television. The system to be described is capable of the full resolution and detail associated with the present day television standards.

By the ingenious use of scanning pulses taken from any standard television broadcast station by means of a standard TV receiver, much of the complication of a commercial transmitter is avoided.

The expensive image orthicons and iconoscopes are replaced by standard cathode-ray tubes which may be of the surplus variety.

Reception of the signal is accomplished by any TV receiver equipped with a simple converter. If desired it is possible to use the same receiver to pick up both the scanning pulses from the transmitter, and for reception of the transmitter picture from another amateur TV station.

Operation is on the 420-450 mc. band, permitting the use of small high gain antennas and readily available tubes.

While the equipment may appear complicated, it has been broken into several component parts to simplify the construction. This enables the advanced amateur to construct and test the units individually and avoid many of the pitfalls associated with a combined unit.

It should be pointed out that the equipment is operating on an amateur band and only licensed amateurs may operate this television equipment.

This first article will outline the system used and show different ways of accomplishing the final result. Succeeding articles in this series will give details of the various component parts which go to make up the complete station.

Many of the components used are taken from surplus equipment to reduce the over-all cost. Most amateurs will have many of the parts needed and be able to hold the completed cost to a low figure. In any event the cost will be far below that of any comparable system.

This television system uses relatively common components and is capable of being built by the average experimenter experienced in the radio art. It provides a means of making a standard-definition broadcast picture of 525 lines, 60 fields, 30 frames interlaced two-to-one, having a video bandwidth up to 4.5 megacycles. In this system, for simplicity, a single transmitter sends the sound simultaneously with the video by means of frequency modulation of a 4.5 megacycle sub-carrier. The complete signal is transmitted on an amateur carrier frequency, such as 432 megacycles. Reception can, therefore, be accomplished on a standard television receiver preceded by a simple frequency converter.

The basic "picture maker" or camera used in this inexpensive system is derived from an old device used in early television experiments with ro-

BOTH SOUND AND VIDEO ARE INCORPORATED IN SINGLE TRANSMITTER

STANDARD DEFINITION, 525 LINES, 60 FIELDS, 4.5 MC. BANDWIDTH IS PROVIDED

NO EXPENSIVE ICONOSCOPES OR IMAGE ORTHICONS REQUIRED

STATION COVERED OPERATES ON 420 MC. BAND. HIGHER FREQUENCY AMATEUR BANDS CAN BE USED

SYSTEM DESCRIBED IS FOR TRANSMISSION OF STILLS. ALTERNATE METHOD FOR SCANNING MOVING OBJECTS IS DISCUSSED

IMPROVED SYSTEM, ALSO DESCRIBED, EMPLOYS STANDARD TV RECEIVER TO PROVIDE SYNC AND SCANNING PULSES. SAME RECEIVER CAN ALSO BE USED TO RECEIVE PICTURE AND SOUND FROM ANOTHER AMATEUR STATION

TO REDUCE COST, ANY STABLE 420 MC. TRANSMITTER, EITHER SURPLUS OR HOME-BUILT CAN BE USED

OPERATOR OF EQUIPMENT MUST BE A LICENSED AMATEUR. TO BUILD COMPLETE STATION CONSTRUCTOR SHOULD BE FAMILIAR WITH RADIO DESIGN AND THEORY

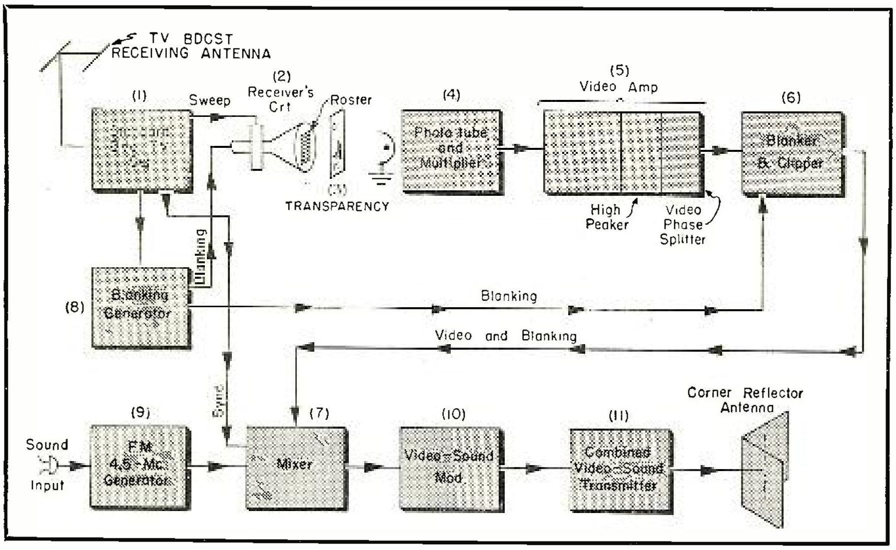


Fig. 2. Block diagram of transmission system showing functions of the units.

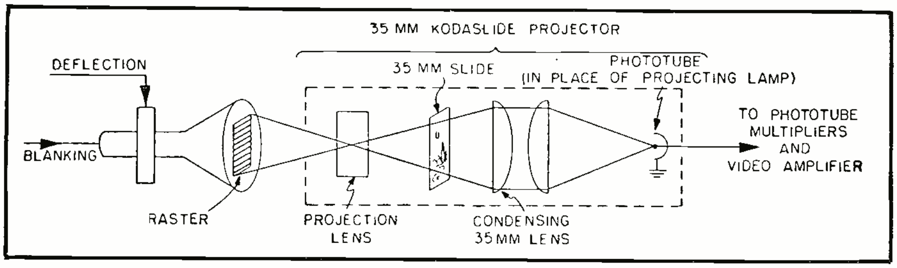


Fig. 3. Method for using cathode-ray tube as light source for 35mm transparencies.

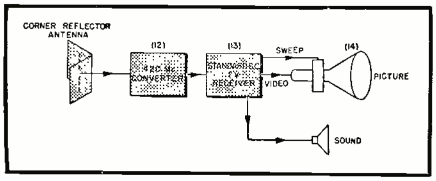
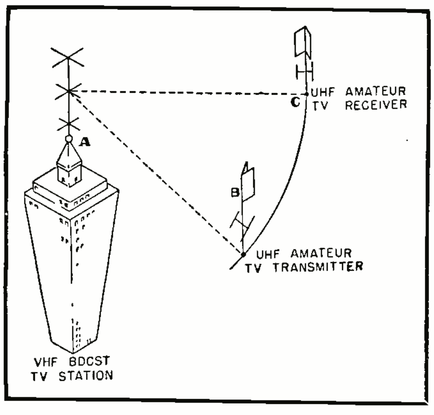


Fig. 4. A 420 mc. converter is used with a standard television set for reception.

tating discs and known as the *flying spot scanner.*

Suppose that a spot of light such as is generated by an arc lamp is fed through a rotating disc with small holes in it arranged spirally so that they progressively become nearer to the center of the disc. This means that if a scene is illuminated by this light,

Fig. 5. Diagram showing direct reception of scanning signals from a TV station.



there will be one small flying spot after another traversing the scene, each illuminating a line of the scene, and each line successively displaced, so that at the end of one revolution of the disc the entire scene has been covered. As the spot of light covers each small portion of the scene, a phototube picks up the light derived from this particular portion of the scene. The phototube current is then a video signal suitable for transmission. (At the receiver the corresponding signal is amplified and drives a source of light which can be modulated in intensity. This light is then viewed through a similar receiving disc rotating in synchronism with the transmitting disc, allowing the original scene to be observed.) This old principle is applied electronically in the modern flying-spot scanner. Instead of using the rotating disc with holes, a raster is generated on the screen of the cathode-ray tube shown as unit (2) in Fig. 2. Since the raster is produced by the motion of one dot behind the transparency, the variations of light value from point to point of the transparency are picked up by the phototube.

In the present system the transmitter uses an ordinary TV receiver altered so as to separate the sync from the received television signal from any local TV station. This sync is then used to generate the interlaced standard RMA sweeps. A block diagram of the sending end of the system is given in Fig. 2. Unit (1) is the broadcast TV set, which is standard and whose sweeps and sync-separating circuits are as normally found. It is tuned to any local TV broadcasting station. In the event that it is not possible to receive a standard TV signal, then it is merely necessary to derive the sync and blanking from the TV set's own sweep circuits. In this case the picture will often have only 262 lines non-interlaced, since the horizontal oscillator is running free. The picture retains the same horizontal resolution but the vertical resolution is reduced by a possible factor of two. For this type of operation it is desirable to sync the vertical to the 60-cycle power supply so that hum effects will be reduced.

The lead to the video amplifier from the grid of the television set's cathode-ray tube (2) is disconnected in the set and is instead connected to the blanking generator (8). (For this source (2) of the flying-spot illumination, practically any CRT can be used, including surplus P7-phosphor radar types.) In addition, the sync derived from (1) is to be used later for transmission purposes in mixer (7). The light from the raster of (2) is then passed through a transparency (3) (which is the picture being transmitted). This can be held in a slide projector holder or put directly on the face of the cathode-ray tube (2). If a slide projector is used the phototube is substituted for the slide projector light source, as shown in Fig. 3. Returning to Fig. 2, the light passing through the transparency is picked up by a phototube (4), amplified by a video amplifier (5), passed through a video clipper and blanking inserter (6), and then passed through a sync and sound sub-carrier mixer (7). The output of the mixer is fed to a combined video-sound modulator (10), which modulates a transmitter (11), and this feeds an antenna radiating the picture and sound signals simultaneously.

The receiver block diagram is given in Fig. 4. The combined picture and sound carrier is picked up by a converter (12), which includes a "cascode" (grounded-cathode triode followed by a grounded-grid triode) i.f. amplifier as its output section; it delivers an output corresponding to an unused channel of a regular standard broadcast TV set (13), where the picture and sound are separated by the normal processes.

Other possibilities lend themselves suitably to this system. In Fig. 5 the TV station *A* supplies picture and sync for the amateur television transmitting station located at *B*. If the receiving station is located along a circumference of radius *AB*, say at *C*, it becomes possible for the receiver *C* to use the sync directly derived from station *A* without having to receive sync from transmitter *B*. This means that all that is necessary to receive *B*'s transmission is to disconnect the video from the picture-tube grid of *C*'s receiver and use instead the video received from *B* over the u.h.f. link. The broadcast TV receiver at *C* is tuned to station *A* and is, therefore, scanned in synchronism.

Under these conditions reception of *B*'s picture at *C* will be accompanied by a horizontal shift or displacement of the picture proportional to the delay with which *B*'s picture arrives at *C* with reference to the sync received from *A*. For short distances this shift is small. For greater shifts recentering of the picture at *C* or adjustment of the horizontal sync phasing control becomes necessary.

This system is not limited to transparencies. It is possible to send pictures of live subjects or of fixed objects as shown in Fig. 7. The raster from the CRT is projected by a projection lens on the object, and the reflected light from the object is collected by a condensing-lens system for delivery to the phototube. The remaining operations are then just the same as with a transparency. Considerably greater light is needed than for the transparencies, and a 5TP4 or 5WP15 projection-type CRT with associated high voltage is suitable.

For sending motion pictures the setup is essentially the same as for still transparencies. A film projector has its light source removed and the phototube put in its place. A 60-cycle synchronous motor is used to drive the film sprocket and the film is run through the projector at 30 frames per second instead of 24. This speeds up the motion on the film somewhat. It is also necessary to blank the raster during the film pulldown time. More elaborate means are needed to show the film at 24 frames per second.

Since the transmitter (unit (11) in Fig. 2) sends out the picture double-sideband, a total bandwidth of nine megacycles at the transmitter is desirable. This presents no problem on 420 megacycles. However, in order to use a standard receiver advantageously it is preferable to follow the vestigial-sideband method as in broadcast practice. One TV sideband with the vestigial other sideband is obtained by the selectivity of the receiver's i.f. amplifier, resulting in reception and reproduction of standard RMA pictures. See Fig. 8. The shaded portion represents the sideband eliminated by the selectivity of the receiver. Of course in tuning up the transmitter it is also possible to adjust the tuning in such a way that one sideband is amplified more than the other—naturally the sideband to be used in the receiver should be favored.

Since the sound is transmitted as a sub-carrier, it becomes impossible to use full modulation on the transmitter for pictures as this would not allow the sub-carrier of 4.5 megacycles to be continuously transmitted. Generally fifty per-cent modulation is used for the sideband carrying the FM sub-carrier and the other fifty per-cent devoted to video signal. Changing these proportions of modulation in favor of more picture modulation will result in undesirable buzz in the sound portion of the transmission. Of course, if it is

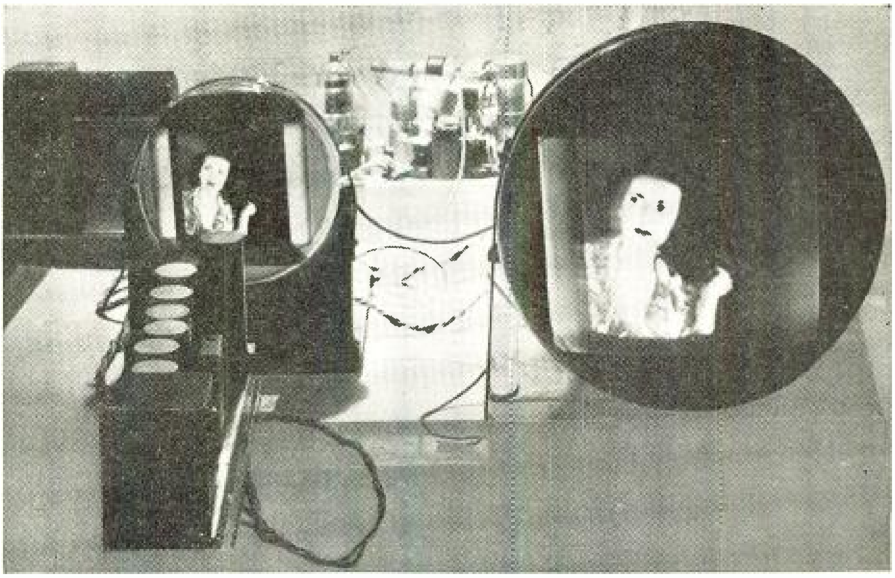


Fig. 6. The original transparency (left) compared to the reproduced image (right).

desired, a separate sound transmitter spaced 4.5 mc. can be used, or other sound not necessarily associated with a picture can be used.

The phototube used is a standard surplus 931A multiplier type. These were used in most of the radar countermeasure noise generators for radar jamming (AN/APT-5). In the noise-generator application, use is made of the extreme amplification capabilities of the tube. However, it is not desirable, in the present case, to employ enough gain to reach the noise-level capabilities of the tube, as this results in "snow" in the television picture. For convenience in handling the total of 550 volts supply potential, a positive and negative source of voltage is used. The gain control of the whole video system is obtained by adjusting the value of the negative supply voltage.

The output of the phototube is fed to a series of video amplifiers, including one stage, known as the high-frequency peaker. This peaker is necessary to equalize or compensate for the time it takes a spot of light to build up and decay, as the phosphor of the cathode-ray tube (2) does not light up or die down instantly. This corresponds to a pulse of voltage in the phototube which is exponential in rise and decay time. This is the same as saying that the pulse derived from the spot of light is deficient in high frequencies, which are then equalized by the additional high-frequency response of this stage. The desired rise and fall time of the pulse is shown in Fig. 9 by the dotted line. The actual pulse without the high-frequency peaker is shown by the heavy lines. If the peaker is used, the higher video frequencies are favored so that the dotted wave shape is obtained. This effect is produced by an *RC* network. As the condenser *C* is adjusted, the "blurs" and smears in the video picture will disappear causing the picture to sharpen up and display the detail expected.

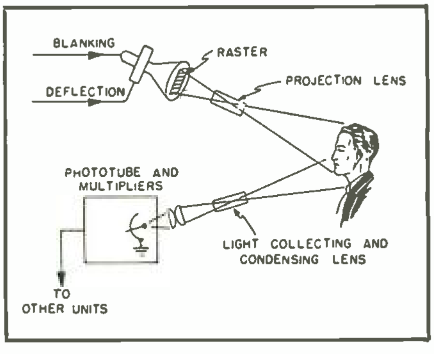


Fig. 7. Method of using cathode-ray tube as a light source for scanning live subjects.

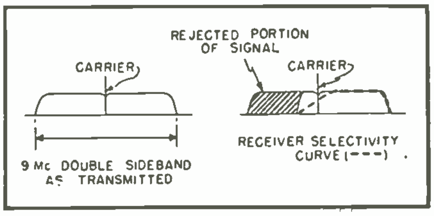
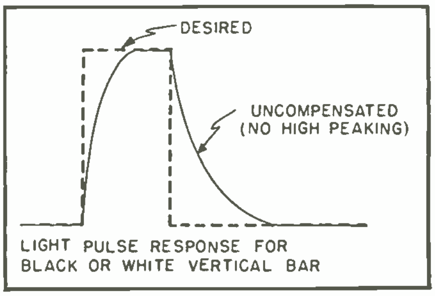


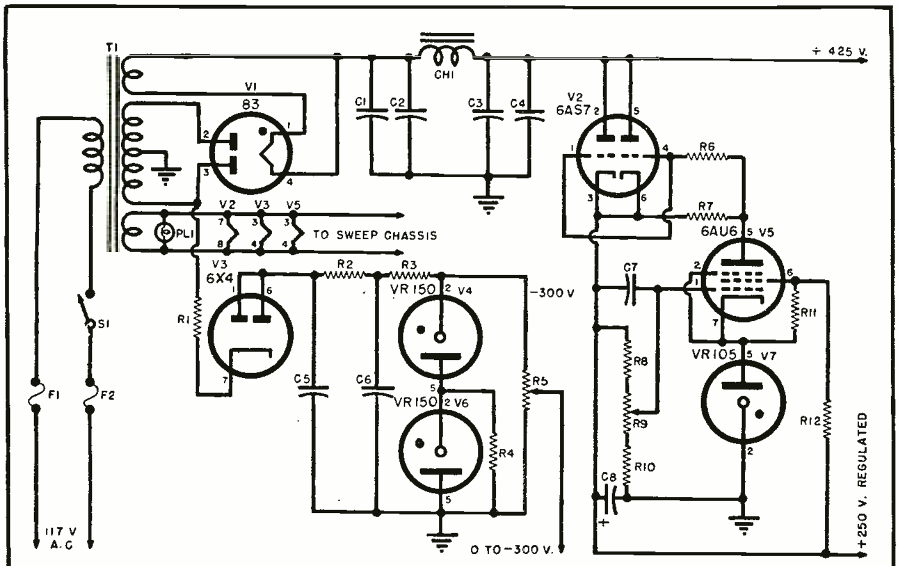
Fig. 8. The carrier as transmitted and the vestigial sideband obtained (right).

It is necessary to provide for picture reversal in order to transmit from either a negative or positive picture transparency. The received picture will then always be positive.

The blanking portion in the RMA signal cannot generally be used be-

Fig. 9. Compensation in the video stage.





R_1—4700 ohm, 2 w. res.
R_2—33,000 ohm, 2 w. res.
R_3—5600 ohm, 2 w. res.
R_4, R_7—1 megohm, ½ w. res.
R_5—500,000 ohm pot. (screwdriver adj.)
R_6—100 ohm, ½ w. res.
R_8—100,000 ohm, ½ w. res.
R_9—250,000 ohm pot (screwdriver adj.)
R_{10}—50,000 ohm, ½ w. res.
R_{11}—10,000 ohm, ½ w. res.
R_{12}—22,000 ohm, ½ w. res.

C_1—10 μfd., 600 v. oil-filled cond.
C_2, C_3, C_4—6 μfd., 600 v. oil-filled cond.
C_5, C_6—4 μfd., 600 v. oil-filled cond.
C_7—.5 μfd., 600 v. cond.
C_8—16 μfd., 450 v. elec. cond.
T_1—Power trans. 400-0-400 v. @ 250 ma.; 5 v. @ 3 amp.; 6.3 v. @ 8 amp.
CH_1—Filter choke, 6 hy. @ 250 ma., 85 ohm
S_1—S.p.s.t. toggle sw.
PL_1—6.3 v. pilot light
F_1, F_2—5 amp. fuse

Fig. 10. The regulated supply used to power all units except the r.f. section.

cause the black portions of broadcast pictures are sometimes so close to the blacker-than-black region of the composite signal that the flying-spot raster might have some unwanted black portions. However it is possible to use the horizontal sync pulses as H blanking pulses. A better way is to use the flyback period of the H and V oscillators in the receiver for deriving blanking signals. It is usually possible to find some place in the sweep circuits which already has a good pulse of the proper polarity. For example, the vertical pulse present at the output of the vertical integrating network. The horizontal blanking is easily obtained from the output of the sync separator or by taking a portion of the flyback pulse present in the horizontal deflection coils. These signals are then fed to the blanking generator where they are clipped and then fed to the flying-spot CRT grid and the video blanking inserter.

So far in our discussion, the video has been allowed to go through the video amplifier without thought of what should be done with the blanking and the sync. Actually the video is limited by superimposing on it a pulse which will shut off the picture-tube grid when the time comes for the retraces of the lines to take place. This is accomplished by adding together in unit (6) of Fig. 2 the video signal amplified by (5) and a pulse derived from the blanking generator (8). The extremity of the blanking pulse with its video superimposed is then chopped off in the same unit.

Beyond the clipped portion, the sync signals derived from the TV broadcast (or locally generated) are superimposed in mixer (7). The result is a standard RMA experimental signal capable of being received on a standard receiver without any difficulty.

The FM sub-carrier unit (9) consists of a 4.5-megacycle oscillator modulated by a reactance tube. A portion of the 4.5-megacycle output is mixed with the video and handled then in the same manner as if it were a video component.

The video modulator is a straightforward amplifier similar to the power video stage of an ordinary television set. However, it has to swing over a much wider voltage range than is required in a normal television set. The output of a 6AQ5 feeds a 6AS7G power-handling cathode follower which is used directly to modulate the transmitter. The use of the cathode-follower modulator, with its low source impedance, is especially desirable because of the high bypass and stray capacitances generally associated with the transmitter.

It is desirable to use a regulated power supply for most of the circuits associated with the video, scanning, blanking, and related circuits. For those anxious to get started, a satisfactory supply is illustrated in Fig. 11 with the schematic diagram shown in Fig. 10. Many amateurs will have a supply available which will meet these requirements.

Succeeding articles will deal with the construction of the various units and cover the tuning and adjustment. The experienced amateur will be able to make many changes in the basic design to accommodate equipment on hand.

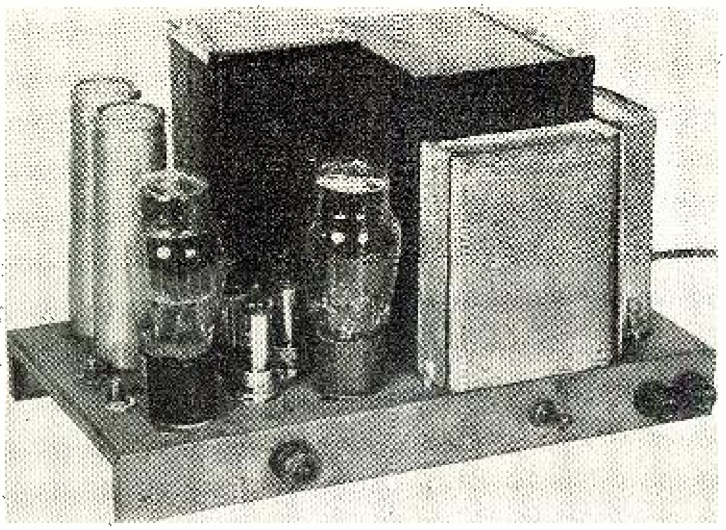
For those who desire more power, a transmitter of the SCR-522 type will serve as a driver for a tripler furnishing an output of ten to twelve watts on the 420 mc. band.

There are several pieces of surplus equipment which operate on the 420 mc. band and if some of this equipment is on hand, many of the components may be used. Usually the receiver portion of this surplus equipment is of the superhet type with a broad i.f. system, and by substituting a front end capable of tuning to a TV station, the necessary signal for scanning may be obtained. In many cases there will be unused tubes which may be adapted to serve as the vertical and horizontal oscillators, or the video section included in the receiver may be used.

Of course operation is not limited to the 420 mc. band and the system may be used on any of the amateur bands above this frequency. The 420 mc. band was chosen as it permits the use of familiar techniques without resorting to waveguides and plumbing.

(To be continued)

Fig. 11. Photograph of the power supply of Fig. 10. Three outputs are available.



Something NEW in TRANSCEIVERS

By KENNETH M. KORTGE, W8AHT

Fig. 1. Battery and audio unit with assembled handset. The r.f. section and antenna are mounted on earphone end of handset. A slot was cut in the shield can to clear projecting antenna socket. Cover is held in place by sheet metal screws.

Details for building a handy two meter transceiver from a readily-available surplus TS-13 field phone.

WITH conditions becoming crowded in the larger cities and with more and more surplus crystal-controlled transmitters being put in use, the modulated oscillator is rapidly becoming a thing of the past on the two meter band and rightly so. But for super-portable, short-range operation the "handie-talkie" version of the standard transceiver is still holding its own.

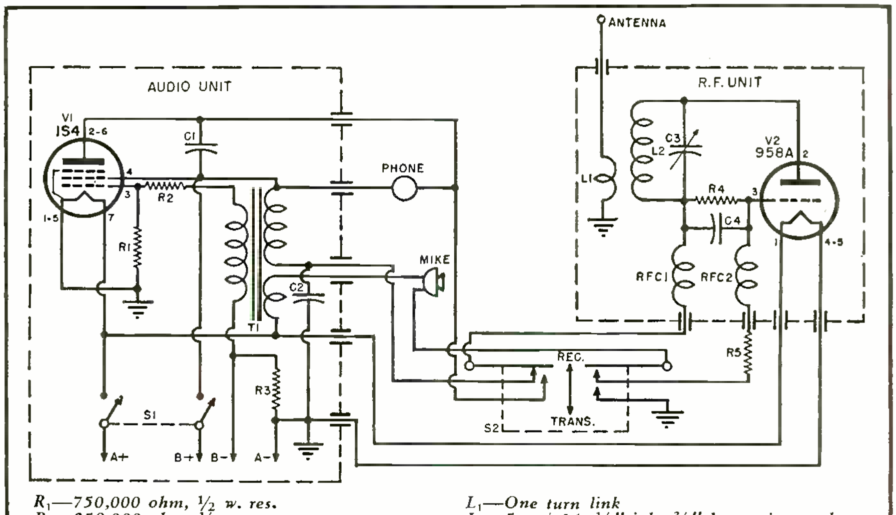
The common method of constructing the handie-talkie is to assemble microphone, headphone, batteries, antenna and all the parts in a single unit. This necessitates handling a fairly bulky package and struggling to manipulate switches as well as supporting the weight of the batteries, which, though relatively light, can tire the operator's arm if used for any length of time. The author decided to make an attempt at eliminating these two evils. The end result is the apparatus shown in the photographs.

To facilitate handling, a surplus TS-13 field telephone handset was used as the basic unit. This unit has a 200 ohm microphone, and a high impedance headphone. Many similar units are available. In order to keep the antenna as high as possible during operation it was decided to mount the r.f. portion, along with the antenna, on the earphone end of the handset. To house this part an aluminum shield can about two inches square and three inches tall was salvaged from the junk box. A base was cut from one-eighth inch aluminum and shaped so that the shield can would fit snugly over it. A flat was filed on the earphone end of the handset in such a way as to lie vertically when the phone is in operating position. The base was then fastened to this flat with machine screws after drilling and tapping two holes, ¾" apart, in the filed portion. A third hole was drilled between the two tapped ones through the base and the bakelite into the chamber occupied by the headphone to accommodate the leads from the r.f. section. Bringing these leads into the switch opening in the handle presented a problem since a hole could not be drilled directly from one opening to the other. The solution was to drill from each chamber toward the next at as close an angle as possible so that the two holes met. A stiff wire was pushed through the resulting "V" shaped path and the small conductors from the r.f. section pulled through with this wire. The same procedure was used to pass several wires from the switch chamber into the microphone opening. (There were conductors moulded in the plastic of the handset but most of them were severed during drilling operations so it was necessary to install replacement wires.)

The switch was found to be a double-pole, single-throw one of the leaf variety and, since a ganged d.p.s.t. and s.p.d.t. is used in the circuit, a

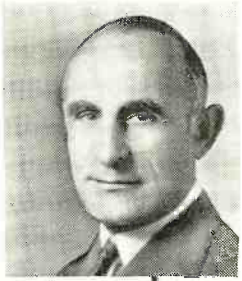
(Continued on page 106)

Fig. 2. Circuit diagram and parts list covering the two meter transceiver unit.



R_1—750,000 ohm, ½ w. res.
R_2—250,000 ohm, ½ w. res.
R_3—850 ohm, ½ w. res.
R_4—10 megohm, ½ w. res.
R_5—10,000 ohm, ½ w. res.
C_1, C_2—.002 μfd., 200 v. cond.
C_3—Midget two-plate var. cond.
C_4—50 μμfd. ceramicon cond.
RFC_1, RFC_2—18 t., #26 en., ¼" diam., ½" long
T_1—Transceiver trans.
L_1—One turn link
L_2—5 t. #14, ¼" i.d., ¾" long, airwound
S_1—D.p.s.t. toggle sw.
S_2—Leaf sw. (See text)
V_1—1S4 tube
V_2—958A tube
1—"A" battery, 1½ v. flashlight cell
1—"B" battery, 67½ v. portable type
1—200 ohm, single-button mike and 5000 ohm headphone handset. (Any higher headphone impedance unit will work.)

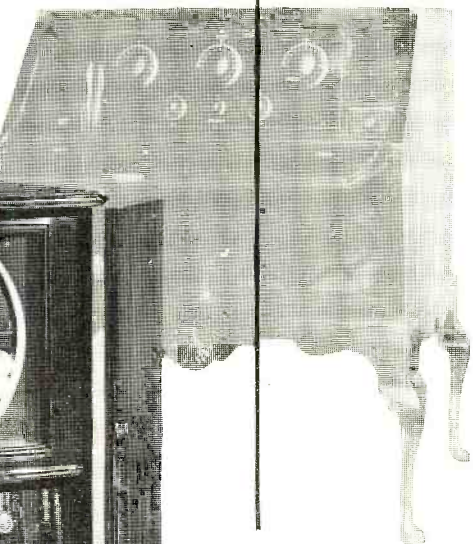
Frank Andrea— RADIO and TELEVISION PIONEER



Thirty years of progress in the radio industry is typified by the life and work of this pioneer.

By

ARTHUR PINE



A typical Andrea "Neutrodyne" set of the 1925 era.

The 19" "Normandy" model, one of the latest Andrea television receivers, with AM-FM radio and an attachment for a record player.

NO HISTORY of the radio or television industry would be complete without the saga of Frank A. D. Andrea, for during the 60 years of his life, this pioneer has added much to the advancement of electronics.

Today, as president of the *Andrea Radio Corporation* of Long Island City, New York, he is still busy each day with experimental work directed toward perfecting television to the point where it is flawless.

1950 is a landmark in his career for it marks his 30th year in radio and television, and places him, along with Lee DeForest and others of that caliber, as one of the pioneers in the industry. Few men still active in radio and television today were in this field back in 1920 when he organized *Frank A. D. Andrea, Inc.* in a small room on Jerome Avenue at 176th Street in the Bronx.

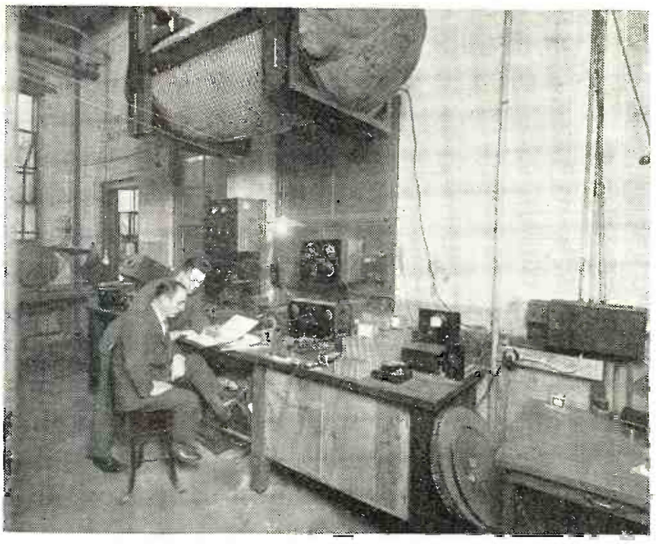
At that time, the entire organization consisted of Frank Andrea and two helpers. Their first efforts were concentrated on producing such items as rheostats, crystal detectors, and sockets for the pioneer set builders of that time.

His interest in radio was stimulated by two of the pioneers in the communications field—Guglielmo Marconi, the "Father of Wireless" and Lee DeForest, one of radio's early "masterminds."

In 1917 he went to work for Lee DeForest. Then in July of 1920, *Frank A. D. Andrea, Inc.,* came into existence. Broadcasting soon came into its own and the company started to expand. By 1922, the organization had begun to prosper, a large percentage of the business being in "Neutrodyne" kits which were sold to amateur set builders for home construction. These were the first radio kits to be offered to the amateur, according to Mr. Andrea.

In 1923 the company produced the first commercial "Neutrodyne" receiver, based on designs by Professor L. A. Hazeltine of Stevens Institute of Technology. By March of that year the new receivers were being turned out in quantity and shipments were on their way to jobbers throughout the country. This receiver captured the pub-

Frank Andrea with one of his engineers, Louis Clement (now Director of Research and Engineering for Crosley Div. of AVCO Mfg. Co.) working on their first cone speaker in the year 1925.



The present-day Andrea cabinet assembly line where the completed chassis are installed into the television cabinets.

The television assembly line at the Andrea plant. Here table model video receivers are being produced in quantity.

lic's fancy and over 30,000 were put on the market before the year was out—an undreamed of output for that era.

By the end of 1925 the company was well on its way to success. Throughout this period and until 1932, Mr. Andrea was interested in the development of television and spent a great deal of time and money developing the scanning method of television. This system used a revolving disc to obtain a picture. In 1931, the *National Broadcasting Company* was telecasting experimentally with the picture being received on television sets via the scanning method.

In 1932, Mr. Andrea was bitten by the "retirement bug," and he relinquished control of the company. It took only two years, however, for him to realize that his interests were too closely allied with radio and electronics to retire, so in 1934 he organized the *Andrea Radio Corporation.*

After much experimentation the first *Andrea* television kit was offered to the public in 1938, and, like the original "Neutrodyne" kit, was sold to those people who wanted to "assemble their own." Over 5000 of these kits were sold in the first year they were offered.

Today Mr. Andrea and his staff of engineers are busily engaged in the problems involved in color television. Like others in the industry, Mr. Andrea believes that the ultimate in television will be color and a third-dimension picture.

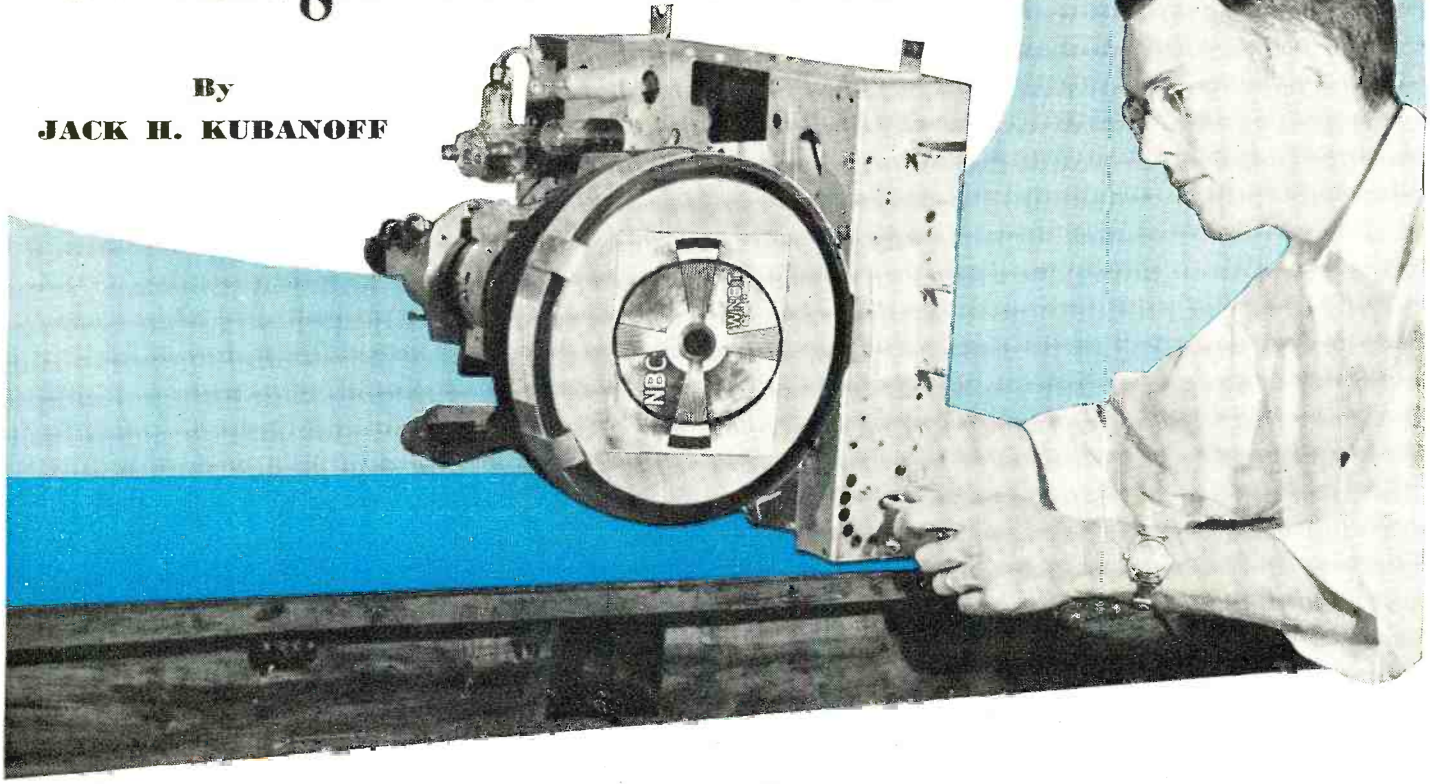
—30—

The original Andrea "Knockdown Neutrodyne Receiver Kit."

(Left) Scene at the original Andrea factory in the Bronx shows engineers testing one of the first Neutrodyne sets in 1923.
(Right) Frank A. D. Andrea demonstrating one of his early Neutrodyne chassis to a group of Canadian engineers.

USE TEST PATTERN To Align Your TV Set

By
JACK H. KUBANOFF



A simple method for aligning video receivers without the use of tools or test instruments.

UNDOUBTEDLY the most accurate method of aligning television receivers is with an oscilloscope, sweep signal generator, and marker generator. The procedure is, however, rather involved and time-consuming. There is also the possibility of error caused by loading of the circuit with the signal generator. In addition, many service technicians find the cost of test instruments a decided handicap. Furthermore this type of alignment procedure is not adaptable to servicing in the field, in homes, or away from the test bench thus entailing the time and trouble in removing the receiver to the shop.

Over a period of years the author has been developing and using a method of television alignment which has proven to be practical, inexpensive, rapid, and accurate within the tolerable limits of visual capabilities. This system has the added advantage of permitting the simultaneous adjustment of the linearity, aspect ratio, focus, and bandpass. No further adjustment of the picture position, size, definition, aspect ratio, focus, or linearity is required after aligning by the method outlined. With the control of the picture present, the technician is assured of the greatest gain, best available frequency response, and the most pleasing picture possible.

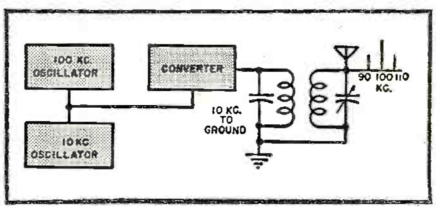
Television alignment without the use of instruments is entirely possible providing the service technician understands basic television circuits and uses his knowledge wisely.

Test Pattern

The test pattern, an integral part of every station's programming, is the basis of the alignment procedure outlined. The test pattern should not be treated as just another picture because it is, in reality, the "last word" in what a properly aligned television receiver should be able to reproduce. In fact, in the final analysis, a good alignment job is one that produces greatest clarity and the finest detail in the test pattern.

In Figs. 2 and 4 are shown typical resolution charts. The more nearly the receiver reproduces these charts

Fig. 1. Heterodyne principle (see text).



the more perfect is the receiver performance. In order to better understand these resolution charts, a brief review of their characteristics is in order. Notice that the chart of Fig. 2 consists of two circles. These circles are used to obtain the proper aspect ratio, *i.e.,* height to width ratio. When the circles are perfectly formed and fill the tube face while remaining circular, the largest possible picture is obtained, compatible with the proper height and width. An improper setting here may cause distorted letters and figures. The linearity and aspect ratio must be set correctly before adjustments are made to obtain the proper bandpass.

Next notice that part of the chart which is in the form of a Maltese Cross. The cross is made up of a number of converging lines. Each line is wide at the periphery of the circle and narrows as it approaches the center circle. At the periphery the left-hand and lower wedges represent about 150 line resolution. This means that approximately 150 lines of that thickness, with equal spaces of the same thickness between lines, will fill the horizontal or vertical space completely and be of the definition visible on the screen of the set. Now the lines become narrower as they approach the center of the test pattern and the spaces between the lines also become narrower, occupying the same space between lines as the line width at each point on the pattern. At the center circle the lines represent 350-450 lines, varying with the pattern. This indicates that the receiver is capable of reproducing 350-450 lines and spaces, vertically and horizontally. Naturally the more lines and spaces a receiver can distinguish, the finer the detail it will be capable of reproducing. Fine detail is the result of optimum amplification of the full 6 mc. television bandwidth and particularly that part of the bandwidth associated with the video (5.25 mc.).

Notice, too, that the pattern contains wedges of varying degrees of shading in addition to the Indian head. These are used in adjusting the contrast and brightness controls to provide a full range of contrasting black to grey to light grey to white. The proper setting of the brightness control almost always requires a slight compensation in the contrast control. If the four distinct shades of the pattern are not visible in the wedges it is an indication of nonlinear distortion in the video amplifier. This is usually caused by an improperly biased or gassy tube. The signal from a second transmitter should be checked to insure that this trouble is not in the transmitter.

Focusing of the test pattern is very important and since present-day cathode-ray tubes do not focus evenly over the entire face of the tube a median setting must be obtained so that the most satisfactory over-all focus is achieved. This can be set tentatively as the point at which the lines of the raster are distinguishable and are of the minimum possible width.

Alongside of the wedges (Fig. 2) are a series of numbers from 20 to 45 (indicating 200 to 450 lines). These numbers are indicative of the number of lines represented by that particular line and space thickness. It is of great advantage not only to know the number of lines a receiver is capable of producing (as indicated on the test pattern) but also the frequency represented by that number of lines in order to check the definition as well as the lowest and highest frequencies capable of being received clearly. Table 1 is a handy chart which lists the number of vertical lines and the equivalent frequency in megacycles. The chart may be used in judging the bandpass of the resultant adjustments to the receiver.

The diagonal lines for interlace check enable the user to test for improper interlace. A television picture is scanned with alternate lines and the lines must interlace perfectly. An irregular saw-tooth effect on the diagonal lines indicates poor interlace caused by an improperly functioning vertical sweep system.

The horizontal lines of varying length at the bottom of the circle are for the purpose of checking low frequency response. They should be sharply defined and without variation in intensity. Any variation in the intensity of these lines will indicate poor low frequency response.

The group of vertical rectangular areas located on either side of the inner circle are used to check "ringing" caused by overcompensation at the high frequencies. If the video output stages are overcompensated, these rectangles are followed by multiple images similar to ghosts but spaced equally from each other.

Heterodyne

Few people realize the dramatic changes which take place in a superheterodyne receiver during the heterodyne process. Prior to the advent of television little attention was paid to the high or low frequencies since in broadcast work most of the channels are so narrow that they can be easily tuned and the complete band of frequencies is always transmitted. Although many persons have a fairly sensitive ear for alignment, often a broadcast set receives only a portion of the transmitted signal. Tuning in a broadcast signal emphasizes the lows or increases the hisses and other high frequencies on the sides of the carrier. This same principle can be used not only in the alignment of the video section but in the proper adjustment of the sound portion of the television receiver.

Whenever two signals are mixed together in a nonlinear device two new signals are generated, *i.e.*, the original two signals are still in evidence but the presence of two new

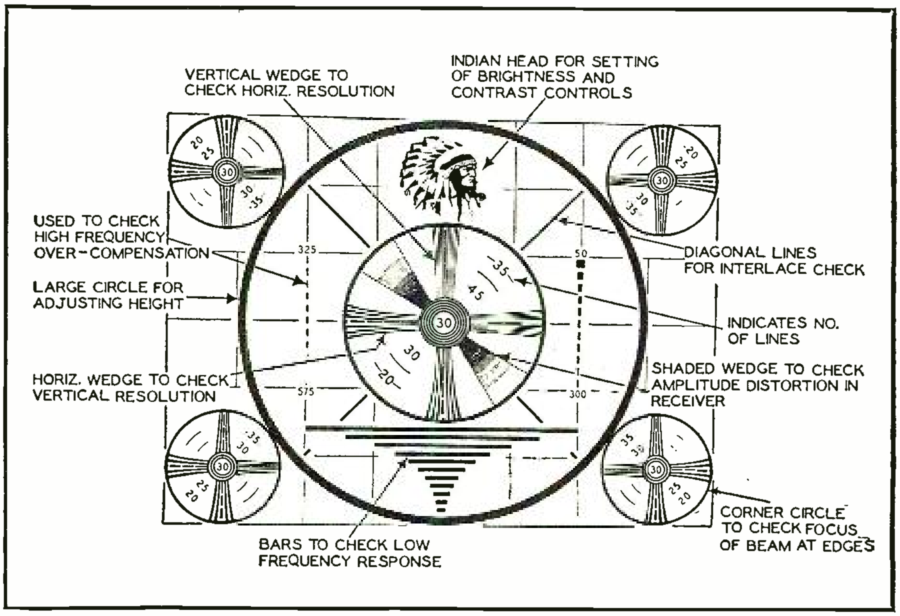
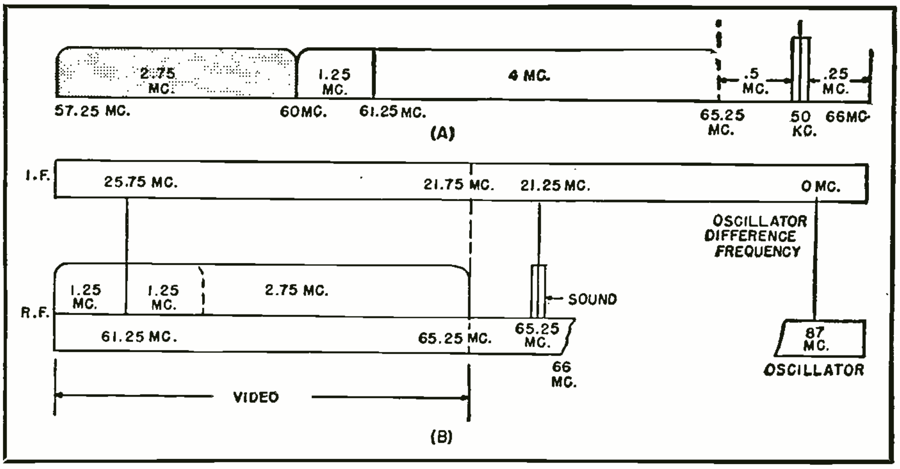


Fig. 2. The familiar Indian head test pattern used by many television stations.

VERTICAL LINES	FREQ. (mc.)
100	1.25
150	1.56
200	2.50
250	3.12
300	3.75
350	4.37
400	5.00

Table. 1. Chart for determining the frequency from number of lines on pattern.

Fig. 3. (A) Spectrum of Channel 3. (B) Comparison of the r.f. and i.f. bands in TV.



signals is always apparent. These signals are the sum and difference between the two original frequencies. Therefore, if a 100 kc. and a 10 kc. signal are mixed in an amplifier, the r.f. output stage will contain signals of 100 kc., 10 kc., 110 kc. and 90 kc. If an r.f. stage follows (as in the final stage of the video transmitter) the only signal present on the antenna will be 100 kc., 110 kc., and 90 kc. The original low frequency signal is attenuated due to the limited bandwidth of the r.f. stage. Fig. 1 demonstrates this principle.

Thus it may be said that a 10 kc. signal represents a full bandwidth of 20 kc. (from 90 kc. to 110 kc. in this example) and in order to produce this 10 kc. signal properly *all* of the bandwidth should be received and amplified. In television an attempt is made to approach this ideal. Fig. 3A shows the ideal television signal for Channel 3 (60 to 66 mc.).

However, for the present, our concern will be with the video. Since the highest signal produced will be in the region of 4 mc. it is reasonable to assume a bandwidth of 8 mc. But experiment has shown that a great deal of space may be saved by transmitting only a portion of the difference frequencies (that portion below the carrier frequency is referred to as the *difference frequency* while that above the carrier is known as the *sum frequency*). The portion transmitted is only 1.25 mc. of the original 4 mc. difference frequency. This signal can, however, produce an intelligible video picture and yet maintain a minimum of bandwidth. This principle is known as vestigial sideband transmission. This is the reason that the video carrier appears as it does in Fig. 3A.

A careful study of Fig. 3A reveals that the center of the video carrier is 61.25 mc. Low frequencies are gathered close to this point while the high video frequencies are farther away (both higher and lower than 61.25 mc.). Referring again to the test chart and frequency table it may be seen that a few kilocycles on either side of 61.25 mc. corresponds to definition in the horizontal wedges whereas high frequency video or vertical wedge detail is located at points well over 1 mc. and as high as 4 mc. on either side of the 61.25 mc. carrier. However, for video frequencies greater than 1.25 mc. the picture information is located in the *sum frequency* region of the video. Now add an oscillator signal, *i.e.,* mix with this r.f. carrier from the station a local oscillator of fixed frequency as is the case in the superheterodyne process.

In the superheterodyne process an oscillator of fixed frequency is used and mixed with the incoming r.f. signal thus taking the difference frequency as the signal we call i.f. or intermediate frequency. Fig. 3B represents the video signal with the oscillator.

Notice that for Channel 3 the oscillator is tuned to 87 mc. Thus the center of the audio band is 21.25 mc. below and the center of the video band is 25.75 mc. below the oscillator. This is the reason for the two i.f. frequencies, 21.25 mc. and 25.75 mc. This choice of i.f. frequencies varies from receiver to receiver but in all cases the video and audio i.f.'s are separated by 4.5 mc.

Up to this point the processes do not materially differ from broadcast methods. Reviewing the r.f. video spectrum again and comparing the i.f. as is diagrammed in Fig. 3, the low frequency or horizontal wedge information is located at 61.25 mc. and extends a few kc. on either side. The i.f. low frequency horizontal wedge information is located a few kc. on either side of 25.75. Note too that the frequencies up to 1.25 mc. are gathered about the center carriers as before. This frequency will produce about 100 lines of vertical wedge information. We are striving, however, toward 400 line vertical wedge information which lies in the r.f. frequency range of 62.5 mc. to 65.25 mc. and in the i.f. range of 21.75 mc. and 24.5 mc.

This is very important and may be stated in various ways. The high frequency r.f. video is, when heterodyned, transformed to low frequency i.f. video. Note that the high frequency r.f. is the low frequency i.f. and that the low frequency r.f. is high frequency i.f. and that the higher the desired definition, *i.e.,* the finer the vertical wedge definition required, the *lower* the i.f. frequency must be. In short, to tune for low frequency video, 100-200 lines, iron slugs are pulled out of the coil forms. For high frequency video the slugs are turned into the center of the coil to increase the inductance and lower the i.f. frequency.

Remember that as more and more vertical wedge is required, the inductance and capacitance of the i.f. amplifiers must be increased. Also in order to produce greater clarity in the horizontal wedge, inductance and capacitance must be decreased.

Presetting the I.F.'s

Presetting the i.f.'s is necessary only when the receiver is completely misaligned. Set all the slugs in the video i.f. coils so that they are in the center of their respective coils. Then set all of the audio i.f. slugs so that they are in the center of their respective coils.

Stagger Tuning

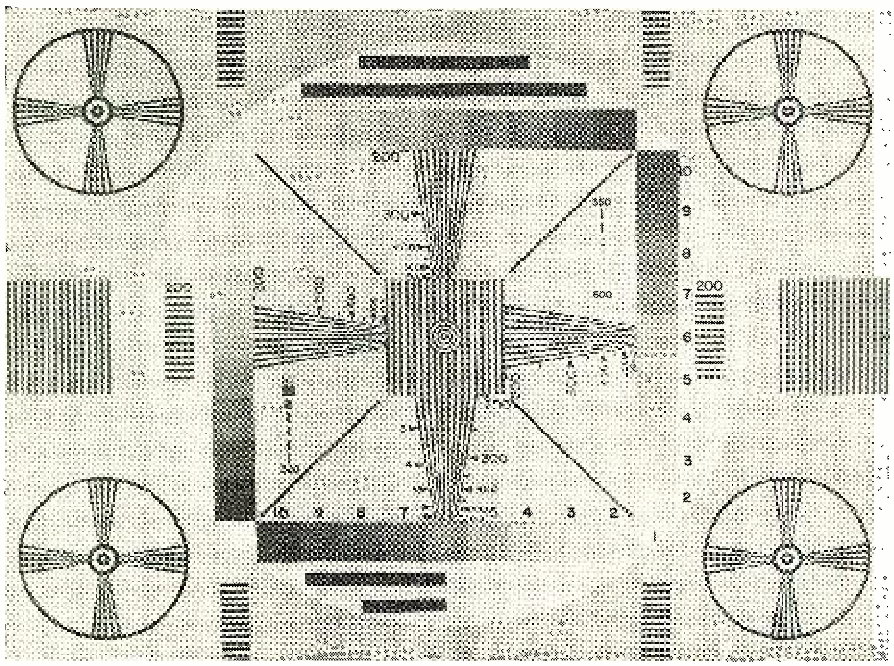
Stagger tuning is used to broaden the frequency response of the video i.f. It is not too difficult to accomplish without the use of a sweep generator if care is taken and every movement of the i.f. slug and the resultant effect upon the test pattern is noted.

First observe where or from what i.f. the audio is obtained. This will be the lowest video i.f. The slug will be set approximately in the center of the coil form. The last i.f. should be set for high frequency video information or at low i.f. frequency, *i.e.,* the slug here will also be set at approximately the center of the coil form. It is therefore advisable to leave the last video i.f. and the video i.f. from which the audio is taken strictly alone. Between these stages the slugs in the video i.f. are set in gradual steps to cover the full coil length. If the audio is taken from any stage but the first video the stages remaining from the converter to this point are staggered in gradual steps from the high i.f. (slug out of coil) to the low i.f. (slug in center of coil), that stage immediately following the converter being set to high i.f. setting.

Now the set may be turned on and

(*Continued on page* 168)

Fig. 4. The television resolution chart adopted as a standard in 1946 by the RMA.



A SIMPLE ELECTRONIC METRONOME

By
GUY DEXTER

THE metronome is a device well known to music students. In its long-used mechanical form, it consists essentially of a small adjustable pendulum driven by clockwork, which audibly beats time. Aside from setting rhythm accurately for musicians and dancers, the metronome has found use in totally unrelated fields. Some applications include the beating of seconds in completely darkened photographic laboratories, timing of mechanisms when the eye cannot be transferred to a stop watch, timing of successive steps observed in chemical or biological processes when the sight is totally occupied with watching the process, marking time in physical training exercises, etc. An electronic metronome has the advantage of freedom from moving parts. It requires no winding and does not run down. Its volume may be adjusted to suit room conditions.

The heart of any electronic metronome is a low-frequency oscillator or recurrent discharge circuit of some kind. The frequency of this oscillator is continuously variable over a small range. For simplicity, compactness, and good service, the circuit must be simple.

The author tested several circuits while developing the instrument described in this article. These included a multivibrator with two-stage audio amplifier, blocking oscillator and amplifier, gas-triode saw-tooth oscillator with amplifier, low-frequency resistance-tuned high-output oscillator, and neon-bulb oscillator with amplifier.

Results obtained with the neon-bulb oscillator driving a single-stage loudspeaker amplifier were good enough to justify turning away from the more complicated schemes. There has been a great deal of opposition to using neon-type relaxation oscillators in timing operations because of the instability of these units. However, the frequency of the neon circuit can be made sufficiently stable for metronome use by regulating the applied voltage and by using good-grade condensers in the circuit.

The final circuit (see Fig. 2) delivers readily-controlled beats ranging in rate from slightly less than 1 per second to 5 per second. This corresponds to a little under 60 to 300 per minute. The beats are delivered by a small loudspeaker and are "plops" which are not harsh to the ear. This metronome is small enough to be

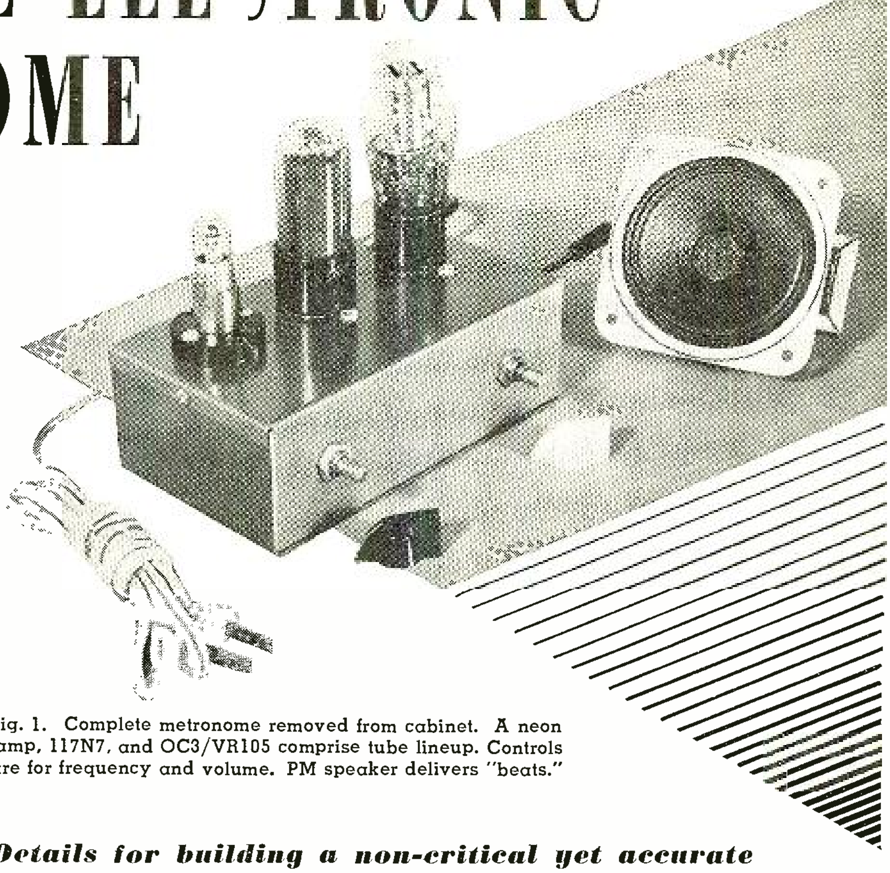


Fig. 1. Complete metronome removed from cabinet. A neon lamp, 117N7, and OC3/VR105 comprise tube lineup. Controls are for frequency and volume. PM speaker delivers "beats."

Details for building a non-critical yet accurate marker for various laboratory and service jobs.

mounted in a midget radio or intercom cabinet and is inexpensive to build and operate. It is an ac.-d.c. device.

Circuit Features

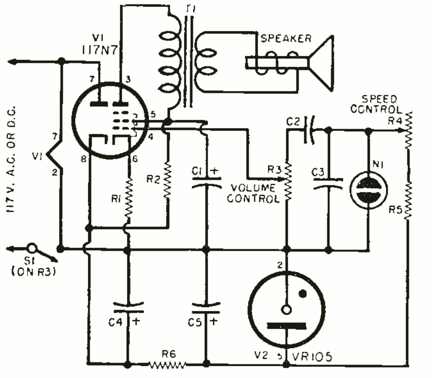
The relaxation oscillator consists of resistors R_4 and R_5, condenser C_3, and neon lamp N_1. Rheostat R_4 is the speed control. The highest beat rate is obtained at the minimum-resistance setting of R_4. Resistor R_5 sets the high-frequency limit of oscillation by raising the lowest resistance value to which R_4 may be set. Condenser C_2 couples the oscillator output into the volume control, R_3, and thence into the grid circuit of the amplifier. Adjustment of the volume control has no effect upon the frequency (speed). High-grade oil-impregnated, oil-filled .1 µfd. condensers are used for C_2 and C_3. For high stability of frequency, ordinary wax condensers must not be used.

The 117N7-GT tube supplies both the pentode amplifier and half-wave power supply rectifier. The cathode resistor (R_1) of the pentode is left unbypassed to obtain a small amount of degeneration. This serves to make the sound of the beats more agreeable to the ear. The pentode drives a 3-inch PM dynamic speaker which was found to deliver enough volume for an average size room. If louder beats are required, as for use in a large classroom

(*Continued on page* 143)

Fig. 2. Complete schematic diagram and parts list for the electronic metronome.

R_1—100 ohm, 1 w. res.
R_2—600 ohm, 5 w. wirewound res.
R_3—1 megohm pot.
R_4—5 megohm pot.
R_5—2.2 megohm, 1/2 w. res.
R_6—1500 ohm, 2 w. res.
C_1—40 µfd., 150 v. elec. cond.
C_2, C_3—.1 µfd., 400 v. oil-filled cond.
C_4, C_5—40/40 µfd., 150/150 v. elec. cond.
N_1—1/4 watt neon lamp (G. E. Type NE-48)
S_1—S.p.s.t. sw. (on R_3)
T_1—Speaker matching trans. (single 3000 ohm plate-to-v.c.)
Spkr.—3 or 5 in PM dynamic speaker
V_1—117N7 tube
V_2—VR105 tube



Extra Income for the SERVICE SHOP

By JOHN B. LEDBETTER

Eng., WKRC-TV

Profitable sidelines help stabilize a service business and provide a good economic cushion.

IN THESE days of servicing complicated receivers and electronic equipment, it is almost heresy to mention "sidelines" as a means of increasing shop income. The average service technician usually has his hands full keeping up with radio service alone. However, those little "odds and ends" often are welcome fill-ins and can often be built up to a point where employment of extra or full-time radio or appliance service technicians is justified. At the same time, these sidelines often attract new customers who might otherwise have taken their sets elsewhere for repairs.

There are many things which may be done to expand shop income. Here are a few: (1) sales and rental service of small p.a. systems, (2) installation of sound systems and intercom units in offices, large homes, schools, farms, and plants, (3) modernizing old-model a.c. receivers, p.a. amplifiers, intercoms, etc., (4) replacing electrodynamic speakers with new, more efficient PM units, (5) improving the performance of a.c.-d.c. receivers (6) electrifying battery sets, (7) servicing small home appliances, (8) custom-building radio and television installations, (9) sales of records, record-players, and other attachments, and (10) operating a small recording studio in the shop.

Appliance Servicing

Small appliance servicing is probably one of the most effective ways of increasing shop repair work. Although not too profitable in itself, it *does* pave the way for more profitable work on radios, washers, refrigerators and other large household appliances. Each repair job on a small item provides an opportunity to suggest a replacement, a check on other appliances, an examination of radio sets in the home, or the sale or repair of large appliances.

Service can be expanded to include electric irons, toasters, waffle irons, hot-plates, heaters, lamps, fans, mixers, washing machines, vacuum cleaners, and even electric ranges, without requiring an expensive outlay of tools or replacement parts. Test instruments needed for most repairs need only include a volt-ohm-milliammeter with a 150 volt scale, an a.c. ammeter (0-20 amps.), and a simple a.c. test lamp. Anyone with any knowledge at all of simple a.c. circuits can repair small appliances; for washing machines, ranges, etc., where repair or replacement of motors, thermostats, etc., is necessary, a little more knowledge and preparation will be helpful.

Trouble in small appliances usually is limited to faulty connections in the plug or line cord, or breaks in the elements or wiring due to long use or rough handling. Permanent wave machines, hair dryers, ultraviolet lamps, etc., are subject to the above troubles; very seldom will trouble be found in their timing units.

Electric irons will perhaps need service more often than other small appliances. The usual difficulty is a faulty line cord or plug, or open or corroded elements or contacts. In automatic irons, the thermostat may be defective.

In *electric mixers, fans*, etc., motor trouble can be caused by dirty, worn brushes, lack of tension in the brush springs, or a dirty armature. Sometimes high mica between the armature segments prevents proper contact with the brushes. See that the motor is clean and properly lubricated. (Clean by disassembling and dipping each part in gasoline, or use a gasoline-saturated brush. Don't use carbon tetrachloride; it is corrosive). Worn take-up and thrust washers may be replaced, but for worn or "frozen" bearings, open armature, field coil, etc., the motor should be sent to a local automotive or electrical repair shop, returned to the factory, or replaced.

Vacuum cleaners have the same motor troubles just mentioned. In addition, the brush holders, fan, shaft, and intake tubes may be clogged with dirt, strings, wool nap, and other foreign matter picked up in cleaning. Usually the belt needs replacing. Check the switch, cord and plug as a safety measure.

Electric lamps (wall, desk, floor, etc.) are easy to service. Troubles include a defective switch, cord or plug, occasionally a bad socket. In fluorescent lamps, a bad lamp tube or faulty starter is usually encountered.

Electric ranges and *washing machines* are not difficult to repair. Defective heating elements in ranges can be replaced with exact factory replacements or universal elements; washing machine motors can be repaired at a local electric shop, returned to the factory, or replaced with a new unit. Wringer rollers, gears, and other worn parts can usually be obtained from the factory or from a local distributor. If the unit is so old that replacement parts are no longer available, the customer is a prospect for a new machine.

Another source of income is the *installation* of new electric ranges. Right now, you probably know several customers who are definite prospects for an electric range. You can do your "good deed" by recommending a particular dealer to the customer, and notifying the dealer of the customer's needs.

You may wonder how the radio service technician can profit by this. Here's how—many dealers do not employ regular installation men but call in outside help, and in many cases will be glad to pass this business along to you or your electrician associates. A good installation inevitably leads to future contacts with the customer and provides the opportunity to inquire about the condition of radios and other appliances in his home and in the homes of his neighbors. Don't overlook any of these opportunities. (A number of small, well-equipped service shops have carried the idea of sales, service, and installation a bit further by having an extra man (or men) specialize solely in work of this kind. Some have added refrigeration servicing as a profitable sideline). The *Norwood Radio Service* (see photograph on page 46) is a practical example of how sidelines may be added. This shop is not elaborate, neither does it let the grass grow in its show window. Note the sidelines offered: vacation and picnic portables, electric roasters, fans, irons, toasters (and for summer comfort, insect repellent lamps). Included are vacuum cleaners, washing machines, and, in the background, several console radios and an auto radio demonstrator—everything but the kitchen sink. Well, look again—the kitchen sink is there too! You may not want to go this far with sidelines, but you'll have to admit it's a good way to get customers into the shop, and it has paid off for this one.

Small P.A. Rentals

Many small amateur dance bands, schools, clubs, and other organizations need a low-power p.a. system occasionally but cannot afford the usual high-fidelity, high-power system. For these occasions, however, they *are* able to pay a nominal fee for a small 5- or 10-watt system. Old-model p.a. amplifiers can often be bought quite reasonably from large sound equipment companies and modernized, or if you prefer, you can build your own in spare time. A number of such rental systems in constant circulation will help pay for quite a few "incidentals" around the shop and, what is more important, will be valuable in promoting good-will and keeping your name before the public. (Along these lines, be sure your business name, address, and phone number are neatly painted or decaled on speakers, amplifiers and microphones). It is also good publicity to donate a p.a. system, receiver, record-player, etc., to civic organizations, business clubs, etc. It does not take long for cooperation of this sort to bring its rewards in increased sales, service, and business contacts. Many customers are connected with or own business concerns which could use intercom systems, paging systems, or sound equipment, or have equipment which is in need of repairs. In many cases the equipment is obsolete, or its effectiveness has been outgrown by expanding business. Situations of this sort are ripe for replacement units—make it your business to bring up these points. Sales can be helped along with a simple demonstrator like the one shown in Fig. 1. This set-up permits actual listening and comparison tests of amplifiers, low- and high-frequency speaker units, and record-changers; several different makes can be switched in for comparisons.

Small Recording Studio

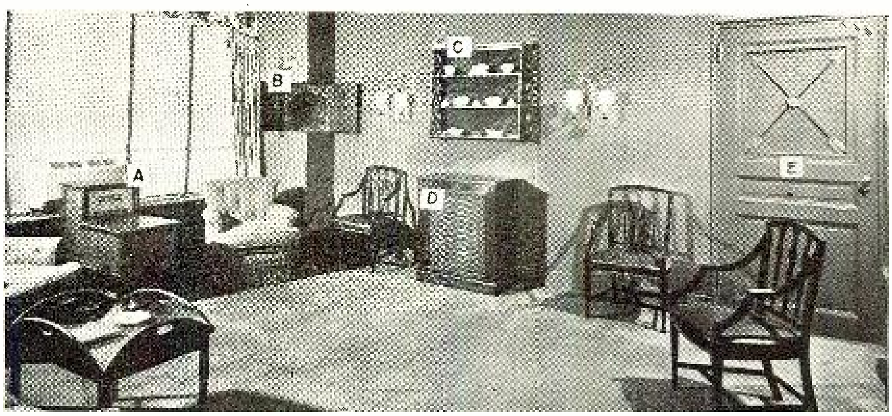
A number of progressive service shops regularly make recordings of speeches, group functions, or special occasions on inexpensive paper discs and pass them out to the participants. These make good "plugs" for the shop and often bring requests for more professional recordings from musicians, singers, and voice students who are interested in keeping permanent records of their progress. Small bands, school orchestras (and parents anxious to record junior's gurgling for posterity) help in making a small recording studio feasible. Many vocalists like to try new arrangements without the presence and attendant costs of a "live" orchestra. Special records and transcriptions (known commercially as "Synchro-discs") are available for this purpose. The vocalist and "canned" orchestra can be mixed very realistically.

Recording equipment, especially at the start, need not be too expensive. You can build your own mixer, preamplifiers, and recording amplifier, or you can use a rebuilt 5- or 10-watt p.a. amplifier if its quality is fairly good.

(Continued on page 152)

Fig. 1. A simple demonstrator unit for merchandising amplifiers, low and high frequency speaker units, and record-changers. It is a good sales stimulant.

Fig. 2. A special room for demonstrating the possibilities of custom installations set up by Altec-Lansing but equally adaptable to the smaller radio service shop.



The Variable Permeability Sweep Generator

By M. E. CLARK
General Electric Company

THERE have been many approaches to the problem of wide-band sweep generator design. Most of these have involved mechanically moving parts such as rotating or reciprocating variable condensers or a reciprocating disc moving near enough to a pancake coil to change its inductance as the disc moves. Such mechanically moving parts are subject to the usual problems of mechanical devices. Sliding surfaces wear and grow loose while flexed pieces fatigue and break. They are also subject to irregularities of motion when shocked or jarred as so often happens under ordinary working conditions in the laboratory or the service shop.

The obvious solution would be an electronic sweep such as the reactance tube type so commonly used for FM visual alignment work. In practice it turns out that it is extremely difficult to get sweeps of the width needed for TV work from the reactance tube sweep. The variable permeability sweep solves these problems by providing the needed width of sweep along with a total absence of moving parts.

As in any other design of an oscillator which is to be varied in frequency, it is necessary to vary either the inductance of the coil or the capacity of the condenser in the frequency determining network. Here we achieve the sweep by varying the inductance.

Fig. 1. Front view of the generator. The vernier r.f. output attenuator is at left of the coaxial cable.

Complete electronic control of sweep eliminates the many problems inherent in the often-used mechanical type systems.

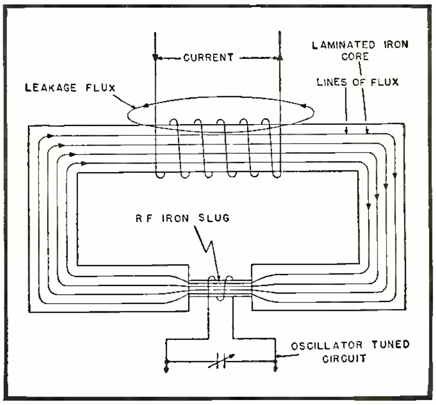
Variable Permeability Unit

As is generally known, the inductance of a choke falls off when the d.c. through it is increased. This is true because as the flux is increased in the iron the permeability of the iron is decreased and its effectiveness in increasing the inductance over that of an air core coil is lessened. Obviously, if this choke were a part of a tuned circuit the resonant frequency of the circuit would go up with saturation. By opening up a wide gap in the choke and putting a small piece of iron in that gap, it becomes possible to saturate the small piece of iron well in advance of the main part of the core because of its limited cross section. By using a piece of high quality radio frequency iron for the small slug and winding the oscillator coil on it we can cause a variation of inductance of the oscillator coil simply by running d.c. through the winding of the original choke. See Fig. 2 for the development of this part which is the heart of the instrument under discussion.

Fig. 5 shows the final form of the variable permeability unit itself. L_1 is the choke or wide gap reactor, and L_2 is the high frequency oscillator coil. The small caps over the end of the laminated core serve merely to reduce losses by keeping r.f. out of the low frequency iron, and do not enter into the creation of the sweep.

When there is no d.c. through the choke coil, the iron slug in the tuned circuit lowers the frequency of the oscillator by many megacycles over what it would be without the core. Now if the d.c. through the choke is increased the iron slug will gradually saturate and become less and less effective in increasing the coil inductance. Consequently, the oscillator will go up in frequency in much the same way as it would if the slug were withdrawn from the coil (as it is in many common iron-slug tuned circuits such as i.f. transformers).

Fig. 2. Inductance of oscillator coil is varied by saturating the r.f. iron slug.



Characteristics of the Unit

If frequency is plotted as the choke current is varied the resulting graph approximates a straight line as shown in Fig. 4, and the frequency is said to be linear with respect to the current. Note that if the current is reversed, the same frequencies are covered again. In other words, a saturated condition is reached regardless of which way the saturating flux happens to be flowing.

When a sine wave of voltage is applied to an inductance, the resulting current is also of a sine wave form, but shifted in phase. Since the wide gap choke coil (or wide gap reactor as it is often called) is nothing more than an inductance, the current through it will be a sine wave if a sine wave voltage is applied to it. The radio frequency will then be varied according to this same sine wave voltage because, as is shown in Fig. 4, the frequency varies the same way the current does. Saturation of the iron circuit would make this statement not strictly true, but saturation of the r.f. iron changes the over-all reluctance so slightly as to cause no trouble.

As also shown in Fig. 4, the frequency will repeat itself if the current is swung the same amount negative as it is positive. Under the condition where a sine wave is applied, this would cause the frequency to repeat four times. For example, going up toward 10 ma., it would pass through 205 mc. and it would pass back through 205 mc. on the way down toward zero. Then it would do the same thing on the negative half of the cycle, thus covering any one frequency (except at the extremities), four times. Two of these can be eliminated very simply by introducing a positive direct current of such a value as to prevent the total current from ever going in a negative direction. This is similar in principle to the negative bias on a class A amplifier which prevents the grid from ever going positive, but in this case the polarity happens to be reversed.

If the oscillator is turned off during the time when the frequency is sweeping back there will then remain only one repetition of any one frequency for each cycle of the sweeping voltage. This is referred to as blanking and is accomplished by biasing the oscillator grid so far negative that oscillations cease. The source and wave shape of the blanking voltage will be discussed later.

Now if the same voltage that is causing the frequency to sweep is applied to the horizontal amplifier of a scope, the spot will move across the screen at the same rate as the frequency is changing. By introducing a phasing control in the voltage applied to the scope it is possible to cause the spot to move not only at the same rate as the frequency, but to cause it also to be in step with the frequency at all times. We now have the basic unit upon which the variable permeability sweep was built.

A Practical Design

In applying the above principle to a practical design, it was found that a sweep oscillator could readily be made to cover the television channels in the frequency range of 165 to 220 mc. The lower channels and intermediate frequencies were then covered by taking the difference frequency between the swept oscillator and a c.w. oscillator. To effectively take this difference, a mixer was used in which one oscillator was fed to one grid of a dual triode, and the other oscillator to the second grid of the same tube. The plates were connected in parallel and the difference output taken directly from the plates into an attenuator. When the c.w. (or beat oscillator) is turned off the mixer becomes simply an amplifier using one half of the tube to carry the swept oscillator output to the attenuator. Fig. 3 is a block diagram showing the above arrangement.

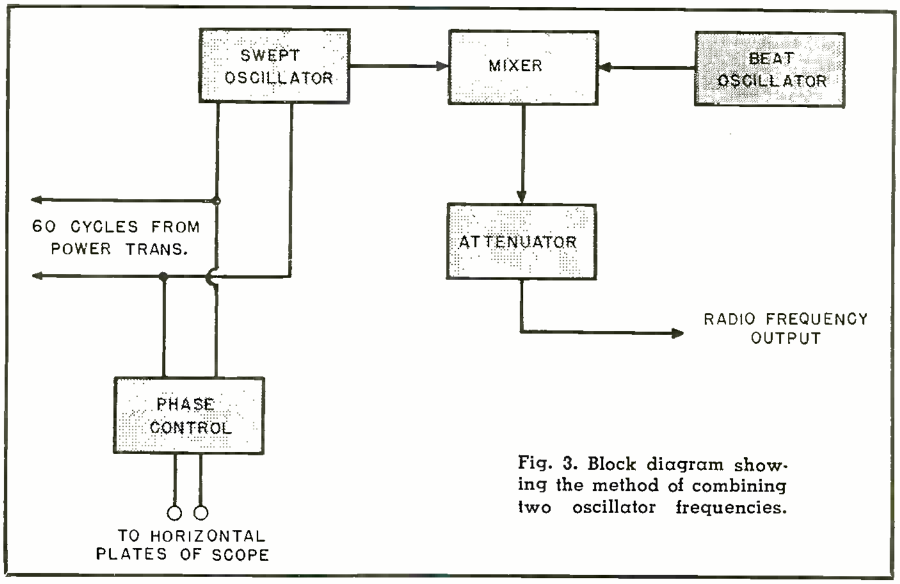


Fig. 3. Block diagram showing the method of combining two oscillator frequencies.

The high television band is covered by the direct output of the swept oscillator which covers from 165 to 220 mc. The low television band is covered by leaving the c.w. oscillator fixed at 275 mc., and tuning the swept oscillator over the high band again. A range of 275 minus 220 to 275 minus 165 is then covered. This is 55 to 110 mc., and covers the low television band and the FM band.

Next, the swept oscillator is left tuned to 220 mc. while the c.w. oscillator is varied from 220 to 275, thus yielding 275 minus 220 to 220 minus 220. This is a range of 55 to zero mc. Actually it is impossible to arrive close to zero output frequency because the oscillators lock together and there is then no beat output at all. With no special inter-oscillator shielding the generator works very well down to 4 mc. which allows it to safely cover 4.5 mc. intermediate frequency amplifiers. Differences rather than sums are used in all cases in order to remove the beating oscillators to frequencies above the beat output.

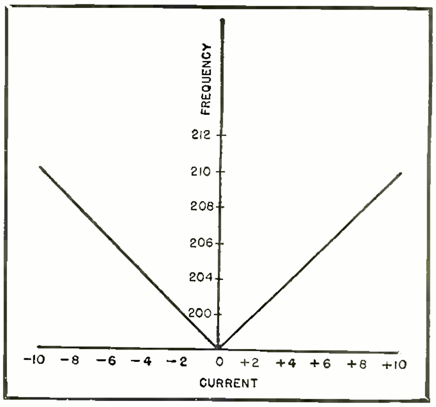
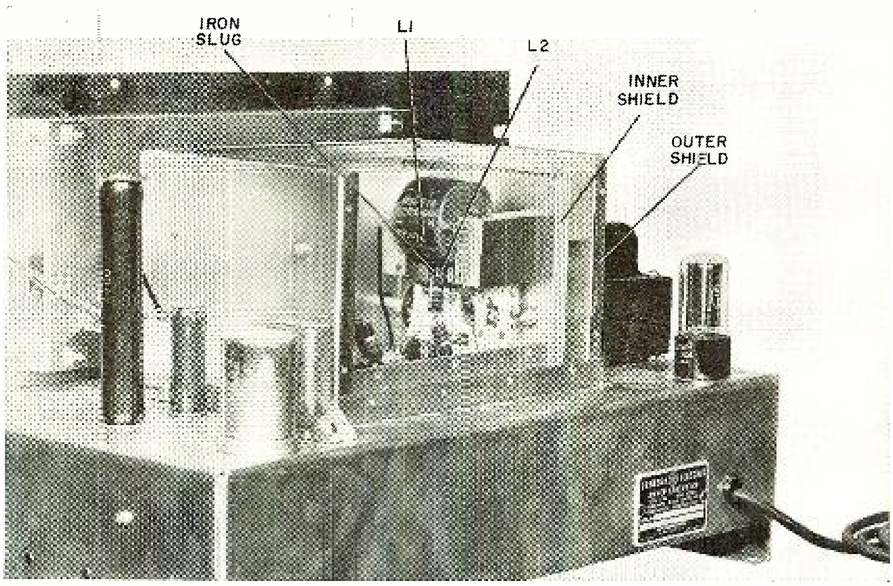
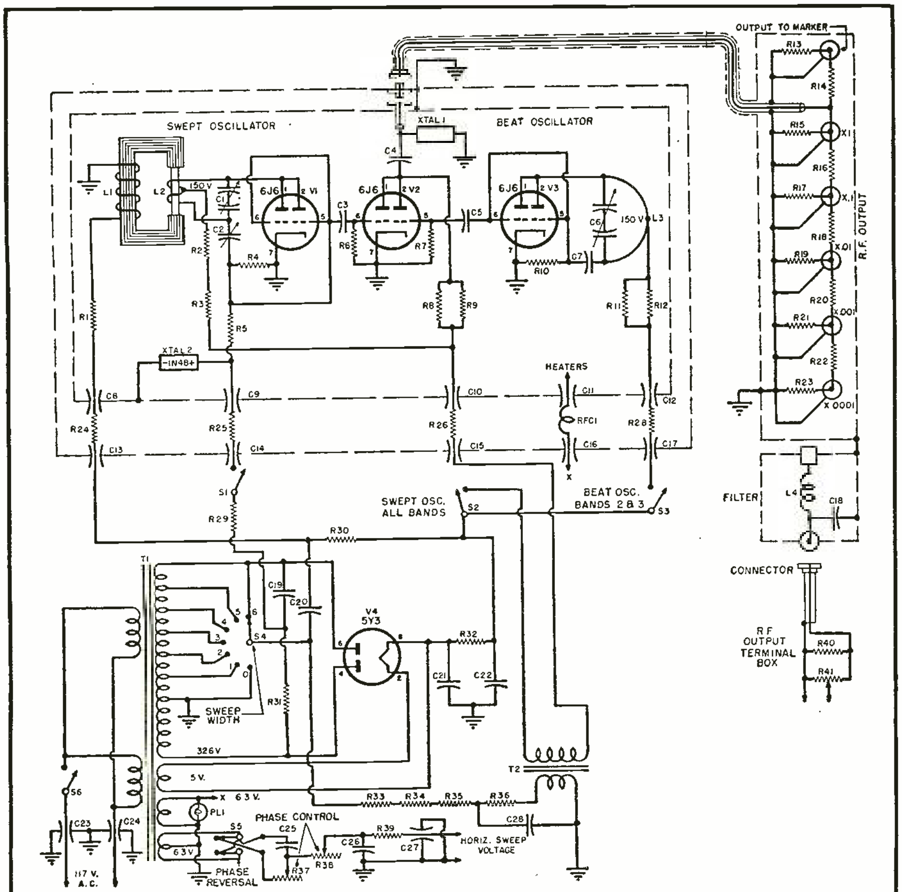


Fig. 4. Variation in oscillator frequency as a result of change in the core flux.

One of the most important characteristics of a good sweep generator is

Fig. 5. Rear view of generator. The frequency sweep unit is shown inside the shield.



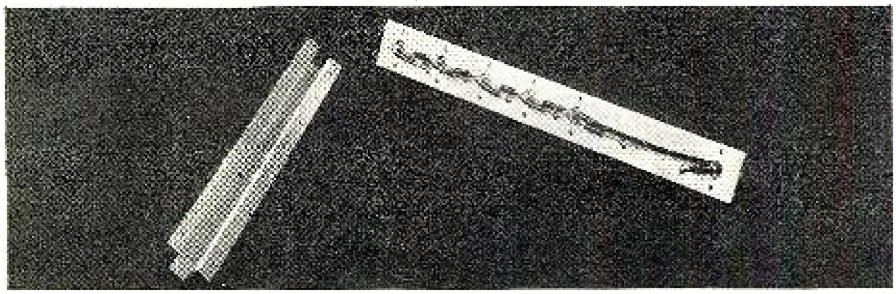


R_1—120 ohm, 1 w. res.
R_2, R_3—1200 ohm, 1/2 w. res.
R_4—2200 ohm, 1/2 w. res.
R_5, R_{25}, R_{33}, R_{34}, R_{35}—6800 ohm, 1/2 w. res.
R_6, R_7—100,000 ohm, 1/2 w. res.
R_8, R_9—12,000 ohm, 1/2 w. res.
R_{10}—4700 ohm, 1/2 w. res.
R_{11}, R_{12}—5600 ohm, 1/2 w. res.
R_{13}, R_{23}—100 ohm, 1/2 w. res.
R_{14}, R_{16}—430 ohm, 1/2 w. res.
R_{15}, R_{17}, R_{19}, R_{21}, R_{24}—120 ohm, 1/2 w. res.
R_{18}, R_{20}, R_{22}—910 ohm, 1/2 w. res.
R_{26}, R_{28}—1000 ohm, 1/2 w. res.
R_{29}—8200 ohm, 1/2 w. res.
R_{30}—4000 ohm, 1 w. res.
R_{31}—330,000 ohm, 1/2 w. res.
R_{32}—3000 ohm, 10 w. res.
R_{36}—1500 ohm, 1 w. res.
R_{37}, R_{38}—100.000 ohm pot.
R_{39}—220,000 ohm, 1/2 w. res.
R_{40}—180 ohm, 1/2 w. res.
R_{41}—200 ohm carbon pot.
C_1, C_6—Special tuning cond.
C_2—5-20 μμfd. trimmer cond.
C_3, C_5—56 μμfd. ceramic cond.
C_4—500 μμfd. mica cond.
C_7, C_{18}—20 μμfd. ceramic cond.
C_8, C_9, C_{10}, C_{11}, C_{12}, C_{13}, C_{14}, C_{15}, C_{16}, C_{17}—500 μμfd. feedthrough mica cond.
C_{19}—.1 μfd., 400 v. cond.
C_{20}, C_{28}—1 μfd., 400 v. cond.
C_{21}—10 μfd., 450 v. elec. cond.
C_{22}—30 μfd., 450 v. elec. cond.
C_{23}, C_{24}, C_{27}—.01 μfd., 400 v. feedthrough cond.
C_{25}—.25 μfd., 200 v. cond.
C_{26}—.01 μfd., 200 v. cond.
L_1, L_2—Special swept oscillator assembly
L_3—Beat osc. tank circuit coil
L_4—Attenuator filter coil
$Xtal_1$—Special GE type G6 crystal diode
$Xtal_2$—1N48 crystal diode
S_1, S_2, S_3, S_6—S.p.s.t. toggle sw.
S_4—S.p. 6-pos. rotary sw.
S_5—D.p.d.t. toggle sw.
T_1—Plate and sweep width supply trans.
T_2—Modulation trans.
RFC_1—R.f. choke, (Ohmite Z1)

Fig. 6. Schematic diagram of the sweep generator. Complete shielding is incorporated.

that the output remain constant while it is being swept across a band of frequencies. As might well be imagined the "Q" of the oscillator tuned circuit varies as the iron slug is saturated. This results in a variation of output of about 20% which is far too much for a laboratory quality instrument. Fortunately, this variation is about as linear with the current through the choke as is the frequency shift. This makes it practical to plate modulate by an approximately equal amount in the opposite direction. This is accomplished by inserting a modulation transformer in the "B plus" lead to the swept oscillator and modulating it with a little of the same voltage that causes the sweep.

Fig. 7. Step attenuator. Capacity coupling, encountered when switches are used, is avoided.



Attenuator

In line with the constant output requirement it becomes absolutely necessary that there be no tuned circuits accidentally built into the unit which might cause resonant rises or take up some of the desired energy and cause the output to fall off for certain frequencies. This was taken into consideration in the design of the step attenuator by making all the leads as short as possible and inclosing the whole unit in a close fitting shield. The resistors were all strung out in a long line in order that capacitive and inductive coupling would be minimized as much as possible. Fig. 7 shows the construction and clearly illustrates the close fitting channel shaped shield. A rotary switch to replace the plug and jack arrangement would be very handy but the problem of decoupling one step from the next is difficult and expensive to solve.

A vernier attenuator was also desired, but whenever a potentiometer was placed anywhere in the circuit between the mixer and the step attenuator it caused the output to vary with frequency. It was found, however, that a low ohmage potentiometer could be placed at the end of the cable without causing any trouble provided that it matched the cable. While the vernier attenuator was put in the output box for a good electrical reason, it has since been found that it is in about the most convenient place possible as well.

Fig. 8 shows the output cable and the vernier attenuator just described along with a filter which will be mentioned later.

Leakage

If a signal generator, whether it be a sweep or not, cannot be cut down in output to match the weakest signal to be received it cannot do an adequate job of alignment. To meet this requirement it was necessary to resort to complete double shielding of the two oscillators, the mixer, and the lead which goes to the attenuator. Fig. 5 shows the double shields with the covers removed. All incoming leads were filtered between the shield cans and again inside the inner can to minimize leakage. Both condensers and one resistor of such a filter are shown in Fig. 9 and will be found on the schematic with the same symbol numbers. The two shields were connected together and grounded at only one point—where the output lead goes through. Fig. 9 illustrates the final solution of this problem. Note the double shielded cable passing over V_1 to the attenuator strip.

Power Supply

The power supply, to meet all requirements of this sweep design, is somewhat more complicated than one

(*Continued on page* 94)

A Supermodulated PHONE TRANSMITTER

By RUFUS P. TURNER, K6AI
and
JOHN W. GRAVES, W6MYR

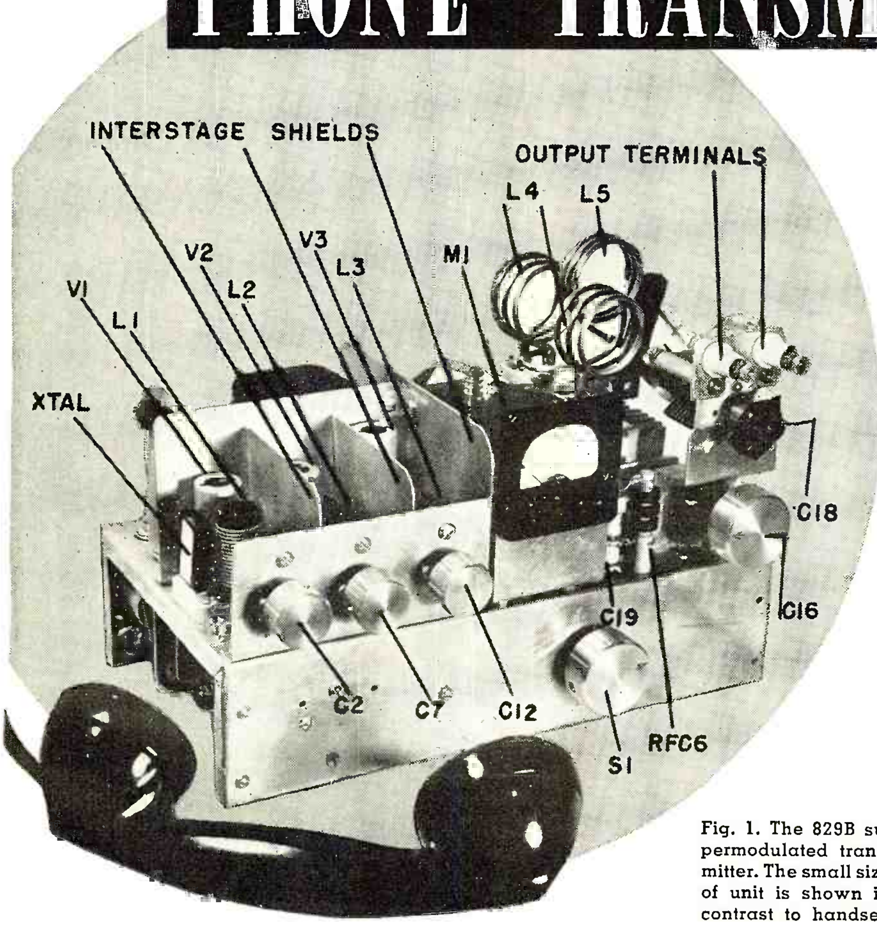


Fig. 1. The 829B supermodulated transmitter. The small size of unit is shown in contrast to handset.

Constructional data on a small transmitter which uses the Taylor modulation system and is capable of handling as high as 90 watts of power input.

THE Taylor system of supermodulation has been a constant attention attractor during the past year. Hams who have supermodulated rigs on the air have been peppered with questions regarding technical details of the circuit and method of adjustment. Receiving operators are intrigued by the characteristic audio punch of the signal, noticed even when the carrier seems weak. Authors of articles on the subject have been kept busy answering letters.

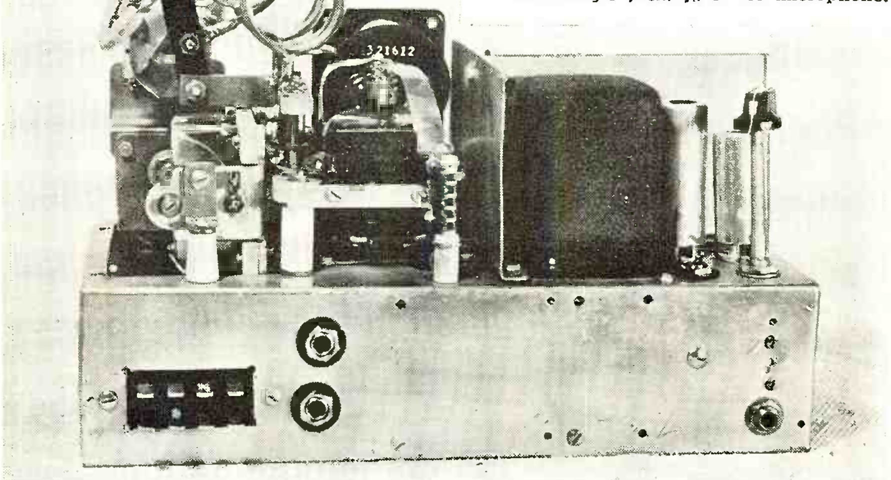
Considerable interest has been expressed in the use of supermodulation in mobile transmitters and especially in the design of a small transmitter which might be used interchangeably as a mobile rig or home unit. This article describes a transmitter which should satisfy the present demand. It is an inexpensive and compact unit.

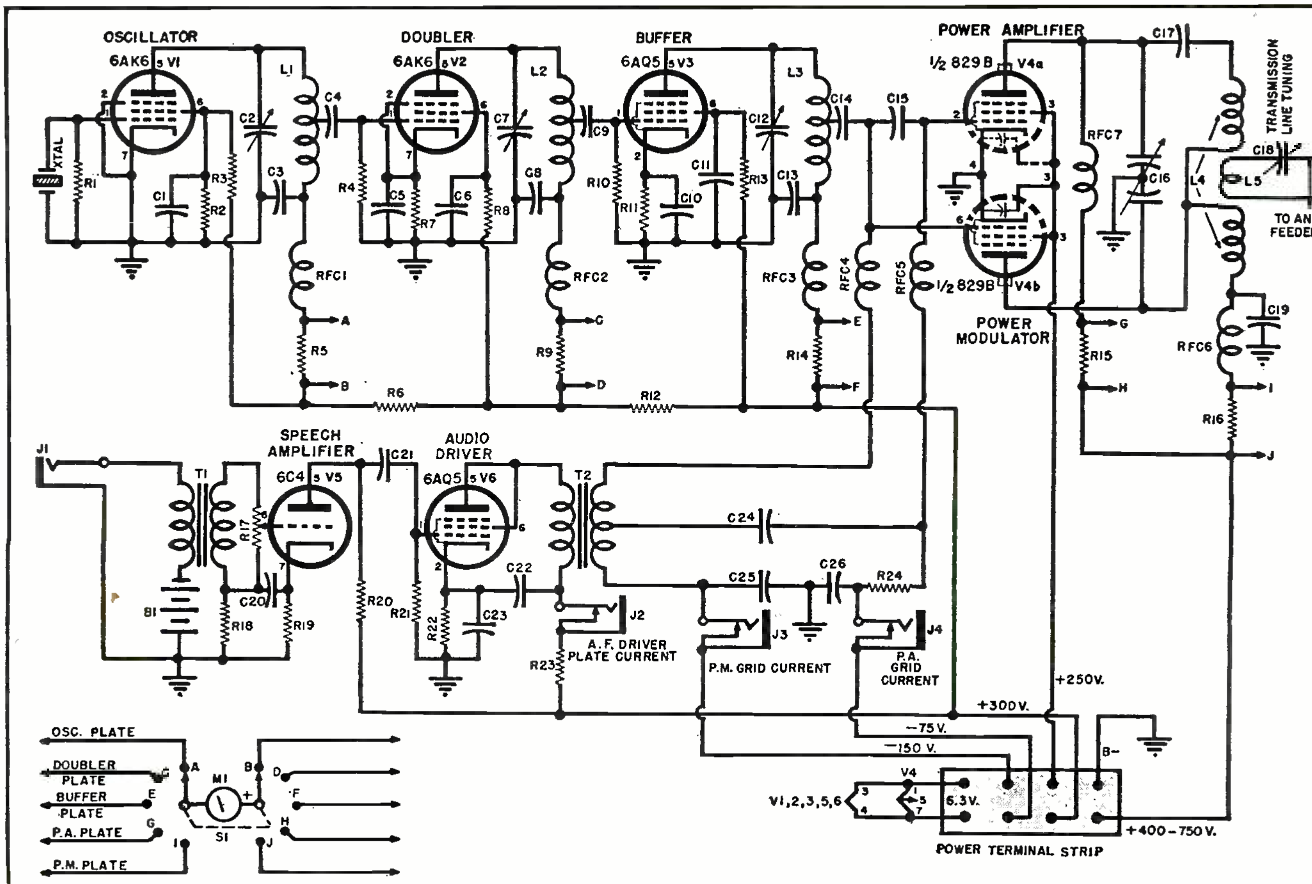
The transmitter shown here uses an 829B tube in the final amplifier, one half serving as the power amplifier and the other as the positive modulator. All "supporting" stages, down to the speech amplifier and crystal oscillator, are self-contained. With the exception of the 829B, miniature tubes are used throughout. This transmitter has been developed especially for interchangeable mobile and home use and is the prototype of the forthcoming *Taylor* Model 100A. It is capable of 40 watts input at 500 volts on the 829B plates, and approximately 75 watts input at 750 plate volts. The input power has been increased safely to better than 90 watts.

The stage lineup is: 6AK6 20-meter crystal oscillator, 6AK6 10-meter doubler, 6AQ5 10-meter buffer-driver, 829B combination power amplifier and positive modulator, 6C4 speech amplifier, and 6AQ5 audio driver. A straight-through 10-meter buffer is used, since experimental data has shown that this type of driver gives better supermodulation efficiency and stability than a doubler. The number of stages was minimized by employing a 20-meter oscillator. However, 40-meter crystals can be used if the builder is willing to add a 20-meter doubler to the stage lineup.

The complete circuit schematic is given in Fig. 3. Up to the output of

Fig. 2. Rear chassis view of unit. The power terminal plug is seen on the left. The two vertically mounted jacks are J_4 and J_3 for PA and PM grid current indication. Single jack, J_1, is for microphone.





R_1—100,000 ohm, ½ w. res.
R_2—20,000 ohm, 1 w. res.
R_3, R_8, R_{13}—27,000 ohm, 1 w. res.
R_4, R_{10}, R_{18}—100,000 ohm, 1 w. res.
R_5, R_9, R_{14}, R_{15}, R_{16}—Meter shunt (See text)
R_6, R_{12}—5000 ohm, 5 w. wirewound res.
R_7—470 ohm, 1 w. res.
R_{11}, R_{19}—1000 ohm, 1 w. res.
R_{17}—500,000 ohm pot.
R_{20}—50,000 ohm, 1 w. res.
R_{21}—250,000 ohm, 1 w. res.
R_{22}—470 ohm, 2 w. res.
R_{23}—1000 ohm, 5 w. wirewound res.
R_{24}—27,000 ohm, 2 w. res.
C_1, C_6, C_{10}, C_{11}, C_{21}—.01 μfd. mica cond.
C_2, C_7, C_{12}—50 μμfd. midget var. cond.
C_3, C_8, C_{13}—.002 μfd. mica cond.
C_4, C_{15}—100 μμfd. mica cond.
C_5—.05 μfd., 200 v. oil-filled cond.
C_9, C_{14}—250 μμfd. mica cond.
C_{16}—Dual tuning cond. 35 μμfd. per sec. Spacing .085" (National TMH-35D)
C_{17}, C_{19}—.002 μfd., 1000 v. mica cond.
C_{18}—50 μμfd. double-spaced midget var. cond.
C_{20}—25 μfd., 25 v. elec. cond.
C_{22}—.5 μfd., 600 v. oil-filled cond.
C_{23}—10 μfd., 50 v. elec. cond.
C_{24}—.5 μfd., 400 v. oil-filled cond.
C_{25}, C_{26}—.1 μfd., 400 v. oil-filled cond.
L_1, L_2, L_3, L_4, L_5—See Table 1
B_1—1½ to 3 volt pen-size flashlight cell
J_1—Midget open circuit jack
J_2, J_3, J_4—Midget insulated closed circuit jack
M_1—D.c. milliammeter (See text)
RFC_1, RFC_2, RFC_3, RFC_4, RFC_5, RFC_6—2½ mhy., 125 ma. pi-wound r.f. choke
RFC_7—1 mhy., 300 ma. pi-wound r.f. choke
S_1—D.p. 5-pos., non-shorting rotary sel. sw.
T_1—Mic. trans., 200 ohms to single grid
T_2—Special supermodulation trans. (Taylor TSM-75 Gaertner Company, 3612 S. Maple St., Los Angeles, California)
Xtal.—20 meter crystal
V_1, V_2—6AK6 tube
V_3, V_6—6AQ5 tube
V_4—829B tube
V_5—6C4 tube

Fig. 3. Complete circuit diagram and parts list covering the 829B supermodulated transmitter.

the buffer stage, this arrangement is an entirely conventional capacitance-coupled exciter with separately-tuned tanks. The r. f. output from the buffer passes through the two coupling condensers, C_{14} and C_{15} in series, which together form a radio-frequency voltage divider. This divider maintains the proper ratio between r. f. grid voltages presented to the PA and PM sections of the 829B.

Audio voltages are presented to the final amplifier by the secondary winding of the special coupling transformer T_2, condenser network C_{24}-C_{25}-C_{26}, and resistor R_{24}. Audio voltage at the center tap of the T_2 secondary is equal to one-half the voltage across the entire secondary winding.

The microphone input is intended for a Type F-1 single-button handset-type carbon microphone (See Fig. 1). However, any other single-button unit may be used. Excellent quality reports have been received when the F-1 unit has been employed. The 6C4 speech amplifier is a conventional stage with transformer input and resistance-capacitance output. The 6AQ5 audio driver tube is triode connected (screen tied to plate) to insure good audio output regulation and to provide about 1 watt of audio which is adequate for full modulation.

A swinging link, L_5, provides variable antenna coupling. This feature plus the antenna tuning condenser, C_{18}, both are essential to peak performance of the supermodulation circuit. C_{18} must be included in the circuit regardless of the impedance of the feeder cable employed.

A self-contained d.c. milliammeter, M_1, is switched successively across shunt resistors R_5, R_9, R_{14}, R_{15}, and R_{16} to read plate currents in the oscillator, doubler, buffer, power amplifier, and power modulator respectively. In addition, jack J_3 is provided for plugging-in a low-range d.c. milliammeter to read PM grid current, and J_4 for PA grid current. Jack J_2 permits occasional checking of audio driver plate current. All three of these jacks may be dispensed with, since none is essential to tune-up operations.

The shunt resistor values must be selected to give the milliammeter a range of 0-100 ma. when reading oscillator, doubler, buffer, and PA plate currents, and 0-200 ma. when reading PM plate current. A 10-milliampere meter was used in the rig shown for the sole reason that it was immediately available. However, most builders will prefer to use the popular 0-1 ma. instrument. For the latter meter (with an internal movement resistance of 105 ohms), the shunts must have the following values: R_5, R_9, R_{14}, and R_{15} each 1.06 ohms (1 ohm will be close enough). R_{16} must be 0.527 ohm. The first four shunts may be made by winding the proper length of resistance wire on a ¼-inch diameter bakelite rod, or on the body of a burned-out carbon resistor. The last one (R_{16}) can consist of a small loop of resistance wire fastened to the two-terminal strip.

A 4-pair rear terminal strip receives the plug and cable from an external power supply. Two values of plate voltage (750 or 500, and 300), one value of screen voltage (250), two values of grid bias voltage (—75 and —150 for 75 watts input) and (—50 and —75 for 40 watts input), and 6.3 volt tube heater voltage must be supplied, as indicated on the appropriate terminal strip connections in Fig. 3. The plate and screen voltages may be derived from a single high-voltage power supply through a voltage divider. However, some means must be provided for reducing the final amplifier plate voltage during tune-up operations. This is very essential, since it is difficult to adjust the final amplifier properly while employing high plate voltage.

An important point in the transmitter design is the matter of placing the excitation taps on coils L_1, L_2, and L_3. Note from Table 1 that these taps are taken near the *bottom* end of each coil. This is essential to proper impedance matching between one plate and the succeeding grid.

Construction

Mechanical arrangement of the transmitter may be noted from the photographs (Figs. 1, 2, 4, and 5) and from Fig. 1 which identifies the components.

The reader will notice the extensive use of interstage shields both on top of the chassis (See Figs. 1, 2, and 4) and below chassis (See Fig. 5). It is imperative to shield each of the exciter stages separately, as shown, and to shield the audio section from the exciter and final amplifier. Each tube in the exciter and audio sections has its own shield can.

A common ground is a must! Do not merely run the low end of a component to the chassis as a ground point, but make *all* returns in each stage to the *same* single point. Bond all of the separate stage-ground points together with a length of heavy bus wire. This is especially important in the 829B stage where multiple grounds are very apt to rob the transmitter almost completely of efficient super-modulation action.

The transmitter as shown is built on a metal chassis 11¼″ long, 2¾″ high, and 6″ deep. This makes a compact assembly but the reader may deviate from these dimensions if necessary. To complete the shielding, a metal base is fastened to the bottom of the chassis, and the entire unit may be slipped into a metal case.

Power Supply

The power supply must furnish 500 or 750 volts d. c. at 100 milliamperes full load, 300 volts d. c. at 30 ma., and 250 volts d. c. at 15 ma. The latter two voltages may be obtained from taps on a voltage divider. Additionally, two separate bias voltages (—75 and —150 for 75 watts input and —50 and —75 for 40 watts input), will be required. These may be obtained in the field conveniently from the nearest battery values, but at the home location probably will best be derived from an a.c.-operated bias supply.

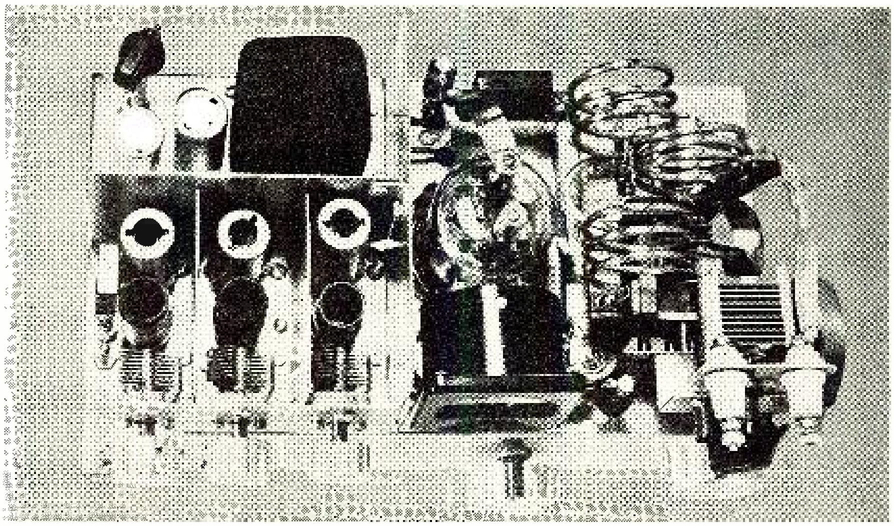


Fig. 4. Top view of the transmitter showing the correct layout of parts. The oscillator, doubler, and buffer stages are shown at the left-front portion of the chassis. The audio section is immediately to the rear. The 829 stage occupies the entire right hand portion of the chassis. Note the adequate interstage shielding employed throughout.

6.3 volts a. c. or d. c. will be required for the tube heaters which draw a total of 3.6 amperes. For complete tube protection, the power supply should be arranged so that the bias voltages are applied automatically as soon as the heater voltage is switched on. The 829B screen voltage must never be applied ahead of the plate voltage.

Tuning Up

For best results, the following tuning operations must be followed closely.

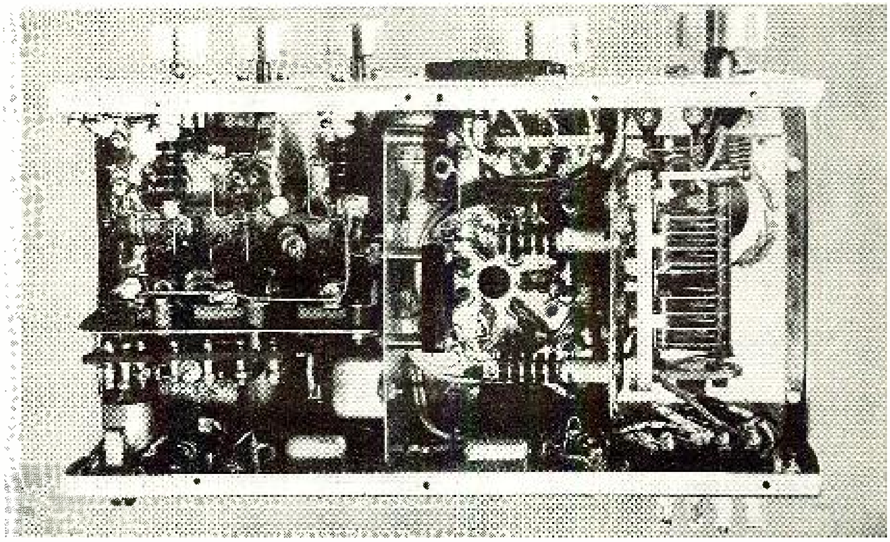
1. Tune-up at a plate voltage not in excess of 500 v. to the 829B.
2. Swing the coupling coil (L_5) completely out of coil L_4.
3. Unplug the microphone and turn the audio gain control, R_{17}, to its *"off"* position.
4. (a) Switch the milliammeter, M_1, to the oscillator stage and tune C_2 for plate current dip. Then, for maximum

(*Continued on page* 104)

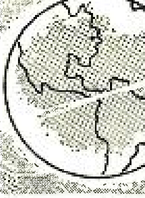
L_1 (Osc.)	16 t. No. 18 en. on ¾″ diam. form. Space to winding length of 1⅛″. Tap 4th t. from "B-plus" end.
L_2 (Doubler)	7 t. No. 18 en. on ¾″ diam. form. Space to winding length of 1″. Tap 2nd t. from "B-plus" end.
L_3 (Buffer)	5 t. No. 18 en. on ¾″ diam. form. Space to winding length of ⅝″. Tap 2nd t. from "B-plus" end.
L_4 (Final)	Each half consists of 3 t. of ⅛″ copper tubing airwound 1½″ in diam., each in the same direction. Space each half to winding length of 1″. Spacing between halves 1¼″. Junction of inside ends of the two halves forms center tap.
L_5 (Ant. Coup.)	(Swinging Link) 3 t. ⅛″ copper tubing airwound 1½″ in diam. and spaced to winding length of ½″. This coil is hinged so as to be swung between the halves of L_4 for var. antenna coupling.

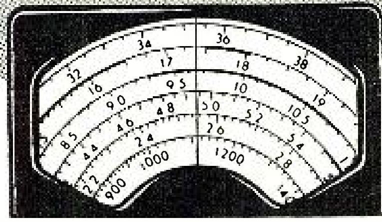
Table 1. Coil winding data for L_1 through L_5.

Fig. 5. Under chassis view of the transmitter. Note the use of baffle shields below the chassis as well as on top (Figs. 1 and 4). Rectangular cutout clears tuning condenser, C_{16}.



International SHORT-WAVE





***Compiled by* KENNETH R. BOORD**

T IS a pleasure this month to dedicate the *ISW DEPARTMENT* to s.w. radio outlets in Brazil. The following current data on Brazil stations comes direct from Flavio Serrano, an *ISW DEPARTMENT* monitor in Rio de Janeiro:

The Tropical Band—4.785, ZYM6, Radio Ribamar, Sao Luiz, Maranhao, 0.5 kw.; 4.805, ZYS8, R. Difusora do Amazonas, Manaus, Amazonas, 5 kw.; 4.825, ZYE7, R. Educadora de Parnaiba, Parnaiba, Piaui, 0.5 kw.; 4.845, ZYU8, R. Difusora de Teresina, Teresina, Piaui, 0.5 kw.; 4.865, PRC5, Radio Clube do Para, Belem, Para, 2 kw.; 4.895, PRF6, Radio Bare, Manaus, Amazonas, 2.5 kw.

The 49 Meter Band—6.000, PRK5, R. Inconfidencia, Belo Horizonte, Minas Gerais, 5 kw.; 6.015, PRA8, R. Clube de Pernambuco, Recife, Pernambuco, 25 kw.; 6.085, ZYK2, R. Jornal do Commercio, Recife, Pernambuco, 16 kw.; 6.095, ZYB7,, R. Difusora Sao Paulo, Sao Paulo, Sao Paulo, 25 kw.; 6.105, R. Nacional, Rio de Janeiro, Distrito Federal, 50 kw.

The 31 Meter Band—9.500, PRL7, R. Nacional, Rio de Janeiro, Distrito Federal, 50 kw.; 9.505, PRL7, R. Nacional, Rio de Janeiro, Distrito Federal, 50 kw.; 9.565, ZYK3, R. Jornal do Commercio Recife, Pernambuco, 16 kw.; 9.61, ZYC8, R. Tamoio, Rio de Janeiro, Distrito Federal, 25 kw.; 9.77, PRL4, Ministerio da Educacao e Saude, Rio de Janeiro, Distrito Federal, 1 kw.

The 25 Meter Band—11.72, PRL8, R. Nacional, Rio de Janeiro, Distrito Federal, 50 kw.; 11.765, ZYB8, R. Difusora Sao Paulo, Sao Paulo, Sao Paulo, 25 kw.; 11.825, ZYK3, R. Jornal do Commercio, Recife, Parnambuco, 16 kw.; 11.95, PRL5, Ministerio da Educacao e Saude, Rio de Janeiro, Distrito Federal, 1 kw.

The 19 Meter Band—15.145, ZYK2, R. Jornal do Commercio, Recife, Pernambuco, 16 kw.; 15.155, ZYB9, R. Difusora Sao Paulo, Sao Paulo, Sao Paulo, 25 kw.; 15.165, ZYN7, Ceara Radio Clube, Fortaleza, Ceara, 10 kw.; 15.19, PRK9, R. Inconfidencia, Belo Horizonte, Minas Gerais, 5 kw.; 15.37, ZYC9, R. Tamoio, Rio de Janeiro, Distrito Federal, 25 kw.

The 16 Meter Band—17.85, PRL9, R. Nacional, Rio de Janeiro, Distrito Federal, 50 kw.

Construction Permits—For *Tropical Band*—Radio Poti, Natal, Rio Grande do Norte; Radio Brasil, Campinas, Sao Paulo, 1 kw. day, and 0.5 kw. night; R. Industrial de Juiz de Fora, Juiz de Fora, Minas Gerais, 0.5 kw.; R. Brasil Central, Goiania, Goias, 1 kw.; R. Quitandinha, Petropolis, Rio de Janeiro; R. A. Voz de Oeste, Cuiaba, Mato Grosso, 0.5 kw.; Government of the Territory of Guapore, Porto Velho, Guapore, 0.5 kw.; R. Relogio Federal, Rio de Janeiro, Distrito Federal. For *Short-Wave Band*—Radio Guaiba, Porto Alegre, Rio Grande do Sul.

Further comments by Mr. Serrano include—ZYE7, 4.825, has m.w. station on 1470 kc., call PRJ4, 500 w.; ZYU8, 4.845, has m.w. station on 1410 kc., call ZYQ3, 1 kw.; PRC5, 4.865, has m.w. station on 1450 kc., call PRC5, also, 500 w.; PRK5, 6.000, has m.w. station on 880 kc., call PRI3, 22 kw., to be increased to 50 kw.; PRA8, 6.015, noted on 6.016, has m.w. station 720 kc., call PRA8 also, 50 kw.; ZYK2, 6.085, effective radiated power is 64 kw., has m.w. outlet on 780 kc., 20 kw. day, and 10 kw. night, also FM stations (4); ZYB7, 6.095, has m.w. outlet on 960 kc., 5 kw., call PRF3, also FM station with call PRF3-FM; ZYN6, 6.105, has m.w. outlet on 1200 kc., 10 kw., call PRE9; PRL9, 6.147, has m.w. outlet on 980 kc., 50 kw., call PRE8, also on FM; PRL7, 9.50, 9.505, 9.72, see PRL9, 6.147; ZYK3, 9.565, see ZYK2, 6.085; ZYC8, 9.61, has m.w. outlet on 900 kc., 5 kw., call PRB7; PRL4, 9.77, has m.w. outlet on 800 kc., 25 kw., call PRA2 (power on m.w. to be increased to 50 kw.; will have new s.w. transmitter of 7.5 kw. soon), this channel is inactive, station now radiates on 11.95; PRL8, 11.72, see PRL9, 6.147; ZYB8, 11.765, now inactive on this channel, owned by Radio Difusora Sao Paulo, but transmits programs from Radio Tupi, Sao Paulo, which has m.w. outlet on 1040 kc., call PRG2, 50 kw.; ZYK3, 11.825, see ZYK2, 6.085, as this channel is inactive; PRL5, 11.95, see PRL4, 9.77; ZYK2, 15.145, see ZYK2, 6.085; ZYB9, 15.155, noted on 15.156, transmits Radio Difusora Sao Paulo and Radio Tupi programs, also see ZYB7 and ZYB8; PRK9, 15.19, inactive, see PRK5, 6.000; ZYC9, 15.37, is owned by Radio Tamoio but is operated by Radio Tupi, Rio de Janeiro, which has m.w. outlet on 1280 kc., PRG3, 50 kw.; PRL9, 17.85, inactive now, but is expected to be in use again soon see PRL9, 6.147.

The sound effects department in action during a radio theater transmission at Radio Nacional in Rio de Janeiro, Brazil.

PRN9, Distrito Federal Police Dept., 9.29, 5 kw., has daily transmission in Portuguese from 1700; lasts 30 minutes to two hours; programs consist of principal events and news of the Police Department; station maintains correspondence with overseas listeners; QRA is Departamento Federal de Saguranca Publica, Estacao de Radio, Rua da Relacao 55, Rio de Janeiro, Brazil.

Flashes just received from both Mr. Serrano and Hans Leven (of Sao Paulo) state that *Radio Record*, Sao Paulo, has just taken to the shortwaves—heard testing around 0600-2100 on 9.590 or 9.595; using m.w. call PRB9, which m.w. outlet, on 1000 kc., is one of the four m.w. stations in Brazil with 50 kw. power; QRA is Radio Record, Rua Quintino Bocaiuva 22, Sao Paulo, Brazil. Mr. Leven reports as *new*, Radio Difusora de Teresina, Teresina, State of Piaui, with call ZYU8, on (announced) 4.845 in parallel with m.w. ZYQ3 on 1370 kc. (m.w. outlet listed 1410 kc. by Mr. Serrano); heard with good signal to sign-off around 2000.

Mr. Leven says PRL5, 11.95, is scheduled weekdays 0400-1000, 1400-2030; Sunday 0700-2030; power 1 kw.

(*Continued on page* 126)

(Note: Unless otherwise indicated, all time is expressed in American EST; add 5 hours for GCT. "News" refers to newscasts in the English language. In order to avoid confusion, the 24 hour clock has been used in designating the times of broadcasts. The hours from midnight until noon are shown as 0000 to 1200 while from 1 p.m. to midnight are shown as 1300 to 2400.) The symbol "V" following a listed frequency indicates "varying." The station may operate either above or below the frequency given.

A HIGH EFFICIENCY TRIODE AMPLIFIER

By
MELVIN C. SPRINKLE
Peerless Electrical Products Div.
Altec Lansing Corporation

Fig. 1. Peerless amplifier which is available in either the kit (10722) or completely assembled form (A-100A).

Design details of a versatile audio amplifier incorporating a preamp and adjustable equalizing network for magnetic pickups.

THE legion of audio enthusiasts who have stuck by their triode amplifiers through thick and thin have been a hardy lot. They have been assailed by the beam power camp and have been deserted by commercial amplifier engineers, but through it all have held the bridge like Horatius. Through all the controversy they have always maintained that "triodes sound better."

The Achilles' heel in their argument, however, has been the inefficiency of triodes. In spite of all the subjective arguments the fact remained that up to the present time triode quality was costly. In order to realize the full benefits of triodes it was necessary to operate with fixed bias—this meant either a higher voltage power supply with higher voltage condensers or a separate bias supply. Furthermore, because of the high bias required, transformer coupling into the final stage was necessary. Resistance coupled amplifier stages just don't put out high quality signals with enough amplitude to drive triodes. Both triode power supplies and/or transformer coupling are expensive.

On the theoretical side, triodes have had at least a strike and a half on them. Assuming proper power supply for both plate and bias, and good transformers, Terman states that the maximum theoretical efficiency of a Class A amplifier is 50%, and that practical amplifiers have efficiencies from 35% down to 20%. This meant that in order to get an output of 10 watts (developed plate-to-plate—not necessarily in the load) it was necessary to put 28.6 watts into a pair of tubes, and if the efficiency was of the order of 20% the input power had to be 50 watts. No wonder that triodes were limited to low output power! As a matter of fact the heads of many designers were scratched in the search for a high plate dissipation triode without going into the expensive transmitting tubes. The development of Class AB operation was a partial solution as the efficiencies were raised. Terman gives efficiencies of 40% to 50% for this operation, but the tube manual in its typical operation data for 2A3 tubes says that the efficiency is 34.1% when the tubes are operated with fixed bias.

Class AB_1 operation of triodes has become accepted by audio enthusiasts who require high quality, but they have been in general very dubious about Class AB_2. Up to the present time there has been some justification for their doubts. Recently, however, with the general availability of high quality transformers, operation of tubes up to, and possibly into, grid current becomes possible, with *no* more distortion than strict Class A operation, and with a prodigious increase in efficiency.

Recently the writer has become interested in a circuit which makes possible 18.6 watts output from a pair of 6A5 tubes at a distortion of 5% total harmonics! This represents an efficiency of 49.3%, a truly remarkable achievement. The amazing performance is made possible by two factors: (1) A good output transformer and (2) use of a cathode follower driver.

The output transformer is the heart of an amplifier. Almost invariably the output transformer is the only audio transformer used, the other stages, with the possible exception of an occasional input transformer, being resistance-capacity coupled. The techniques for building wide range resistance coupled stages are well known and easily put into practice. If the results are not satisfactory, the builder can easily change values until the desired results are obtained. However, when one buys a transformer he must accept whatever the manufacturer puts into the unit. There are a few things that the user can do, but in general these have minor effects on over-all performance. For example, one cannot alter external circuits to improve efficiency—the ratio between primary power and the power delivered to the load.

It behooves the constructor, therefore, to buy the best possible transformer, considering the following points:

(a) Insertion loss. The useful power output of an amplifier is the power delivered to the load, not the power measured plate-to-plate on the primary side.

(b) Power output over frequency extremes. Vast numbers of amplifiers are built by audio enthusiasts who have absolutely no idea of how many watts their amplifiers deliver at 40 cycles and 10,000 cycles. Their conception of performance is based upon frequency response, which is a gain measurement, not a power measurement. The factors which contribute to power output at frequency extremes are not controllable by the user.

(c) Frequency response. The frequency response of a transformer is a measure of its ability to transmit various frequencies; *i.e.,* it is inherently a gain measurement. As pointed out above, the power output characteristic is often a more important property in output transformers, and it bears no relationship to the frequency response characteristic. On frequency response most manufacturers show response in the audible part of the spectrum, but what is more important is the response at frequencies above and below audibility. This response is of importance because in amplifiers employing inverse feedback, the response must be much broader than the range to be covered if the amplifier is to be stable.

(d) Concomitant with frequency response is phase shift. This is of importance if complex signals are to be transmitted without phase distortion and also if stability with inverse feedback is to be achieved. Phase shift, frequency response, and transient oscillation are most easily checked with square waves.

Most audio enthusiasts are familiar with conventional resistance or transformer coupling to Class A or AB_1 amplifiers. These systems are quite satisfactory within certain limitations, but fail when Class AB_2 operation is approached. The fundamental reason is that when the grid of a tube is driven positive, instantaneously, there is a flow of electrons to the grid, which when they flow through the grid resistor, or even an interstage transformer, produce a voltage which is additive to the tube's bias. The effect is the same as the bias developed in an oscillator's grid leak due to grid current. In the usual Class AB_2 design a special transformer, called a driver transformer, is used, which is a stepdown transformer. In order to supply enough signal with a stepdown turns ratio, and also to supply power to the grids of the final when they draw grid current, it has been necessary to use a power tube as a driver.

Another factor that touches a sore spot in constructors is the cost of a good driver transformer. The cathode follower driver overcomes these limitations. It has been pointed out that a cathode follower is not a voltage amplifier, *i.e.,* the output voltage can approach but not exceed the input signal. However, and this is not as widely known, a cathode follower can be a power amplifier. The power in a resistor is given by the familiar formula $P = E^2/R$. Thus for a constant volt-

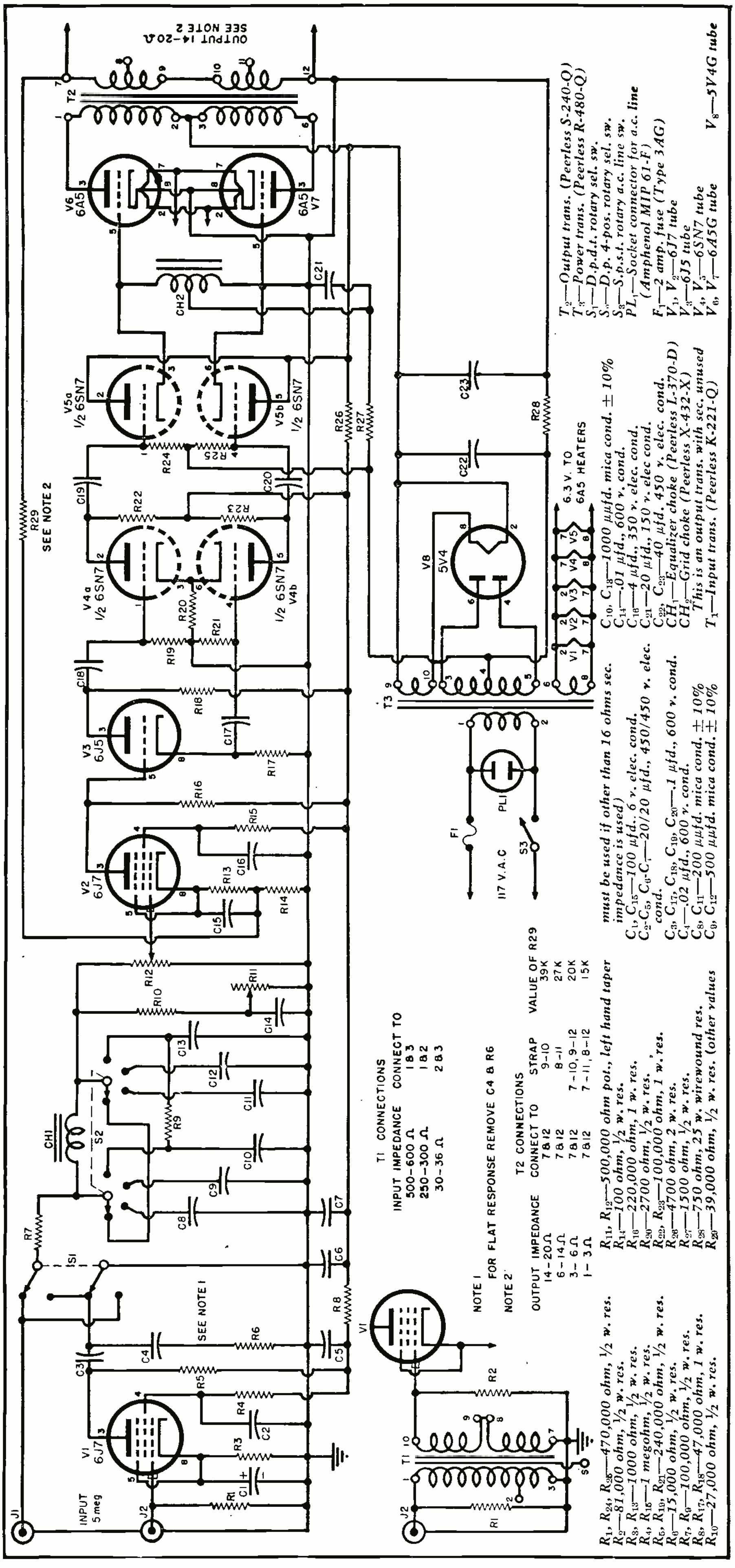


Fig. 2. Diagram of the Peerless 10722 amplifier. Circuit includes a preamplifier for magnetic phono pickups. With the addition of a special input transformer (circuit shown in lower left) the amplifier becomes suitable for use with a 30, 250, or 500 ohm microphone or other low-impedance, low level source. The equalizing network can be removed when used with microphone.

age, the power varies inversely as the resistance. Halving the resistance gives a 3 db. power increase for the same voltage. Thus a cathode follower can take in say 25 volts and in its output develop this same voltage (almost) across a much lower load, and thus give a power gain. By simple circuit manipulation a cathode follower driver stage can be direct-coupled to a final amplifier. It is possible to achieve excellent frequency response by the direct coupling and yet supply all the normal d.c. voltages to both stages. A low grid circuit impedance for both a.c. and d.c. is provided and there is sufficient power in the cathode follower to take care of grid current demands should operation in this region occur. The combination of two equally important factors—a good output transformer and a cathode follower driver—produces a high efficiency, high quality circuit that puts the triode on a more equal basis with beam power tubes.

This high efficiency circuit has been incorporated into a general purpose amplifier, specifically designed for high quality music reproduction, called the *Peerless* A-100A Amplifier.

With the development of this amplifier, the problem of low efficiency in triodes has been largely overcome. The unit has a maximum output of 20.3 watts. It uses two type 6A5 tubes in a newly developed high efficiency circuit which makes practical efficiencies of 49.3%. Moreover, and this is the crux of the matter, this power is *useful secondary power,* the implications of which were considered previously.

The frequency response of the amplifier is flat from 20 c.p.s. to 15,000 c.p.s. and is down only ½ db. at 20,000 c.p.s.—an undetectable amount.

The distortion is remarkably low. Using the familiar 5% harmonic content standard, the power output is 18.6 watts at 100 and 400 c.p.s. At 40 c.p.s. the power output is 14.8 watts and at 5000 c.p.s. the power output is 18.3 watts. Using the intermodulation method with test frequencies of 40 and 2000 c.p.s., the power output at 8% intermodulation is 17 watts.

The schematic diagram is shown in Fig. 2, and it will be seen that the amplifier is entirely straightforward in design. The first stage uses a type 6J7 tube as a voltage amplifier. This stage is used as a preamplifier for the magnetic phono pickups so popular in high quality music systems. The plate circuit contains a series resistor-condenser combination, the values of which are adjusted to give the bass boost required for proper equalization of magnetic pickups. A feature of the amplifier is the fact that a chassis cutout is provided for installation of a *Peerless* K-221-Q 20/20 input transformer. With the transformer installed, the amplifier becomes suitable for use with a 30, 250, or 500 ohm microphone or other low impedance low level source, the equalization network being removed when a microphone is used.

Two inputs are provided, one for phono and the other for radio. A switch, S_1, selects the desired input and grounds the channel not in use to prevent crosstalk. In the phono channel a gain of 107 db. at 1000 cycles is available, which permits full power output from LP records. The radio channel has a gain of 84 db. which is more than adequate for any FM or AM radio tuner.

Following the radio-phono switch, is a four position, pi-type low-pass filter which is intended for record scratch reduction. The filter uses an inductance to give sharp cut-off so that the maximum usable recorded signal can be reproduced, and the higher noise-frequencies eliminated. The circuit must not be confused with resistor-condenser treble roll-off circuits and is quite different in performance. Four positions are provided, the characteristics of which are shown in Fig. 4.

In addition to the low pass filter, there is provided a continuously variable bass boost circuit. A resistor-condenser network is used to provide up to 10 db. of bass boost as shown in Fig. 4. A word of caution might be in order at this time. The bass boost control must be used with discretion, since the transformers provide considerable power at low frequencies.

The second stage uses a type 6J7 tube (V_2), pentode connected to give high gain and very low distortion. A small portion of the cathode resistor is not bypassed as this is used for inverse feedback. The third stage (V_3) is a type 6J5 used in a split load or cathodyne phase inverter circuit. This type of circuit has several advantages among which are almost perfect balance in the output over wide frequency ranges, independence of changes in performance with tube replacement,

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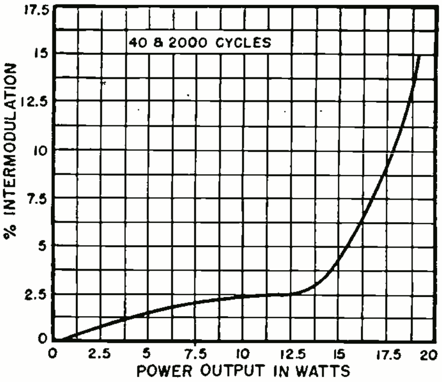

Fig. 3. Power output in watts vs. per-cent intermodulation distortion of amplifier.

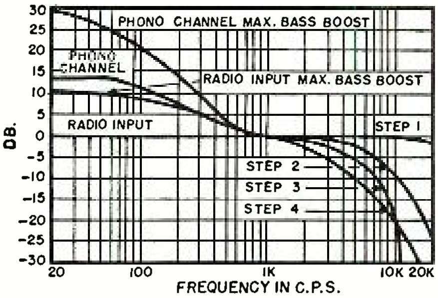

Fig. 4. Amplifier response with low-pass filter and bass-boost circuits operating.

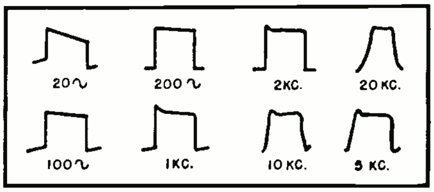

Fig. 5. Square wave patterns at various frequencies throughout amplifier range.

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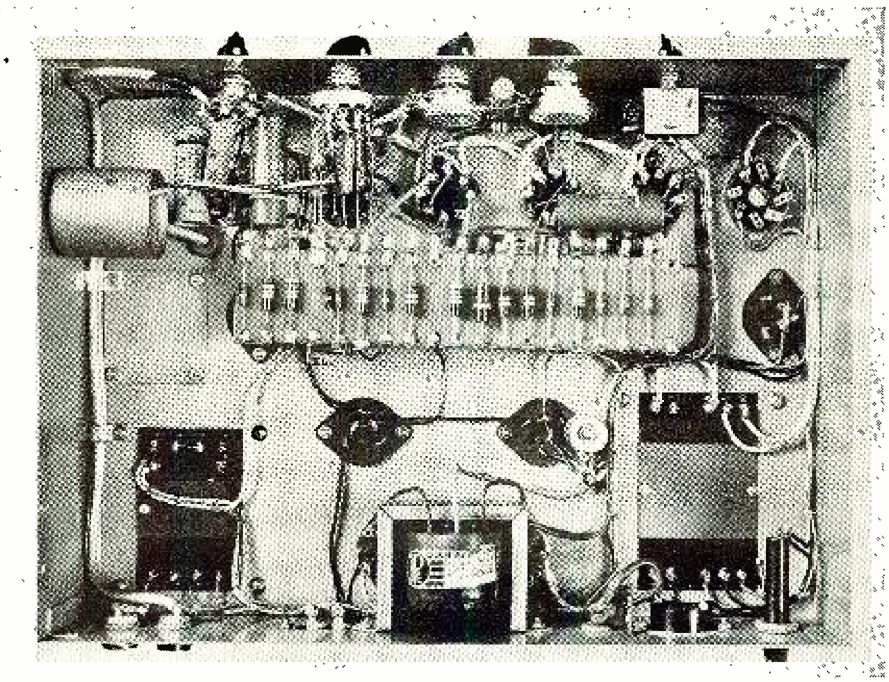
Fig. 6. Under chassis view of the amplifier which may be built from a commercial kit.



Sterling—First "HAM" On FCC

By JACK TERRY

The experience gained in 42 years of radio is now being used to foster all segments of the industry.

WHEN President Truman appointed George Edward Sterling a Commissioner of the Federal Communications Commission, he got not only a top-notch engineer-administrator; he got a radio amateur from Peake's Island, Maine. Sterling is the first and only ham to reach the bench of the FCC.

In 1908, at the age 14, young Sterling became interested in wireless. He talked his chums, Ray Hutchins and Al Ranger, into joining him in this fascinating scientific endeavor. The trio are well remembered by their teachers. One professor recalls, "they were smart as mustard—curious—particularly that George Sterling, but they didn't have the time to study ordinary academic things. Wireless was all that interested them and they would stay up all night combing the air waves with their home-made sets."

One of the trio reported: "We made almost everything we used. We had to buy our headphones though, and had a tough time getting the money. The local druggist, who also operated the Western Union office, helped us make wet batteries using salvaged carbon poles and zinc from old dry batteries. We made our spark gap out of an old copper lightning rod. That spark gap used to get so hot we were always worried about fire. Our spark transformer was wound by hand."

Reminiscing about those days, Sterling says, "When we started transmitting in 1908 we used the self-assigned call 'GS.' In those days we used a half inch spark coil in the transmitter.

"In 1912 the government licensed me as 1AE. Progress came in the form of a galena detector. And when we finally rigged up a variable coupler, the ultimate was in our grasp. The antenna was a big 4 wire flat-top hung between a couple of 65 foot poles out of the woods.

"The *Titanic* disaster was a first-hand thing to us. Advertised as an unsinkable ship, she rammed an iceberg on her maiden voyage on 1912 with the loss of over 1500 souls. We helped all we could with our wireless. We copied all the traffic—the pitifully small survivor list was an unforgettable event!"

In 1916 young Sterling went to sea as a pioneer radio operator. This career ended abruptly when the United States declared war on Germany. April, 1917, found his ship returning from South America. On arrival in New York, Sterling found orders to duty with his National Guard unit.

Among the first troops sent to France in the fall of 1917, his special radio talents were quickly recognized. He was transferred from the Infantry to the Signal Corps, commissioned a Second Lieutenant, and assigned as an instructor. It is interesting to note that these few months in the infantry mark his only separation from radio in the 42 years since 1908!

After World War I, the seafaring blood of his Maine ancestry was too strong to resist. It was inevitable that he should return to the merchant marine as a radio operator. For two years he traveled widely, following his profession. During this time he participated in salvage operations following an SOS from the *S.S. Suwide* and was paid $300 salvage money according to Admiralty Law. He believes with pride that this is the only case on record of a radio operator being paid salvage money.

In 1922 the infant *Radio Corporation of America* invited young Sterling ashore as a Marine Radio Inspector.

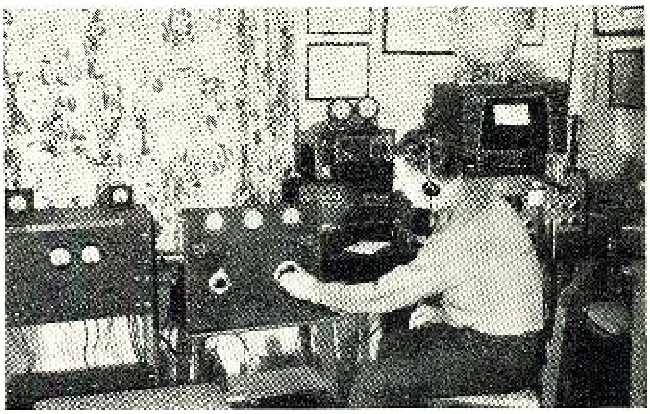
A year later he began his long association with the enforcement of radio laws and regulations, joining the Bureau of Navigation, Department of Commerce, as a Radio Inspector.

Questioned as to his ham activities in those days, he replied, "I had a rig on top of the icebox in 1924. It was soon after I was married and space was at a premium in our apartment. That rig used a 5 watter—202—in a Hartley oscillator and its power supply used a chemical rectifier for which I borrowed all my wife's jelly glasses. They were later replaced by *AmRad* S tubes. The receiver was a *Reinartz* tuner. I had a lot of fun. In 1926-27, when I was writing the 'Radio Manual,' that same kitchen and ham setup were used to test out unfamiliar cir-

(*Continued on page* 122)

Sterling at the controls. Present equipment at W3DF includes an SX-42 and SX-71 double-conversion unit (not shown in photo).

The "ham shack" at W3DF. An HT-18 unit drives either a 600 w. phone or 400 w. c.w. rig. Transmitting gear is home-constructed.



Built-in TV ANTENNA

Complete design characteristics of a tunable built-in antenna used for TV receivers.

By

ROBERT B. ALBRIGHT

Eng. Dept., Philco Corporation

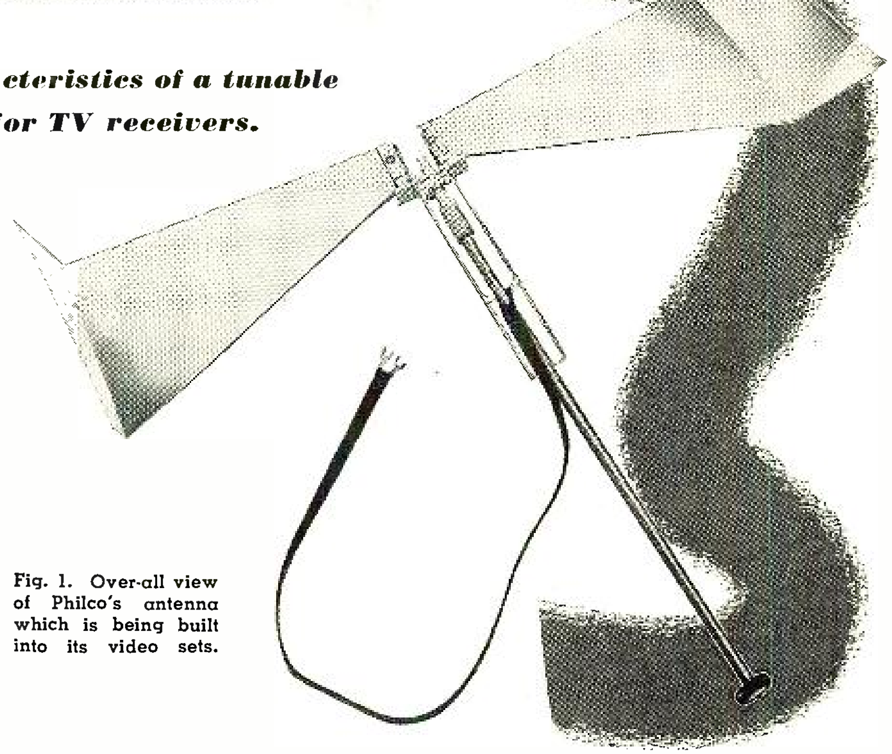


Fig. 1. Over-all view of Philco's antenna which is being built into its video sets.

THE increased popularity of the built-in television antenna can be attributed to various causes but the fact remains that most manufacturers have recognized the need for such a unit and are, consequently, equipping their receivers with self-contained antennas.

In most cases the built-in antenna consists of a length of 300 ohm transmission line folded over inside the television receiver cabinet. This antenna may take the shape of an ordinary dipole or the transmission line may be fanned out from the center to form a sort of conical type. In all respects this antenna is essentially an untuned system, but one that can be used in high signal areas to receive a television signal. What are the disadvantages of such a system? The relatively small size of this built-in antenna makes for a very small signal capture area. This may be compared to a fisherman with a net. With a large net he will surely seine more fish than with a small net. Since the antenna is still more or less of a dipole, it will be difficult to secure a ghost-free picture in many urban areas. Again, since the antenna is essentially a dipole, its impedance at the feed point, that is, where the transmission line is attached to feed the front end of the receiver, will change radically above and below its resonant frequency.

Some built-in antenna systems use two antennas, spaced at some angle less than 90 degrees from each other, permitting either antenna to be switched in separately to give some degree of directivity.

The tunable and matched built-in antenna system has several distinct advantages over the previously described types, for by providing a tun-

(*Continued on page* 144)

Fig. 2. Both series and parallel resonances are used in Philco's built-in antennas.

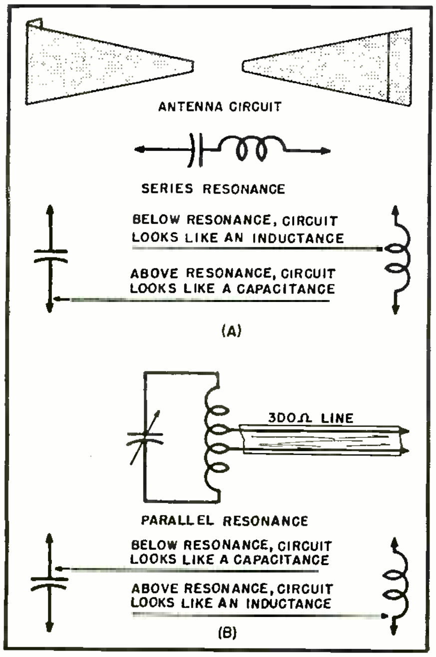
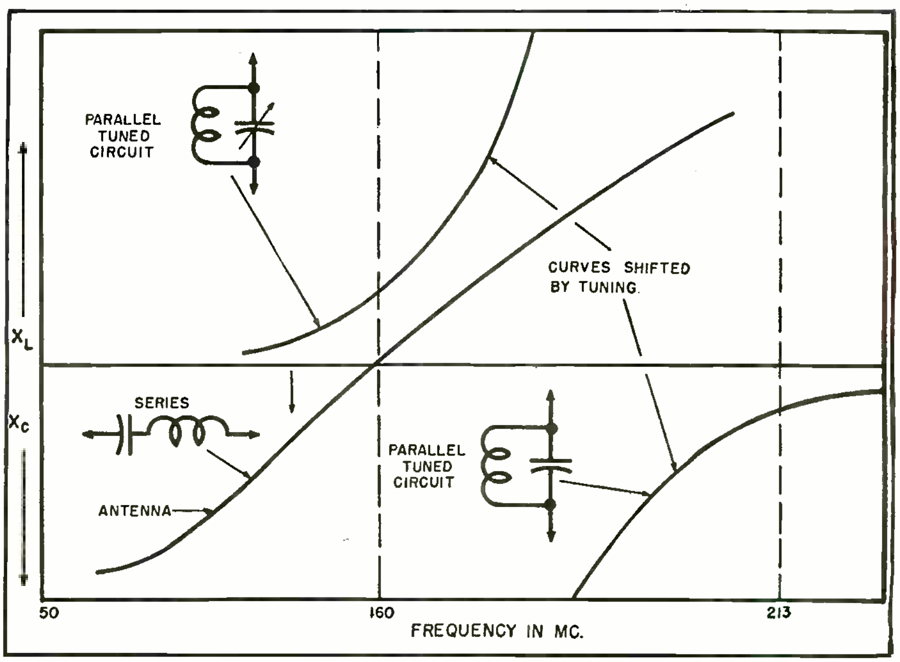


Fig. 3. Graphical representation of the circuit illustrated in Fig. 2, showing how the reactance of the antenna is matched to the load throughout the band.



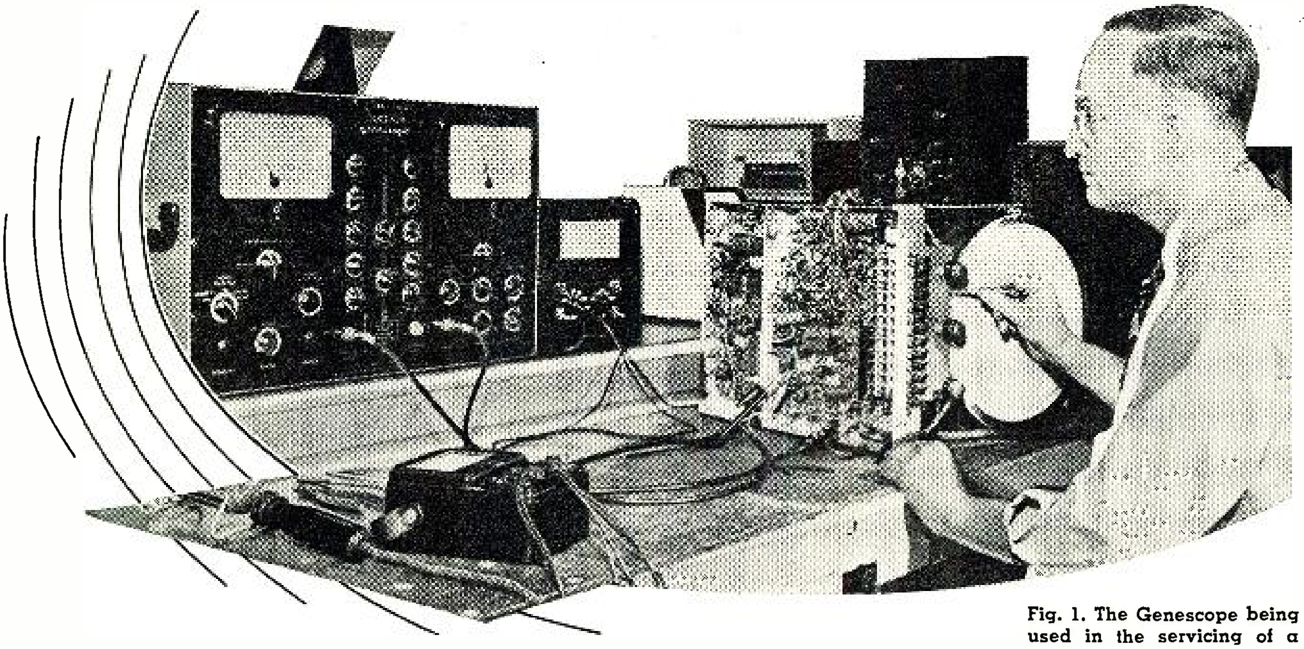


Fig. 1. The Genescope being used in the servicing of a television receiver chassis.

The GENESCOPE—A TV Test Instrument

By MILTON S. KIVER

A marker generator, an oscilloscope, a 400 cycle audio signal, and an FM and TV sweep generator are included in one test unit.

RADIO service technicians, together with radio engineers, long ago demonstrated by their eager acceptance of the multitester, that they prefer test instruments to be as compact and all-inclusive as possible. Thus, the vacuum-tube voltmeter, embracing within itself the functions of an ohmmeter, voltmeter, ammeter, and output meter is today easily the most popular and most important instrument in the service shop or the engineering laboratory. It is accurate, compact, and neat and can be used to perform any of the foregoing functions with a flip of a switch.

Due to this desire for speed and efficiency it was almost inevitable that an instrument like the *Simpson* Genescope should appear. Here, upon one chassis, is available an FM sweep generator, a television sweep generator, a 400-cycle audio signal, a marker generator, and an oscilloscope. In short, everything is provided for the proper alignment, signal tracing, and waveform servicing of FM and television receivers. This instrument, in conjunction with a vacuum-tube voltmeter, represents essentially all of the test and service equipment required by the modern television service shop.

The Genescope, shown in Figs. 1 and 8, is divided into three sections. The left-hand section contains a three-range r.f. generator, a crystal oscillator, and a 400-cycle audio oscillator. Frequencies generated extend from 3.3 mc. to 250 mc., divided into six ranges:

Band A—3.3-7.8 mc. (on fundamentals) and 6.6-15.6 mc. (on second harmonics).

Band B—15-38 mc. (on fundamentals) and 30-76 mc. (on second harmonics).

Band C—75-125 mc. on (fundamentals) and 150-250 mc. (on second harmonics).

The output of the r.f. generator may either be unmodulated or modulated by a 400-cycle note.

The center section of the Genescope contains a 3-inch oscilloscope and all its operating controls. In order to conserve space, the cathode-ray tube is mounted vertically. The pattern on the tube is then made visible to someone standing in front of the instrument by reflection from a tilted mirror mounted at the top of the cabinet. Provision is made for direct connection to the deflecting elements of the CRT by removing a small cover at the lower center of the panel.

The right-hand section of the Genescope contains an FM signal generator, a 140 mc. fixed frequency oscillator, mixer, phasing, and blanking circuits. Frequency-swept signals can be obtained in two ranges extending from 2 to 120 mc. and from 140 to 260 mc. A sweep control permits adjustment of the frequency sweep from zero to over 15 megacycles.

A feature which is unique in this sweep generator is a blanking circuit which injects a negative pulse into the FM oscillator circuit in such a manner that oscillation is stopped during the return trace of the oscilloscope, thereby producing a base line and a single trace response curve on the oscilloscope screen. Thus, as the electron beam sweeps forward, from left to right, the response curve of the circuit under test is traced out. On the return trip, the beam would ordinarily trace back over the response curve produced on the forward sweep. This second tracing is not actually necessary since it provides the same information as the forward trace. Furthermore, there is generally sufficient unbalance existing in the circuit so that the second trace does not coincide at all points with the first trace, thereby producing two curves. See Fig. 3A. In the Genescope, this second trace is removed by stopping the oscillations of the sweep generator during this period. Within the scope, however, the beam is not similarly blanked out, but permitted instead to produce a zero voltage or reference base line. See Fig. 3B. The presence of this base line aids the technician to better orient the various values of the response curve and thereby tends to simplify and hasten the servicing and alignment process. The zero base line proves to be especially valuable for FM discriminator alignment since in this instance the linear portion of the S-response curve should extend for equal distances above and below this level. See Fig. 3C.

Appropriate connecting cables are furnished with the instrument for making connections between the Genescope and the receiver under test. Also included is a high-frequency probe for signal tracing of high-frequency circuits; this connects to the vertical input jack of the oscilloscope section.

Applications

Any problem in a TV or FM receiver that requires an oscilloscope or an alignment generator can be handled by this instrument. Thus, consider the alignment of a television receiver. The usual order of adjustment is as follows:

1. Video i.f. traps
2. Video i.f. transformers
3. Sound discriminator
4. Sound i.f. transformers
5. The r.f. section

The video i.f. traps require adjustment at certain definite frequencies—each of which can be supplied by the AM generator in the Genescope. As an illustration, consider the typical video i.f. system shown in Fig. 5. The signal output lead from the Genescope would connect to point *F* of Fig. 5, while the ground lead of this cable would be attached to the receiver chassis. The vertical input cable (attached to the vertical amplifier of the oscilloscope) would be placed across the video detector load resistor—point *A* and ground in Fig. 5. The r.f. signal is amplitude modulated by the 400 cycle audio note in order that a varying voltage be developed at point *A*. The visual indication on the oscilloscope will be the 400 cycle sine wave.

Set the r.f. generator for a frequency of 19.75 mc. and adjust the core of L_7 for minimum height of the oscilloscope pattern. If the pattern disappears completely, increase the signal output of the generator until the exact minimum point can be observed on CRT screen. This trap circuit is now properly adjusted. In a similar manner, using the proper frequencies, traps L_3, L_5, and L_9, are adjusted, in each instance making certain that a definite minimum indication is observed on the screen. Particular attention should be given the 21.25 mc. traps since these prevent the sound voltages of the signal being received from reaching the image tube screen.

Coils L_2, L_4, L_6, L_8, and L_{11} provide the video response characteristic for this i.f. system and each coil is peaked at its own frequency for maximum indication of the 400 cycle sine-wave pattern on the CRT screen.

Although the accuracy of the AM generator is designed to exceed 1 per-cent, even greater accuracy is required when adjusting television receivers. For this reason the Genescope is provided with a crystal standard having an accuracy of .05 per-cent or better. By using this standard and a special scale provided for the AM generator (in addition to its regular scale), frequencies having crystal accuracy may be obtained at any point within the range of the AM generator. This calibrating procedure would be applied to the trap and i.f. peaking frequencies just mentioned, enabling the service technician to adjust these coils to their exact resonant frequency.

After all of the trap and i.f. adjustments have been completed, we are ready to view the over-all response curve of the video i.f. system. Do not molest the connecting cables between the Genescope and the receiver. These remain intact as set for the previous adjustments. Merely switch the FM generator to the appropriate range and adjust the sweeping range for a value of 6 to 7 mc. Rotate the phasing control until the two traces visi-

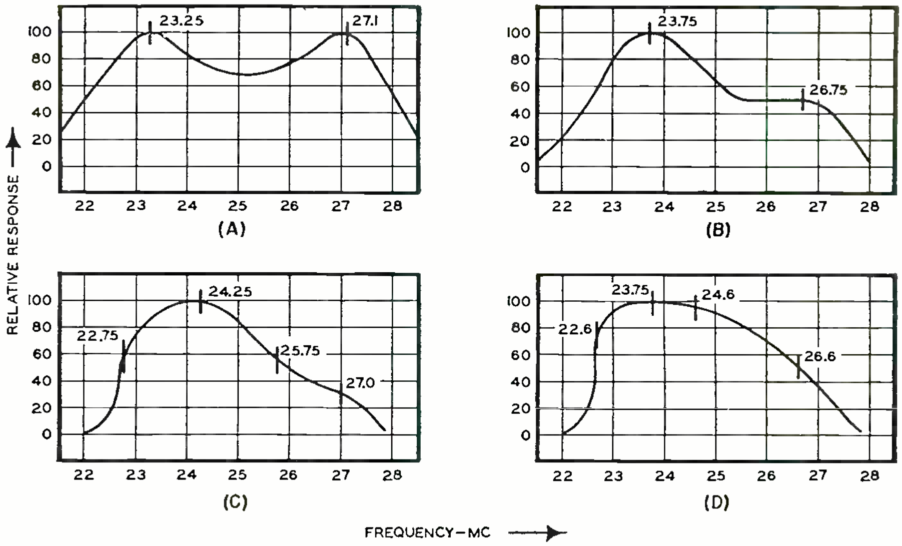


Fig. 2. Response curves for various portions of Philco's video i.f. See text.

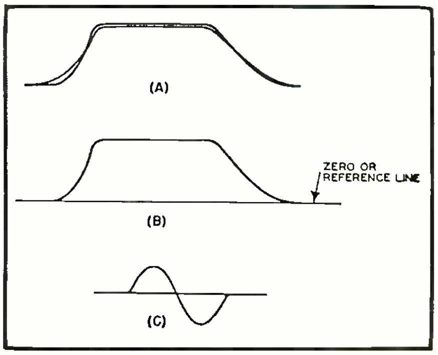


Fig. 3. (A) The response pattern of a video i.f. system as it normally appears. Note the double trace. (B) The same pattern as shown in A with the blanking voltage on. (C) A discriminator response with the special blanking voltage on.

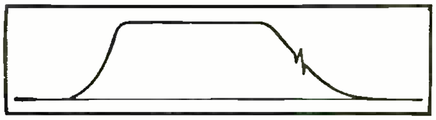
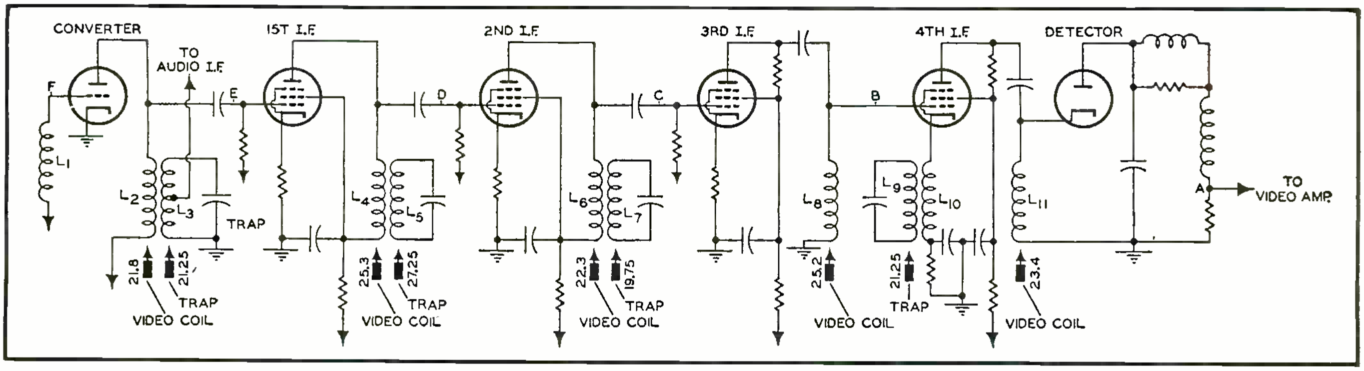


Fig. 4. A video i.f. response curve showing position of marker pip at the point where the video carrier should appear.

Fig. 5. A condensed and simplified version of the video i.f. system found in many commercially-built television receivers.



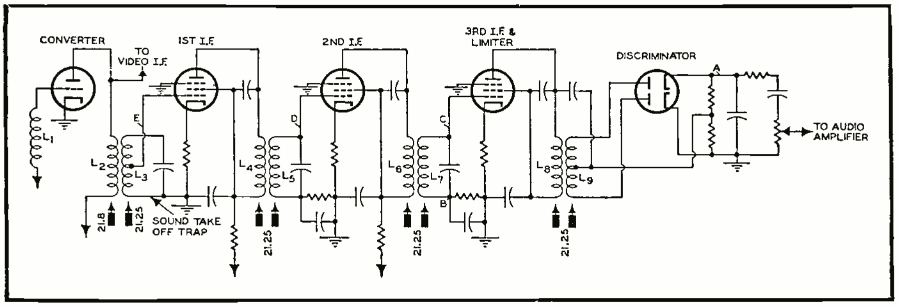


Fig. 6. A conventional sound i.f. system found in many television receivers.

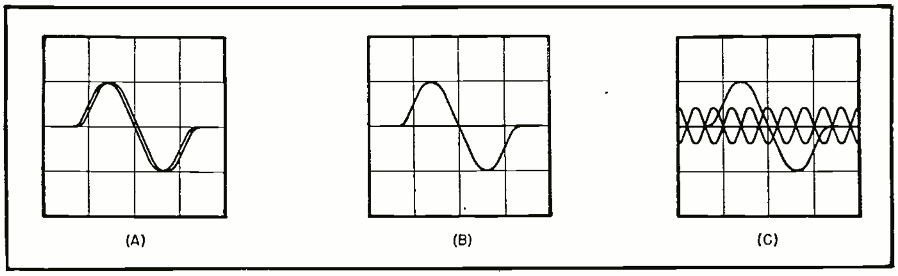


Fig. 7. (A) Discriminator "S" curve before the blanking voltage is applied. (B) The same curve after the blanking voltage is applied. (C) Appearance of the 400 cycle wave, as indicated in text, signifies that discriminator secondary requires some retouching.

ble on the sereen blend as closely into each other as possible and then advance the blanking control until only a single trace is seen on the screen accompanied by a straight base line extending across the screen. If the video system has been properly adjusted, the curve shown in Fig. 3B will be obtained.

Since the video response extends for 3 to 4 mc. (depending upon the receiver), it is impossible to judge from a simple viewing of the curve itself whether the carrier and end frequencies are where they should be. Hence, identification markers are required and these are supplied by the AM generator. This generator is switched to the unmodulated position and set to the i.f. frequency of the video carrier, say 25.75 mc. A pip should appear halfway up the right-hand slope of the response curve. See Fig. 4. To determine the extent of the curve, the frequency of the AM generator is changed until the marker pip appears along the left-hand slope of the response curve. The frequency of the pip can now be read from the scale of the AM generator.

Care should be exercised that the marker pip is kept as low as possible, otherwise the response curve will be seriously distorted and it will be difficult to establish the exact position of the trace. In this respect a separate attenuator permits the operator to adjust the amplitude of the marker pip independently of the FM sweep signal.

The foregoing alignment considered only a stagger-tuned video i.f. system. Equally good results can be obtained with video i.f. systems using complex coupling. *Du Mont, Stromberg-Carlson,* and *Philco* television receivers are good examples of such systems. For these systems, the alignment begins with the last i.f. stage and proceeds back to the mixer. To start, the vertical input cable of the Genescope is connected across the video detector output while the cable from the FM sweep generator is connected between grid and ground of the last video i.f. amplifier. The response curve for the tuned circuit between this last i.f. stage and the video detector will appear on the scope screen. The shape of this curve should be compared with the curve recommended by the manufacturer (in his service manual) for this i.f. stage. If a difference exists, the proper adjustments should be made to bring the response curve into line. Marker frequencies, if desired, can again be supplied by using the AM generator portion of the Genescope.

In *Philco* receivers, the vertical input cable of the oscilloscope is left across the video detector output while the sweep generator output is moved back in turn from the last video i.f. stage (the 3rd video i.f. amplifier) to the 2nd video i.f. stage to the 1st stage and finally to the mixer. In the latter position, the response curve of the entire video i.f. system is obtained on the scope screen. The response patterns for each position of the sweep generator are shown in Fig. 2, together with various identifying frequencies.

In *Du Mont* and other television receivers, the manufacturer recommends that the response pattern of each i.f. stage be considered by itself. To enable the service technician to do this, a high-frequency probe with a self-contained detector is provided. The probe output leads are connected to the vertical input terminals of the Genescope oscilloscope. Now, by connecting the sweep generator leads to the control grid of one i.f. amplifier tube and placing the probe at the control grid of the following i.f. amplifier tube, we will obtain a response curve of the tuned circuit contained between these stages. This procedure can be followed in any tuned circuit in the video i.f. system. In some instances where the stage gain is low, it may be necessary to feed the signal through two stages to produce a usable indication on the scope screen. In this instance, the tuned circuits between both stages would have to be adjusted together.

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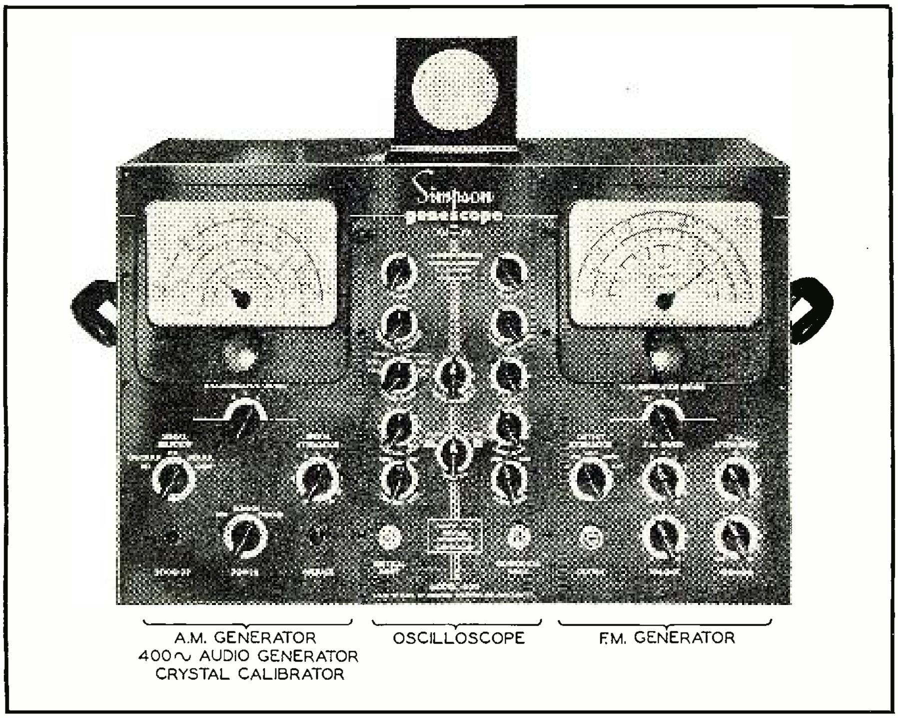
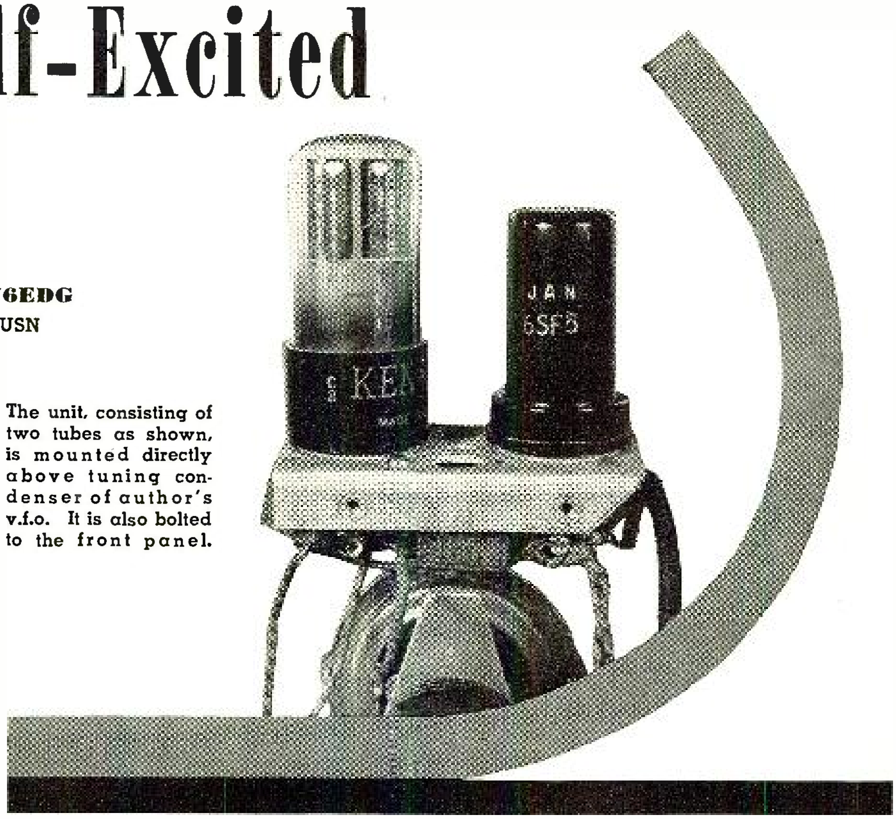
Fig. 8. A front panel view of the Genescope, Simpson's new television service instrument.



NBFM And Frequency Shift Keying Unit For Self-Excited Oscillator

By R. W. JONES, W6EDG
Chief Communications Tech., USN



The unit, consisting of two tubes as shown, is mounted directly above tuning condenser of author's v.f.o. It is also bolted to the front panel.

Design is based on the "Miller Effect" of a 6SL7GT. Provides good NBFM and FSK over eleven meter band.

OF THE many different types of narrow-band frequency modulation circuits none have been described for amateur application using the Miller effect of a vacuum tube. The unit to be described, using the Miller effect of a 6SL7GT, gives good narrow-band frequency modulation with the added feature of frequency shift keying for eleven meter operation.

The input capacity of a vacuum tube depends not only on the actual grid-cathode capacity but will vary with changes in the amplification factor or transconductance of the tube. The change in input capacity with a change in amplification factor is known as the "Miller Effect."

The input capacity of a triode tube with a resistive plate load is calculated from the formula:

$$C_{in} = C_{Gk} + C_{Gp}\,(A + 1)$$

Where: C_{in} = input capacity in μμfd.
C_{Gk} = grid cathode capacity in μμfd.
C_{Gp} = grid-plate capacity in μμfd.
A = gain of triode vacuum tube amplifier.

Note that changing the value of A will change the input capacity of the triode vacuum tube. The amplification of a vacuum tube can be varied by two methods, changing the grid bias or changing the plate voltage. In the application of Miller effect to be described in this article I believe that the plate voltage variation method is the better of the two methods because of better isolation of the audio frequency voltages from the radio frequency energy in the oscillator to be frequency modulated.

The complete diagram is given in Fig. 1. The 6SF5 is a conventional audio amplifier stage to amplify the audio voltage from the crystal mike. The heart of the unit is the 6SL7GT, a twin triode with separate cathode connections. Note that the two plates of the triodes are fed plate voltage through a common plate resistor, R_6.

Any change in plate current to the first section of the 6SL7GT will change the plate voltage on the second section because of the change in voltage drop across the plate resistor with changes in plate current. This change in plate voltage in the second section of the 6SL7GT will cause a change in amplification of the second section. Referring again to the formula, a change in the gain A of a triode stage will cause a change in input capacity. The input circuit of the second section of the 6SL7GT is across the grid inductance of the oscillator circuit. Changes in input capacity of the 6SL7GT will cause a change in frequency of the oscillator. The input circuit of the second section of the 6SL7GT is, in reality, then a variable condenser across the grid inductance of the self-excited oscillator. The variable condenser changes capacity with

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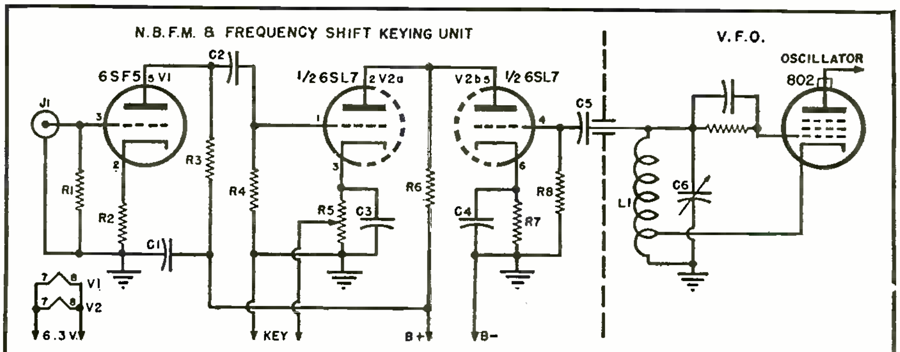
Diagram of NBFM and FSK unit. The entire design is based around the 6SL7 tube.



R₁—2 megohm, ½ w. res.
R₂—1000 ohm, ½ w. res.
R₃, R₆—100,000 ohm, ½ w. res.
R₄, R₈—1 megohm, ½ w. res.
R₅—10,000 ohm wirewound pot.
R₇—12,000 ohm, ½ w. res.
C₁—.01 μfd., 400 v. cond.
C₂—.006 μfd., 400 v. cond.
C₃, C₄—100 μμfd. mica cond.
C₅—15 μμfd. mica cond.
C₆—200 μμfd., v.f.o. tuning cond.
L₁—10 μh. v.f.o. grid coil
J₁—Mike jack
1—6SL7GT tube
1—6SF5 tube

Experimental Magnetic-Type D.C.-A.C. Signal Inverter

By
JAMES KAUKE

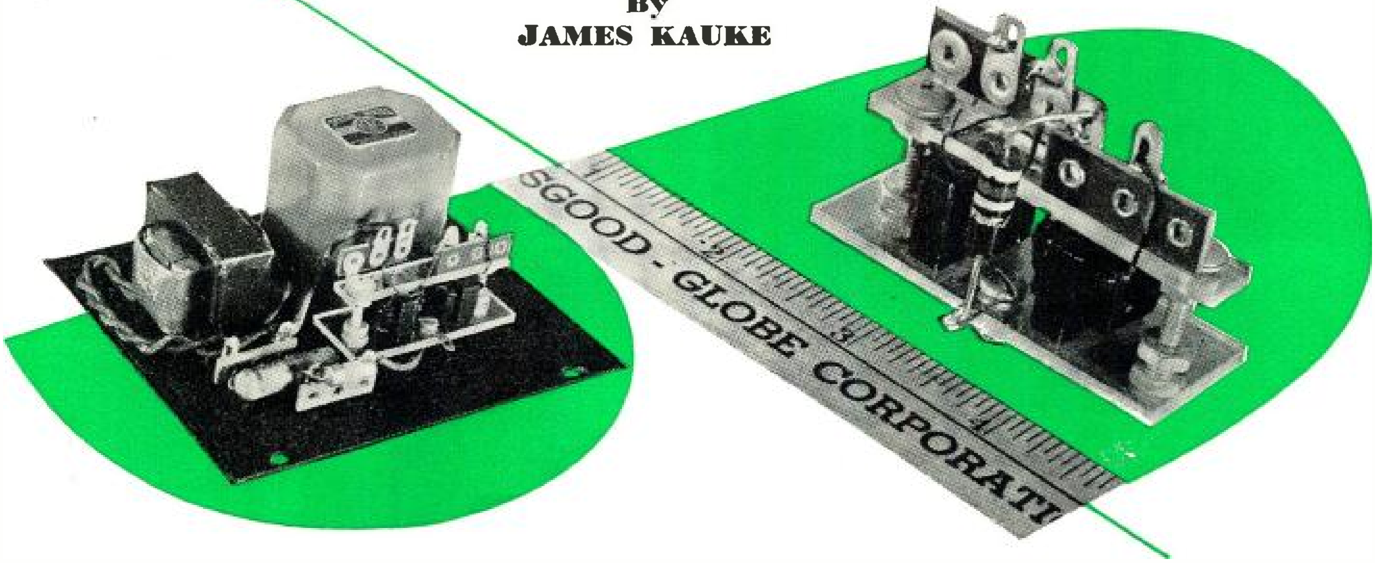


Fig. 1. (Top) A simple, two-transformer type saturable reactor for d.c. to a.c. inversion. This unit was built for installation on audio amplifier chassis to be used for measuring d.c. millivolts. Connections are made to the terminal strip lugs and to load resistor. See Fig. 3A for circuit. The a.c. supply transformer was eliminated as the necessary voltage was obtained from the amplifier filaments.

Fig. 2. (Left) A simple magnetic d.c. amplifier. This unit uses the circuit shown in Fig. 3B. A cable, connected to the terminal strip point, connects with input and output terminals and the power line which is installed in the unit's mounting case.

Complete details on a new gadget. This saturable reactor type of tubeless magnetic amplifier can be used for instrumentation and control purposes.

ELECTROMECHANICAL vibrators or choppers usually are employed as tubeless devices to convert small d.c. voltages to a.c. for measurement or control purposes. A familiar example of the use of such devices is in the amplification of d.c. voltages through a conventional a.c. amplifier. In this application, the small d.c. voltage is turned into a.c. by a vibrator or chopper somewhat similar to an auto radio vibrator. The a.c. is then applied to the input terminals of a regular a.c. amplifier (which can be made much more stable than most d.c. amplifiers). Finally, the output of the amplifier is rectified, and a high d.c. voltage (proportional to the original small voltage) is obtained which may be readily measured or used to actuate a husky d.c. relay.

Electromechanical inverters have proven unsatisfactory to most amateur experimenters because of the presence of moving parts which are subject to sparking, sticking, wearing, noise generation, unsteady output amplitude, and frequency shift. Highly refined vibrators designed for stable instrument use are priced out of the reach of the ordinary experimenter.

By making use of the saturable reactor principle, a simple low-level d.c.-to-a.c. inverter can be constructed without moving parts or tubes. The operating principle of the saturable reactor is quite simple. In its simplest form, this device consists essentially of two coils wound transformer-fashion on a suitable iron core. An alternating current is passed through one winding in series with a load circuit. The d.c. is applied to the other winding. The inductance (and reactance) of the a.c. winding changes in accordance with the amount of d.c. flowing through the d.c. winding. As the inductance changes, so does the alternating current flowing through the a.c. coil and load circuit. In this way, d.c. changes are converted readily into a.c. changes. This explanation applies to the most rudimentary type. Most commercial saturable reactors sufficiently sensitive for instrumentation and control are more complicated, but the basic operating principle is the same.

If the core of a saturable reactor has the proper magnetic properties, a relatively large alternating current in one winding can be controlled by a small d.c. in the other winding. This is a type of amplification and is the principle of the *magnetic amplifier*, a device which is assuming increased importance in electronic applications. Saturable reactor devices require only a straight a.c. power supply, an advantage when working for simplicity and compactness.

Like the instrument-type vibrators, commercial high-quality saturable reactors and magnetic amplifier-transformers are priced beyond the budgets of amateur experimenters. This article describes a simple, inexpensive saturable reactor-type d.c.-to-a.c. inverter which can be constructed by the experimenter. Many radio technicians will have the necessary parts already on hand. Aside from the applications listed by the author, the simple inverter can be used for numerous other purposes which will suggest themselves to the ingenious experimenter.

Simple D.C.-A.C. Inverter

A saturable reactor can be made, as shown in Fig. 3A, with two *UTC* Type S0-2 "Subouncer" transformers, T_2 and T_3. These are subminiature transformers having cores with high nickel content which enables them to be used much more successfully as saturable reactors than conventional transformers. The secondaries are connected in parallel to handle the a.c. The d.c. signal input voltage is applied to the primary windings which are connected in series *bucking* to eliminate any induced a.c. from the d.c. input terminals. The d.c. input terminals have no particular polarity.

The a.c. operating voltage is supplied by a 6.3 volt filament transformer, T_1. This may be the lowest-current unit available, since the drain is not severe. The a.c. output signal voltage is developed across a 400 ohm load resistor, and may be applied to any high-impedance device, such as an a.c. vacuum tube voltmeter or a.c. amplifier. The signal output voltage will be as steady as the a.c. operating voltage.

A steady value of 0.1 volt a.c. appears across the 400 ohm resistor when no d.c. is applied to the input terminals. This may be reduced to zero by means of an a.c. bucking voltage of the same value applied in series with the resistor, or by means of a bucking voltage applied in series with one of the output leads. If this initial voltage is of no consequence in a particular application, it may be neglected entirely.

The operating curve for this d.c.-a.c. inverter is given in Fig. 5B. It will be observed from this curve that the simple inverter is not an amplifier, the a.c. output voltage being lower than the applied d.c. voltage. However, this is not important, since the chief application of the simple inverter is ahead of a standard high-gain a.c. amplifier, as shown in Fig. 4. In an application of this sort, the small a.c. output voltage of the inverter is applied to the amplifier input terminals. The 6.3 volt operating voltage may be obtained from the filament circuit in the amplifier, and transformer T_1 dispensed with, if desired. The a.c. output of the amplifier is rectified by means of a crystal or selenium rectifier and used to actuate a d.c. milliammeter or husky d.c. relay. A suitable amplifier to use is the familiar 6SJ7-6J5-6V6 (or 6L6) combination. With the inverter-amplifier setup, small d.c. voltages in the millivolt region or less can be measured or used for performing control operations.

It will be noted from the curve, Fig. 5B, that the inverter response is not linear. The shape of the curve is caused by the magnetic properties of the transformer core material. This nonlinearity will occasion little difficulty, however, since a special scale or calibration curve can be drawn for the meter in the amplifier output circuit when the device is to be used for measurements. When the combination is used for control purposes, fixed-point operation ordinarily is desired, and curve shape is of little consequence. Input resistance of the d.c. circuit is 500 ohms. The dotted curve in Fig. 5B shows the d.c. milliamperes drain over the operating voltage range. While the 500 ohm input is a relatively low value, it is considerably higher than the resistance of common d.c. millivoltmeters ordinarily employed.

Fig. 1 shows an assembled simple inverter with transformers T_2 and T_3 and the 400 ohm load resistor. The

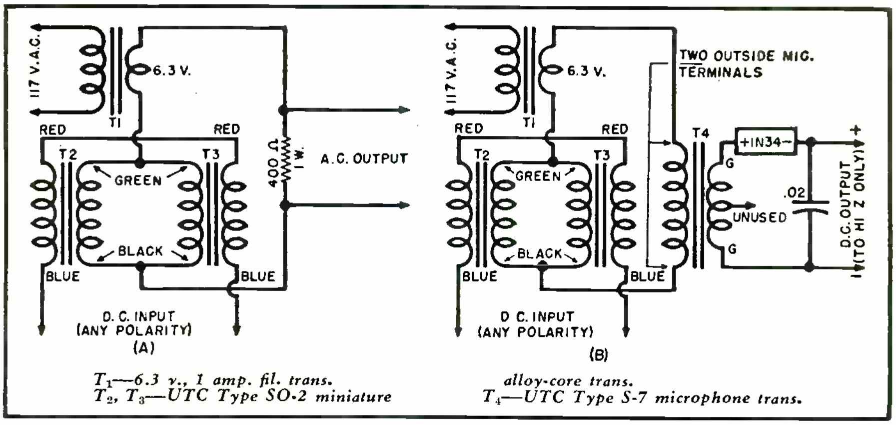


Fig. 3. (A) A simple d.c.-a.c. inverter. (B) Magnetic d.c. amplifier ("d.c. transformer").

6.3 volt transformer was eliminated in this model, since the inverter was built for installation in an amplifier having 6.3 volts available at the tube filament terminals.

Amplifier-Type Inverter

When more voltage output is desired than is supplied by the simple inverter, the 400 ohm output resistor may be replaced by the primary winding of a step-up transformer. This arrangement gives a simple magnetic amplifier, the gain of which is determined by the step-up turns ratio of the output transformer.

Fig. 3B shows such a circuit. Transformer T_4 steps up the output voltage which then is turned back into d.c. by the 1N34 rectifier. The circuit has been referred to frequently as a "d.c. transformer" because it, in effect, steps up a small d.c. input voltage to a higher value through a transformer. If a.c. output is desired, the 1N34 may be omitted and output taken directly from the T_4 secondary.

This circuit permits use of a d.c. vacuum tube voltmeter (connected to the d.c. output terminals of the inverter circuit) to check small d.c. voltages. The curve in Fig. 5A shows operating characteristics of the circuit of Fig. 3B. Note that the voltage gain varies from 5 (for a d.c. input of 0.1 v.) to 11.8 (for a d.c. input of 0.8 v.). The average gain over the d.c. input range of 0.1 to 1.1 v. is 10.4. At d.c. input values lower than 0.1 v., gain falls off rapidly because of the magnetic properties of the T_2 and T_3 cores. This may be improved, along with the gain at all other points, by using a transformer with higher turns ratio than the one specified in Fig. 3B for

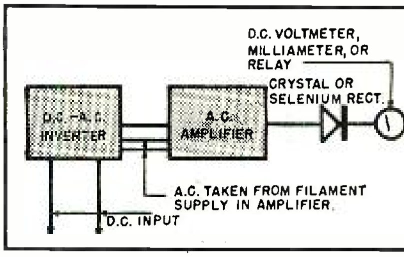


Fig. 4. The d.c. amplifier setup.

T_4. Inexpensive line-to-grid transformers, for example, are available with turns ratios of 60 to 1 and higher.

A steady d.c. voltage of approximately 1.2 v. appears at the d.c. output terminals when no d.c. is applied to the input terminals. This may be reduced to zero by means of a bucking voltage of the same value applied between the amplifier (inverter) output and the input of the high-impedance load device.

It should be noted that the circuit given in Fig. 3B is strictly a voltage amplifier. It gives neither current nor power gain. For that reason, it must be operated only into a high impedance, such as a d.c. vacuum tube voltmeter or relay-tube grid circuit.

Fig. 2 shows an amplifier type of inverter completely assembled.

Voltage Variation and Impedance

In each of the circuits given, variations of the 6.3 volt a.c. supply voltage will affect the a.c. output voltage value. However, because of the step-down ratio of the 6.3 volt transformer, higher line-voltage excursions can be tolerated than in other circuits. When the inverter is followed by an

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Fig. 5. (A) Operating characteristics of the magnetic d.c. amplifier shown in Fig. 3B. (B) Operating characteristics of simple inverter shown schematically in Fig. 3A.

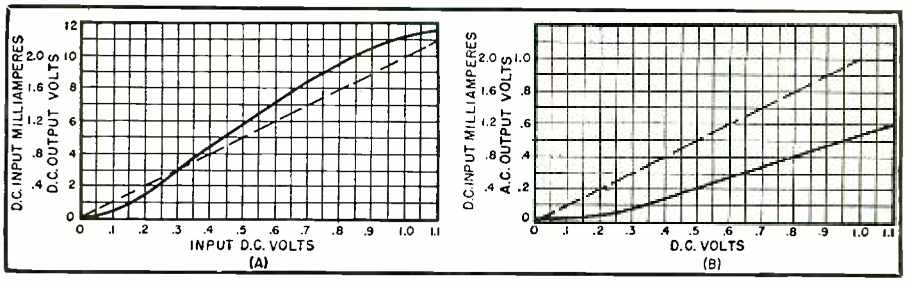


Fig. 1. Commercially-built fan type antenna designed and constructed by Channel Master Corp. engineers.

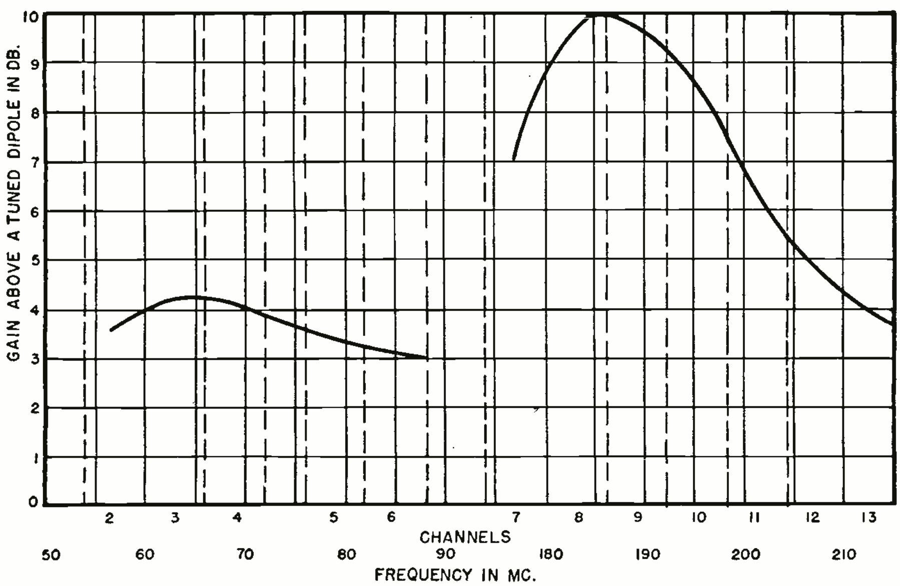
By
HARRY GREENBERG*
and
HAROLD HARRIS†
Channel Master Corporation

DEVELOPMENT of FAN TYPE TV ANTENNA

Design of an antenna which maintains the good broadband performance of conical antennas yet provides better high-band gain characteristics.

THE past year has seen the phenomenal emergence of the conical type as the predominant suburban and fringe area antenna. Its characteristics are superior to the folded or straight dipole type of antenna from the standpoint of gain and of bandwidth. The use of separate high and low sections can be eliminated in most cases. However, this antenna does have several drawbacks. The first is the poor response brought about by its drooping gain characteristic on the high end of the high band from Channels 10 to 13. (See Fig. 2.) This is accompanied by a splitting of the major lobe into two large side lobes in the horizontal polar pattern. (See Figs. 3A and 3B.) This means that there is both loss in gain on these channels and a high susceptivity to ghosts due to the splitting lobe. The sharp slopes in the gain curve indicate that in a channel having a 6 megacycle bandwidth, there can be differences in gain in an antenna of 2 to 3 db. These sharp slopes and non-uniform gains introduce distortion to video components of the telecast signal.

Fig. 2. A typical curve showing the gain of a conventional conical antenna.



About six months ago work was undertaken at the *Channel Master Laboratories* on the design of an antenna which would match or improve the broadband and gain characteristics of the conical antenna without the deterioration of the horizontal polar pattern on the high end of the high band and the resultant drooping gain characteristic.

A brief discussion of field strength standards would help to clarify some of the points which will follow. Field strength contours from transmitters are generally plotted in microvolts-per-meter. Contours are generally shown for 5000 μv., 1000 μv., 500 μv. and 100 μv. This means specifically that on the 100 μv. contours, a wire one meter long will intercept that number of microvolts. Fig. 4 shows three contours for a theoretical telecasting setup. For the purpose of this illustration, both Channel 2 and Channel 13 are telecasting from the same point with exactly the same amount of power. A tuned dipole for Channel 2 is roughly two meters long and a tuned dipole for Channel 13 is about half a meter long. This means that at the 100 μv. contour where the one meter wire reference is placed, the Channel 2 dipole will give approximately 200 μv. since it is twice as long as the reference and the Channel 13 dipole will give 50 μv. since it is only half as long as the reference wire. It can be seen that although both tuned dipoles are placed on the same field strength contour, one will give four times as much signal as the other.

* Chief Electronic Engineer.
† Sales Manager.

In other words, in areas of equal signal strength, tuned dipoles for low band channels will supply stronger signals to the set than tuned dipoles for high band channels. Moreover, transmission line losses are greater on the high band, and in general, receiver front ends are less efficient on the high band. The chief problem then is to design antennas which can supply more energy on high band channels than the conventional half-wave dipole or dipole and reflector combinations.

Since this is the problem, more energy must be intercepted by the antenna. This means that the high band dipole must be longer than a half-wave. On the average, a half-wave dipole for the low band is three times as long as the half-wave dipole for the high band. This means that three times as much signal would be intercepted on the high band with this dipole. However, since on the high band this low band dipole is three half-waves long, it is operating on the third harmonic at high band frequencies and the resultant lobe pattern is a clover leaf somewhat similar to Fig. 3B. This split lobe means that the antenna is insensitive to "head on" reception and that if one major lobe is pointed toward the station, the other is highly receptive to ghosts and stray pickup. (It is assumed that rear lobes will be reduced by the use of reflectors.) The problem then is to keep the antenna length but to "focus" the energy into one lobe. This is accomplished by arranging the antenna so that it forms a "V" (Fig. 3C). The "V" type antenna gains efficiency as the legs of the "V" become a greater number of wavelengths. The higher the channel, the greater the gain and the narrower the lobe.

However, when this is done, low band efficiency decreases. The reason for this is that veeing forward of the elements reduces the space aperture or area of interception. In addition to this, the nulls at 90 degrees are not complete. (Fig. 3D.)

At this point in the discussion, it is necessary to deviate slightly to consider the evolution and theory of a conical element. What is ultimately accomplished is the incorporation of these two principles, the "V" type element and the conical element into one broadband antenna. The conical element was developed out of the need to create a dipole antenna which would operate efficiently over a wide range of frequencies and also present a relatively uniform impedance over this range of frequencies. A dipole can be considered a special case of the parallel wire transmission line. As is commonly known, the characteristic impedance of such a line depends upon the diameter of the conductors and the spacing between them and is independent of frequency. If such a line is opened and bent so that the two conductors are formed into right angles opposite to each other and each conductor is cut a quarter-wavelength from the bend, a half-wave dipole is obtained. Before the bend, while the wires are still parallel to each other, voltages and currents in each conductor are equal and opposite as are the fields surrounding these conductors

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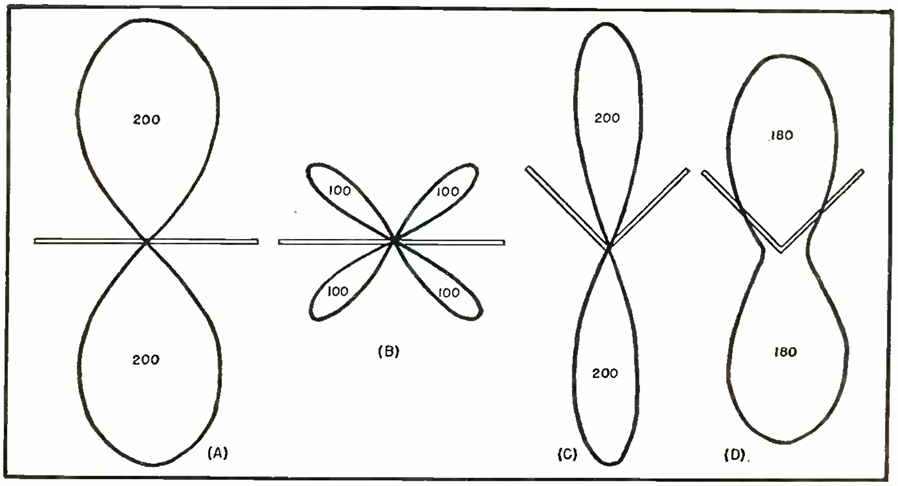


Fig. 3. (A) Horizontal pattern of half-wave dipole cut for Channel 2. (B) Pattern of same antenna when operated on its fourth harmonic or Channel 13. (C) Pattern of antenna shown in B when the elements are bent into the form of a "V". (D) pattern of this same "V" antenna when it is used on Channel 2.

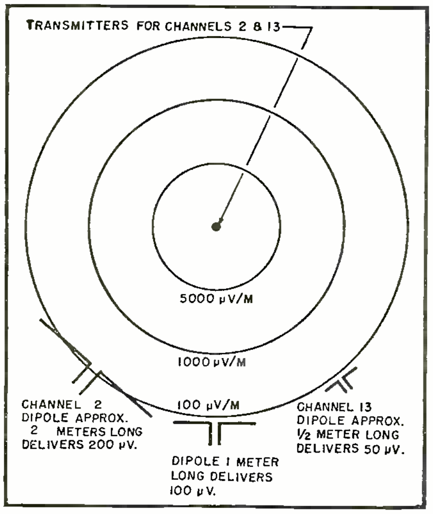


Fig. 4. Reduction in gain of a Channel 13 dipole due to its shorter physical length.

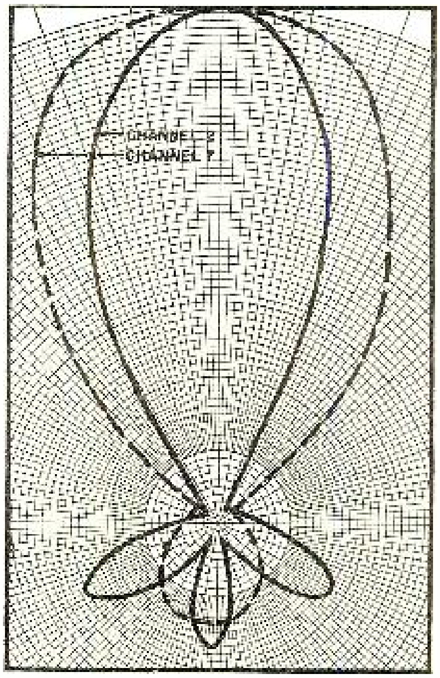
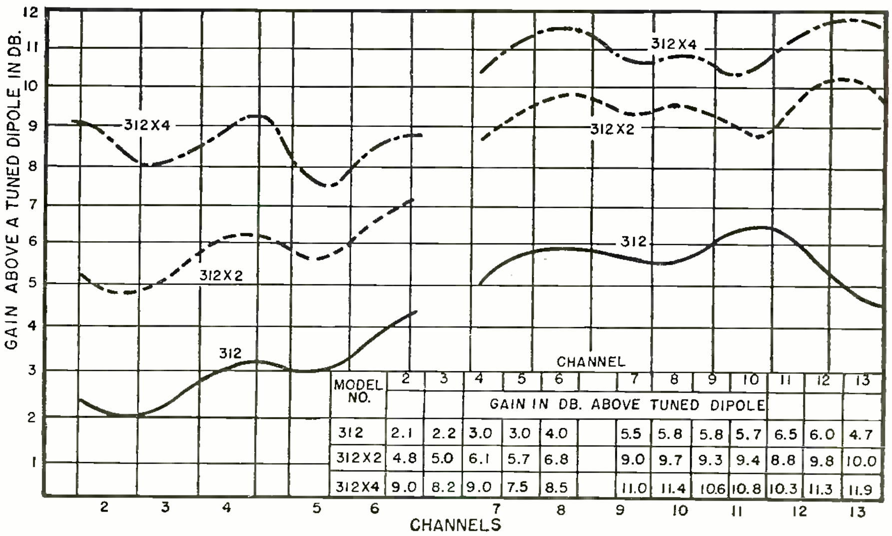


Fig. 5. Polar pattern of fan antenna.

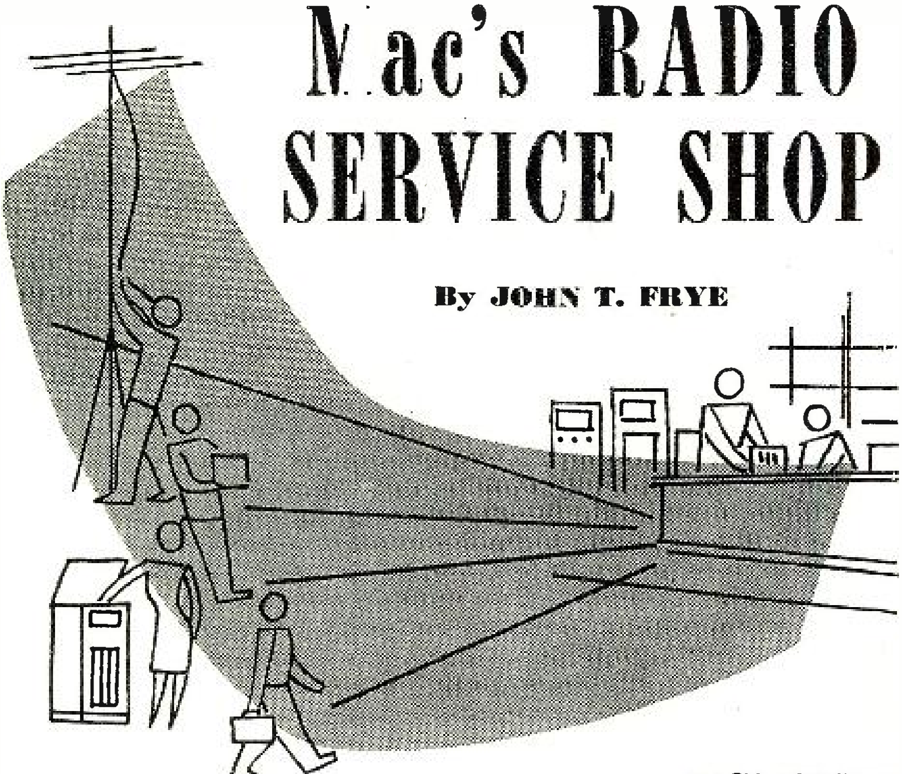
Fig. 6. Gain curves for single, double, and four-bay arrays.



MODEL NO.	2	3	4	5	6	7	8	9	10	11	12	13
	GAIN IN DB. ABOVE TUNED DIPOLE											
312	2.1	2.2	3.0	3.0	4.0	5.5	5.8	5.8	5.7	6.5	6.0	4.7
312X2	4.8	5.0	6.1	5.7	6.8	9.0	9.7	9.3	9.4	8.8	9.8	10.0
312X4	9.0	8.2	9.0	7.5	8.5	11.0	11.4	10.6	10.8	10.3	11.3	11.9

Mac's RADIO SERVICE SHOP

By JOHN T. FRYE



MAC'S "SYSTEM"

IT WAS really too nice an afternoon to work. The whole early May day had been a sneak preview of late June. Outside the open door of Mac's Radio Service Shop the warm sun beat down on the concrete sidewalk that had been washed clean by a shower the night before and sent shimmering heat waves rising through the quiet air. Only the ever-busy, worm-stretching robins seemed to feel industrious.

Inside the service shop that noon hour there certainly was no out-of-tune display of ambition. Mac himself occupied the high stool that was precariously balanced on two legs so that he could lean back against the wall of the service department. Across from him Barney, the apprentice, sat on the service bench with his long legs doubled up and his arms clasped about them so as to form a rest for his chin.

"Hey, Mac," the boy finally drawled.

"Uh huh," Mac acknowledged.

"A guy down at the radio club last night asked me what kind of a system of troubleshooting you use. He looked at me kind of funny when I said I didn't know. What system *do* you use?"

The stool came down on four legs with a thud as Mac straightened up. "That darned question always makes me mad!" he exploded. "A lot of people can't rest until they get any form of activity boiled down to a neatly-labelled little 'system.' The next time he asks, just tell him we use the looking-and-thinking system."

"Don't you believe in using a regular method in running down trouble?"

"Depends on what you mean by 'regular method.' If you mean working logically from observed symptoms to likely causes of trouble, I certainly do; but if you mean a religious and exclusive following of the voltage-checking system, the resistance-measurement system, the signal injection system, the signal-tracing system, or the touching-the-grids system—which I now see labelled with the hoity-toity name of 'circuit disturbance method'—the answer is a flat and emphatic No."

"You don't use any of these?"

"I use all of 'em—and a lot of other 'systems' besides. As far as I am concerned, I need everything I can lay my hands and brains on in running down trouble in a receiver. When an intermittent and I go to the mat, it is a fight to the finish with no holds barred. Those devils employ every trick they can hatch up to keep you from finding what ails them, and if you fight fair by following some sort of electronic Marquis of Queensberry rules, they'll tie you up in knots.

"Just look at how dirty they play: a mica condenser, that ought to be like Caesar's wife, above suspicion, will become leaky just often enough to escape an investigation until you have exhausted every other possibility. And then there are those sets that behave like angels on the bench but start cutting out just as soon as you have them all bolted down in the cabinet. When you are dealing with fiendish cases like those, it is no time to be hobbled with a single system. You need every method of diagnosis you can conjure up and a strong dash of inspiration besides."

Barney drew a careful bead on the doorknob with the solder gun as he asked, "You say you need to use everything?"

"That's right. Take the eyes: when I turn on a set, the first thing I do is to look at the rectifier to see if it glows that gorgeous shade that indicates gas or if the plates turn a cherry red because of a shorted filter condenser.

"The nose comes in mighty handy, too. One whiff of the inside of a cabinet in which a power transformer has been too hot is all a service technician needs to tell him that he had better do some checking before he turns *that* set on."

"And I suppose you use the master's *touch* to fix them," Barney suggested.

"Modesty forbids my saying Yes," Mac replied with a grin; "but the sense of touch is really a very useful service tool. It will locate a stone-cold metal tube with an open filament or spot a leaky filter condenser that is running a temperature and should be replaced; moreover, a finger probed lightly around the rim of a speaker with a rubbing voice coil will quickly tell you *where* it is rubbing and which way it should be moved to free it.

"I don't think I need to go into any illustrations of the hundred and one things your ears can tell you about a sick set. If you just know how to listen, it will babble all its symptoms to you. I must admit, though," he said musingly, "that I have never been able to figure out a way to use the sense of taste to help fix radios. I wish I could."

"If you forget how the polarity of a bias cell goes, you might try touching a couple of leads from it to your tongue," was Barney's bright suggestion. "I think the positive lead—or maybe it's the negative one—is supposed to taste salty."

"I'll remember that valuable suggestion," Mac promised dryly. "Seriously, though, all of the well-known methods of running down trouble have good qualities, and I want you to be perfectly at home with any of them. Quite likely any one of them, if followed carefully, would eventually spot a trouble; but the service technician can make much better time if he has all of the methods at his finger tips and can change freely from one to the other as he tracks down a receiver fault. Each of the systems should be looked on as a service *tool*. Just as you pick up first one tool and then another when you are working on a mechanical job, so you should be able to switch from one system to another when you are cornering an electronic trouble."

"Let's have a 'ferinstance,'" Barney suggested.

"Well, for instance, suppose you turn on a set and start checking the voltage. You find voltage at the rectifier cathode and the plate of the output tube, but there is none on the i.f. tube plate. It is a good idea to turn the set off at once because of the possibility that there may be a short somewhere that will burn up a resistor—perhaps inside the i.f.—or do

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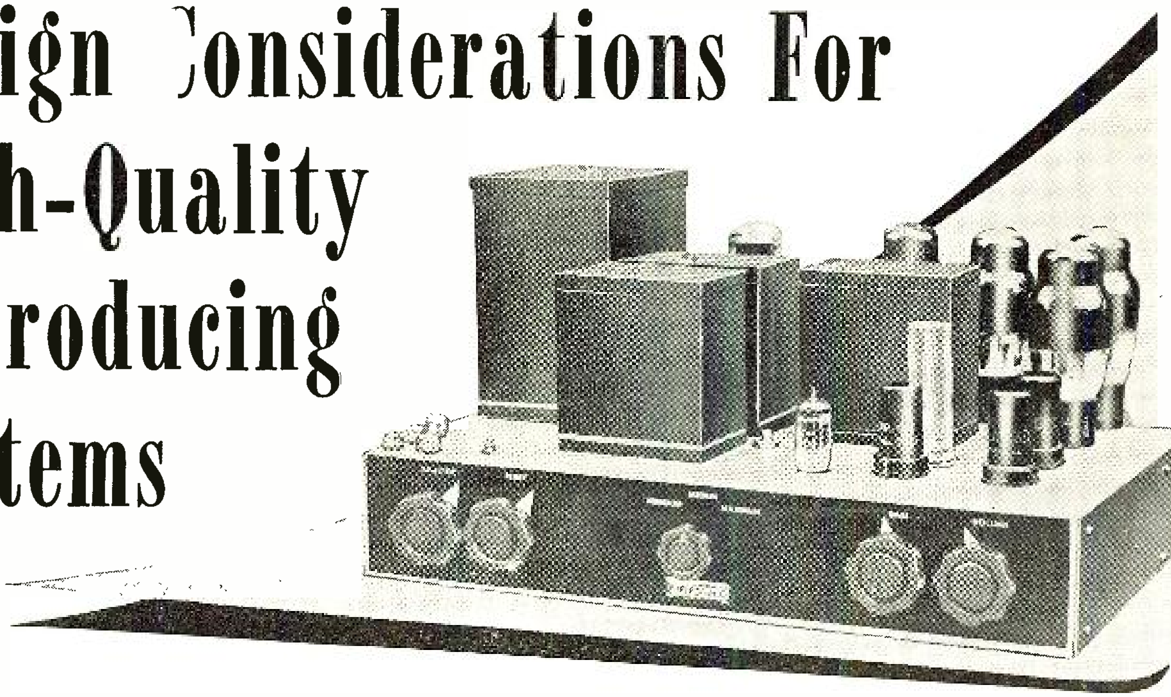
Design Considerations For High-Quality Reproducing Systems



By
HERB MATTHEWS

Fig. 1. Over-all view of audio amplifier built by the author. The unit incorporates many of the design features covered in text. Schematic diagram appears on page 72.

Part 2. Frequency characteristics of various RC tone control circuits used in high-quality audio amplifiers. The concluding article of the series.

"TONE control" is an ill-used phrase which has been employed to describe a multitude of functions and hide a multitude of sins. Tone controls may range from a simple capacitive roll-off, intended to reduce noise and distortion, to a complex *LCR* network designed to make every music lover his own conductor with complete control over the tonal balance of the orchestra. Neither of these extremes are befitting a high fidelity system. (The term "high fidelity" is used in its pure sense with blatant disregard for its corrupted connotation.)

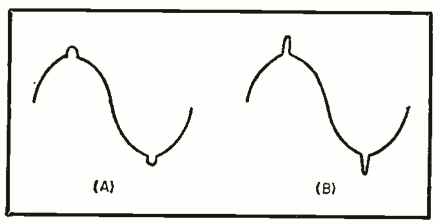
Tone control, or equalization, may be considered in two distinct classifications: equalization to offset deficiencies (which are generally fixed) in the reproducing system and equalization to offset deficiencies in the original program material. Unless this distinction is recognized it is impossible to design or operate tone controls intelligently.

Deficiencies in the reproducing system may include anything from a phonograph pickup to a human ear. The effect of loudness variations of the ear was covered in Part 1; any other deficiencies in the ear need not affect the audio designer. If a listener has a 10 db. peak in hearing perception in the range of 1000 to 3000 c.p.s., there is no point in trying to change his tonal perspective in the reproducing system because all sounds will be natural to him with the frequency distortion to which he has become conditioned. If his hearing falls off rapidly above 5000 c.p.s., however, do not expect him to appreciate the full tonal beauty of your wide-range system.

As was illustrated in a preceding article, variations in the loudspeaker system are something which frequently occur and for which compensation may be introduced. Variations in amplifier transformers may also be compensated for by equalization. However, poor frequency response in a transformer is usually indicative of other deficiencies and though the frequency response may be flattened out by means of equalization, other distortions cannot be removed so simply. Where high quality is desired, the best obtainable audio transformers should be used.

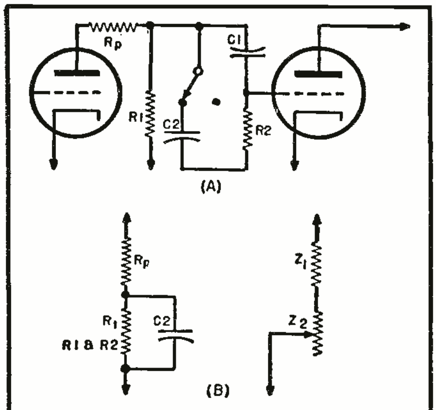
The loss of high frequencies in amplifier circuits because of shunt capacities and Miller Effects can readily be compensated by simple treble boost circuits. Low frequency loss is primarily a result of undersized coupling and screen and cathode bypass condensers. These components are relatively cheap and you can generally afford to use larger sizes than those specified by many designers with beneficial results. Small losses in various stages of an amplifier can multiply to surprising proportions; when an amplifier is found to have inadequate frequency response it will usually be due to more than one cause.

Fig. 2



Deficiencies in input sources such as phonograph pickups, microphones, and radio tuners can usually be made up but not always as readily as those previously discussed. When compensating for high frequency losses it must be remembered that a rising high frequency curve emphasizes distortion. A distorted wave (Fig. 2A) having its high frequency components (harmonic distortion) emphasized would look greatly distorted (Fig. 2B) if observed on an oscilloscope. If, however, a wave of the form of Fig. 2A were passed through a system with high frequency loss (Fig. 6A) and then through a corrective equalizer, its harmonic distortion would remain unchanged. There is, therefore, a limit to the benefit accruing from treble equalization and the best means of achieving real high fidelity is the simple expedient of having every part of the system flat. (This, of course, is a bit more difficult than it may sound.) Corrective equalization is a very useful device, but its proper use must be based on careful consideration of all factors.

The acoustics of the room, then, should also be considered as a property of the reproducing system. A heavily carpeted room with drapery and upholstered furniture will absorb high frequency energy to an abnormal degree. This will not only cause an



Equivalent circuits (B) show basic operating principle of all RC tone control systems. Z_1 (equal to R_p) remains constant while Z_2 (the a.c. resistance of C_2 and R_t in parallel) varies with the frequency.

Fig. 3

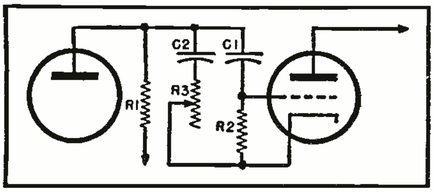


Fig. 4

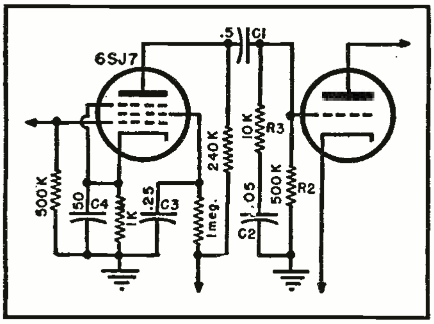


Fig. 5

acoustic attenuation, particularly of the higher frequencies, but will also shorten the reverberation time in the treble region, effecting a marked loss of brilliance. For this reason high frequency boost may be desirable in this type of room; conversely a treble droop may be required in a room with large, smooth-surfaced areas. Other characteristics of the room may affect the response in other portions of the audio spectrum. For example, a long room may act as a resonant air column and produce a peak at certain low frequencies which will result in boominess.

After the reproducing system has been made as flat as possible, the system may still sound unbalanced because nothing has yet been done to equalize variations in the program source. These variations should actually be compensated for in a recording or broadcast studio control room, but unfortunately there are not only differences of opinion as to what correct balance should be, but there are also different recording standards. Low frequency turnover points vary from 250 to 1000 c.p.s. and high frequency pre-emphasis varies considerably among different recording studios. In many broadcast studios it is the practice to place bass instruments abnormally close to the microphone as a means of compensating for poor low frequency response in most home receivers.

These external variations in frequency response may change every time a radio program source changes or a different record is played. For this reason "tone controls" intended to compensate for these changes should have great flexibility and should be convenient to use. The author firmly believes that the only panel variable tone controls provided should be for compensation of program differences and that the deficiencies peculiar to the reproducing system should be taken care of by fixed pre-set equalizers.

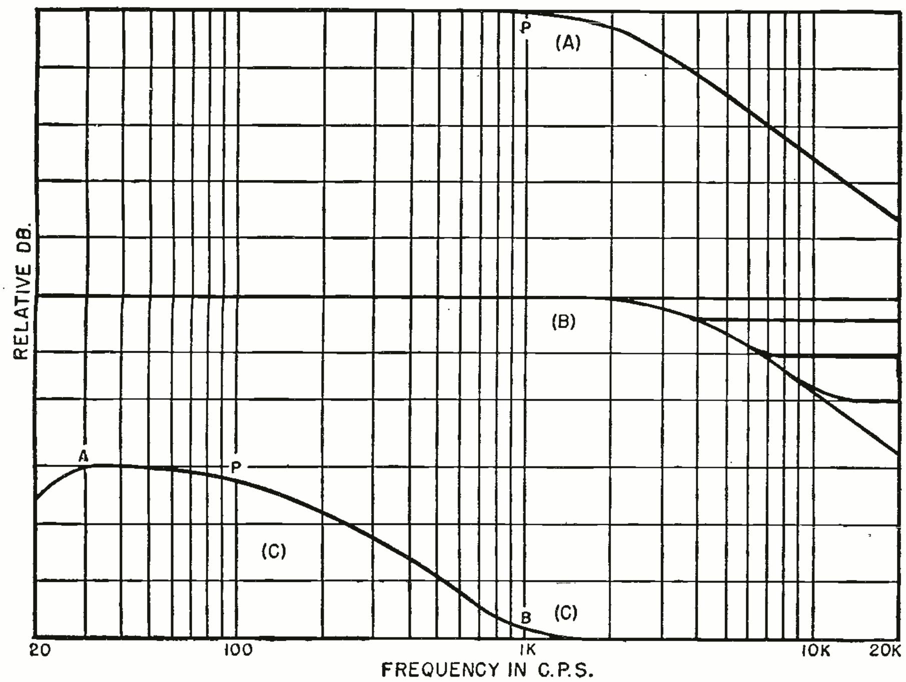
Now that the need for equalization and the philosophy by which it should be applied has been explained, actual tone control circuits may be discussed. The most familiar circuit is the treble cut-off tone control found in most commercial radios. It may be a single condenser switched across the audio section (Figs. 3A and 6A) or a volume control type of rheostat which may be used to connect it into the circuit gradually (Figs. 4 and 6B). In the circuit of Fig. 3A it will be observed that the impedance (a.c. resistance) of C_2 will vary with frequency as follows:

At all low frequencies up to a certain point, *P*, (Fig. 6A) which shall be called the take-off point, the impedance will be higher than the total impedance across the tube, R_t. $R_t = (R_1+R_2)/R_1R_2$. *Don't* be afraid of the *algebra.* All the formula means is that the resistance R_t, is equal to the total resistance of the two parallel resistors shown in Fig. 3A. It will be necessary to understand the behavior of R_t in all circuits to be presented in order to apply them properly to any given existing circuit. If you are not yet used to the mathematical form of presentation, now is as good a time as any to familiarize yourself with it. The more you understand about the behavior of radio circuits the more you can do with them.

To continue with the action of a treble cut-off; as the impedance of C_2 approaches that of R_t, C_2 will begin to absorb power and a voltage dividing network will be operating. From this point on, the amplification will halve as the frequency doubles. This is equivalent to saying that the frequency response of this circuit drops at the rate of 6 db. per octave. The limit which can be accomplished with any single stage of *RC* tone control of any form is 6 db. per octave. Because of the shunting action of R_t across C_2 the theoretical maximum of 6 db. per octave is never reached.

When a resistor is connected in series with C_2 (Fig. 4), it limits the maximum effect that the condenser can have and further reduces the slope. As shown in Fig. 6B a variable resistance can make the curve move vertically to any desired degree within the 6 db. per octave limit. Changing the value of C_2 will make the curve move horizontally as desired. Doubling C_2 would move the take-off point one octave (a frequency ratio of 2 to 1) toward the low frequency end of the curve. Using just C_2 it can be seen that the treble range would be seriously affected, but if a limiting resistor is inserted into the circuit the entire frequency spectrum is easily controlled. Fig. 5 shows a practical circuit used in the amplifier illustrated in Fig. 1 to produce bass boost with the response of Fig. 7A. It will be noticed

Fig. 6



that a pentode tube is specified. The reason for this is that the plate resistance of a triode is so low that the triode operates at constant voltage and the voltage dividing network described above will not operate. With a pentode the plate resistance is quite high and a constant current condition exists. Where a triode is used, the circuit of Fig. 8 will produce approximately the same frequency response; however, the insertion loss of the frequency controlling network will be somewhat greater.

It will be helpful to review the various points of Fig. 6C so that if a different curve were desired by the reader he might readily make changes in the circuit constants to suit his requirements. The point labeled *A* is the point at which the low frequency response falls off. As in any other resistance coupled circuit this point is controlled by the size of the coupling and bypass condensers, C_1, C_3, C_4 of Fig. 5. Satisfactory formulas for computing these values for any desired frequency will be found in the *"Sylvania Technical Manual"* (page 25, 7th edition). The point *P* is the same as previously discussed and is controlled by the size of C_2. For any given value of C_2 the location of point *B* is determined by the size of limiting resistor R_3. If point *P* were to be moved down one octave by doubling C_2, point *B* would also move down one octave. To move point *B* back up one octave halve the resistance of R_3. This effectively increases the length of the slope *P-B*, and therefore increases the total boost and the insertion loss. See Fig. 7.

It may be seen that any response desired may readily be obtained along a 6 db. per octave slope using simple *RC* circuits. Obviously a smaller rise than 6 db. per octave might be required and this may readily be accomplished by placing a shunt resistor (R_5 Fig. 10) across C_2 or by making R_3 (Fig. 5) large. By making R_5 variable a simple variable bass boost results. By using two stages of bass boost a 12 db. per octave slope may be approached and by using a dual pot to serve as R_5 in each stage any desired boost from 0 to nearly 12 db. per octave results. (Fig. 10.) Constants for this circuit are the same as for Fig. 5 with R_5 equal to 1 megohm.

It might be required that a complex curve be produced for low frequency equalization. Combinations of various boosts such as those shown in Fig. 7 could be added together by making the constants of the two stages different. The permissible combinations are almost infinite. Another arrangement which permits the take-off point of the curve to be moved about at will by means of a panel control is shown in Fig. 9. For the constants given, rotation of R_2 will produce any of the curves shown in Fig. 11 including intermediate values. The operation of this novel circuit is easily explained. With R_2 set nearest R_1 both condensers are shorted to ground and no boost will result. With R_2 at the center position the two condensers are effectively in series and therefore their effective capacity is .008 μfd., resulting in a 6 db. per octave boost starting at about 2000 c.p.s. This characteristic is ideal for aural compensation at low volume levels. As the control moves toward the other end the effective capacity approaches .05 μfd., resulting in a 6 db. per octave boost rising from about 300 c.p.s. This control has been found to be very effective.

All of the circuits discussed so far are of the low-pass type. The curves produced all slope downwards and the only factor that determines whether they are low or high frequency controls is the size of C_2. Let us now turn our attention to circuits whose curves slope in the other direction, the high pass type of equalizer. Fig. 12 illustrates a filter so simple that you may not recognize it, although you may have unwittingly designed it into some of your own equipment.

C_1 is the basic high pass filter. Its characteristic slope is also 6 db. per octave and its low frequency effect may be limited by a shunt resistor across it. Fig. 14 illustrates a simple high pass circuit which will suffice for almost all treble boost circuits. The

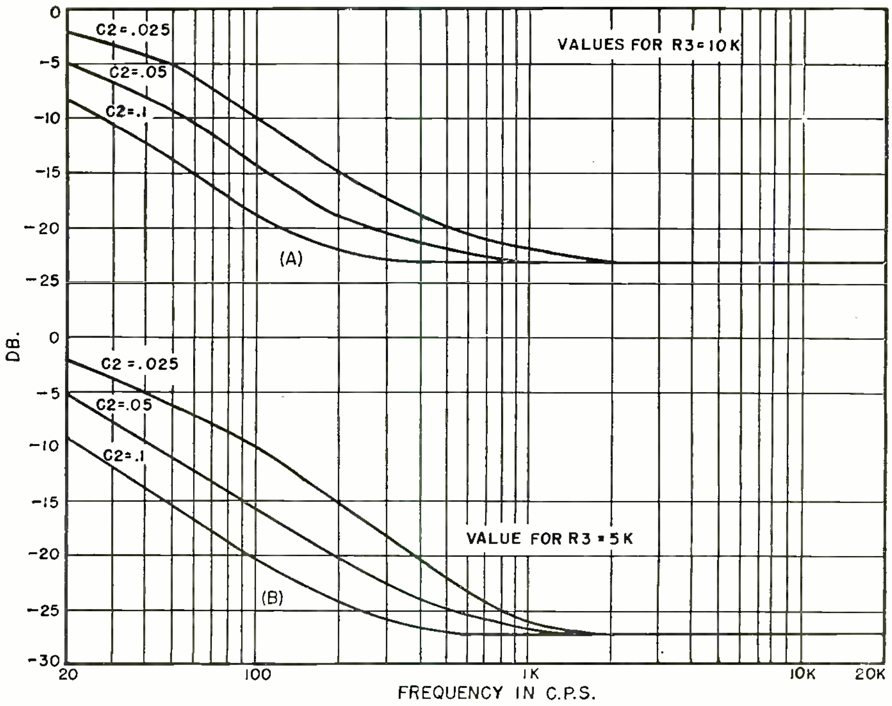


Fig. 7

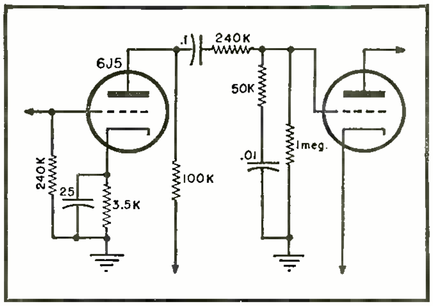


Fig. 8

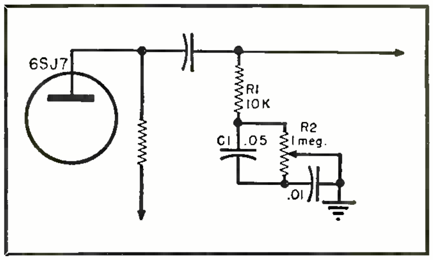
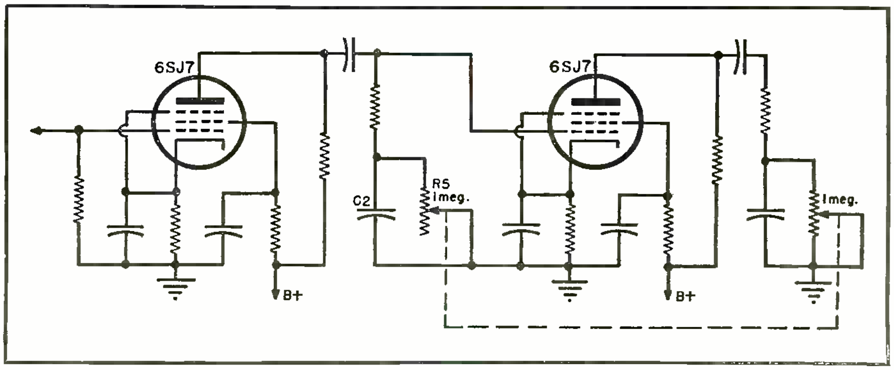


Fig. 9

Fig. 10



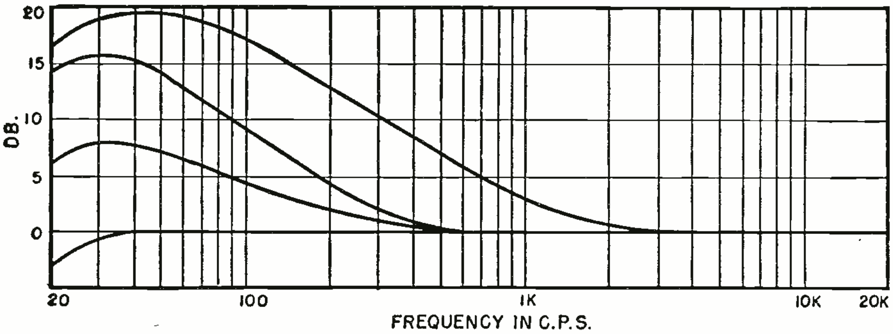


Fig. 11

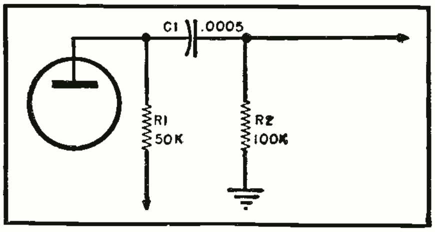


Fig. 12

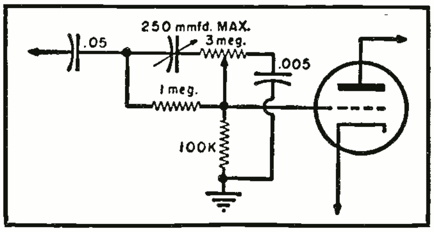


Fig. 13

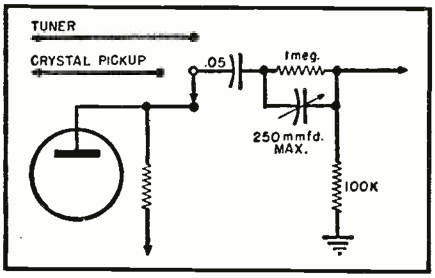


Fig. 14

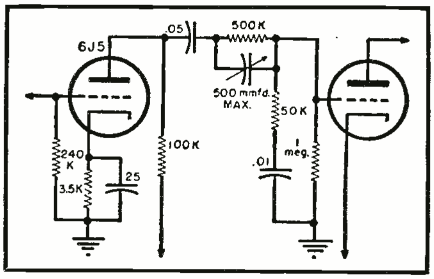
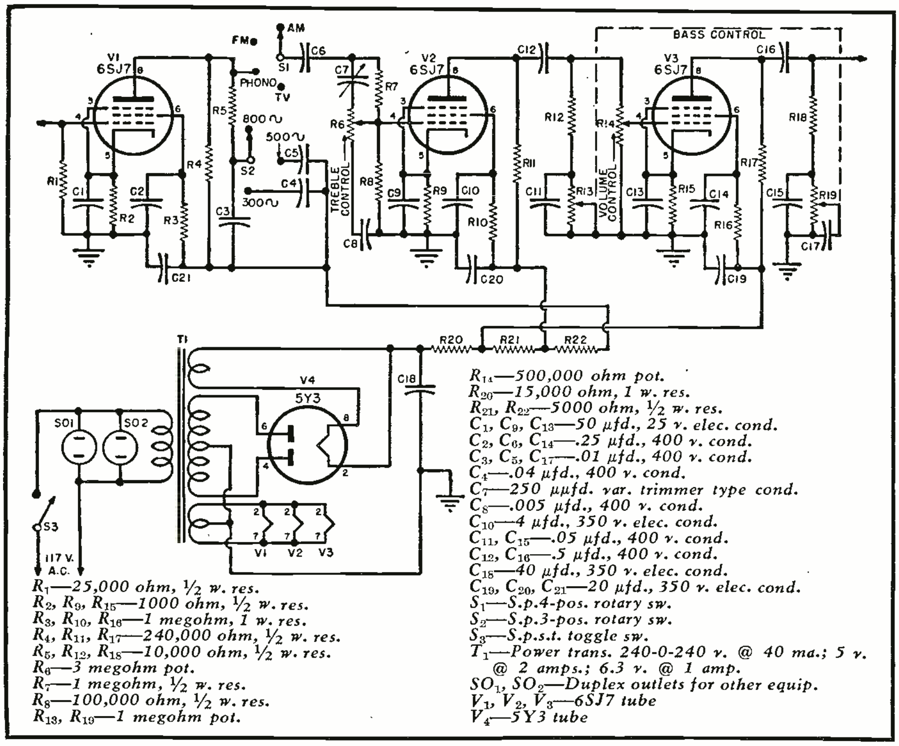


Fig. 15

condenser is made variable in order to move the take-off point horizontally along the frequency spectrum. The

value shown will allow wide flexibility with the rise starting anywhere between 1000 c.p.s. and 6000 c.p.s. The

Fig. 16



R_1—25,000 ohm, ½ w. res.
R_2, R_9, R_{15}—1000 ohm, ½ w. res.
R_3, R_{10}, R_{16}—1 megohm, 1 w. res.
R_4, R_{11}, R_{17}—240,000 ohm, ½ w. res.
R_5, R_{12}, R_{18}—10,000 ohm, ½ w. res.
R_6—3 megohm pot.
R_7—1 megohm, ½ w. res.
R_8—100,000 ohm, ½ w. res.
R_{13}, R_{19}—1 megohm pot.
R_{14}—500,000 ohm pot.
R_{20}—15,000 ohm, 1 w. res.
R_{21}, R_{22}—5000 ohm, ½ w. res.
C_1, C_9, C_{13}—50 μfd., 25 v. elec. cond.
C_2, C_6, C_{14}—.25 μfd., 400 v. cond.
C_3, C_5, C_{17}—.01 μfd., 400 v. cond.
C_4—.04 μfd., 400 v. cond.
C_7—250 μμfd. var. trimmer type cond.
C_8—.005 μfd., 400 v. cond.
C_{10}—4 μfd., 350 v. elec. cond.
C_{11}, C_{15}—.05 μfd., 400 v. cond.
C_{12}, C_{16}—.5 μfd., 400 v. cond.
C_{18}—40 μfd., 350 v. elec. cond.
C_{19}, C_{20}, C_{21}—20 μfd., 350 v. elec. cond.
S_1—S.p.4-pos. rotary sw.
S_2—S.p.3-pos. rotary sw.
S_3—S.p.s.t. toggle sw.
T_1—Power trans. 240-0-240 v. @ 40 ma.; 5 v. @ 2 amps.; 6.3 v. @ 1 amp.
SO_1, SO_2—Duplex outlets for other equip.
V_1, V_2, V_3—6SJ7 tube
V_4—5Y3 tube

selector switch is included only to show that this circuit will work from any source. Fig. 13 is a variation of Fig. 14 which shows a potentiometer connected to permit either treble boost or treble cut. The take-off points for the boost and cut are entirely independent and are controlled by the value of the condensers employed. Many variations of these basic illustrations may present themselves. As an example of the type of thing which can be done Fig. 15 illustrates a combination of Fig. 14 and Fig. 8 which will give a combined high and low boost with a minimum insertion loss.

It is realized that some readers may not wish to take the time and trouble to work out circuits which suit their individual requirements precisely and therefore Fig. 16 has been included to show a completely self-contained preamplifier which may be used to feed an existing power amplifier or other equipment which the reader may possess. This unit includes a preamplifier for a magnetic phonograph pickup such as the *GE, Pickering,* or *Clarkstan.* The switch included in the phono preamp section is designed to equalize the pickup for various low frequency turnover characteristics as indicated. The treble control incorporated is the same as shown in Fig. 13 and discussed above. The bass control will provide a complex characteristic which will give approximately 24 db. maximum boost at 50 c.p.s. With the controls set at the flat position this unit is capable of uniform frequency response of ±1 db. over the entire range of 20–20,000 c.p.s.

It is suggested that the power supply section be kept as far from the input section as possible to minimize hum difficulties. The large amount of bass boost called for presents some difficulties in keeping hum out of the circuit and care should be exercised. Grounds have been grouped on the schematic and you are strongly urged to follow the recommended grouping in your wiring. There should be only one place on the chassis where the electrical ground and the chassis are mechanically connected. The best way to stay out of ground loop difficulty (the worst source of hum in home built equipment) is to forget that the chassis can be a conductor and plan all ground returns so that each stage is wired to its own ground point and separate ground points are tied together by a deliberately wired connection. Do not use the chassis as part of the filament circuit. If your power transformer has no center tapped filament winding, connect one side of the filament circuit to ground at one point only.

Prefer to shield hum generating sources rather than the audio wiring. Shielded pair on filament wiring and a metallic shield around the power supply section generally accomplish this satisfactorily. By not shielding audio wiring itself, the circuit capacity is reduced and 20,000 c.p.s. response is readily attained. —30—

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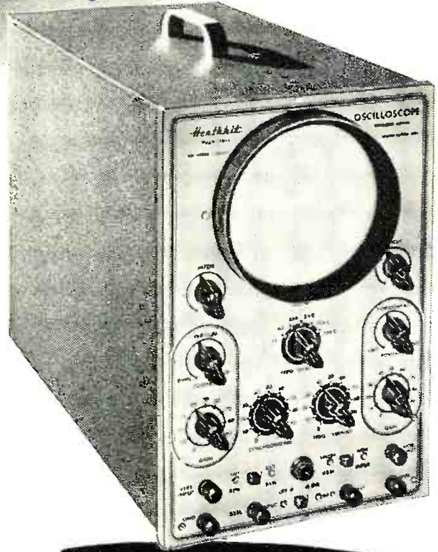

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- The first truly television oscilloscope.
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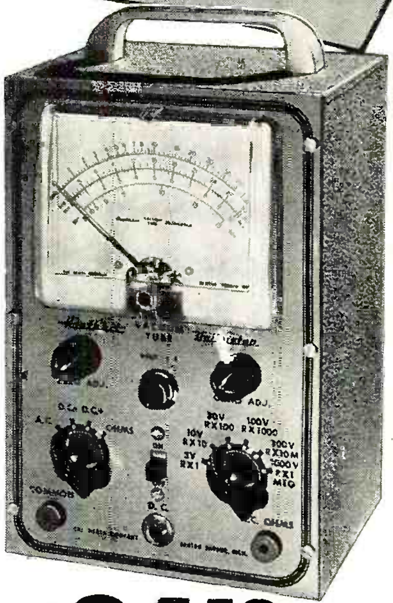

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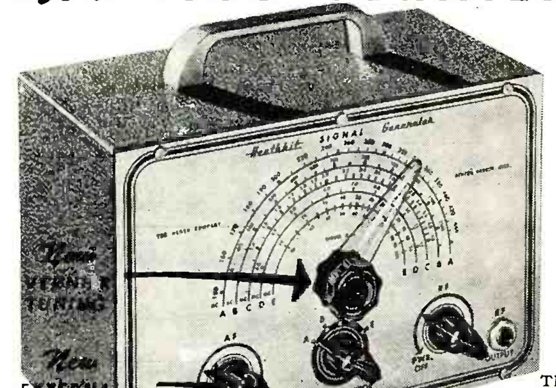

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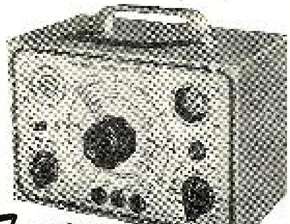

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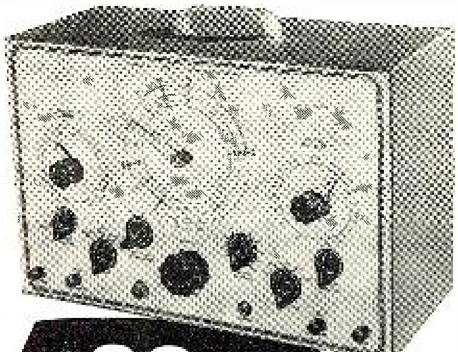

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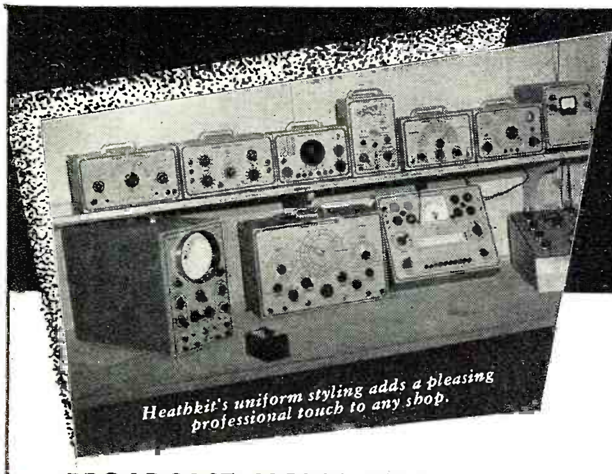

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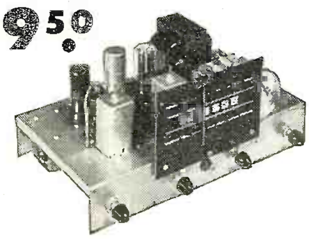

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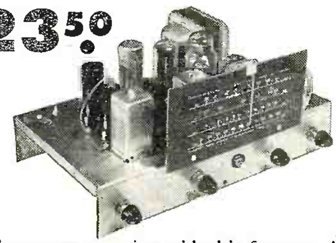

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Multi-TV Receiver Operation From Single Antenna

One solution to the problem of antenna-laden rooftops is the installation of a "master" unit.

By
DANIEL LERNER
TV Field Service Engr.
Philco Corporation

URING the past few years the number of television receiver owners has increased at an amazing pace. It is predicted that there will be nine million television receiver owners by the end of 1950. With this marked increase comes the problem of providing enough space for outdoor antennas in crowded urban areas. In many locations in New York the larger apartment buildings are beginning to resemble houses with a fringe on top. The probable solution lies in a central antenna system which can be used to feed a large number of receivers.

Many such systems have been tried, but probably one of the most efficient is the recently developed unit called the "Antenaplex." This system is adaptable for apartment houses, hotels, institutions, and for numerous other applications.

Fundamentally, this system includes either a separate antenna for each channel in one particular area, or merely a separate antenna section for each channel on one mast. Of course the antenna system used depends upon the type of reception in the particular location.

The signals from the individual antenna are fed to a master amplifier

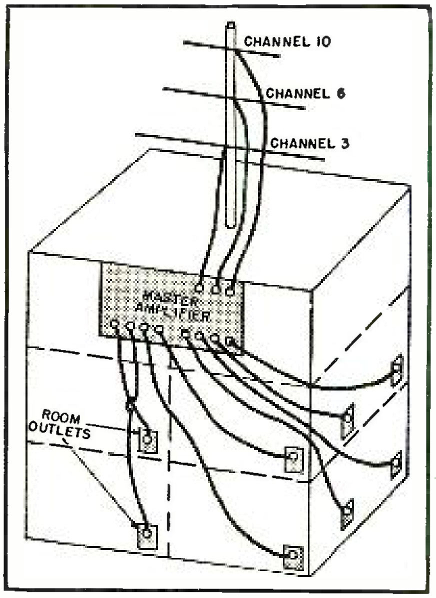
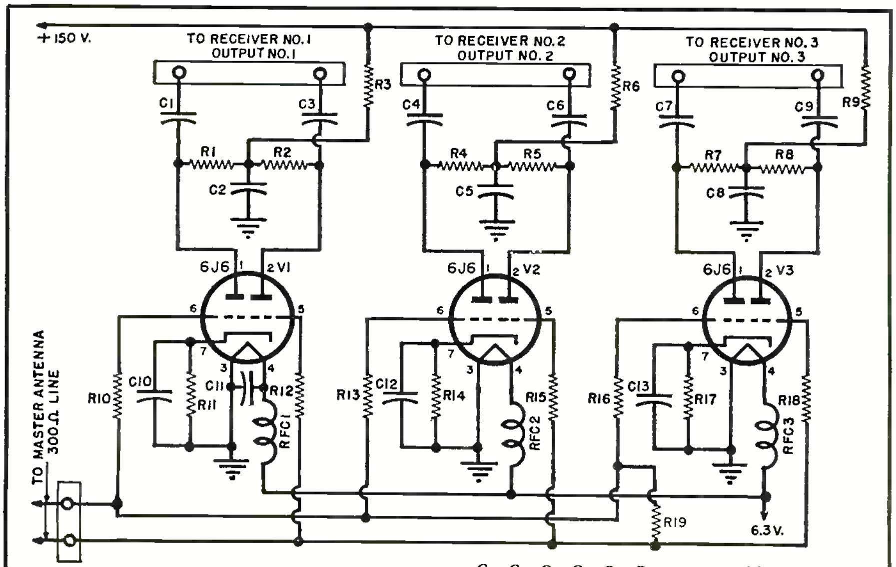


Fig. 1. "Antenaplex" multiple antenna system.

Fig. 2. Multiple antenna system used in department store and dealer installations.



R_1, R_2, R_4, R_5, R_7, R_8—150 ohm, 1/2 w. res.
R_3, R_6, R_9—1000 ohm, 1/2 w. res.
R_{10}, R_{12}, R_{13}, R_{15}, R_{16}, R_{18}—300 ohm 1/2 w. res.
R_{11}, R_{14}, R_{17}—62 ohm, 1/2 w. res.
R_{19}—300 ohm, 1 w. res.
C_1, C_3, C_4, C_6, C_7, C_9—1500 μμfd. mica cond.
C_2, C_5, C_8—1000 μμfd. mica cond.
C_{10}, C_{11}, C_{12}, C_{13}—500 μμfd. mica cond.
RFC_1, RFC_2, RFC_3—R.f. choke (Ohmite Z-144 or equiv.)
V_1, V_2, V_3—6J6 tube

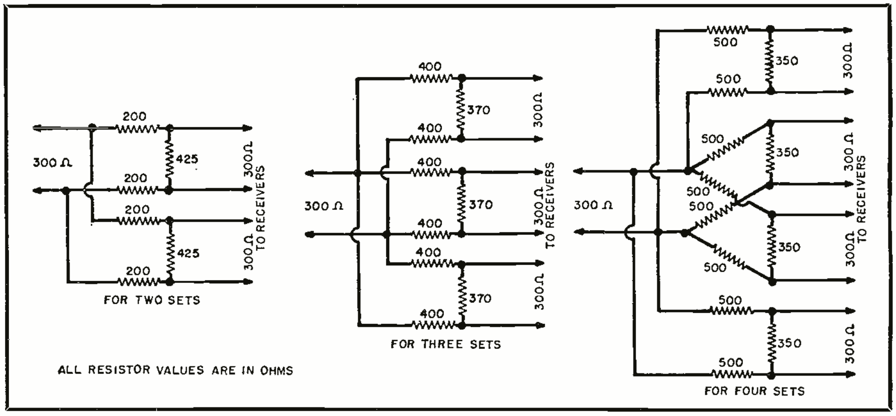


Fig. 3. Simple system for feeding two, three, or four sets by multi-pad arrangement.

which increases the strength of the signal and provides the proper isolation to prevent receiver interaction. The outputs, of a necessarily low impedance to prevent noise and interference pickup, are fed over coaxial cables to room outlets. See Fig. 1.

Another type of system used in some department store, dealer, and school applications is shown in Fig. 2. Here we have a series of 6J6 tubes used as isolation amplifiers. The master antenna is fed to the grids of the 6J6 in parallel, with one triode for each side of the balanced 300 ohm line. It should be noted that a 300 ohm match is maintained at both the grid and plate sides of the triode. With this type of unit quite a bit of loss, in the order of 60%, should be expected but good isolation is effected nevertheless. Thus receiver local oscillator interaction is kept to a minimum. By using a booster amplifier before the signal is fed to this system, the effects of this loss may be minimized.

A simple system for feeding more than one receiver is a multi-pad arrangement as shown in Fig. 3. With this system a large amount of initial signal is required as the available signal decreases in proportion with the number of receivers fed. In all cases, however, the 300 ohm impedance is kept constant. —30—

SET OWNERSHIP IN FOREIGN COUNTRIES

FROM the Consumers Merchandise Branch of the United States Department of Commerce comes new and additional data on set ownership in various foreign countries, as reported by U. S. legations, embassies, and consulates.

Austria has an estimated 1,280,000 radio receivers in operation, as of November, 1949, of which 64,000 are unlicensed. Approximately 356,000 of the sets are equipped to receive short-wave broadcasts, and an estimated 3 persons listen to each receiver.

An estimated 25,000 radio receivers are in use in Burma of which 7000 were manufactured prior to 1939. Radios of United Kingdom manufacture dominate the Burmese radio market, followed by the United States and the Netherlands. Import controls on radio equipment have been liberalized since September 1949, resulting in increased imports.

Canadian manufacturers sold a total of 460,649 units during the first nine months of 1949 at a total value of $33,326,189, an increase over the same period in 1948.

Imports during January-September 1949 amounted to 41,416 sets of which 39,974 sets were designated as "sets imported under special conditions". Exports of radio sets in the same period totaled 25,210 units.

Canadian production of radio receiving tubes in the first nine months of 1949 totaled 3,363,410 units, while for the corresponding period in 1948, 3,241,728 tubes were produced. Imports of receiving tubes during the January-September 1949 period aggregated 914,352 units as compared with 759,122 in the same period of 1948. Imports of radio tube parts during January-September 1949 were valued at $391,862 as compared with $216,004 in the like period of 1948.

The report from Finland indicates an estimated 727,000 receivers in use as of December 31, 1949, of which 662,000 were licensed. About 71 per-cent are equipped to receive short-wave broadcasts. Approximately 3.6 persons listen to each set.

An estimated 42,000 radio receivers were in use in Iceland as of December 15, 1949. Approximately 65 per-cent of the sets in operation were Philips (Netherlands and the United Kingdom), 7 per-cent were Marconi (United Kingdom), 4 per-cent Telefunken (Germany), 7 per-cent other European brands, and 17 per-cent United States manufacture.

An estimated 80,000 radio receivers are in use in Iran, most of which were manufactured after 1945. About 60 per-cent of the sets are of United States manufacture, 30 per-cent British, and the remainder Dutch and Swiss.

Because of the shortage of electric power, particularly in the provinces, an estimated 50 per-cent of the radios currently imported are battery operated. The life expectancy of batteries by the time they reach the Iranian market is reported to be as little as two months.

Some European exporters extend three months' credit and are reported to be contemplating extending credit up to six and nine months. It is reported that Iranian importers complain of the continued failure of United States exporters to extend credit.

—30—

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Mac's Service Shop

(*Continued from page* 68)

some other damage. You simply switch over to the ohmmeter and use the resistance-checking method to find out if your trouble is an open i.f. transformer primary, an open plate-isolating resistor, a shorted bypass condenser, or maybe a shorted tube."

"That makes sense," Barney observed judiciously.

"Another fault with being married to one system," Mac went on, "is that it tends to kill a guy's originality. A good service technician ought to be constantly trying to find better ways of doing his work. Just last week I had a convincing demonstration of that. For twenty years I've been trying to cook up a really good way to service those sets that are plagued with a rustling sound. You know what I mean: the kind of sound you get when an i.f. winding is opening up or an output primary is going out or a grid cap solder connection is poor or you have a noisy plate resistor.

"Those rustling sounds are produced by small, instantaneous current fluctuations. They are too quick to show on a meter, and you can't go probing around with an ohmmeter without running the risk of temporarily 'healing' the trouble you are trying to spot by running the ohmmeter current through the coils or resistors. Even a signal tracer cannot be used to advantage unless it is of extremely high gain and very, very quiet.

"The other day, when I had one of these sets, I suddenly got the bright idea of putting the vertical input of the scope across the units I suspected while the sweep was working on a low frequency and drawing out about a three-inch horizontal line. With the input across the output transformer, every little rustle would shoot up a little hair-like filament from the line. These little offshoots kept right on showing up as I moved back through the receiver until I reached the grid of the audio stage. On the plate I saw them; on the grid I didn't. When the tube was yanked, they were still there for a few seconds until the rectifier cathode started to cool—it was an a.c.-d.c. set—so the tube was not at fault. When the mica r.f. bypass was cut loose from the plate, no little spikes were present across the resistor. That condenser was leaky *only* when a certain critical voltage was across it. It checked OK with the battery voltages ordinarily used with an ohmmeter.

"From now on I intend to use the scope to track down all of these 'rustlers.' If my mind hadn't been burdened with the idea that a scope was only good for aligning, waveform analysis, and distortion-spotting, I might have discovered this much sooner. The less hidebound your service technique is, the more likely you are to discover new and better methods of doing your work.

"Really it all goes back to how you feel about radio servicing. Personally, the thing I like about servicing is that it is a *thinking business* and cannot be easily systemized. The problems you encounter are far too complex and varied and changing to allow you to settle into a dull routine; and, by the same token, they are not to be solved with the greatest efficiency and dispatch by the application of any neat little universal formula or procedure. I am confident that the next set I put on the bench—and incidentally it is high time we started putting some sets on the bench—will be a little different in some detail or other from any I have worked on before—say," he broke off, "what the heck are you trying to do with that solder gun?"

"Just following your advice and working out a new and better method of servicing," Barney explained blandly. "It always gripes me when I want to see if a voice coil is open and I have to unsolder the output transformer secondary from across the coil before I can test it. About half the time I lose the flexible voice coil lead out of the terminal and have a tough time working it back. Now I've got a better way. When you pull the trigger on this gun anyways near the output transformer, you get a strong hum from the speaker if the transformer secondary and the voice coil are both OK. It must be a.c. induction from the gun transformer."

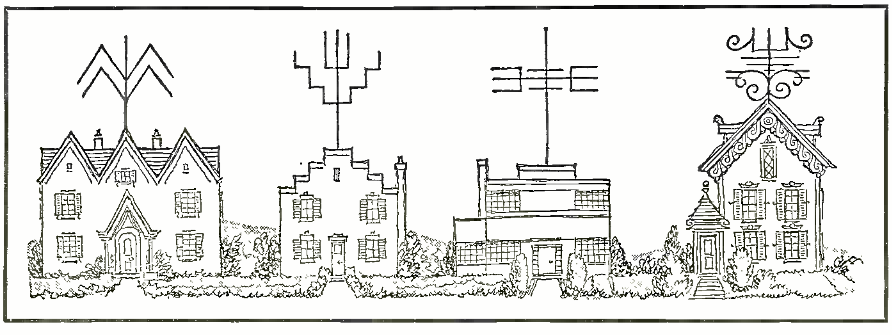
"My boy, I am proud of you!" Mac beamed. "You are really using that old flame-colored noggin. That makes me feel good."

"That's not what makes you feel good," Barney observed.

"What does, then?"

"Getting the 'systems' out of your system," the boy said with a knowing grin as he slid from the bench.

—30—



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7DP4	17.95
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10Y	.39
10SPEC	.69
10BP4	22.45
10CP4	29.50
12DP7	12.50
12DP8	14.95
12FP7	14.95
12GP7	12.95
12HP7	12.95
12KP4	49.50
12LP4	49.50
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23D4	.49
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218	12.50
221A	1.75
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274B	1.00
275A	7.95
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283A	10.95
286A	10.95
290A	4.95
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294A	4.50
300A	3.95
301A	6.95
304B	5.95
304TH	3.50
304TL	1.30
307A	4.95
310A	7.95
315A	6.95
316A	.50
327A	2.50
338A	3.75
348A	5.95
350A/B	2.75
354C/D	19.95
357B	49.50
368AS	4.93
371A/B	.50
374A	2.50
393A	3.50
394A	3.50
399A	2.50
400A	3.25
401A	1.95
403A/B	1.75
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434A	2.75
446A	1.00
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703A	3.50
705A	1.00
706AY	18.50
706CY	18.50
706GY	49.50
707A/B	14.00
708A	3.75
710A	2.95
713A	1.00
714AY	4.75
715A/B	6.75
715C	22.50
717A	.53
720DY	34.95
721A/B	2.60
723AB	7.95
724A/B	2.75
725A	6.75
726A/B/C	13.50
728GY	24.95
730A	9.75
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Type	Price
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802	4.25
803	3.45
804	8.50
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808	1.35
809	2.50
810	7.75
811	2.00
812	2.50
812H	6.50
813	6.75
814	2.40
815	1.25
816	1.19
826	.35
829A/B	7.25
830	2.95
830B	3.25
832/A	4.95
833A	34.25
834	5.50
836	.90
837	1.50
838	2.25
841	.30
843	.25
845/W	4.00
849A/H	69.50
851	25.00
860	5.75
861	35.00
864	.35
865	1.95
866A	.99
866JR	1.19
872A	1.30
874	.35
876	.28
878	1.75
884	1.49
885	.98
889R	140.00
891	110.00
892	115.00
902P1	3.50
905	2.75
907	11.95
913	4.95
917	1.50
918	1.50
922	1.00
923	.75
925	1.40
930	.80
931A	2.60
934GT	1.50
949A	69.50
950	.98
954	.30
955	.35
956	.35
957	.19
958A	.18
959	.35
966A	.99
972A	2.95
975A	14.95
991	.23
1613	.45
1614	1.35
1616	.50
1619	.15
1620	4.95
1621	.98
1622	1.75
1624	1.05
1625	.35
1626	.25
1628	4.95
1629	.19
1631	1.35
1633	.75
1634	.79
1636	3.50
1638	.75
1641	.45
1642	.25
1644	1.49
1645	1.98
1649	1.25
1665	1.05
1851	.95
1852	1.06
1853	1.06
1960	.85
2050	.95
2051	.40
5514	4.95
5516	5.95
5562	10.00
7193	.18
8005	4.60
8011	2.00
8012A	1.25
8013A	1.25

Type	Price
8014A	24.95
8016	1.10
8020	1.25
8025A	7.95
8026	12.95
BR	2.50
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C1A	4.95
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CEQ72	1.95
CK1005	.08
CK1006	.69
CK1090	2.75
EF50	.35
EL1C	4.95
EL3C	4.95
F123A	12.50
F128A	70.00
F660	110.00
FG17	2.75
FG27A	8.95
FG32	5.95
FG33	8.95
FG81A	3.75
FG95	9.95
FG105	9.50
FG172A	13.75
FG235	59.50
FG238B	160.00
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GL473	65.00
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GL530	49.50
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R100	3.75
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R1130	12.95
REL36	.55
RK20A	7.50
RK22	4.95
RK23	4.75
RK31	2.50
RK33	.25
RK34	.25
RK39	1.75
RK51	3.95
RK52	4.50
RK59	1.75
RK60	.79
RK62	1.98
RK63	12.95
RK65	24.95
RK72	.65
RK73	.65
RX21	3.10
RX120	8.75
T20	1.50
T21	1.75
T55	3.95
T200	10.95
TZ20	1.50
TZ40	2.95
UH50	5.95
UX200	.75
V70D	6.95
VR75	.98
VR78	.25
VR90	.65
VR91	1.49
VR105	.75
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VT127A	2.00
VU111	.50
WL460	14.95
WL468	6.75
WL532A	1.75
WL562	150.00
WL616	85.00
Z225	1.95
ZB120	6.95
ZB3200	150.00
ZP477/12DP8	14.95

Type	Price
0A2	1.56
0A3/VR75	.98
0A4G	.94
0B2	1.74
0B3/VR90	.64
0C3/VR105	.78
0D3/VR150	.54
0Y4	.88
0Z4	.56
0Z4G	.56
01A	.24
1A3	.43
1A4	1.08
1A4P	.96
1A5GT	.48
1A6	.78
1A7GT	.66
1B3GT	1.49
1B4	1.18
1B5/25S	.88
1B7GT	1.06
1C5GT	.66
1C6	.88
1C7G	.88
1D5GP	.96
1D7G	.88
1D8GT	.94
1E5GT	1.38
1E7G	1.56
1F4	.74
1F5G	.74
1F6	1.56
1F7G	1.56
1G4GT	.68
1G6GT	.68
1H4G	.68
1H5GT	.53
1H6G	.86
1H6GT	.86
1J6GT	.88
1L4	.54
1LA4	.78
1LA6	.88
1LB4	.88
1LC5	.78
1LC6	.56
1LD5	.78
1LE3	.88
1LG5	.88
1LH4	.64
1LN5	.66
1N5GT	.58
1P5GT	.66
1Q5GT	.66
1R4	.68
1R5	.68
1S4	.78
1S5	.56
1T4	.56
1T5GT	.78
1U4	.58
1U5	.72
1V	.68
2A3	.96
2A4G	1.06
2A5	.68
2A6	.78
2A7	.88
2B7	.88
2V3G	.98
2X2A	.68
3A4	.36
3A5	.98
3A8GT	1.98
3B7	.34
3D6	.34
3LF4	1.28
3Q4	.58
3Q5GT	.66
3S4	.66
3V4	.80
5A74	.50
5R4GY	1.09
5T4	.88
5U4G	.56
5V4G	.88
5W4	.78
5W4GT	.66
5X4G	.58
5Y3GT	.36
5Y4G	.48
5Z3	.48
5Z4	.78
6A3	1.28
6A6	.88
6A7	.68
6A8	.78
6A8GT	.80
6AB5/6N5	.88
6AB7/1853	.78
6AC5GT	1.16

Type	Price
6AC7/1852	0.76
6AD6	.88
6AD7G	1.28
6AF6G	.78
6AG5	.76
6AG7	.97
6AH6	1.28
6AJ5	.78
6AK5	.84
6AK6	.78
6AL5	.64
6AL7GT	1.06
6AQ5	.58
6AQ6	.58
6AQ7GT	.88
6AR5	.66
6AS7G	1.95
6AT6	.46
6AU6	.58
6AV6	.46
6B4G	.88
6B5	1.56
6B6G	.78
6B7	.88
6B8	.88
6B8G	1.28
6BA6	.54
6BE6	.56
6BG6G	1.46
6BH6	.56
6BJ6	.58
6C4	.24
6C5	.46
6C5GT	.46
6C6	.56
6C7	1.28
6C8G	.68
6D6	.16
6D8G	.87
6E5	.68
6E6	1.06
6F5	.46
6F5GT	.46
6F6	.64
6F6GT	.66
6F7	.84
6F8G	.86
6G6G	.88
6G8G	.68
6H6	.46
6H6GT	.46
6J5	.48
6J5GT	.48
6J6	.76
6J7	.66
6J7GT	.66
6J8G	1.28
6K5GT	.96
6K6GT	.44
6K7	.48
6K7GT	.48
6K8	.78
6K8GT	.78
6L5G	1.06
6L6	1.16
6L6G	.86
6L6GA	.86
6L7	.78
6L7G	1.16
6N6G	1.56
6N7	.78
6N7GT	.78
6P5GT	.96
6Q6G	1.06
6Q7	.58
6Q7GT	.58
6R7	.78
6R7GT	.78
6S7	.88
6S7G	.88
6S8GT	1.06
6SA7	.43
6SA7GT	.43
6SB7Y	.88
6SC7	.58
6SD7GT	.68
6SF5	.48
6SF5GT	.54
6SF7	.58
6SG7	.58
6SH7	.48
6SJ7	.56
6SJ7GT	.56
6SK7	.54
6SK7GT	.54
6SL7GT	.64
6SN7GT	.64
6SQ7	.43
6SQ7GT	.43
6SR7	.56
6SR7GT	.56
6SS7	.58

Type	Price
6ST7	.88
6SV7	.88
6T7G	.97
6U5/G5	.64
6U6GT	.72
6U7G	.54
6V6	.96
6V6GT	.62
6W7G	.88
6X4	.58
6X5GT	.48
6Y6G	.66
6Y7G	.88
6Z7G	1.14
6ZY5G	.68
7A4/XXL	.58
7A5	.72
7A6	.66
7A7	.56
7A8	.72
7AD7	1.06
7AF7	.72
7AG7	.71
7AH7	.88
7B4	.56
7B5	.72
7B6	.58
7B7	.58
7B8	.72
7C4/1203A	.36
7C5	.56
7C6	.72
7C7	.58
7E5/1201	.66
7E6	.58
7E7	.68
7F7	.68
7F8	1.06
7G7/1232	1.06
7H7	.63
7J7	1.06
7K7	1.06
7L7	.68
7N7	.66
7Q7	.58
7R7	.68
7S7	1.06
7V7	1.06
7W7	.88
7X7/XXFM	.88
7Y4	.56
7Z4	.56
10	.69
12A	.56
12A6	.18
12A6GT	.18
12A7	.97
12A8GT	.58
12AH7GT	.84
12AL5	.80
12AT6	.44
12AT7	1.16
12AU6	.66
12AU7	.78
12BA6	.56
12BE6	.48
12C8	.48
12F5GT	.57
12H6	.26
12J5GT	.26
12J7G	.80
12J7GT	.80
12K7GT	.53
12K8	.58
12K8GT	.66
12Q7GT	.48
12SA7	.56
12SA7GT	.56
12SC7	.56
12SF5	.56
12SF5GT	.56
12SF7	.56
12SF7GT	.56
12SG7	.56
12SH7	.34
12SJ7	.48
12SJ7GT	.48
12SK7	.56
12SK7GT	.56
12SL7GT	.58
12SN7GT	.51
12SQ7	.48
12SQ7GT	.48
12SR7	.48
12SR7GT	.48
12Z3	.78
12X3	.98
14A7/12B7	.68
14AF7/XXD	.88
14B6	.68

Type	Price
14B8	.88
14C5	.88
14C7	.88
14E6	.72
14E7	.88
14F7	.68
14F8	.88
14H7	.64
14J7	1.06
14N7	.88
14Q7	.56
14R7	.66
14S7	1.06
14W7	1.06
14X7	1.06
14X4	.88
19	.97
19T8	1.56
22	1.28
24A	.66
25A6	1.06
25A6G	1.06
25AC5GT	1.16
25L6GT	.52
25Y5	1.16
25Z5	.48
25Z6GT	.48
26	.56
27	.46
28D7	.34
30	.56
31	.86
32	.96
32L7GT	.96
33	.68
34	.68
35/51	.56
35A5	.66
35B5	.64
35L6GT	.53
35W4	.38
35Y4	.48
35Z3	.56
35Z4GT	.43
35Z5GT	.38
36	.39
37	.34
38	.27
39/44	.26
41	.51
42	.48
43	.48
45	.51
45Z3	.56
45Z5GT	.48
46	.68
47	.68
49	.88
50	1.56
50A5	.68
50B5	.54
50L6GT	.53
50Y6GT	.56
53	.86
56	.43
57	.37
58	.48
59	.88
70L7GT	1.16
71A	.66
75	.52
76	.38
77	.42
78	.44
79	.88
80	.38
81	1.28
82	.86
83	.71
83V	.88
84/6Z4	.62
85	.68
89	.72
89Y	.38
117L7GT	1.28
117M7GT	1.56
117N7GT	1.36
117P7GT	1.26
117Z3	.56
117Z4GT	1.16
117Z6GT	.64
FM-1000	1.28
UX120	1.38
UX200	1.28
8001	.36
9002	.28
9003	.32
9004	.36
9005	1.90
9006	.23

Minimum Order $5.00. Quantity Prices on Request. All tube types in stock now—subject to prior sale—prices subject to change without notice. 20% Deposit with orders unless rated. All prices F. O. B., N.Y.C.

Niagara Radio Supply Corp.

Phone Digby 9-1132-3-4

Dept. N-50 160 Greenwich Street, New York 6, N. Y.

Technical BOOKS

"THE RADIO AMATEUR'S HANDBOOK" by the ARRL Staff. Published by *The American Radio Relay League,* West Hartford, Conn. 605 pages. Price $2.00. (27th Edition—1950.)

As indicative of the coming of Spring as the first crocus, the new edition of the "Handbook" has arrived on the amateur horizon.

Long the bible of the ham fraternity, this newest volume enhances its already formidable reputation by the presentation of new and up-to-the-minute information on all phases of ham equipment and operation.

The twenty-five chapters into which the book is divided cover the entire field of ham communications from the basic fundamentals to the latest techniques in single-sideband telephony.

Since few persons in the field need any introduction to the "Handbook" suffice it to say that this edition is the "best ever."

* * *

"RADIO TECHNOLOGY" by Ernest J. Vogt. Published by *Pitman Publishing Corporation,* New York. 542 pages. Price $6.00.

The publishers of this book have dubbed it a "one volume reference library" and they are not far wrong. Covering telegraphy, telephony, television, transcription, and facsimile in addition to radio, this text packs an amazing amount of basic information into its 500 plus pages.

Designed as an interim handbook which fills the gap between elementary radio texts and books at an engineering level, the author has managed to present his subject matter without resorting to complicated mathematical formulas. What little math is required in the text is fully explained in a chapter devoted to radio mathematics. The first chapter covers basic electrical concepts while additional chapters are devoted to the direct current theory, basic a.c. theory, motors and generators, inductance, capacitance, advanced a.c. theory, the vacuum tube, the v.t. oscillator, receiving circuit principles, transmitting circuit principles, antennas, sound conversion, radio aids to navigation, measurements in radio, studio and control equipment, and television and facsimile.

Seven tables in the appendix deal with schematic radio symbols, mantissas of common logarithms, trigonometric functions, db. vs. voltage and power, frequency tolerances, loss constants for attenuation pads, and the international "Q" signal code.

The work is written by and for the practical radio man with the result that all of the material is presented in usable and convenient form. Practical radio technicians, those studying or holding operators' licenses, and practical radio engineers will all find this book valuable in their work.

* * *

"RADIO OPERATING QUESTIONS AND ANSWERS" by J. L. Hornung. Published by *McGraw-Hill Book Company,* New York. 574 pages. Price $5.00. (Tenth Edition.)

This well-known study text, making its appearance for the tenth time, has been completely revised to provide concise information on radio communication—theory, apparatus, circuits, laws and regulations, FM, television, aircraft radio, radar and loran, grouped into the seven elements which go to make up the FCC commercial radio operator licensing examinations.

The new FCC element, Element 7, which became effective on January 3, 1950 is covered by 266 questions dealing with rules and regulations, radio theory operations, and special air navigation problems.

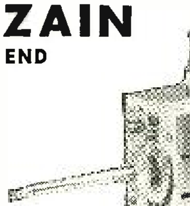
In addition, this new volume includes 46 special problems covering the more complex questions given in the FCC Guide.

Specifically the book provides 1753 answers to the examination elements. In addition much of the data will prove valuable to those in all branches of electricity, radio broadcasting, and marine radio operation. —30—

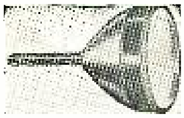
Members of the Federation of Radio Servicemen's Association group around Robert H. Bishop, vice-president in charge of sales, who accepted the Federation's award on behalf of Sylvania Electric Products Inc. The company was awarded the plaque for outstanding promotion and advertising efforts in stimulating public confidence.

McGEE SCOOP! 16" BLACK FACE PICTURE TUBE $24.95

SARKES-TARZAIN
13-CHANNEL T.V. FRONT END
WITH TUBES AND DIAGRAM $7.95



This popular Sarkes-Tarzain television front end is widely used to-day. The 13 channel rotary switch type with individually tuned coils. Price includes a schematic diagram and 3 tubes, 6C4 osc, 6BH6 RF and 6AG5 mixer. Regular factory cost is twice our price. Each tuner and its own tube sockets are wired, ready to hook up to a video and sound IF strip. May be used with either inter-carrier or separate sound IF circuits. Built-in fine frequency control. Ship. weight 3 lbs. Sarkes-Tarzain Type 2 TV tuner with tubes net.......................$7.95
Combination deal, Sarkes-Tarzain TV tuner and 205-XX video coil kit both for..$14.95
Sarkes-Tarzain Type 3—Same as Type 2 only has input IF coil built-on. Tapped for sound IF channel. Net.......................$9.95
Sarkes-Tarzain Type 3 tuner and 205-XX coil kit both for.......................$16.95

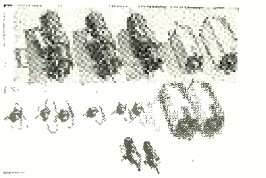


16JP4 BLACK FACE $24.95
16JP4 NEUTRAL FACE $22.95
12LP4 BLACK FACE $18.95
12LP4 NEUTRAL FACE $16.95

★Every Tube Guaranteed to You for 90 days ★ Limited Quantity ★ Best Value in America

Factory changes in tube specifications make this picture tube sale possible. Quality of these tubes is number one. All are guaranteed by us for 90 days. You must be satisfied. The 16JP4 equivalent, a direct replacement for any 16" picture tube, is available with new style black face. Specify "Black Face" when ordering. Shipping weight 25 lbs. Net price **$24.95.**
16JP4 equivalent is also furnished with a neutral or standard face, at **$22.95.** Specify "Neutral Face" when ordering.
12LP4 equivalent is furnished with neutral face at the scoop price of **$16.95.** Shipping weight 19 lbs.
12LP4 equivalent with black face. Specify "Black Face" when ordering. Net price **$18.95.** Shipping weight 19 lbs.
All above tubes are not seconds and pass RMA standards. Guaranteed for 90 days by us. Name of famous maker has been withheld and does not appear on the tubes for obvious reasons.

TELEVISION VIDEO COIL KIT $7.95



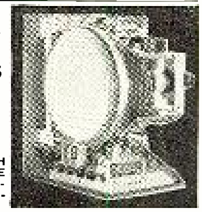
★ BUY SARKES-TARZAIN FRONT END and COIL KIT for $14.95
- **20 MATCHED COILS**
- **FOR SEPARATE PICTURE & SOUND**

20 matched TV coils; video and sound IF. McGee Scoop price **$7.95.** Television video coil kit, for TV sets up to 16", using separate sound and picture circuits. Consists of 20 coils for use in the nationally famous 30 tube and 22 tube TV circuit. All coils are of the finest construction, furnished to you, just like they go to a TV set maker. Each coil is identified. These are not made by RCA, but by a top quality coil company, especially for McGee. If you are going to use the RCA circuit, you can use this set of coils. Coil kit has 1-180 uh, 1-250 uh, 2-120 uh, 2-93 uh peaking coils. 4 picture IF coils for 25.75 mc, 1 cathode trap. 2 sound IF's 21.25 mc, 1 discriminator, 1 convertor and 5 filament chokes, Stock No. 205-XX, shipping weight 3 lbs. McGee's sale price **$7.95.** These coils match the Sarkes-Tarzain TV front end listed above. Why not order both the tuner and the coils?

10-INCH PICTURE TUBE $7.95

Super-duper 10 inch television picture tube sale. 10BP4 equivalent. These tubes came from a factory that rejected them because of slight screen defects. We offer them to you at low prices. Low enough to use them for building or testing purposes. Shipping weight 12 lbs. Each tube guaranteed 90 days. Stock No. X-10BP4. Net price **$7.95** each.

15-INCH NATIONALLY FAMOUS T.V. CHASSIS COMPLETE



$149.95

COMPLETE WITH PICTURE TUBE FULL DESCRIPTION ON REQUEST

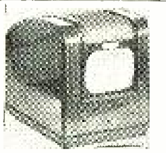
A complete television receiver chassis made by a manufacturer whose name you will recognize. Not a kit, but a 15" TV set with all tubes, 8" speaker and 15DP4 picture tube. Has 19 tubes, plus three rectifiers. Supplied with wood frame for wall or cabinet mounting. Size 19½ x 23" wide and 21¼" deep. Price was **$259.00.** Now at McGee for **$149.95.** Stock No. 520E. Shipping weight 80 lbs.
We will furnish the above 520E television chassis with a black face 16" picture tube instead of the 15" tube for **$10.00** extra.

Regular $25.00 Television Magnifier
SALE PRICE $7.95

Stock No. HA-22
FOR 7-10-12 INCH TUBES

Stock No. HA-22 12 x 17 in. television magnifier. Made of crystal-clear plastic and oil-filled. Magnifies your present 7-, 10-, or 12-inch television picture up to four times. We offer you these new factory cartoned magnifiers, you provide your own means of mounting to your set. Edge of magnifier may be drilled and hung on your set with cord. This lens is $25.00 value, but McGee offers them to you for only **$7.95.** Shipped by express only. Ship. wt. 22 lbs.

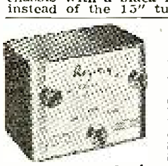
10-INCH TELEVISION CABINET $5.95



Buy this 10" streamlined mahogany television cabinet at less than the manufacturer's cost. Originally intended for use in the Farnsworth factory. Top quality and good looking. Size 13 x 19 x 17" high. Shipping weight 33 lbs. Stock No. RY-10. Net price **$5.95.**
Buy both the RY-10 cabinet and partially wired GVZ-60 television chassis. Plenty of usable resistors and condensers. Chassis is made for cabinet. Both cabinet and chassis for $7.95.
1948 Supreme TV manual has GVZ-60 diagram and many others $3.00 extra.

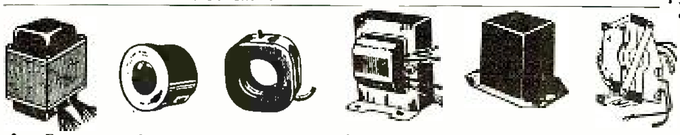
Walsco filters for TV sets at scoop prices. 12½" filter **$1.69,** 3 for **$4.49.** 16" filter **$2.69,** 3 for **$7.49.** 10" Polaroid, only a few, **$2.95** each.

REGENCY T.V. BOOSTER $17.61



Regency Model DB-213 all channel Television Booster. Tuned grid, tuned plate with 6J6 triodes. Two boosters can be hooked in series without circuit instability. Size 5¼ x 3¼ x 4". Shipping wt. 3 lbs.

Anchor $22.05
Anchor Model ARC-101-50 Television Booster. Research organizations accept this as a number one booster. Tuned plate, tuned grid circuit All channel. Size 8¼ x 5 x 4". Shipping wt. 6 lbs. Net **$22.05.**
Anchor new 1950 model 2 stage television booster Model ARC-101-100. Single knob control. A completely engineered and manufactured article. Anchor has made this new 2 stage booster to increase TV signals 5 times. Anchor Model ARC-101-100. Net Price **$26.43.**



A. Power transformer suitable for RCA 630 circuit 760 volts CT at 300 MA. 5 volts 3 amps., 5 volts 3 amps. and 6.3 volts 8 amps. Jefferson built. Shipping weight 12 lbs. Stock No. MB-4F, Net price...........$5.95

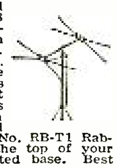
B. Deflection Yoke 201D1 for 12 or 10 inch picture tube. Net price **$2.95 ea.**

C. Focus Coil 202D1, 247 ohms DC resistance, for 10 or 12" picture tube. Scoop price...........$1.95 each

D. Vertical deflection output transformer 204T2 for 10, 12 or 16" picture tube. Net price...............$1.95 each

E. Vertical oscillator transformer 208T2. for 10, 12 or 16" picture tube. Net price...............$1.50 each

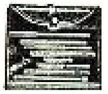
F. Horizontal scanning output transformer (flyback) supplies H.V. to picture tube. Has rect. filament winding for 10 or 12" picture tube. Also, feeds horizontal scanning coil of deflection yoke. Net price. . . . $3.49



Television all band conical antenna, as pictured with 8 foot mast and mounting hardware. You furnish your own 300 ohm lead. Stock No. RT-44LL. Net price $6.75. Conical elements only, same as above antenna, but less mast. Stock No. SK-22. Net price $4.69. Stacking bars 90c per pair. Order one each of the above for a stacked conical TV antenna. Stock No. RB-T1 Rabbit Ear or V antenna for the top of your TV set. Has heavy weighted base. Best quality. Net price. **$2.29.**

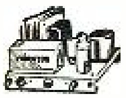
Top quality control circuit parts for TV replacement and construction. 201R1 Width control **44c** each. 201R3 Linearity control **44c** each. 208T8 Syncrolok **99c** each.

TELEVISION ALIGNMENT KIT $3.95



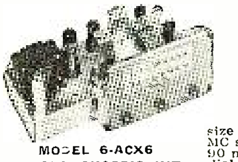
9 latest television alignment tools packed in a leatherette case. No serviceman can be without these. Stock No. 6165. McGee's price **$3.95.**

6-110V. POWER SUPPLY KIT $14.95



New utility power supply kit, works on either a 6 volt storage battery or 110 volts AC. Furnishes Power for a 25 watt amplifier (135 mils B at 300 volts) and will run a turntable (110 volts AC at 25 watts) from a storage battery. Kit 6-110 KR complete with diagram, **$14.95.** 6-110 volt 60 cycle vibrator only **$1.98.** 6-110 power transformer, **$5.95.**

RED HOT VALUES IN COMPLETE RADIO KITS
6 TUBE AC SUPERHET KIT BROADCAST AND SHORTWAVE MATCHED PARTS $11.95



MODEL 6-ACX6
2 BAND CHASSIS KIT

A complete kit of parts, tubes and ready punched chassis to build a fine 6 tube, 2 band AC power transformer type radio chassis. (No cabinet.) We furnish all pieces as well as a printed diagram and photograph. Chassis size 14x7½x7". Receives standard broadcast and 6 to 18 MC shortwave. 3 gang tuning condenser used on both bands. 90 mil power transformer and 6V6 output tube. The chassis, dial mechanism, gang and coils used in this kit were manufactured for use in a high quality Detrola radio. The heavy plate glass dial has etched-in numerals. This is a complete 2 band AC chassis kit, with tubes. The output transformer is furnished but the speaker is not. Use any standard PM speaker.
Stock No. 6-ACX6. Net price **$11.95.**
10" Heavy duty PM speaker, **$3.95** extra.
8" Heavy duty PM speaker, **$2.95 extra.**
12" Heavy duty PM speaker, **4.95 extra.**

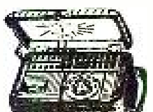
MOLDED PLASTIC CAPACITORS
★ LATEST 1950 PRODUCTION ★

Scoop prices on 85 degree molded plastic tubular condensers. All 600 volt rated. Order 100 and take 10% off. Fully guaranteed. Best value we know of today. Specify XX quality, when ordering. .001, .002, .005 **10c** each. .01 **11c each.** .02 **12c** each. .05 **14c** each. .1 **16c** each. Plastic condensers for buffers, .005 or .01 **19c** each.

F.P. ALUMINUM CAN ELECTROLYTICS—TWIST TAB TYPE—YEAR GUARANTEE NAME BRANDS

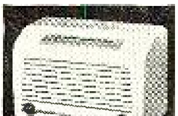
			Size	
40X40	mfd.	150V.	1"x2"	29c
50X30	mfd.	150V.	1"x3"	39c
15X10	mfd.	350V.	20X25V.	39c
50X30	mfd.	150V.	100X10V.	49c
8	mfd.	450V.	1"x2"	29c
16	mfd.	450V.	1"x2"	34c
15X15	mfd.	450V.	1"x3"	49c
30	mfd.	450V.	1"x3"	39c
10X10X10	mfd.	450V.		59c

GAROD PERSONAL PORTABLE KIT



Complete Garod personal portable kit, Model X-45. Made from genuine Garod factory-matched parts. A complete kit to build a broadcast battery-operated 4-tube receiver. Small in size, 6½x3¼x4½". Weight 3½ lbs. 2-gang superhet circuit. Set comes on when lid opens. Rugged metal case with colored plastic front and back. Loop antenna in lid. Furnished with diagram, photos and tubes. 67½ volt B battery and flashlight cell, **$1.65** extra. Will go together like a factory-built radio. Shipping weight 6 lbs. Model X-45. Net price, **$9.95.**

NEW 1950 MODEL 5-TUBE SUPERHET RADIO KIT
MODEL NS-5 $9.95

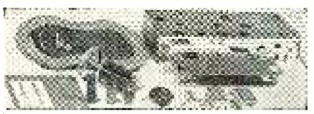


McGee's new 1950 Model 5 tube AC-DC superheterodyne radio kit. Has loop antenna and 2 gang condenser, with lighted slide rule dial and attractive plastic cabinet. Receives broadcast, 550 to 1650 kc. Full size dynamic speaker, matched 456 I.F.'s, automatic volume control. This is a complete radio kit. Everything furnished, including diagram, photos and tubes: 12BE6, 12BA6, 12AT6, 50B5 and 35W4. Shipping weight 7 lbs. Stock No. NS-5. Net price, **$9.95.**

1950 PRODUCTION 600 VOLT TUBULARS

Manufactured this year by a big supplier of condensers to set manufacturers. 600 volt rated. Paper tubes, wax dipped. Specify type PP, moisture proof. Order 100 and take 10% off. .001, .002, .005, .01, .02 **6c** each. .05 **7c** each. .1 **8c** each. 1600 volt wax dipped for buffers .005, .008, .01 **12c** each.

2-BAND DETROLA—SCOOP COILS, GANG, DIAL, PAN $3.95



Genuine Detrola Chassis pan with 6 octal sockets. Heavy glass slide rule dial, 3 Gang Tuning condenser. All RF and IF coils and band switch for standard broadcast and foreign short wave. Buy these parts for less than the coil value alone. These parts all fit the chassis properly. Only material pictured and listed above is offered with diagram. It is not a complete kit. You supply your own tubes, speaker, resistors, condensers, etc. Stock No. DET-2. Shipping weight 9 lbs. Net **$3.95.**

SCOOP PRICES ON ELECTROLYTICS

MN-8.	8 mfd 450 volt	.29c
MN-16.	16 mfd 450 volt	.39c
MN-20.	20 mfd 150 volt	.29c
MN-40.	40 mfd 150 volt	.39c
MN-220.	20-20 mfd 150v	.39c
MN-53.	50-30 mfd 150v	.49c

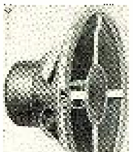
Save on these. One year guarantee. All single condensers are in sealed metal tubes with paper insulating sleeves. Dual banks in cardboard tubes with long flexible leads. Not surplus, but the best. All 1950 production. You must be satisfied.

BUILD YOUR OWN MINIATURE RADIO STATION KIT MODEL DE-6X $6.95

Kit Model DE-6X. With this simple kit you can build your own radio station in miniature. Has 4 tubes. Broadcast on frequency from 800 to 1500 KC, from either a crystal microphone or phonograph record. (This transmitter will transmit about 170 feet, with the short antenna lead furnished.) One control fades from mike to record. Price includes parts, diagram, instructions, photo and tubes. Everyone will enjoy your miniature broadcast station. Kit Model DE-6X. Shipping weight 4 lbs. Net price, **$6.95.**
Model DE-6XWT, miniature transmitter, wired and tested. Net price, **$8.95.**
Crystal mike and desk stand, pictured with transmitter, **$4.95** extra.
Dynamic mike, small palm-of-your-hand type, **$5.95** extra.
Stock No. T-001 small aluminum cased crystal mike, response 40 to 9000 CPS. About the size of an overcoat button. Furnished less cable. Just solder on connections for concealed use, **$3.95** extra.

McGEE RADIO COMPANY Prices F.O.B. K.C. Send 25% Deposit with Order, Balance Sent C.O.D. With Parcel Post Orders, Include Postage **TELEPHONE VICTOR 9045. WRITE FOR FLYER 1422 GRAND AVE., KANSAS CITY, MISSOURI**

YOUR DOLLAR BUYS "BIGGER AND BETTER SPEAKERS" AT McGEE



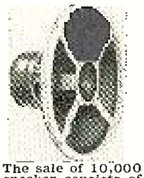
MODEL P15-8
15 INCH "COAXIAL" P.M. SPEAKER

- NEW 1950 MODEL
- REGULAR $62.50 LIST

$19.95

"IT WOOFS AS IT TWEETS"

This 15", 35 watt peak coaxial PM speaker is not surplus. It is manufactured by a leading speaker company, to our own specifications. We buy them by the hundreds in order to offer them to you at this low $19.95 price. They are comparable to any $62.50 list speaker on the market. The 15" woofer will reproduce down to 20 cycles. It has a 22 oz. Alnico V magnet and molded cone with 1½" voice coil. The high frequency tweeter is coaxially built in, with a special cone that will produce notes up to 17,500 cycles. The input impedance of both reproducers combined, is 8 ohms. Matching network is concealed under the pot cover. Just hook this up like any other 8 ohm speaker and hear the difference. Shipping wt. 14 lbs. Stock No. P15-8. Sale price, $19.95; 2 for $38.00

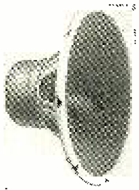


MODEL CU-13X
12 INCH "COAXIAL" P.M. SPEAKER

- New Aluminum Voice Coil Model
- Wide Range, 40 to 17,500 CPS.
- Reg. $32.50 List at McGee for

$9.95

McGee announces its new 1950 Model 12" coaxial PM speaker. A regular $32.50 list speaker, but mass production enables a new low price of $9.95. Made especially for McGee by a famous speaker manufacturer, to our own specifications. It's a new 1950 model. The sale of 10,000 coaxial speakers assures you that this speaker is a smart choice. The speaker consists of a 12" Alnico V PM with coaxially suspended 3" hard cone tweeter. The 12" portion has a 6.8 oz. Alnico V magnet with 1" voice coil and heavy one piece ribbed cone. This responds to the lower register of the audio spectrum. The tweeter has its own separate 2.15 oz. Alnico V magnet. A high pass filter is concealed under the pot cover. This prevents low frequency from reaching the tweeter. The 3" tweeter has a very stiff cone and responds only to the upper register of the audio spectrum. With all this the speaker is still just as simple to connect as any ordinary PM. Only two wires to connect. Input impedence is 8 ohms. Designed especially for the critical music listener with a keen ear for the higher audio register. Response is from 40 to 17,000 cps. 18 watts. This speaker is ideal for the home music system. Generally used in only $400 to $800 radio installations. The high piano, cymbal and violin notes will reproduce clearly with our new 12" coaxial speaker. Model CU-13X. Shipping weight 8 lbs. Net price, $9.95; 2 for $19.00

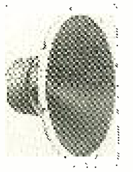


MODEL 15-LS
15 INCH 40 WATT P.M. SPEAKER

- A Super Heavy Duty Deluxe P.M.
- 21.5 Oz. Alnico V Magnet

$15.95

A regular $43.00 list 15" molded cone Alnico V PM speaker. 21½ oz. Alnico V magnet, with molded cone and 1½", 8 ohm voice coil. Truly a super heavy duty speaker that will take 35 watts with ease, up to a 50 watt peak. The King Juke PM. Response down to 20 cps and up to 12,000 cps. Shipping weight 14 lbs. Model 15-LS, Net price, $15.95; 2 for ...... $30.00 Model 15-KR, standard juke box PM. 15" with 8 ohm voice coil and 12 oz. Alnico V magnet. Shipping weight 10 lbs. Net price, $9.95; 2 for $19.00

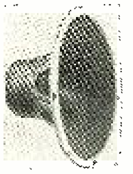


MODEL A-50
12 INCH 40 WATT P.M. SPEAKER

- FOR RUGGED P. A. USE

$13.95

Model A-50, 12" 40 watt super heavy duty permanent magnet speaker. Has 1½", 8 ohm treated voice coil and one piece molded cone. Heavy half inch machined pot, with bolt secured 21 oz. Alnico V magnet. Frame is of heavy construction with metal pot cover. Finished in silver-grey enamel. This speaker is the best possible value today. Efficiency is two or three that of ordinary speaker. Especially recommended for all public address systems and high quality home audio systems. Will handle 35 watts with ease and 50 watts peak for short lengths of time. Its retail value is $50.00. Wt. 8 lbs. But, by our large purchase, we are able to offer it to you for only .. $13.95



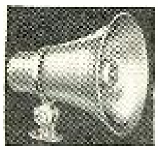
MODEL 1202-X
12 INCH WIDE RANGE P.M. SPEAKER

RESPONSE 35 TO 12,500 CRS.

$9.95

Why pay more? McGee's new 1950 model 1202-X Music Lovers' Reproducer. A full heavy duty 14½ oz. Alnico magnet PM speaker. Full 1¼", 8 ohm voice coil. One piece molded curveliniar cone forms a trumpet for the high note distribution. An ideal speaker for high fidelity music system and P.A. work. The rugged construction of this speaker enables handling of low notes down to 35 cps; organ lows, etc. Highs up to 12,500 cps. Made for us by a famous speaker builder, to our own specifications. Lustre-grey finish, metal pot cover. Shipping weight 7 lbs. Stock No. 1202-X. Net price, $9.95; 2 for $19.00

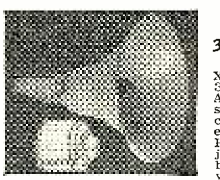
McGEE'S DOUBLE X LINE OF TRUMPETS & DRIVERS



10 WATT PAGING SPEAKER

$11.95

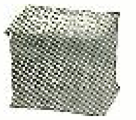
McGee's XX quality - paging speaker is made by a big name mfgr. Outdoor or indoor, all-weather paging speaker. A 10 watt, 15 ohm Alnico V driver, attached to a spun metal exponential horn, with swivel bracket. Stock No. 10-XXP. This is a complete speaker driver and horn attached. Full 1 year guarantee. Bell diameter is 7". Shipping weight 4 lbs. McGee's scoop price, $11.95. Why pay more?



25 WATT DRIVER, $12.50
3½ Foot Horn, $13.50
Both for $23.95

XX-100, all weather 3½' reflex trumpet. Aluminum castings and spinnings. Exponental curve for best low freq. efficiency 19" bell diam. Hammertone finish, adjustable angle mounting bracket. Can be used with all standard driver units. (1⅜x18 thread.) Sh. wt. 15 lbs. Stock No. XX-100. As pictured. McGee's net price, $13.50. RM-30. A new model driver, designed to fit all standard trumpets and especially for use with the XX-100 described above. Power rated 25 to 30 watts peak. An Alnico V job that is completely weather and water proof. 1 year guarantee. Impedance 15 ohms. Standard thread 1⅜x18. Sh. wt. 6 lbs. McGee's XX quality second to none. Why pay more? Stock No. RM-30. McGee's price, $12.50. Note: To have a complete exponental speaker, order a RM-30 driver unit and XX-100 trumpet. Stock No. XX100-RM30. Both for $23.95.

WHY PAY $20.00 OR $30.00 FOR AN OUTPUT TRANSFORMER?



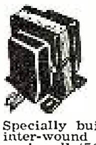
McGEE'S SUPER High Fidelity

OUTPUT TRANS. 20-20,000 CPS.

$6.95

Best Value in U.S.A.

Model A-403 High fidelity output transformer. Why pay $20 or $30 for an output, when our A-403 is available at $6.95? Impedance, 6600 ohms plate to plate. (for PP 6L6 or 6V6), 10% feedback winding, 4-8-15-250 and 500 ohm secondary. Housed in a potted case. Net weight 6 lbs. Recommended for all amplifiers up to 34 watts. Size 3⅞x4½x3". Suggested diagram furnished. Shipping weight 8 lbs. Net Price A-403 $6.95.

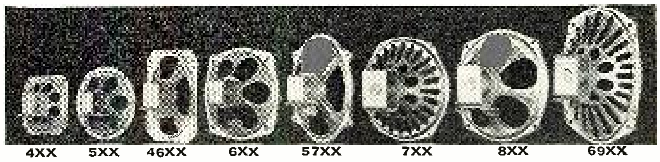


40-WATT CAPEHART High Fidelity

Output Worth $20.00

$7.95

Specially built for Capehart, this 40 watt inter-wound wide range output, for 6L6 push-pull (5000 ohms plate to plate), 10% feedback winding, 4 and 8 ohm voice coil taps. Response 30 to 15,000 CPS. Down about 6DB at 20,00 CPS. Size 3½ x 4 x 4⅜". Net weight 6 lbs. Shipping weight 8 lbs. One of the best outputs we have ever seen. Stock No. SX-55, Net $7.95. Stock No. SX-44, same as above only 25 watt capacity and one voice coil tap at 8 ohms. Net price $4.95.

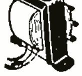


Best Prices in America—ALUMINUM VOICE COIL SPEAKERS

McGee's Double X (XX) replacement speaker line is unconditionally guaranteed. All in individual cartons. Manufactured this year, by a renowned speaker builder, to our order. Newest Aluminum voice coil, Alnico V magnets, standard RMA 3.2 ohm voice coil. Why pay more? These speakers are second to none. We want your speaker business. We carry 50,000 speakers in stock, for you to pick from. Buy from McGee and save.

Double X Aluminum Voice Coil, Alnico V Magnet, RMA 3.2 ohm V.C.

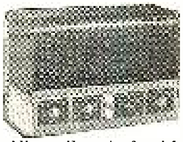
Stock No.					
4XX	4" square	1 Oz. Mag.	$1.09 ea.,	10 for	$10.00
5XX	5" round	1 Oz. Mag.	1.09 ea.,	10 for	10.00
6XX	6" pincushion	1.47 Oz. Mag.	1.69 ea.,	10 for	14.95
6XX2	6" pincushion	2.15 Oz. Mag.	1.95 ea.,	10 for	17.95
46XX	4x6"	1 Oz. Mag.	1.49 ea.,	10 for	13.95
57XX	5x7" oval	1.47 Oz. Mag.	1.95 ea.,	10 for	17.95
7XX	7" pincushion (Auto set)	3.15 Oz. Mag.	2.79 ea.,	10 for	24.95
8XX	8" pincushion	3.16 Oz. Mag.	2.95 ea.,	10 for	27.95
69XX	6x9" oval	3.16 Oz. Mag.	2.95 ea.,	10 for	27.95



Universal replacement output transformers for any push-pull or single plate 2500 to 13,000 ohms from 2 to 16 ohms voice coil. Standard size strap mounting with long leads and lugs for voice coil connections.

U- 5	5 watt universal output	$ .79 each,	10 for	$ 7.50
U- 8	8 watt universal output	.99 each,	10 for	9.50
U-15	15 watt universal output	1.19 each,	10 for	11.00
U-20	20 watt universal output	1.49 each,	10 for	13.95

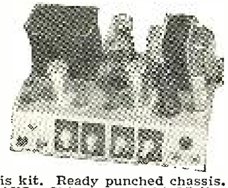
JJ-4 Single universal output. Any plate to 3.2 ohm voice coil. 4 watt, small size. 49c each. 10 for $4.50



MODEL ZZ-30—30-WATT
Commercial Quality Amp Kit $19.95
"Build an Amp Like You Would Buy"

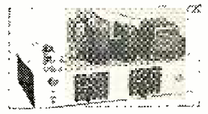
A complete kit of parts to build a factory quality 30 watt public address amplifier. Servicemen, you can wire this amplifier and have a commercial looking unit. Pan and cover are ready punched and grey splatter finished. Size 5½x12". Inputs for two mikes and one phono. Base boost tone control. 4-8-16-250 and 500 ohm shielded output. With tubes: 2—12AX7, 6SN7, 2—6L6 and 5U4. Full size power transformer. All small parts furnished, nothing else to buy. Printed diagram furnished. Shipping weight 25 lbs. Stock No. ZZ-30. Net price .... $19.95 Why not order a mike? See our specials below.

34 WATT WIDE RANGE AMP KIT $29.95



- RESPONSE 20 TO 20,000 C.P.S.
- TWIN ELECTRONIC TONE CONTROLS

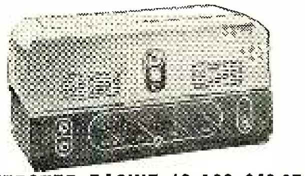
It's the newest thing in audio amplifiers. McGee's wide range, 34 watt amplifier kit with inputs for crystal or dynamic mikes and any crystal phono cartridge, as well as the new G.E. variable reluctance cartridge. Output transformer is wax impregnated, weighs 6 lbs. Voice coil taps 4-8-15-250 and 500 ohms. Push-pull 6L6 output tubes. Separate electronic base and treble boost. Inverse feedback. Input tube filament is DC heated to reduce hum level to nil. Frequency response from 20 to 20,000 cps. Easy to follow diagram and photos for easy assembly of this kit. Ready punched chassis. Every part furnished, including tubes: 2—6L6, 5V4, 3—12AX7. Shipping weight 25 lbs. Stock No. XX-34, net .... $29.95 XX-34 WT (wired and tested) $10.00 extra. Buy a mike: see our listing below.



NEW 15 WATT UTILITY AMP KIT

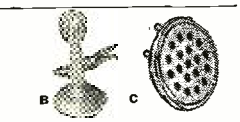
- INPUT FOR VARIABLE REL. PICK UP
- MIKE INPUT
- TONE CONTROL
- FADER CONTROL
- COMPLETE KIT $12.95

Kit Model TM-15, push-pull wide-range 15 watt amplifier kit. Ideal for a high quality record player, as a P. A. system or recording amplifier. Matched component parts, ready punched chassis. One control fades from phono to mike. Input compensation for G.E. variable reluctance, pickup, fully shielded. Output matches 8 ohm voice coil. 100 mil power transformer. Complete with tubes, photos and diagram. 2—6V6, 2—12AX7 and rectifier. Variable tone control. Model TM-15. Weight 10 lbs. Net .... $12.95 AA-49 crystal utility mike and desk stand $4.95 extra.*



WEBSTER RACINE 16-A20 $42.95

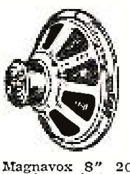
Webster Electric 20 watt (PP 6L6) super quality amplifier, 2 mike inputs, phono input, universal output taps. Plus or minus 1 DB from 50 to 10,000 CPS. Made to retail for $187.00. McGee's scoop price $42.95. Price includes all tubes. Factory cartoned. Limited quantity left. Shipping weight 33 lbs. No. 16A20.
Webster Electric Model DS12-50HN, split type portable speaker case with 2 12" Jensen A-12 PM speakers, 50 feet of speaker wire and plugs to fit 16A20 amplifier. Regular list $156.00. McGee's close out price $44.95. Shipping weight 49 lbs.
Webster Electric S-4626 12" super heavy duty PM, Jensen A-12 speaker only, no case. Shipping weight 19 lbs. While our limited stock lasts. $13.95 each.



A. Crystal mike. New recording type. Small size, for all of our amplifiers. Stock No. CS-50. Net price ..... $4.95 Same as "A," only new dynamic type. Stock No. CS-51D. Net price ... $5.95

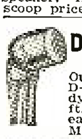
B. Crystal mike and desk stand. Latest production. Stock No. AA-49. Net price $4.95

C. New hidden mike, crystal unit, only 1¼" in diameter. High fidelity response, 60 to 8,000 cps. No cable furnished. For concealed use or experimentors. Stock No. T-001. Net price $3.95



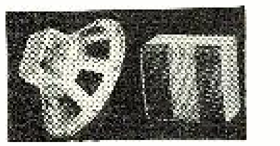
MODEL CN-1232
12 INCH 25 WATT P.M. $5.95

Another McGee red hot special, 12" 32 oz. Alnico #3 ring magnet PM, 8 ohm voice coil speaker. Made by Consolidated. A regular $17.00 list. Shipping weight 8 lbs. Model CN-1232. Net price $5.95 each, 4 for $22.00.
Magnavox 8" 20 oz. Alnico #3 magnet speaker. A top quality speaker. McGee's scoop price $2.95 each, 10 for $27.50.



DYNAMIC MIKE $9.95

Our leader dynamic mike Model D-4. Our leader high impedance dynamic mike. Shipped with 12 ft. cable. Very special at $9.95 each. Top Quality Chrome Floor Mike Stand, $4.95.



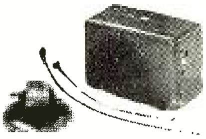
SALE
PLASTIC FRONT BAFFLES AND SPEAKERS

Stock SE-SX 8 inch heavy duty 6.8 oz. Alnico V PM with 1" 8 ohm voice coil. (as illustrated) $2.95 each, 10 for $27.50. Stock No. 8-RCM 8 inch tri-color, plastic front wall baffle. Very popular with music box operators. Sale price $1.95 each, 10 for $17.50.

Stock No. 12-RCM 12 inch tri-color, plastic front wall baffle. Conventional slanting front type. An item used every day by the sound man. On sale at McGee for $2.95 each.

Very special scoop deal, 12" Alnico V PM speaker, 10 watt capacity to go with above baffle. Stock No. AM-124, Net $3.95 each. (Note: 12" baffle and 12" PM add up to only $6.90. This is a terrific bargain.)

McGEE RADIO COMPANY Prices F.O.B. K.C. Send 25% Deposit with Order, Balance Sent C.O.D. With Parcel Post Orders, Include Postage. **TELEPHONE VICTOR 9045. WRITE FOR FLYER 1422 GRAND AVE., KANSAS CITY, MISSOURI**



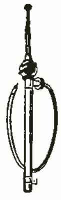
MOTOROLA SALE $44.95

BRAND NEW 8-TUBE AUTO RADIO MODEL 708-T6 PUSH PULL AUDIO

UNIVERSAL REMOTE CONTROL $1.95 EXTRA

World famous 8 tube Motorola auto set. Merchandised by Tucker, but branded Motorola. A real distance getter with high fidelity audio. Tone control and push buttons. Fits most cars and trucks. Compact size, 9⅞x5¼x6⅝". Everything furnished including 6" PM speaker, cables, hardware, etc. You furnish any push button custom control or buy our 2A1 universal underdash control at $1.95 extra. Shipping weight 17 lbs. List price over $80.00. Motorola 708-T6 complete, less remote control, Net **$44.95.** 2A1 remote control $1.95 extra. (Will supply 7" or 6x9" or 8" PM speaker in place of 6" for $1.95 extra.) Note: Pick a custom control from our limited list for **$1.95** extra.

Regular $6.95. 3 section top cowl or fender mounting antenna may be ordered with your Motorola set or purchased extra for **$2.95. Stock No. DCF-3.** Weight 2 lbs.

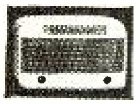


DC-F3 ANT $2.95

10 ASSORTED MOTOROLA REMOTE CONTROL HEADS $14.95

10 assorted genuine Motorola remote control heads with knobs, pilot light, etc. 5 of each type, manual and automatic. Automatic heads: 42 Hudson, 46-47 Packard, 40 Hudson, 46-47 Hudson, 42-46 Cadillac, 42 Oldsmobile, 41 Nash, 41 Packard, 40 Pontiac, 40 Lincoln Zephyr, 40 Nash, 42-46 Lincoln Zephyr. Manual Heads: 42 Cadillac, 42 Hudson, 46-47 Hudson, 40 Nash, 42 Oldsmobile, 46 Packard, 42-46 Lincoln, 40 LaSalle, 42-46 Cadillac, 40 Hudson, 41 Lincoln Zephyr. **$1.95** each; 10 for **$14.95.**

6-TUBE—3 BAND RADIO



ANOTHER McGEE SCOOP

ONLY $15.95

LIGHTED SLIDE RULE DIAL
BEAUTIFUL PLASTIC CABINET
FULL 2-GANG SUPERHET

Another red hot McGee special. We made a lucky purchase of 250 6 tube 3 band ac dc 3 band radios. Attractive ivory plastic cabinet with lighted slide rule dial. Receives standard broadcast, foreign short wave and police. A full 6 tube 2 gang superhet with AVC. Made by a well known radio factory. Stock No. FR-63. Ship. weight 10 lbs. Sale price, **$15.95.** two for **$30.00.**

RADIO AND RECORD PLAYER $14.95

For your children's room. Buy this superhet radio and record player. Here is what you get: A full 5 tube superhet broadcast chassis all wired and tested, Walnut cabinet, 78 RPM phono motor and crystal pickup. All you do, when you receive your set is drill mounting holes in cabinet. We are offering you this radio-phonograph at the price of an ordinary record player. Shipping weight 15 lbs. **Stock No. JA-70.** Net price **$14.95.** **Stock No. AUT-JO.** Same radio chassis and cabinet as above, but furnished with a 78 RPM automatic record changer. Shipping weight 25 lbs. Net price **$24.95.**

1950 MODEL PORTABLE TAPE RECORDER $99.50

Our brand new 1950 model portable tape recorder. Response, 60 to 8,000 CPS. With this you make and playback top quality tape recordings. Tape speed, 7½ feet per second. New mechanism records 1 hour on 1200 ft. reel of tape. Fast rewind. Record 30 minutes, turn spool over and record second 30 minutes on 1200 ft. reel. Has an AC transformer type amplifier with 6" speaker. Inputs for mike and radio. External speaker jack. Price includes 30 minute reel of tape and mike. Hinged lid is removable. Case is attractive leatherette covered. Size 10x13x14". Shipping weight 29 lbs. **Stock No. PLT-3.** Net price **$99.50.** Extra reels of recording tape. Latest type recording tape, plastic with red oxide coating. 5" reel **$2.10** each. 7" reel **$3.30** each.

Latest type Kraft base, red oxide coating. 5" reel **$1.35** each. 7" reel **$2.10** each.

ARMCHAIR CABINETS FOR S-56 HALLICRAFTERS OR WITH BLANK PANEL $29.95

Armchair radio-phono combination cabinet, ready-cut to house the S-56 Hallicrafters. 24" high x 27 x 16½". Hinged lid covers record changer compartment. Will accommodate up to a 12" speaker and space for a record changer up to 14" square. Changer board is blank, you cut to fit your changer. Dial knob and mounting holes cut for S-56 Hallicrafters. Cabinet is of top quality and has furniture type finish. Shipping weight 40 lbs. Available in walnut, mahogany or blond.

Walnut cut for S-56. Net....... **$29.95**

Mahogany cut for S-56. Net..... **29.95**

Blond cut for S-56. Net........ **34.95**

Any of the above may also be had with blank radio panel. (Specify blank radio panel when ordering.) You can cut blank armchair cabinet to hold 7B-22 chassis.

RECORD PLAYER KIT $9.95

Complete record player kit, for 78 RPM records. All parts, tubes and diagram for building a 70L7 type amplifier. Attractive ready cut walnut base (speaker cut-out on top). Ballentine phono motor and Astatic pickup with permanent needle. Shipping weight 10 lbs. Model No. MD-78. Net price $9.95.

Three-speed model No. D-3378, same as above only has 3 speed motor and Webster flip-over pickup and twin needles. Net price **$14.95.**

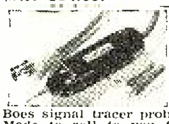
3-SPEED AUTOMATIC PLAYER KIT $39.95

Walnut cabinet, automatic 3 speed record player kit. Attractive cabinet with hinged lid. Two tube amplifier kit of parts including diagram, tubes and Alnico V PM speaker. Latest 3 speed automatic record changer that intermixes records of the same speed, 33⅓, 78 and 45 RPM changer Model VM-406, with twin needles. A complete easy to assemble kit with instructions. Shipping weight 20 lbs. Stock No. LL-374. Net price **$39.95.**

Model LB-23 same as above only with 78 RPM changer, **$24.95.**

We have a few walnut record player cabinets only, to offer by themselves, for the builders. Changer area is 12½ x 16 x 5½", cut for 5" speaker. Stock No. BJC-1, weight 10 lbs. Net price **$6.95.**

BOES MODEL 103 REG. $7.77



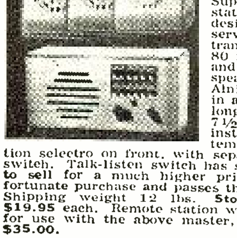
SIGNAL TRACER PROBE. WHILE OUR STOCK LASTS

Boes signal tracer probe, with instructions. Made to sell to you for $7.77. McGee's sale price only **$2.95.** You get this: a heavy bakelite probe containing a 6F5GT tube. (The end of the probe is secured by three screws and may be taken apart easily.) A 5 foot lead with 3 circuit amphenol plugs and receptacle and Mueller peewee clip. You can connect this probe to any AC amplifier and have a signal tracer. Shpg. Wt. 1 lb. Net. **$2.95**; 2 for **$4.95.**

PHONO NEEDLES

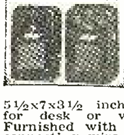
DUOTONE 99 Sapphires, **59c** ea.: 10/**$4.95**
DUOTONE Ruby with Record Brush.... **99c**
DUOTONE NYLON, very popular.... **$1.25**
DECCA-CHEEP BRASS NEEDLES .50 for **19c**

10 STATION MASTER $19.95 SUBS, $3.95 EACH



Super heavy duty. 10 station intercom master, designed for continuous service. A powerful AC transformer type with 80 rectifier, 6V6 output and 6SJ7 driver. 5" speaker with 2.15 oz. Alnico V magnet. Housed in a walnut cabinet 14" long, 6½" deep and 7½" high. Designed to install as a 3 wire system. 10 push button station selectro on front, with separate all station call switch. Talk-listen switch has silent position. Made to sell for a much higher price. McGee made a fortunate purchase and passes the bargain on to you. Shipping weight 12 lbs. **Stock No. 2520.** Net **$19.95** each. Remote station with call back switch, for use with the above master, **$3.95** each, 10 for **$35.00.**

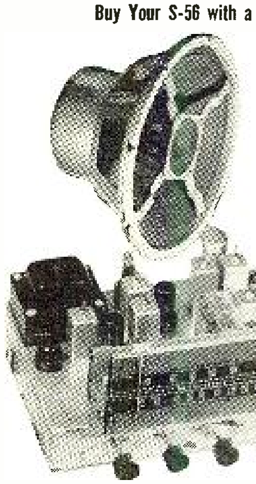
McGEE HAS INTERCOMS AT TERRIFIC PRICES



Sale McGRADE $14.95

McGrade Intercom. Master and sub-station, housed in small matching walnut plastic cabinets, 5½x7x3½ inches. Sloping front for desk or wall installations. Furnished with 50 feet of interconnecting wire. Sub-station may be used up to 1000 feet from master station. These units are new and factory cartoned. Complete with tubes. Made to retail at $29.95. A lucky purchase enables us to offer these to you for only **$14.95.** Include postage for 8 lbs. **Stock No. MB-3S.**

Buy Your S-56 with a $62.50 List, 15" Coaxial Speaker for $77.95



S-56 HALLICRAFTERS

11-TUBE FM-AM CUSTOM CHASSIS. A $110.00 VALUE AT McGEE FOR ONLY . . . $59.95

● **WIDE RANGE** ● **AUTOMATIC FREQUENCY CONTROL ON F.M.**

Receives 88 to 108 MC F.M. and Broadcast 550 to 1650 K.C.

Fine for Custom Installation

Model **S-56 Hallicrafters,** 11 tube AM-FM radio receiver chassis for broadcast and FM 88 to 108 mc. Automatic frequency control on FM, holds the receiver in perfect tune. Phono connection on rear of chassis. Full range tone control with bass boost. Push-pull 6K6 tubes in audio system. Frequency response essentially flat, from 50 to 14,000 CPS. Wide vision accurately calibrated slide rule dial, with pre-selection on broadcast band. Output transformer matches any 8 ohm speaker. 4 antenna terminals, two for AM and two for FM. This is the finest type of home radio that we know of today. Better get your order in early. Designed to be used in commercial radio selling in the $400 to $600 class. The regular dealers' net on this chassis is $110.00. However, a lucky purchase enables us to offer these brand new, factory cartoned S-56 Hallicrafters chassis, complete with tubes and operating instructions, at only **$59.95** less speaker. Chassis size 12¾x10x7¾". Weight 25 lbs. Brand new factory cartoned. Buy your S-56 with a **wide range PM speaker.**

S-56 chassis with our **$62.50** list 15" coaxial (P15-8) PM speaker, on sale for **$77.95.**

S-56 chassis with our **$32.50** list 12" coaxial (CU-13X) PM speaker, both for **$69.50.**

S-56 chassis with our new 12" curvilinear cone (1202-X) PM speaker, both for **$67.95.**

VM-406 Tri-O-Matic, 3 speed changer **$33.21.**

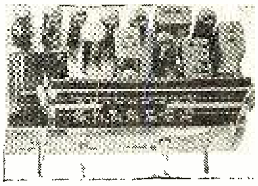
VM-406GE, 3 speed changer with new GE RPX-050 V.R. cartridge **$36.01.**

Pre-amplifier for S-56 $3.95

Dual purpose preamplifier for either S-56. Only 4 wires to connect (instructions furnished). With this you can convert set to operate either a G.E. variable reluctance pick-up or a crystal or dynamic mike, making your S-56 a home P.A. system. Preamp Model SS-69. Size 3½x4x3". Shipping weight 2 lbs. Net price, **$3.95.**

Crystal mike and desk stand, **$4.95** extra.

NEW VERSATILE 12 TUBE FM-AM CHASSIS $49.95

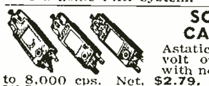


★ **BUILT IN PRE-AMPLIFIER FOR G.E. VARIABLE RELUCTANCE PICKUP**
★ **WIDE RANGE AUDIO**
★ **MAY BE USED WITH A CRYSTAL MIKE AS A HOME P.A. SYSTEM**

7B-22 CHASSIS $49.95

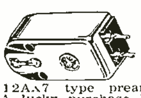
McGee's new 1950 model 12 tube FM/AM chassis. Latest design with phono inputs for all types of record players, crystal or G.E. variable reluctance. Receives standard broadcast 550 to 1700 KC and FM 88 to 108 MC. Wide range audio response (push-pull 7C5) and base boost tone control. Loop antenna for broadcast and 300 ohm line type antenna, may be stapled in cabinet. Attractive lighted slide rule dial. Chassis size, 13½x9" high and 9" deep. Shipping weight 20 lbs. **Stock No. 7B-22.** Made to sell at a much higher price. McGee's sale price is **$49.95,** less speaker (output matches 8 ohms). **7B-22** chassis with our 12" PM model 1202X, both for **$57.95. 7B-22** chassis with our 12" coaxial PM, CU-13X, both **$59.50. 7B-22** chassis with our 15" coaxial PM, P-158, both **$67.95.** Crystal mike, new style recording type, plugs in G.E. variable reluctance input of the 7B-22 chassis. Buy a mike for **your chassis and** have a home P.A. system. **Model CS-50.** Net **$4.95.**

SCOOP ON CARTRIDGES



Astatic N1-J Nylon 1 volt output cartridge with needle. Response to 8,000 cps. Net. **$2.79.**
MLP-1 Astatic cart. with needle. Net, **$1.19.**
Astatic L-72 or Webster equal, 3 volt output. Net. **$1.79.**
Astatic L-70 or Webster equal, 1 volt output. Net. **$1.79.**
Flip-over cartridge with twin needles. Net, **$2.98.**

G.E. RPX010 V.R. CART. $2.95



G.E. RPX010, with permanent needle. **$2.95** each; 10 for **$24.95.**

Kit of parts to build 12AX7 type preamplifier, **$2.49** extra. A lucky purchase by us enables this terrific General Electric cartridge value.

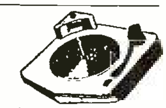
GE-RPX-040, new removable needle, 3 mill cartridge. Net, **$5.85.**
GE-RPX-041, new removable needle, 1 mill microgroove cartridge. Net, **$5.85.**
GE-RPX-050, new all in one variable reluctance cartridge, triple play, as currently advertised. Net, **$8.20.**
Kit of parts, including 12AX7 to build **a** VR preamp. Power for same to be picked up from your radio or amp. **$2.49** extra.

Webster crystal pickup arm with 3 volt cartridge. Light weight stamped type. Stock No. W-1. Net, **$1.49.**
Webster crystal pickup arm with 3 volt cartridge. New attractive die cast arm. Stock No. W-2. Net, **$2.29.**
Astatic crystal pickup arm with 1 volt cartridge and permanent needle. Stock No. A-TP. Net, **$1.95.**
New crystal pickup for all records. Flip-over cartridge with both 1 and 3 mill needles. Stock No. CX2-2. Net, **$4.95.**

VM-406 Tri-O-Matic 3-Speed Changer $33.21

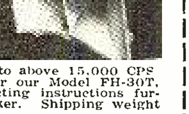
The new VM model 406 Tri-O-Matic automatically plays all records, all sizes and all speeds now on the market. Protective features: records are lowered, not dropped, no wobbling down the spindle, no slip or scrape, no possibility of the tiny microgrooves on the new type records being damaged. Plays 12 10", 33⅓ or 78 RPM, 10 12", 33⅓ or 78 RPM, any 10 or 12" records of the same type intermixed, 12 7" 33⅓ RPM and 12 7" 45 RPM records. Automatically shuts off on the last record, base size 13 13/16 x 12¼", 7¼" high overall. Equipped with flipover crystal cartridge and needles. Stock No. VM-406. Shipping weight 12 lbs. Net price **$33.21.** New 1950 Model VM-406 with All-in-one General Electric Variable Reluctance Cartridge and Twin Needles. Model 406GE. Specify VM406-GE. Add **$2.85** to above cost.

Our Leader Changer Scoop $10.95, 2 for $20.90



Our leader, automatic changer scoop. Base size 13 x 13". Plays 10 12" or 12 10" 78 RPM records automatically. Has Astatic L-70 cartridge. Priced complete with a metal base, which can be used in slide away compartment or as a table top base, or changer can be lifted off base to fit your needs. Stock No. AD-12. Shipping weight 17 lbs. Scoop price **$10.95** each; 2 for **$20.90.**

MODEL FH-30T High Frequency Speaker "McGee's Own Tweeter" $14.95



RES. CAP. IND. CROSSOVER NETWORK $9.95

McGee's own double X (XX) quality, high fidelity, high frequency speaker. Dispersion angles, 100 degrees horizontal and 50 degrees vertical. Large size two cell trumpet. Wide super rated driver for use with all audio systems up to 30 watts. Response from 900 cycles to above 15,000 CPS for the critical music listeners, who want the best. Order our Model FH-30T, regular $30.00 list. McGee's sale price **$14.95.** Connecting instructions furnished. May be used in conjunction with any woofer speaker. Shipping weight 4 lbs. **FH-30T** Tweeter. Net price **$14.95.**

Crossover Network, 1000 CPS. Capacity inductance type with attenuator. **Stock No. SS-V3.** Regular $22.50 list. McGee sale price **$9.95.** For your low frequency or woofer speaker we suggest our 15" 15-LS at **$15.95** or our 12" A-50 at **$13.95.**

Full line of speakers listed on other pages of this ad.

Note: Crossover Network Tweeter and any of our 12 or 15" PMs go together to **match any 8** to 16 ohm radio or amp. The network divides sound into highs and lows, feeding each speaker frequencies they best respond to.

McGEE RADIO COMPANY Prices F.O.B. K.C. Send 25% Deposit with Order, Balance Sent C.O.D. With Parcel Post Orders, Include Postage. **TELEPHONE VICTOR 9045. WRITE FOR FLYER 1422 GRAND AVE., KANSAS CITY, MISSOURI**

FIXED BIAS vs. SELF BIAS

Here are some of the advantages of using self bias for audio amplifier power output stages.

By CHARLES P. BOEGLI
Cincinnati Research Company

FROM time to time various papers have appeared stressing the advantages of fixed bias over self bias for audio amplifier power output stages. Generally the writers utilize the data printed in tube handbooks to prove the superiority of the former. For example, in the case of push-pull 2A3's with 300 volts on the plates, a fixed bias of −62 volts and a load resistance of 3000 ohms (plate-to-plate) result in a power output of 15 watts at 2.5 per-cent distortion. With the same plate voltage and a load resistance of 5000 ohms the self bias produced by a 780-ohm cathode resistor (−62.5 volts with zero signal) permits only 10 watts output with 5 per-cent distortion.

Such a comparison is, however, unfair; in the highest-fidelity amplifiers self bias is actually equal to fixed bias in performance and much better from the standpoint of convenience. That self-bias arrangements are more convenient than fixed bias, and consequently to be preferred if all other things are equal, is almost self-evident. Self bias eliminates the need for separate power supply systems with their associated rectifiers and filter networks. Furthermore, since a greater d.c. grid impedance is permissible with self bias, there is no need for expensive transformer coupling or cumbersome cathode-follower drive, which introduces two extra tubes that provide no gain.

With the 2A3, for example, there are two reasons for the poor showing of self bias in the tube manuals. First is the fact that the tubes under the specified conditions are in class AB_1 operation. Under these circumstances the plate current increases considerably as the signal becomes greater, after the signal has exceeded a certain value. This is an advantage with fixed bias[1] but quite the opposite for self bias, because here if the bias is correct at zero signal, it will be excessive when a large signal is applied to the grids. The cathode bias resistor thus acts in opposition to the input signal level, resulting in greater distortion for a given output.

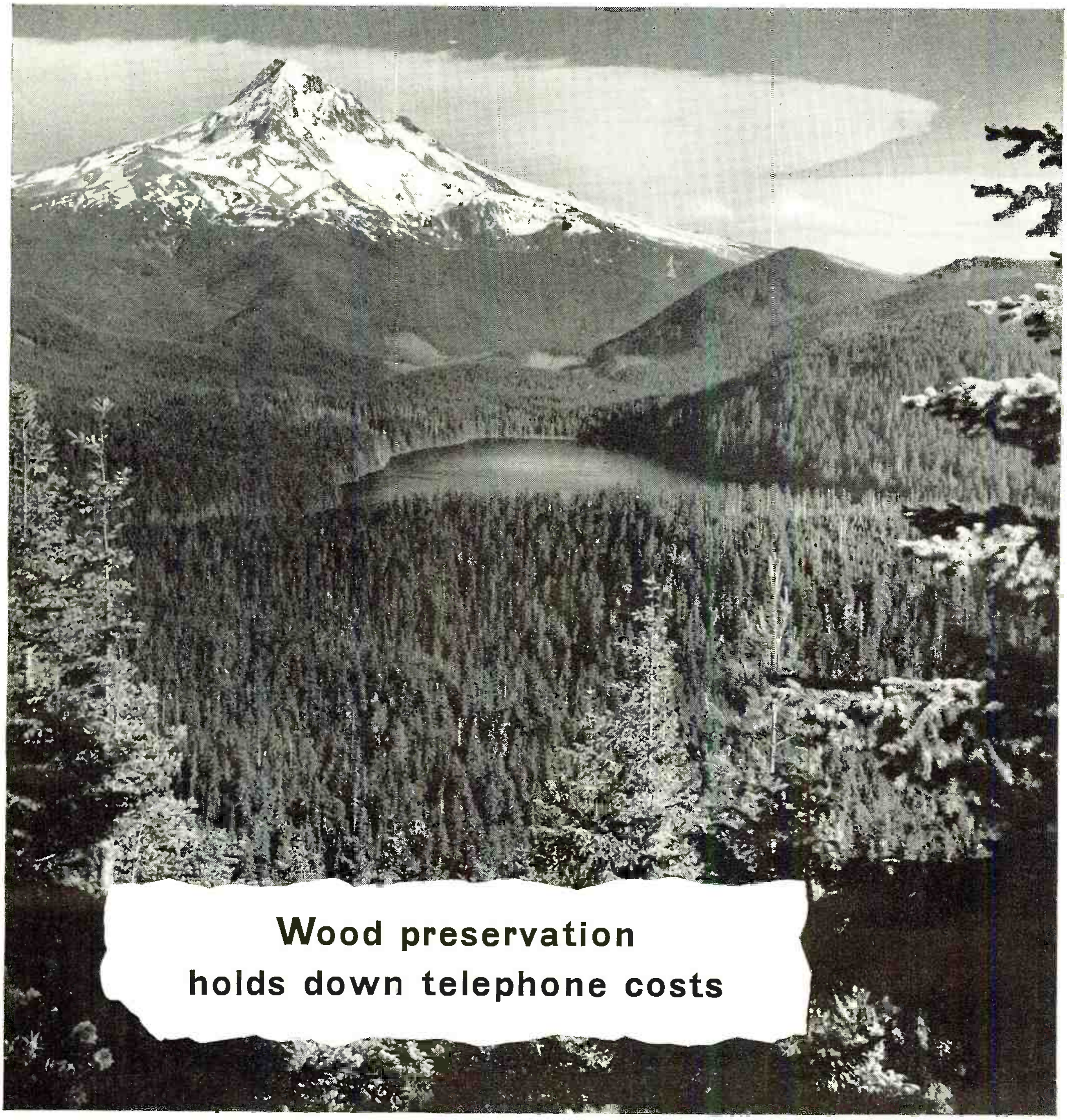
The answer to this objection is that in the highest-fidelity amplifiers class AB_1 output stages simply are not used. The *calculated* freedom from even-harmonic distortion would *actually* be obtained only if perfect coupling existed between the halves of the output transformer primary. This is, of course, never the case. There is no substitute for push-pull Class A output stages when perfect reproduction is demanded. Since with Class A the plate current varies only slightly (because of rectification effects[2]) with the magnitude of the signal, the bias remains substantially at its predetermined value regardless of the method of supplying it.

In designing a push-pull output stage it must be remembered that the term "plate voltage" on the plate characteristics chart actually refers to the voltage between plate and cathode. When fixed bias is used the "plate voltage" is the same as the "B" supply voltage (neglecting the small drop in the output transformer primary) but with self bias, the bias voltage appears between cathode and ground and the "B" supply voltage must equal the "plate voltage" plus the bias voltage. What this means is that instead of furnishing a negative fixed bias by means of rectifiers and filters, we merely add the amount of the bias to the plate supply voltage. We replace all the power supply components of fixed bias with one or two little bias resistors.

For example, if we want to use push-pull 300A's at 400 plate volts and −87 grid volts (plate current = 60 ma. per tube) we can have a 400-volt "B+" supply and a −87-volt bias supply, or a 487-volt "B+" supply and no bias supply. In either case we get the same power output and the same distortion—provided just one more precaution is taken with self bias.

This precaution eliminates the last cause of self-bias trouble. If a common cathode resistor is left unbypassed the second-harmonic voltages are fed back in phase to both grids and a secondary type of harmonic distortion appears in the output. Consequently, that resistor (or resistors) is bypassed—the bigger the bypass condenser the better.

The power output from push-pull class A output stages is generally limited by the allowable plate dissipation of the tubes, which must not be exceeded with no signal on the grids. For this reason class A doesn't furnish the power that class AB_1 does. From 2A3's or 6B4G's only 10 watts maximum is available with 250 plate volts, and an increase in plate voltage much above 250 results in excessive plate dissipation. This merely means that if more power is



Poles are a substantial part of the plant that serves your telephone; making them last longer keeps down repairs and renewals that are part of telephone costs. So Bell Laboratories have long been active in the attack on wood-destroying fungi, the worst enemies of telephone poles.

Better, cleaner creosotes and other preservatives have been developed in co-operation with the wood-preserving industry. Research is now being carried out on greensalt—a new, clean, odorless preservative. Even the products of atomic energy research have been pressed into service—radioactive isotopes are used to measure penetration of fluids into wood.

Treated poles last from three to five times as long as untreated poles. This has saved enough timber during the last quarter century to equal a forest of 25,000,000 trees. More than that, wood preservation has enabled the use of cheaper, quickly growing timber instead of the scarcer varieties.

This and other savings in pole-line costs, such as stronger wires which need fewer poles, are some of the reasons why America's high-quality telephone service can be given at so reasonable a cost. It is one of today's best bargains.

BELL TELEPHONE LABORATORIES

Exploring and Inventing, Devising and Perfecting, for Continued Improvements and Economies in Telephone Service.

required different tubes must be used, like the 275A (12 watts maximum at 300 plate volts), the 252A (19 watts maximum at 500 plate volts) or the 300A (30 watts maximum at 450 plate volts). Push-pull parallel arrangements can also be used for more power.

In a high-fidelity amplifier with push-pull class A output it thus makes little difference, as far as results are concerned, whether fixed or self bias is used. The only difference is in cost and convenience, where self bias excels. There is no reason for the disrepute that has been attached to self-bias circuits and they deserve every consideration in the design of fine audio amplifiers.

REFERENCES

[1] *Terman, F. E.; "Radio Engineer's Handbook", First Edition, McGraw-Hill Book Company, New York, 1943, Page 383.*

[2] *Smith, F. L.; "The Radiotron Designer's Handbook", Third Edition, The Wireless Press, Sydney, 1942, Page 285.*

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MUTING CIRCUITS

By ROBERT HERTZBERG

THE amazing ability of an unshielded receiver to pick up signals from extremely distant stations was demonstrated very forcibly recently. While playing with the numerous adjustments of a 630TS type television receiver, just to see what happens (and believe me, plenty does!), it was found that the v.t.v.m. gave peculiar readings, some of them not related at all to the circuit functions. In twisting some of the alignment screws, it was discovered that the meter responded very nicely with the test signal generator turned off! After two hours of just plain exploring, mixed with a little swearing, I tuned the mysterious impulse through the sound section of the receiver and nearly fell over when a veddy British voice announced a BBC program originating in London!

The signal was killed by pulling out the oscillator tube, and then the circuits beginning with the i.f. stages behaved normally. Eventually, I lined the inside of the receiver cabinet with copper screening, grounded thoroughly. This eliminated not only unwanted voice and c.w. signals, but also TV signals being picked up directly by the chassis. These latter signals previously had produced "leading" ghosts. —30—

"I can't see why that window TV antenna must be adjusted every night at this time!"


ZOOMING AHEAD IN DEMAND!
Feature For Feature
Compare it...You can't beat a
RADIART TELE-ROTOR
HEAVY DUTY MOTOR... most powerful of all TV rotators
Streamlined Weather-Proof Housing, Keeps Out Water, Snow and Ice
TELE-ROTOR
PATS. PEND
HEAVY DUTY Precision STEEL GEARS
12 Heavy Duty Ball Bearings in 6½" diameter Ball Bearing Races
THE RADIART TELE-ROTOR CONTROL BOX
with the PERFECT PATTERN dial... fingertip control with instant indication of Antenna Position shown on the illuminated two-tone face.
Available in the following models:
• TR-1 ... rotator and Control Unit with end of rotation light (uses 4 wire Cable) $37.45
• TR-2 ... Compass Control Rotator with illuminated "Perfect Pattern" dial (uses 8 wire Cable $44.95
You Can't Beat a RADIART ANTENNA on a TELE-ROTOR.... It's TOPS!
STANDARD OF COMPARISON
RADIART
IT'S RIGHT WHEN IT'S RADIART
THE RADIART CORPORATION
CLEVELAND 2, OHIO
SUBSIDIARY OF CORNELL-DUBILIER ELECTRIC CORP.
ROTATORS • VIBRATORS • TV ANTENNAS • AUTO AERIALS • POWER SUPPLIES

OLSON AKRAD

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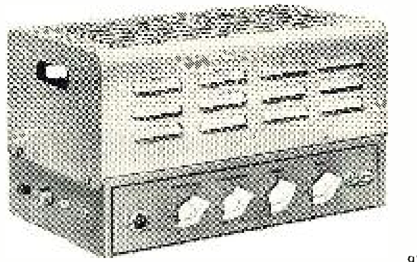
FREE—SEND FOR OUR LATEST RADIO AND TELEVISION BARGAIN CATALOG

AT LAST! THE NEW OLSON HI-FI AMPLIFIER



THE MOST MODERN DELUXE 12-WATT, WIDE-RANGE AMPLIFIER
• WITH INPUT FOR G.E. VARIABLE RELUCTANCE PICKUP

Truly the finest amplifier we have ever offered. You get all this for the one low price: Built-in pre-amp for GE variable reluctance cartridge, Dual tone controls, High fidelity, equalized circuits, Hum-free wide range response. Choice of output impedances and more. In true Olson style we have produced a 12 watt high-fidelity amplifier of which we are proud. Engineered by one of the foremost sound experts in the country and built under strict Western Electric license. This amplifier is guaranteed to satisfy the most particular music lover and the toughest buyer alike. This terrific amplifier is even more astonishing when you look at the low price. Only Olson's amazing genius for high quality mass production makes this value possible. Check the features of this amplifier now, and order today.

LOOK AT THESE FEATURES • Power Output—12 watts • Peak Output—17 watts • Frequency Response—± 2DB, 40 to 15,000 CPS • Input—Switch provides choice of conventional crystal pickup or G.E. Variable Reluctance. Also any crystal, dynamic or ribbon mike. Also any radio tuner • Controls—1 phono or Radio tuner; 1 Mike; 2 bass and treble tone controls • Tubes—2—6SL7gt, 2—6V6gt, 1—5Y3gt • Output Impedances—4 and 8 ohms • Voltage—105-125 Volts AC, 60 cy.

Complete with tubes
STOCK No. RA-38 **$27.95**

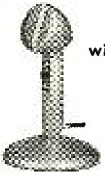
JENSEN PM SPEAKERS

Genuine Jensen Concert Series Extended Range PM speakers for PA or radio use. Cone and coil assembly permanently aligned. Heavy Alnico V magnets. Order early.

Stock limited.

Stock No.	Watts	Diameter	Shpg. Wt.	Net
S-121	9	8″	5	$3.49
S-12	12	12″	7	6.95

Astatic MICROPHONE with ON-OFF Switch!

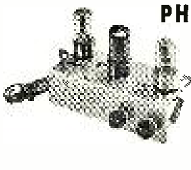


Universal high output crystal for public address, home recording and communications. Equipped with handle which plugs into desk base. 7 ft. shielded cable. Switch in handle. A beauty, too, for this price. Shpg. wt. 3 lbs. M-66, special from OLSON, each . . . $5.95
Same as above but less switch. M-67 . . . . $4.95

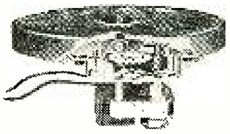
MUSICAL INSTRUMENT MIKE

Nationally-famous quality! Regularly sells for about twice our sale price. Easily attached. Delivers brilliant tone from string instruments. Equipped with 4′ shielded cable.
M-61 with Volume Control **$5.95**

PHONO AMPLIFIER



Easily connected to any phono and speaker . . . or just the thing for a portable. Uses 1 each: 12SQ7, 50L6, 35Z5 tubes. 2 controls: on/off/volume and tone. 7″ x 3¼″ x 2″ chassis. Shpg. wt. 2 lbs.
AS-22 Tube Kit for above **$1.87**
RA-19 Less Tubes **$2.98**



RIM DRIVE PHONO MOTORS

Famous Makes! Real bargains at these low prices. Self-starting; complete with turntable. All parts included. Shpg. wt. 4 lbs.
M-52 78 rpm for 115-volts AC **$2.75**
M-63 3-speed, 33⅓, 45 and 78 rpm **$4.95**

ONLY **$7.95** Model 19

GE LONG-PLAY RECORD PLAYER

A close-out worth much more. Attractive streamlined cabinet contains quiet 33⅓ RPM motor, on-off switch and handsome pick-up with genuine GE variable reluctance phono cartridge and permanent needle. Brand new factory sealed cartons. Can be used on any set with pre-amp. Operates on 115 volts AC. Regular price $19.95. Shpg. wt. 5 lbs.

1000 RESISTOR KIT

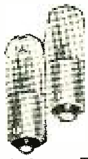
• COLOR CODE GUIDE INCLUDED

A famous resistor manufacturer (you know who it is, too) called to tell us they had a terrific quantity of INSULATED resistors, all brand new clean fresh stock. We grabbed the whole works and Olson is passing the slashed price on to you. Every resistor is color coded and insulated. Guaranteed by the manufacturer and Olson. Included are ¼ and ½ watt values from 100 ohms to 10 megohms in popular ranges.

OLSON'S SPECIAL PRICE $15.95 Stock No. AS-29

Packed in a handsome steel 4 drawer chest with 48 compartments. Size 8¼ x 7½ x 10½″. Here's your chance to get a full thousand Insulated Resistors at less than distributors cost. Your cost is only about 1½c per resistor. Regular price is 9c each or $90.00. Shpg. wt. 12 lbs.

Limit: positively only ONE DEAL to a customer. None sold to Jobbers.



PANEL LAMPS

Westinghouse, GE, and Tung-Sol bayonet panel lamps. Brand new fresh stock. Packed 100 of a type to the box. Sorry, we can't split boxes at this low price.

Stock No.	Type No.	Price per 100
X-161	47	$4.90
X-174	44	

ASTATIC PICKUP

$1.59

Stock No. M-65

With L-26 cartridge. The cartridge alone is worth more than our price for arm and cartridge both. Stock up.

SUPERIOR ALL-PURPOSE TUBE TESTER

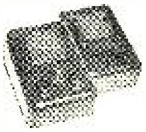
Speedily, efficiently tests every type receiving tube made in the past plus new types since TV and FM!

SPECIFICATIONS: Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut Bantam, Hearing-aid, Thyratron, Miniatures, Sub-Miniatures, Novals, etc. Will also test Pilot Lights. Tests by the well established emission method for tube quality, directly read on the scale of the meter. Tests for "shorts" and "leakages" up to 5 Megohms. Uses the new self-cleaning Lever Action. Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-10 as any of the pins may be placed in the neutral position when necessary. The Model TV-10 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket. Free-moving built-in roll chart provides complete data for all tubes.

Newly designed Line Voltage Control compensates for variation of any line voltage between 105 volts and 130 volts. The Model TV-10 operates on 105-130 Volt 60 cycles A.C. Comes to you housed in a beautiful hand-rubbed oak cabinet complete with portable cover.
Model TV-10 . . . . $39.50

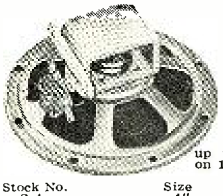
KIT OF 50 BY-PASS CONDENSERS

Quality condensers at a bargain price. Contains all good makes. Voltages from 200 to 1700. .0002 to .25 mfd. Have the right condenser when you need it.
Stock No. AS-35.
Olson's bargain price **$1.59**



INTERCOM

A real high quality intercom ideal for homes, offices, nursery or sick room. Quickly installed without tools. Remote stations may be placed as far as 2000 ft. away. Master station uses 12SJ7, 50L6 and 35Z5 tubes. Supplied with 50 ft. of 2 conductor hookup wire. Size 5½x8½x4″. One or more substations may be used with the master station.
Stock No. RA-40 Master station complete with tubes and 50 ft. cable $9.99
Stock No. RA-41 Substation, each 3.99

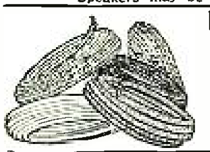


OLSON AKRAD PM SPEAKERS

These are the PM speakers that have made the Olson Akrad brand famous. Brand new, clean, fresh stock. Not surplus. Every speaker individually boxed and labeled. Alnico V magnets. Standard 3.2 ohm voice coils on all speakers up to 10″ size. 6-8 ohm voice coil on 12″ size. Every speaker guaranteed.

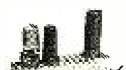
Stock No.	Size	Single each	Lots of 10 each
S-4	4″	$1.29	$1.19
S-5	5″	1.29	1.19
S-98	5¼″	1.79	1.69
S-7	6″	1.79	1.69
S-114	6x9″	2.59	2.39
S-96	7″	2.59	2.39
S-86	8″	2.49	2.39
S-97	10″	3.25	2.95
S-111	12″	3.95	3.95

Speakers may be assorted for 10 lot price.



HOOK-UP WIRE KIT

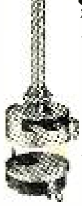
How can we give you so much high grade wire for so little? Olson bought all the wire in sight and is passing the bargain on to you. Kit contains 5 rolls, each 100 ft.—total 500 ft. Various colors, push back, plastic and rubber insulation; solid and stranded copper. Shpg. wt. 3 lb.
AS-19 500 ft. **$2.50**



RCA RADIO ELECTRIFIER

CONVERTS PORTABLES TO AC

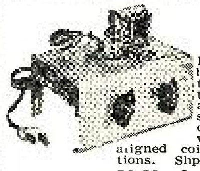
Converts RCA Model 25BK, 25BT2, etc., portable battery sets for operation on 115v AC. Just plug in and set is electric. Can be adapted to other portables, too. Complete with tubes. Shpg. wt. 2 lb.
Stock No. RA-39 . . . . **$1.95**



G.E. VOLUME CONTROLS

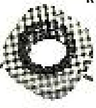
Finest available. Brand new, individually boxed.
Stock No. URC-025 250,000 ohms. List $1.25. Special each 19c
Stock No. URC-034 2 meg. List $1.25. Special each 19c
On-off switches for above controls, snap on easily. USV-001 Special each 10c

TV BOOSTER KIT



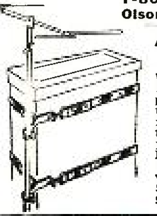
Building your own TV-FM booster? Improve reception in low-signal, low terrain and "fringe" areas. 3 to 5 db gain in signal to noise ratio. All channel tuning. Complete with 6AK5 tube, prealigned coils, components, instructions. Shpg. wt. 5 lb.
RA-26 Complete **$9.95**

TV FOCUS COIL



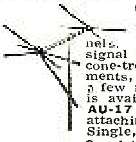
Same as RCA Part No. 202D1. Perfect far all RCA 630-type or similar TV sets. Regular list price is $7.50. Shpg. wt. 2 lbs.
T-80 Only at Olson's, ea. **$1.49**

Adjustable Chimney Antenna Mount

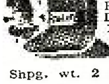


WORTH TWICE OUR PRICE! Strongly made of heavily plated steel. Makes it easy to attach any antenna mast from ¾″ to 1½″ diameter to any chimney. Comes complete with strapping and all hardware. U. S. Patent 2482575. The best. Shpg. wt. 5 lb.
Stock No. X-207 Special, each **$1.59**

OLSON HI-GAIN CONICAL BAY



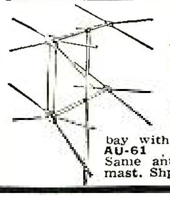
Amazing TV antenna outsells all others. Delivers high gain on all channels. Eliminates ghosts and has excellent signal to noise ratio. Features include silicone-treated insulator, marine type dural elements, and butt seamed tubing. Assembled in a few minutes. Shipped without mast which is available locally.
AU-17 includes universal mounting clamp for attaching to any mast from ¾″ to 1¼″ dia. Single, each $4.49.
Special, price lots of 10, each **$3.99**



TV Deflection Yoke Same as RCA 201D1 for 12″ or 10″ picture tubes. Shpg. wt. 2 lb.
Stock No. T-84 Each **$2.95**

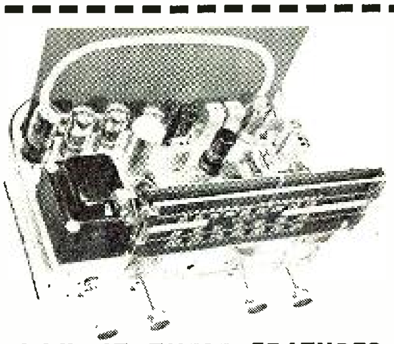
TV FLYBACK TRANSFORMER Same as RCA 211T1. Supplies high voltage to 12″ or 10″ picture tube. Also has filament winding and feeds horizontal scanning coil of deflection yoke. Shpg. wt. 3 lb.
Stock No. T-82, Each **$2.79**

TV-FM ANTENNAS



OLSON'S FINEST QUALITY

Finest ever developed! Exceptionally high gain on all channels. Most efficient for "fringe" areas. Low standing wave ratio permits use with 72, 150 or 300 ohm lines. Special conical section design minimizes noise, reduces "ghosts"—results in sharp, clear picture. Easily assembled. Double bay with 10 ft. mast. Shpg. wt. 16 lbs.
AU-61 . . . . **$11.99**
Same antenna with single bay and 5 ft. mast. Shpg. wt. 10 lbs. **AU-60** **$5.99**



12 TUBE AM-FM CUSTOM CHASSIS

- **NOT A KIT—READY TO PLAY**
- **With built-in pre-amplifier for GE Variable Reluctance Phono Cartridge**
- **Never before a Value like this**

A two-band AM-FM chassis which is perfect for custom installations or to replace obsolete chassis. This value is positively terrific. One of its wonderful features is the built-in pre-amplifier for operating a phono with the GE variable reluctance cartridge. Also has input for standard crystal cartridge as well. Push-pull audio output delivers 10 watts.

Frequency range, 88-108 MC on FM and 550-1700 KC on AM. Equipped with both AM loop and FM pickup dipole. No antenna needed even for distant stations. 12 tubes included as follows: 1—6BA6, 1—7F8, 1—7AH7, 1—6SH7, 1—7A6, 2—6AT6, 1—7F7, 2—7C5, 1—5Y3GT, 1—7Q7. This set was designed for commercial installations in the $500 class. Be the first to have one of these fine chassis. Operates on 105-125 volts AC, 60 cycles, dimensions 9″ x 13″ x 9″. Shpg. wt. 25 lbs. In factory sealed cartons.

LOOK AT THESE FEATURES

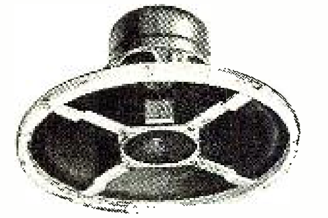
- **High fidelity AM-FM reception**
- **Inputs for GE or crystal pickup**
- **4 dual purpose give 16 tube performance**
- **Automatic volume control**
- **Inverse feed back**
- **Built-in AM-FM antennas**
- **Full range bass-treble tone control**
- **Drift compensated FM circuit**
- **Push-pull beam audio output**
- **Indirectly illuminated slide-rule dial**
- **Licensed under RCA patents**

$55.95

Stock No. RA-37

Chassis complete with tubes, loop and FM dipole.

Can be used with any PM speaker but for best fidelity we recommend our 12″ Co-axial speaker S-122 at.............. **$9.95**



12" CO-AXIAL SPEAKER

40 to 17,000 CPS RESPONSE

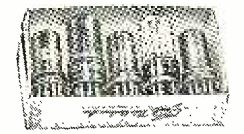
Stock No. S-122, Lots of 2, each **$9.50**

If you've wanted a real high-fidelity co-axial speaker here is your chance to get a brand new 18 watt 1950 model. The 12″ woofer section is driven by a heavy Alnico 5 6.8 oz. magnet and this part delivers the bass notes. The 3″ tweeter which is built into the center of the speaker is driven by a 2.15 oz. Alnico 5 magnet and delivers the treble notes. The high pass filter is built into the speaker and the entire combination gives you tone you never dreamed possible. There are only two wires to connect to any radio or amplifier and the speaker is ready to play for you. Voice coil impedance is 8 ohms. This high quality speaker should not be confused with inferior makeshift units. Olson sells these speakers on an iron clad money back guarantee if you are not 100% satisfied. Order today. Shpg. wt. 8 lb.

Single, each $9.95

OLSON AKRAD

THE HOUSE OF RADIO AND TELEVISION BARGAINS



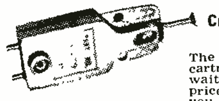
NATIONALLY ADVERTISED RADIO TUBES IN HANDY OLSON KITS AT PRICES THAT SAVE YOU MONEY!

Matched kits that contain popular tube types. All tubes are brand new, fresh and genuine GE, Kenrad, Sylvania and RCA . . . attractively packed in handy shelf boxes. Every tube 100% guaranteed!

"ALL AMERICAN" Kit of 5 tubes
AS-11 each **$2.96½**
Contains one each of following: **12SA7, 12SK7, 12SQ7, 35Z5, 50L6.**

"LOCTAL" Kit of 5 tubes
AS-15 each **$2.96½**
Contains one each of following: **14A7, 14B6, 14Q7, 50A5, 35Y4.**

"MINIATURE" Kit of 4 Tubes
AS-23 each **$2.74½**
Contains one each of following: **12BA6, 12BE6, 50B5, 35W4.**



Olson Akrad Crystal Cartridges 3-Volt Output

XC-50. Standard Crystal Cartridge, single, each **$1.79**, lots of 10, each......... **$1.59**

XC-51, 3-way cartridge with built-in 2 mil needle for 33⅓, 45 and 78 RPM Discs single, each **$2.59**, lots of 10. each.. **$2.39**

The crystal phono cartridge you've been waiting for—and at a price which enables you to use them in your service work profitably. The new Olson Akrad cartridge is interchangeable with any standard cartridge since its mounting centers are ½″. Its high output, 3 volts and wide range response of 50-6000 cps are obtained by advanced methods used in driving the crystal element. The cartridge is supplied with pin plug connectors for ease of connecting leads. Each cartridge is individually packed in a handsome red, white, and blue shelf carton. Order some of each model today.

Above Olson Akrad Cartridges may be assorted to get low 10 lot price.

4-DRAWER STEEL CABINET GIVEN WITH OLSON'S GIGANTIC, NEW AKRAD KIT

Stock No. AS-20 $14.95

You get $45.20 list worth of "Akrad" Condensers plus the 4 drawer steel cabinet, size 8½″ x 7½″ x 10½″. Shpg. wt. 11 lbs.

42 "AKRAD" BY-PASS CONDENSERS!

Qty.	Cap.	Volts	List ea.	Total
2	.001	600	$ .25	$ .50
2	.002	600	.25	.50
2	.005	600	.25	.50
5	.01	600	.30	1.50
5	.02	600	.30	1.50
10	.05	600	.40	4.00
10	.1	600	.45	4.50
2	.005	1600	.55	1.10
2	.008	1600	.55	1.10
2	.01	1600	.60	1.20

ALSO 27 "AKRAD" ELECTROLYTIC CONDENSERS

Qty.	Cap.	Volts	List ea.	Total
2	10	25	$ .75	$1.50
2	25	25	.85	1.70
5	20	150	.95	4.75
5	40	150	1.10	5.50
4	20-20	150	1.30	5.20
5	8	450	.95	4.75

69 Total List Value......545.20

RADIO IN GIANT PEPSI-COLA BOTTLE

A high-grade 5 tube superhet built into a giant plastic Pepsi-Cola Bottle. Stands 24″ tall. Perfect in every detail. Latest features include two double tuned IF stages, PM speaker, built-in antenna, volume control, etc. Stations are tuned by turning the bottle cap. Operates on 115 volts AC-DC. Worth twice our price.

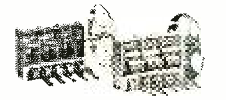
Stock No. RA-32...... $15.95

HOW TO ORDER

How to order: Order directly from this ad. For convenience use this order blank. Fill in columns below with quantity desired, stock number, description and price. You may send remittance with order (include enough for postage or parcel post shipment), or if you prefer SEND NO MONEY. Olson will ship C.O.D. and you may pay mail or expressman for merchandise and postage.

MONEY BACK GUARANTEE: *When you order from Olson we guarantee that if you are not completely satisfied you may return merchandise for exchange or cash refund.*

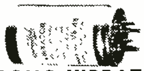
Please Minimum Order $3.00



MATCHED PAIR AM-FM CONDENSERS

Beautifully built! 3-gang. Build a tuner or AM-FM set. AM sections are 365 MMFD; FM is 15 MMFD per section. Can be operated by push-buttons, too. Shaft ⅜″ dia. Condenser 3″ x 1½″ x 4″. Shpg. wt. 3 lbs.

X-201 Only at Olson's, pair 69c



4-PRONG VIBRATORS

Universal 4 prong type, for the majority of sets. NOT SURPLUS. Brand new. Only Olson's terrific buying power can bring you these quiet efficient vibrators. 100% guaranteed or your money back.

Stock No. VB-48 Non-Sync. replaces Mallory 859, 294, 901M; Radiart 5300, 5301. Can size 1½″ x 2⅞″. Single each $1.49.
Each, lots of 10.... $1.19

OFFSET 4 PRONG

VB-43 Delco type. Non-sync. Replaces Mallory 870; Radiart 5333. Can size 1½″ x 2⅞″. Single, each $1.49.
Each, lots of 10.... $1.19

BUICK 5 PRONG

VB-45 Synchronous. Replaces Mallory 716; Radiart 5426. Can size 1 15/16″ x 3½″. Single, each $2.25.
Each, lots of 10.... $1.95

Vibrators may be assorted to obtain the low 10 lot price.

MOLDED BY-PASS KIT

Kit contains 34 Olson Akrad molded condensers which retail at $12.80. Will resist heat, cold, vibration, humidity, physical shock, and electrical overloads. Each kit is packed in durable 6 compartment case with snap lock cover. Also included at no charge is a package of snappy tags to attach to radios which you service.

Each kit contains the following:

Qnt.	Cap.	Volts	Qnt.	Cap.	Volts
2	.001	600	6	.05	600
2	.002	600	4	.1	600
2	.005	600	2	.005	1600
6	.01	600	2	.008	1600
6	.02	600	2	.01	1600

Stock No. AS-34...............$4.95

QUANTITY	STOCK NUMBER	DESCRIPTION	PRICE EACH	TOTAL

TOTAL

NAME ____________________

ADDRESS ____________________ ADD: POSTAGE

CITY ____________ ZONE ____ STATE ________ TOTAL AMOUNT

550

Cut Out and Mail to: OLSON RADIO WAREHOUSE, INC. 73 E. MILL ST. • AKRON 8, OHIO

Sweep Generator

(*Continued from page* 50)

designed to supply only d.c. and filament power. The power transformer is of a rather conventional type except for the several taps on the secondary to supply various 60 cycle sine wave voltages to the sweeping reactor (L_1). The d.c. is supplied to bias the reactor from the regular "B" supply through R_{30}. The a.c. is supplied through C_{20} via the tap switch S_4. Since R_{30} is in series with the d.c. supply, it prevents the filter condensers from shorting the a.c. as supplied to the wide gap reactor. There is considerable a.c. power dissipated in this resistor because the alternating voltage applied to the sweep unit appears across it.

The blanking voltage previously mentioned is obtained from the high voltage secondary via C_{19} and is shaped by the crystal diode $XTAL_2$. Both C_{19} and R_{31} are used to get the blanking phase to correspond to the ends of the trace. Blanking amplitude is not a matter of very great importance because once the oscillator is shut off, it cannot cause any effect on the scope trace until oscillation is again initiated. On the oscillating half cycle, the amplitude of the blanking pulse is carefully controlled by the crystal diode causing a fixed voltage to appear as oscillator bias. A scope applied at pin 6 on the swept oscillator grid will show a half of a square wave during the "on" time, and a half of a sine wave during the "off" time.

Horizontal Sweep

A separate winding is provided for the horizontal voltage for the scope because a 360 degree phase shift is required and a center tap must be incorporated in order to accomplish this. The center tapped winding is not used to supply the oscillators' heaters because every lead into the shield cans

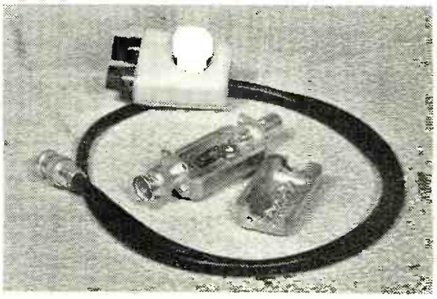


Fig. 8. R.f. output cable and filter.

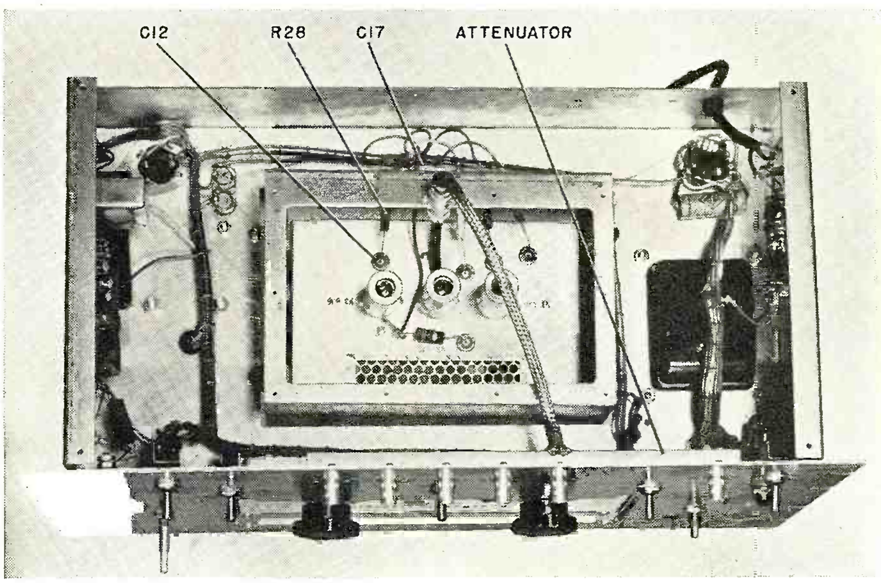
must be double filtered and it is easier to use an extra winding, thus avoiding one filter.

Phase Control

R_{37} and R_{38} in combination with C_{25} and C_{26} permit greater than 180 degree control of the horizontal sweep voltage. This assures that for practically all conditions met in the associated equipment, it will be possible to adjust the phase of the scope sweep to match the phase of the radio frequency sweep. This adjustment is easily made by turning off the blanking and adjusting the phase control until the two images are as nearly superimposed as possible. R_{39} and C_{27} serve to remove harmonics which appear in various amounts on the 60 cycle line voltage. C_{27} was chosen to have exceptionally good high frequency characteristics as an aid in minimizing leakage.

The purpose of the phase reversal switch is most easily explained by an example. Let us assume that the Channel 8 response curve of a television set's head end has been set up on the scope with high frequencies on the right. When the above conditions exist let us say the swept oscillator is moving from low to high frequencies covering 175 to 190 mc. Now if the scope were moved to the video detector to view the set's over-all response curve, the high intermediate frequencies would be on the left. This is

Fig. 9. Bottom view of unit showing details of the double shielded construction.



VEE-D-X

LOW PRICED

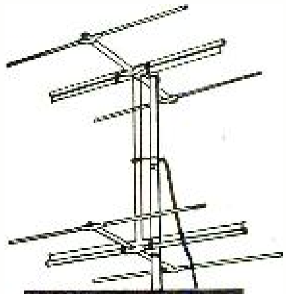
Yagi Arrays

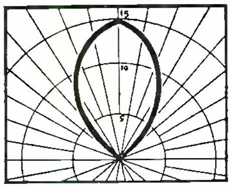
- Transformer ratio of *stepped-up* driven element provides perfect match to 300 ohm line.
- *Lowest* standing wave ratio insures maximum transfer of signal.
- High front to back ratio prevents co-channel interference.
- Sharp horizontal pattern helps reject unwanted interference of all types.
- Extra high forward gain makes this the ideal antenna for single channel fringe reception.
- Not designed to replace the famous heavy-duty RLY and EC series.

J SERIES

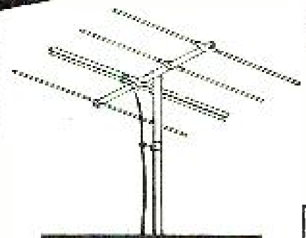
JA

V. S. W. R. = 1.34
Z = 335 ohms





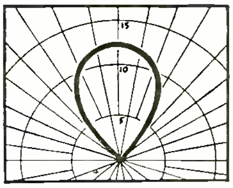
LOW CHANNEL **$17.35** list
HIGH CHANNEL **12.50** list
For double stack as shown



LOW CHANNEL **$13.20** list
HIGH CHANNEL **6.95** list

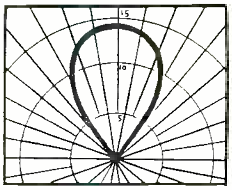
JB

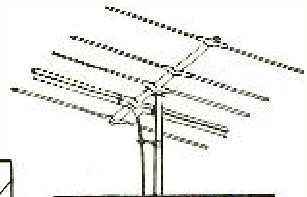
V. S. W. R. = 1.26
Z = 315 ohms



JC

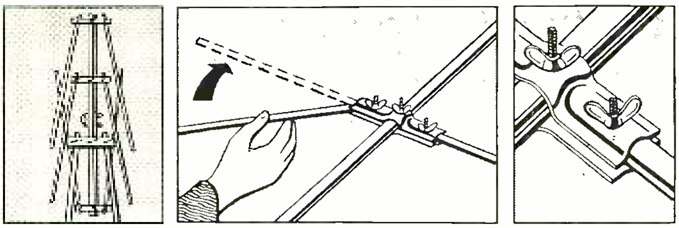
V. S. W. R. = 1.28
Z = 317 ohms



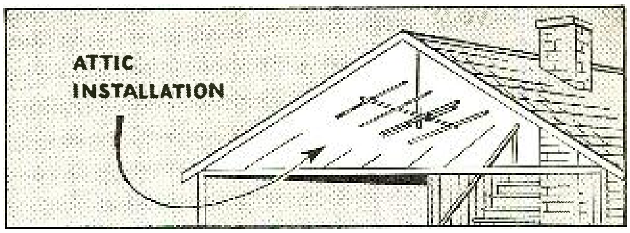


LOW CHANNEL **$14.60** list
HIGH CHANNEL **7.95** list

PRE-ASSEMBLED FOR FAST, EASY INSTALLATION



All the parts are in one package ready for assembly. The new clamp type construction makes it easy to swing each element in place and secure it firmly with the wing nut. No bag of hardware to fuss with — no bolts or screws to lose.



Because of the high gain of this antenna, many people have found that they can obtain excellent results with a single attic installation.

THESE ANTENNAS STAY UP

Only the highest quality duraluminum alloys are used.

Yield Strength	36,000 lbs. per sq. inch
Ultimate Strength	41,000 lbs. per sq. inch
Shearing Strength	24,000 lbs. per sq. inch
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UNIONVILLE, CONNECTICUT

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true because in the usual television set the oscillator is on the high side of the signal. This means then that as the sweep generator's frequency goes up, the intermediate frequency produced goes down, thus turning the curve around. The high frequency side may be returned to the right side by simply flipping the phase reversal switch.

In view of the fact that such reasoning becomes extremely confusing, the following rule of thumb is offered. Turn the sweep generator output frequency *higher*. The response curve on the scope will then move toward the *low* frequency side in terms of sweep output frequency.

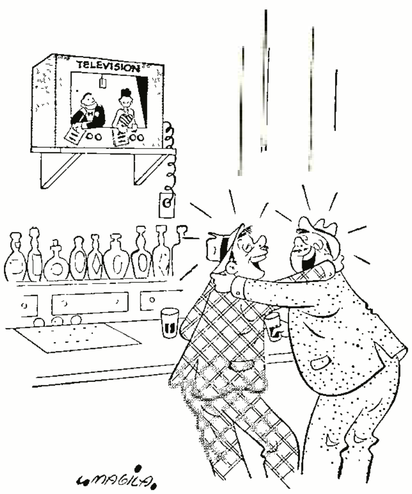
Spurious Outputs

When working at any other frequencies than those in the range of 165 mc. to 220 mc. a generator such as the one outlined above will have two spurious outputs from the two beating oscillators. The usual practice is to overlook these undesired outputs and depend on the selectivity of the receiver to remove them. Where the most accurate results are desired a filter should be used to attenuate the undesired voltages. Such a filter is shown in the schematic as L_4 and C_{18}. Fig. 8 shows the filter with its cover removed inside the loop of the output cable. Some of the undesirable effects which can be caused by spurious outputs of large amplitude are overloading of early stages, excitation of portions of the circuit not under observation, and causing a "hot" output cable.

Conclusion

This article has been confined to discussion of what we believe to be an excellent laboratory-quality sweep generator, but good equipment alone is not sufficient to yield good results. In the field of visual alignment good technique is more important than in almost any other type of electronic measurements. Reliable results can be expected only after a thorough study of available literature on the subject plus many hours of experience.

—30—



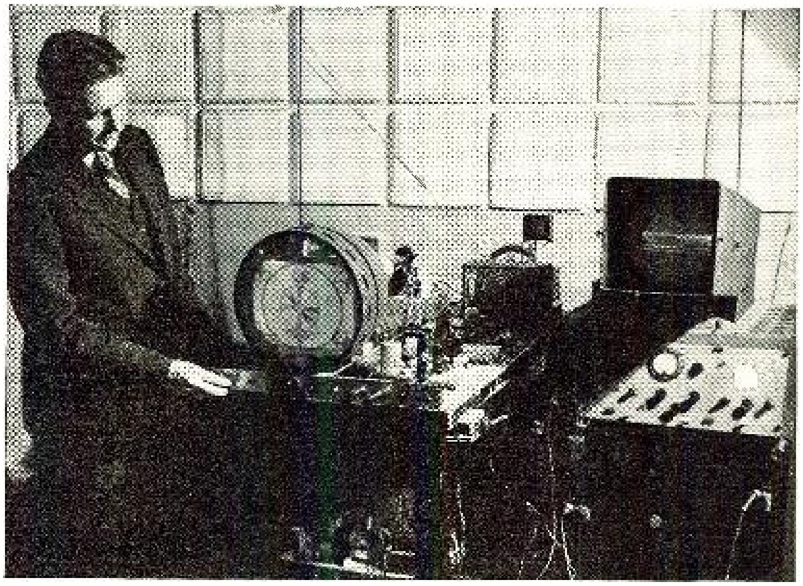
"Sweet Add-O-Line!"

How electronic "paintbrushes" create pictures in our newest art form

There's not a single moving part in a Kinescope —but it gives you pictures in motion

No. 4 in a series outlining high points in television history

Photos from the historical collection of RCA

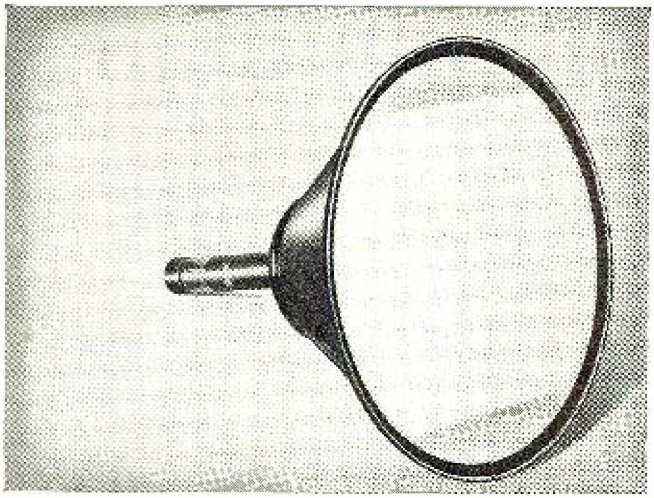


An experimental model of the kinescope—*developed by Dr. V. K. Zworykin of RCA Laboratories—is seen undergoing laboratory tests.*

● Ever watch an artist at work—seen how his brush moves over the canvas to place a dot here, a shadow, a line, a mass, or highlight there, until a picture is formed?

Next time you're asked how television pictures are made, remember the paintbrush comparison. But the "brush" is a stationary electron gun, and the "paint" is a highly refined coating of fluorescent material made light or dark in orderly pattern by electrons.

Developed by Dr. V. K. Zworykin, now of RCA Laboratories, the kinescope picture tube is one of the scientific advances which gave us *all-electronic* television . . . instead of the crude, and now outmoded, mechanical techniques.



New 16-inch *RCA glass-and-metal kinescope picture tube, almost 5 inches shorter than previous types, incorporates a new type of glare-free glass in its faceplate—Filterglass.*

Today, through research at RCA Laboratories, these complex kinescope picture tubes are mass-produced at RCA's tube plants in Lancaster, Pa., and Marion, Indiana. Industrial authorities call this operation one of the most breath-taking applications of mass production methods to the job of making a precision instrument.

Thousands of kinescope faceplates must be precisely and evenly coated with a film of absolutely pure fluorescent material . . . the electron gun is perfectly synchronized with the electron beam in the image orthicon tube of RCA television cameras . . . the vacuum produced in each tube must be *10 times more perfect* than that in a standard radio tube—or in an electric light bulb!

Once it has been completely assembled, your RCA kinescope picture tube is ready to operate in a home television receiver. In action, an electrically heated surface emits a stream of electrons, and the stream is compressed by finely machined cylinders and pin-holed disks into a pencil-thin beam. Moving back and forth in obedience to a radio signal—faster than the eye can perceive—the beam paints a picture on the face of the kinescope. For each picture, the electron beam must race across the "screen" *525 times*. To create the illusion of motion, 30 such pictures are "painted" in every single second.

Yet despite these terrific speeds, there are no moving mechanical parts in an RCA kinescope. You enjoy the newest of our arts because electrons can be made to be obedient.

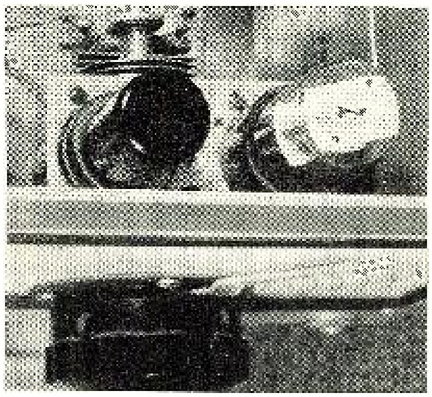
(Advertisement)

Radio Corporation of America
WORLD LEADER IN RADIO—FIRST IN TELEVISION

NBFM Unit
(Continued from page 63)

changes in plate voltage on the plate of the second section of the 6SL7GT. The v.f.o. in use at W6EDG has the grid circuit of the oscillator on 80 meters with 10 microhenrys inductance and 200 $\mu\mu$fd. of capacity. The coupling condenser between the v.f.o. and the grid of the 6SL7GT (C_5, 15 $\mu\mu$fd.) was chosen by installing a variable trimmer and adjusting to optimum value and then replacing the trimmer with a fixed condenser of the same value. This unit has been used on 10, 11, and 20 meter phone with good reports of narrow-band FM quality.

Note that in the first section of the 6SL7GT a potentiometer is used in the cathode lead to ground. The entire potentiometer is used as a bias resistor and the tap is used for connecting a hand key or bug for frequency shift keying of the transmitter. When part of the bias resistor is shorted out, the plate voltage changes on the second section of the 6SL7GT, due to a change in plate current in the first section of the 6SL7GT. This change in plate voltage changes the amplification and the input capacity will change. The magnitude of the frequency shift will be dependent on the amount of bias change or the amount of the bias resistor shorted out. Note that the bias resistors are bypassed for r.f. only. This FSK system has been used by the writer on 11 meters and works very well. The amount of frequency shift on FSK is variable by means of R_5 from 0 to 3200 cycles, on 11 meters, with the circuit constants shown. Receiving FSK is a matter of having a receiver with good enough selectivity to discriminate between the "mark" or key-down signal and the "space" or key-up signal. The transmitter carrier will be on continuously but the frequency will shift from the mark to the space frequency. It is only necessary for the receiving operator to adjust his receiver so that he receives the mark or key-down signal and the space or key-up signal will then be inaudible. A crystal filter or "Q5-er" will discriminate between the mark and space signal and provide a good signal for copying.



Top view looking down into NBFM and FSK unit bolted in place on front of v.f.o.

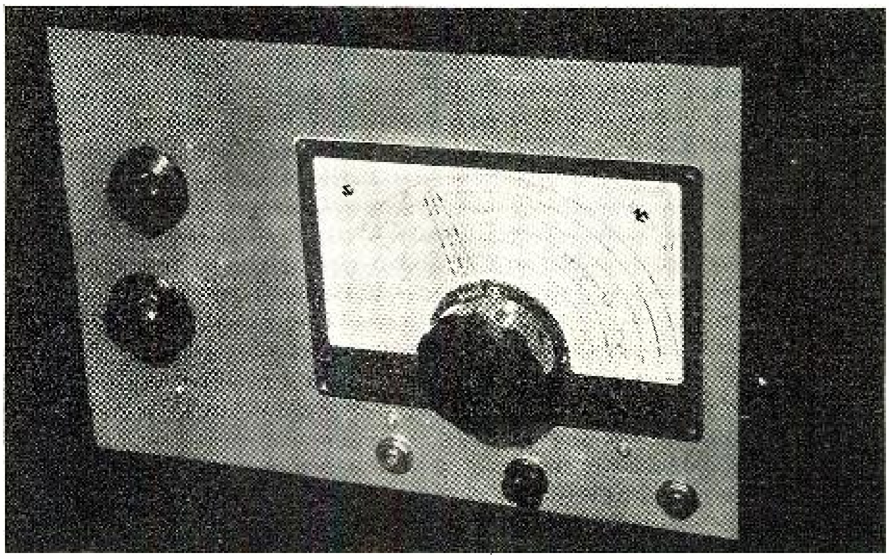
The unit in use in the writer's v.f.o. is built on a small strip salvaged from surplus gear with two conveniently located sockets and tapped holes for mounting. The unit is mounted directly above the tuning condenser of the v.f.o., bolted to the front panel. Filament and plate voltages are taken from the v.f.o. power supply.

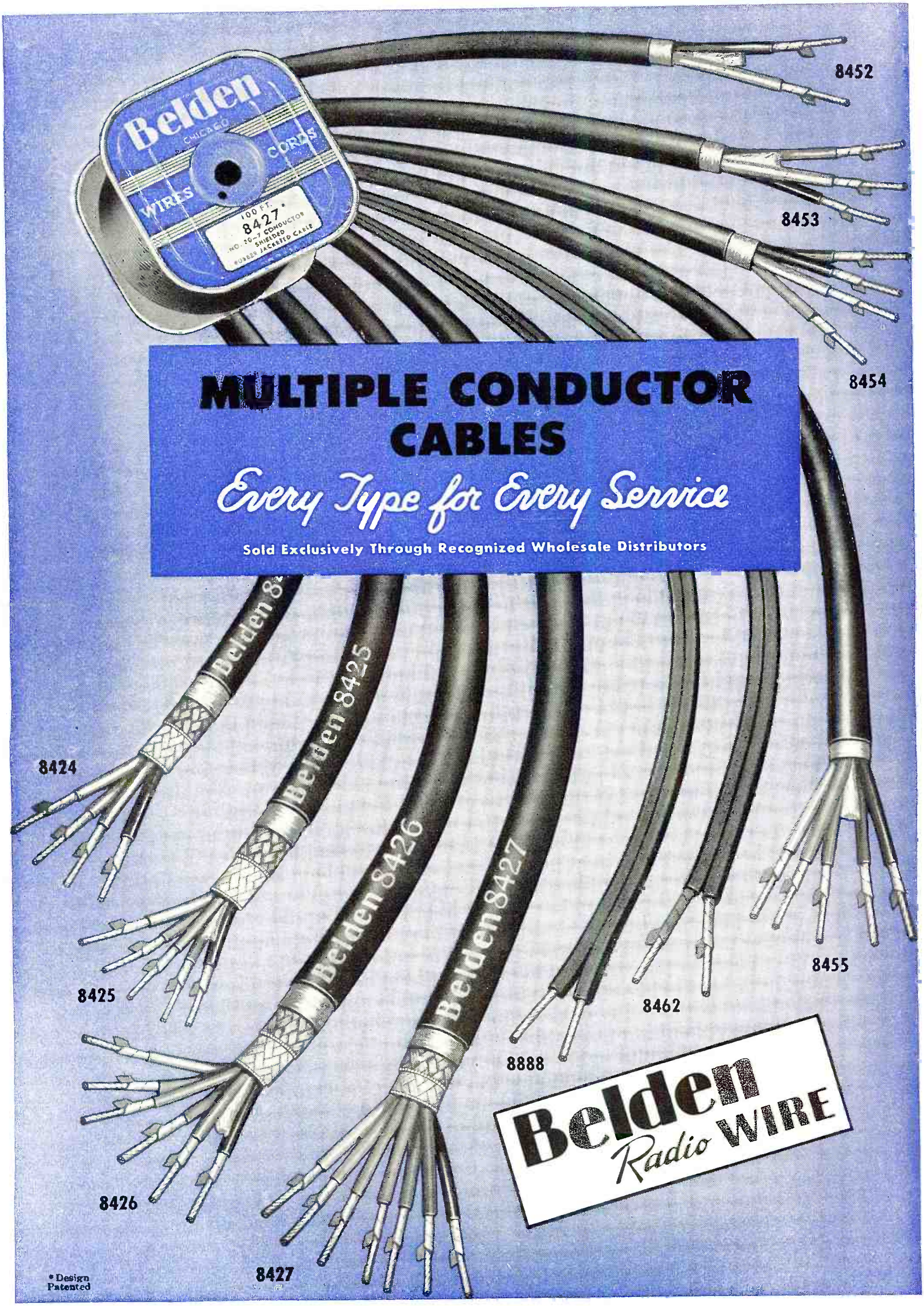
The same technique used for communications would also be adaptable for a wireless record player to be used with FM receivers.

It would be desirable to have the oscillator operate on the higher frequency bands, preferably in the FM band of 88-108 mc. As only low power is needed for this type of service, an oscillator such as a 6C4 will be sufficient. With the ordinary crystal pickups it should be practical to feed the pickup directly into the first grid of the 6SL7. The deviation may be adjusted by the cathode potentiometer.

—30—

Front view of v.f.o. Controls under dial are deviation control for FSK in center, microphone input on left under dial, and key jack for FSK on right.

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MARS Station of the Month

MARS AND NAVY SPONSOR DOUBLE-HEADER PROGRAM MAY 20TH

MARS and the Navy will co-sponsor a double-header program for amateurs on Armed Forces Day, May 20, 1950. The two-fold program will consist of receiving competition, similar to the old Navy-Day Copying Contest, and a QSO and message relay contest which will emphasize the handling of traffic.

The Honorable Louis A. Johnson, Secretary of Defense, will issue a special message to the amateurs. This message will be broadcast on 13 military frequencies at 25 w.p.m. as follows: May 20, 1950 at 2100 EST and at 2300 EST. NSS, Washington, D. C., will transmit on 122 kc., 4390 kc., 9425 kc., 12,630 kc. and 17,000 kc. WAR, Washington, D. C., will transmit on 3497.5 kc., 6997.5 kc., 14,405 kc., 20,994 kc., and 27,994 kc. May 20, 1950 at 2000 PST. NPG, San Francisco, will transmit on 115 kc., 9255 kc., and 12,540 kc.

Anyone who can receive and transcribe the message without error may send his transcribed copy to Headquarters MARS, Room 5 B 519, The Pentagon, Washington 25, D. C., where it will be checked for accuracy. All who submit a perfect copy will receive a special Certificate of Merit attesting to their code copying proficiency.

The QSO and message relay contest will last 12 hours and will have for its main purpose the demonstration on a national scale of the effectiveness of point-to-point or person-to-person communication by amateur radio as a back-up system for normal communications systems which might be knocked out by flood, fire, storm, ice, or sabotage. The contest will begin at 1700 GCT (1200 EST, 1100 CST, 1000 MST, and 0900 PST). Any radio amateur licensed by the FCC or by the Armed Forces of the United States is eligible to compete in the contest. All amateur bands, either fone or c.w. may be used. Single or multi-operator stations will be considered separately for purposes of scoring the contest. Contest log forms (or additional information on the Armed Forces Day program) may be obtained by writing the Headquarters MARS, Room 5 B 519, The Pentagon, Washington 25, D. C.

KING Four Fox Able Charlie, the "MARS" Station of the USAF Special Staff School, Communications-Electronics Division, Gunter Air Force Base, Montgomery, Alabama, has been named the Station of the Month, by Major Rawleigh H. Ralls, Chief MARS, USAF. K4FAC has been "On-the-air" for a year and a half. The station was activated by Lt. Colonel Milburn B. Andrews, Chief, Engineering Section of the school. The original station equipment consisted of a surplus BC-610 transmitter, a "Super-Pro" receiver and a simple dipole antenna. The station was later completely "revamped" and equipped with a new *Gordon* 10-20 rotary beam antenna, *Collins* 30-K1 transmitter, *National* HRO receiver, *RME* preselector, converter, "Panadaptor," and other fine "ham" gear.

Each year two different "K4FAC MARS Clubs" are organized, one from each Senior Air Communications-Electronics Staff Officers' Course. The present club has twenty-two members. Although most of the club members have their own ham stations, most of them will be found on-the-air at

Lt. Colonel Milburn B. Andrews (W4TB), K4FAC station director, hands a message to Sgt. H. B. Solomon, station operator. Sgt. Solomon handles most of the regularly scheduled contacts at K4FAC. Most of the student officers who make up the membership of the MARS Club at Gunter Air Force Base operate in late afternoons or in the evening.

LOWEST PRICES TUBES and PARTS

29c ea. 1U4, 2C26, 2C34, 3A4, 01A, 6A3, 10, 12A, 39/44, 47, 50, 71A, 112A, 182B, 183, 25S, 482B, 483, 1A4, 1A4P, 1A6, 1B5, 1D5GT, 1D7, 1D8GT, 1F4, 1F5G, 1G4GT, 1G6GT, 1H4G, 1H6GT, 1J6G, 1619, 1626

FREE! $20.00 List Value Cornell-Dubilier, Mallory, Aerovox, Sprague, Solar Filter Condensers ten fast moving 150V & 450V filters free with each 100 tubes.

79c each 1B3GT, 1X2, 2A3, 2A4, 3Q5, 6A7, 6AK5, 6BQ6GT, 6E5, 6G5, 6L6G, 6SD7GT, 6U5, 32L7GT, 50A5, 70L7GT, 350B, 807

39c ea. 1T4, 5Y3GT, 35W4, 35Z5GT, 6C4, 6X5GT, 25Z6GT, 30, 31, 32, 33, 34, 35, 35Z4GT, 36, 37, 38, 46, VT-52, 56, 57, 58, 76, 80, 89, HY-615

49c ea. 1C5, 1C6, 1L4, 1R5, 1S5, 1U5, 2A5, 2A7, 3Q4, 3S4, 3V4, 5W4GT, 5X4G, 5Y4G, 6AB4, 6AC4, 6AC5GT, 6AG5, 6AL6, 6AQ5, 6AQ6, 6AR5, 6AS5, 6AT6, 6AU6, 6A8GT, 6B6, 6BA6, 6BD6, 6BE6, 6BH6, 6BJ6, 6C5, 6C8G, 6D6, 6F5GT, 6F6GT, 6G6, 6H6GT, 6J5GT, 6J7GT, 6K7GT, 6K8GT, 6L5, 6S4, 6SA7GT, 6SC7GT, 6SG7GT, 6SH7, 6SJ7GT, 6SK7GT, 6SQ7GT, 6SR7, 6U6GT, 6U7, 6V6GT, 6W4, 6X4, 6Z4, 12A8GT, 12AT6, 12AU6, 12AU7, 12BA6, 12BE6, 12F5GT, 12H6, 12J5GT, 12J7GT, 12K7GT, 12K8GT, 12SF5, 12SF7, 12SH7GT, 12SR7GT, 1629 (eye), 24A, 25L6GT, 25W4GT, 25X6, 26, 27, 35B5, 35C5, 35Z6GT, 50B5, 50C5, 50Y6, 51, 77, 78, 85, 99

89c each 6BG6G, 6B5, 6BN6, 12BN6, 19BG6G, 25AC5GT, 25BQ6GT, 117L7GT, 117P7GT

59c ea. 0Z4, 1A5GT, 1A7GT, 1C7G, 1LA4, 1LE3, 1Q5GT, 1T5GT, 1V, 1C5GT, 2B7, 5U4G, 5V4, 5Z3, 5Z4, 6A8, 6AC7, 6AJ5, 6AK6, 6AL5, 6AV6, 6B4G, 6BA7, 6B8, 6C6, 6CB6, 6D8G, 6F8G, 6J6, 6K5, 6P5GT, 6R7, 6S8GT, 6SF5GT, 6SL7GT, 6SN7GT, 6SS7, 6SU7, 6Q7GT, 6T7G, 6W7G, 6Y6G, 6Z7G, 7A4, 7A6, 7A7, 7B5, 7B6, 7B8, 7C4, 7C6, 7E5, 7E6, 7E7, 7F7, 7G7, 7H7, 7J7, 7L7, 7N7, 7Q7, 7S7, 7T7, 7V7, 7W7, 7Y4, 12A7, 12AT7, 12AV6, 12AX7, 12BA7, 12BF6, 12C8, 12J5, 12Q7GT, 12SA7GT, 12SG7, 12S8GT, 12SJ7GT, 12SK7GT, 12SL7, 12SN7GT, 12SQ7GT, 12Z3, 20, 35/51, 35L6GT, 40, 41, 42, 43, 50L6GT, 53, 75, 84/6Z4, 117Z3, VR150, XXL

69c ea. 1A3, 1AB5, 1H5GT, 1LA6, 1LB4, 1LC5, 1LC6, 1LD5, 1LH4, 1LN5, 1N5GT, 1P5GT, 1S4, 2V3G, 2X2, 3LF4, 4A6G, 6B7, 6BF6, 6J8G, 6S7G, 6SU7GT, 6T8, 7A8, 7C5, 12A6, 12BF6, 14A4, 14A5, 14A7, 14AF7, 14B6, 14B8, 14E6, 14E7, 14H7, 14J7, 14N7, 14Q7, 14W7, 14X7, 14Y4, 19T8, 25Z5, 35Y4, 35Z3, 45, 2050, 2051, 50C6, 81, 83, 117Z6GT, 9001, XXB

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Tube prices are for 50 tubes or more—may be assorted. **Individually boxed—Standard factory guarantee**

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3-Way Portable Tube Kit, 117Z3, 1U5, 3V4, 1R5, 1T4 . . . . . all for	$1.99
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1U4, 3S4, 1S5, 1R5 . . . . 4 tube kit	$1.49
3Q4, 1T4, 1R5, 1S5 . . . . 4 tube kit	$1.49
50A5, 35Y4, 14A7, 14B6, 14Q7 . . . . 5 tubes for	$2.95

Best Quality SPEAKERS Alnico 5 PM

	10 or more Each	Price Each
5″	95c	$1.05
2½″, 3″, 4″	95c	$1.05
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8″	2.95	3.25
10″	4.25	4.50
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Jensen 8″ Speakers 9 watts output, heavy duty 10 oz. Alnico V magnet **$3.25 ea.**
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Jobbers: write for quantity prices.

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Standard Replacement Regular size 455 Kc . . . . ea. **29c**
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Red Hot Vibrator Special. 4-prong, small size Universal, fits 80% of all jobs . . . . ea. **89c**
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4 PRONG VIBRATORS—VERY BEST BRANDS

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OCTAL SOCKETS MOLDED . . . . . 10 for **49c**
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Standard replacement crystal cartridge. Each **$1.39**
NYLON 1J CARTRIDGE $2.59

VOLUME CONTROLS

VERY BEST BRANDS	10 or more Each	Price Each
½ meg. or 1 meg. or 1/10 meg. with switch—long shaft	29c	35c
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1000 ohm	16c	19c
4 meg.	16c	19c
5000 ohm	16c	19c
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OUTPUT TRANSFORMERS

For 50L6, 35L6, 50A5, 35A5, 117L7 . . . . **39c ea.**
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Appliance Cord, up to 1,000 watts, 1 rubber plug. 5 for . . . **99c**
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K4FAC at some time or another. Non-amateur students are also encouraged to join the club and regular instruction in code, equipment construction, and station operation is conducted for their benefit.

Master Sergeant J. E. "Mat" Mathis as Chief Operator, and Sergeant H. B. "Sol" Solomon hold down the regular station operating shifts and also double as code instructors for the members of the "MARS" Club. Mat is a handy man with tools and is usually the one who builds "that new gadget for the station." Sol is the traffic man and is also gradually getting the "DX" bug.

Lt. Colonel Andrews has been a ham for twenty-four years with such former calls as W5AQ, W6SU, W5BIT, W5GIK, W2MSY. His present call is W4TB and he will usually be found on 10 or 20 fone chasing that very elusive and exclusive "DX." He holds both commercial radiotelephone and radiotelegraph licenses and shakes a speedy bug when he can be talked into doing a little brass pounding on the circuit.

K4FAC is anxious to schedule any of the other MARS Stations and will handle traffic for any area. The station works with the "Alabama Emergency Net," and the "Montgomery Emergency Net." During the hurricane season last year the station was on 24-hour status for several periods. Future plans for the station include auxiliary power supply for the main station and additional portable and mobile gear to prepare the station for any type of emergency operation.

—30—

HAM CONVENTION

THE Detroit Area Amateur Radio Council is sponsoring a ham convention to be held at Detroit's Hotel Statler, May 27, 28, and 29.

This is the first convention held by the Great Lakes Division of the A.R.R.L. since its formation from the old Central Division some four years ago.

Because of the long Memorial Day weekend, the committee in charge of arrangements has been able to plan some unique and interesting events. The program includes all sorts of technical and organizational talks and meetings. There will be a mammoth "Swap 'N Shop" session to which all who attend are invited to bring their swapping material. An YLRL luncheon, a DX stag breakfast, and an AEC get-together have also been planned. Entertainment for XYL's has been provided in addition to events catering to specialized ham interests.

The registration fee for the 3-day meet is $3.50 with the banquet ducats costing $4.25—or both for $7.50. Tickets can be secured by writing direct to W8AHH, Box 903, Detroit 31, Michigan, or can be purchased through radio clubs and radio parts dealers in the Michigan, Ohio, and Kentucky area.

General chairman of the convention is Ty Kirby, W8TDO. Frank Taylor, W8AW, is secretary, and Fred Chevillot, W8SWI, is treasurer. George Goldstone, W8MGQ, is serving as vice-chairman of the affair.

—30—

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SX-25 Receiver, less spkr	94.50	69.50
SX-28 Receiver, less spkr	223.00	99.50
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S-40 Receiver	79.95	49.50
SX-42 Receiver, less spkr	275.00	149.50
R-42 Speaker	34.50	20.00
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SP-200 Series with pwr. supp. & Spkr.	250.00	139.50
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HICKOK—288X (xtal controlled)	169.20	99.50
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Phone Transmitter

(*Continued from page* 53)

stability, detune C_2 slightly to one side of exact dip. (b) Switch the meter to the doubler stage and tune C_7 for lowest plate current dip. (c) Switch the meter to the buffer stage and tune C_{12} for plate current dip. (d) Switch the meter to the PM section of the final amplifier (shunt resistor R_{16}) and retune each of the preceding exciter stages except the oscillator for maximum upswing of the meter. This will be between 15 and 20 ma. (e) Switch the meter to the PA section of the final amplifier (shunt resistor R_{15}) and tune C_{16} for plate current dip. This will be 50 to 60 ma.

5. Connect the antenna. Swing coupling coil L_6 into L_4 to increase coupling (always use the minimum permissible coupling) and tune the antenna circuit, watching for a peak indication of a thermocouple ammeter or lamp connected in the transmission line or feeder cable as C_{18} is adjusted.

6. Plug in the microphone, advance gain control R_{17}, and whistle or hum a sustained constant-volume note into the microphone. Under modulation, the PA plate current will fall to a lower value. The PM plate current at the same time will increase to approximately 4 or 5 times its unmodulated value. The meter or lamp in the transmission line will give an upward indication (an increase of up to 50 per-cent, indicating full modulation). A downward indication of either the lamp or antenna ammeter indicates improper tuning of C_{18} and/or the wrong number of turns in coil L_5. The number of turns given for L_5 in Table 1 will be satisfactory for low-impedance cables such as RG8/U, but the number must be increased for 300-ohm lines or 600-ohm open lines. If downward modulation is obtained and further adjustment of C_{18} does not correct the condition, coil L_5 must be rewound. Modulation quality may be checked aurally by means of a non-oscillating diode (crystal or tube) detector and headphones. Modulation percentage may be checked visually by means of an oscilloscope, using wave patterns obtained with the aid of the internal sweep oscillator of the scope.

7. After tuning adjustments are completed, apply the full plate voltage to the 829B and recheck tuning throughout. Use the PM plate current as an indicator, retuning to give maximum PM plate current.

8. As a final check, the difference between the "in-resonance" and "out-of-resonance" unmodulated PA plate current under load should be not less than 5 per-cent and not more than 10 per-cent of the PA operating current.

9. While jacks have been provided for checking PA and PM grid current, these checks are not important to the tuning adjustments and were put in this particular model for laboratory measurements only. They may be omitted if the builder desires.

In the 5 months during which this transmitter has been in use, W6MYR has made approximately 50 contacts for test purposes on 10 meters. Many of these QSO's have been coast to coast and some have been out of the country. Without mentioning beforehand the system of modulation, excellent reports as to carrier strength, talk power, modulation percentage, and speech quality have been received in each instance.

On occasion, W6MYR has operated the supermodulated rig (at 40 watts input) side by side with a standard 40-watt plate-modulated transmitter, switching the antenna from one to the other during a QSO. In these tests, the supermodulated rig has out-performed the standard job, delivering heavier audio at the receiving location even when band conditions were such that the supermodulated carrier seemed weaker momentarily than that of the standard rig. Frequently supermodulation cut through QRM (local at the receiver) when standard plate modulation gave poor account of itself.

In tests at K6AI, 90 watts input to the final amplifier gave excellent supermodulation performance.

Wally Newman, W6FEX, has been operating mobile for the past several months with a duplicate model of this transmitter running about 30 watts input. He reports that excellent results have been obtained and that the transmitter performs very satisfactorily in this type of operation.

While the subject transmitter has been designed specifically for 10-meter operation, the authors can see no reason why the unit should not operate equally well on other bands provided coils are wound for those bands. —30—

TAPE DISTORTION

By TED POWELL

HERE are a few more notes on the subject of tape recorder head-clogging distortion, originally mentioned by Matthew Mandl in the February issue (page 70).

The clogging is also aggravated by the following conditions. 1. Finger oil and perspiration coating of tape due to handling; 2. Dust, dirt, and fumes coating tape; 3. Plastic adhesive gumming of tape caused by Scotch tape splices; and 4. Tape coating deterioration and "chalking" caused by coarse tape guides.

It is obvious that it is not enough to simply clean the recording, playback, and erase heads. A clean, soft cloth held gently against the tape while running will clean off the dirt and oil coating. When the Scotch tape splices are reached, the tape pulling mechanism should be stopped and the Scotch tape cleaned to remove plastic adhesive from the outside surface. Next all rough tape guides are polished down with very fine sandpaper and crocus cloth. Care should be exercised so that no abrasive gets into the tape pulling mechanism during this operation. —30—

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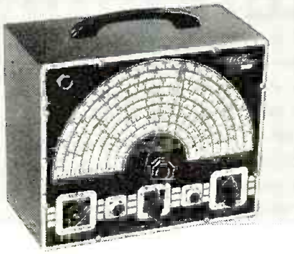

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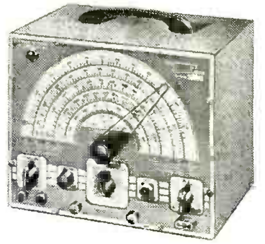

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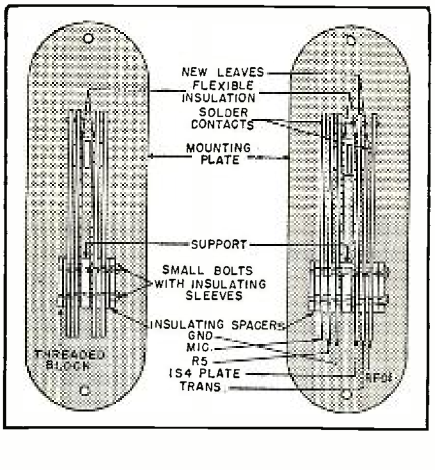
New Transceiver
(*Continued from page* 39)

slight alteration was necessary. The assembly was dismantled and two additional leaves, patterned after the originals, were cut from sheet brass. One of these was cut about 3/16" shorter than the rest and a drop of solder applied for a contact; the contact on the other new leaf was built up to about 1/8" thickness. The switch was then reassembled using heavy paper for the leaf spacers in addition to the original plastic ones and replacing the plastic bolt insulators with ordinary spaghetti tubing. For the s.p.d.t. section, the new leaf with the large contact was put in place with the contact facing outward. Next, the short leaf with its contact also facing out and on the outside one of the four original leaves was bolted in place. The latter is the common terminal and is in contact with the short leaf while in normal (receive) position. When the switch is pressed, the inside leaf bends outward, making contact with the outside leaf and, at the same time, moving it away from the middle leaf. For the d.p.s.t. section, the three remaining leaves were simply placed one next to the other in such a way as to be normally separated and all in common contact when the butterfly knob is turned. Details of the switch before and after alteration are shown in Fig. 3.

The r.f. section came next. The sub-midget, two-plate variable condenser was mounted on two aluminum brackets which were held in place by base mounting bolts and the coil was soldered across it. The plate pin of the 958-A was soldered directly to a stator terminal and the plate r.f. choke was connected to the center of the coil. The grid resistor, condenser, and choke were soldered to the grid pin and all other leads kept short. A piece of 3/8" polystyrene rod, one end of which was drilled to fit the quarter-wave antenna snugly, was used for the radiator socket. The threaded metal part of a tip jack was heated and

Fig. 3. Conversion details on the handset switch. The unit at the left is the original switch while the one at right shows changes made in conversion process.



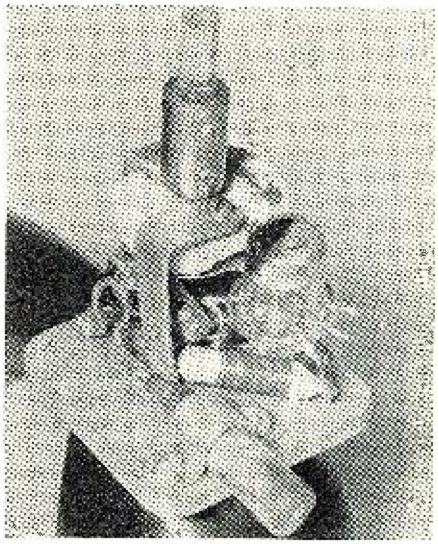


Fig. 4. The r.f. portion of the transceiver. The r.f. grid choke is in the foreground. The grid-leak resistor and feedback condenser can be seen at the left and above the grid choke. The 958-A plate pin (other side of tube) is soldered directly to the stator terminal of the variable condenser. The base was drilled and tapped to accommodate 6-32 machine screws which secure the antenna socket clamp.

turned into the other end after drilling the plastic to accommodate it. A hairpin turn of No. 14 copper wire, connected between the jack and a ground held under a mounting bolt, provided ample pickup. The antenna was cut from the small end of a steel whip but could have been any conductor of equal length and reasonable rigidity. The condenser shaft extension is 1/4" polystyrene rod.

A four foot length of six conductor cable was used to connect the hand unit to the battery pack. Four of the six conductors were fastened to lugs in the microphone chamber and the cable terminated at a shielded octal connector which plugs into the battery box. This box, housing batteries and audio components, was constructed of light gauge aluminum and measures 4" x 7½" x 1⅜". Its size could have been reduced had smaller batteries and transformer been used. The 1S4 provides ample audio for modulation and reception; in fact the gain had to be lessened to prevent excessive frequency modulation of the carrier and to eliminate feedback from headphone to microphone.

Battery current drain is quite low; approximately 15 ma. for the "B" battery and 200 ma. for the "A" battery. The quarter-watt input to the 958-A does surprisingly well. Considerable distances have been covered under most adverse conditions and arm fatigue is a thing of the past. The enjoyment and convenience in operating this little rig has been ample reward for the slight expense and short time required for its construction.

Some adjustment of antenna length may be necessary for optimum results. However, in most cases the rod should be about 19 inches long. —30—

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★ One of the most important improvements, we believe, is the fact that the 4-position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

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Tests for "shorts" and "leakages" up to 5 Megohms.

Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-10 as any of the pins may be placed in the neutral position when necessary.

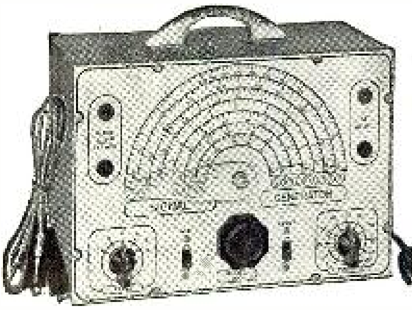
The Model TV-10 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

Free-moving built-in roll chart provides complete data for all tubes.

Newly designed Line Voltage Control compensates for variation of any line voltage between 105 Volts and 130 Volts.

The New Model 200 **AM and FM**

SIGNAL GENERATOR



★ **R.F. FREQUENCY RANGES:** 100 Kilocycles to 150 Megacycles.

★ **MODULATING FREQUENCY:** 400 Cycles. Also available separately.

★ **ATTENUATION:** The constant impedance attenuator is isolated from the oscillating circuit by the buffer tube. Output impedance of this model is only 100 ohms. This low impedance reduces losses in the output cable.

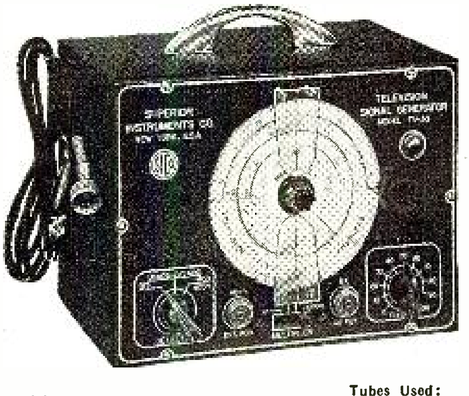
★ **OSCILLATORY CIRCUIT:** Hartley oscillator with cathode follower buffer tube. Frequency stability is assured by modulating the buffer tube.

★ **ACCURACY:** Use of high-Q permeability tuned coils adjusted against 1/10 of 1% standards assures an accuracy of 1% on all ranges from 100 Kilocycles to 10 Megacycles and an accuracy of 2% on the higher frequencies.

•**TUBES USED:**—12AU7—One section is used as oscillator and the second is modulated cathode follower. T-2 is used as modulator. 6C4 is used as rectifier.

The Model 200 operates on 110 Volts A.C. Comes complete with output cable and operating instructions. **$18.85 NET**

The New Model TV-30 **TELEVISION SIGNAL GENERATOR**



Enables alignment of television I. F. and FRONT ENDS without the use of an oscilloscope.

SPECIFICATIONS

Frequency Range: 4 Bands—No switching

18— 32 Mc.
35— 65 Mc.
54— 98 Mc.
150—250 Mc.

Audio Modulating Frequency: 400 cycles (Sine Wave) Attenuator: 4 position, ladder type with constant impedance control for fine adjustment.

Tubes Used:
6C4 as Cathode follower and modulated buffer.
6C4 as R.F. Oscillator.
6SN7 as Audio Oscillator and power rectifier.

Model TV-30 comes complete with shielded co-axial lead and all operating instructions. **$29.95 NET**

THE NEW MODEL 670

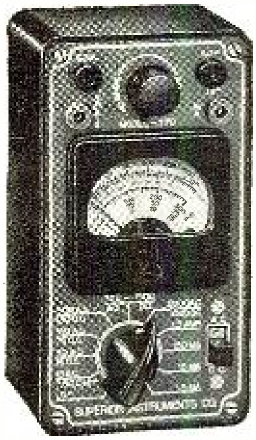
SUPER METER

A Combination **VOLT-OHM-MILLIAMMETER plus CAPACITY REACTANCE, INDUCTANCE and DECIBEL MEASUREMENTS.**

D.C. VOLTS: 0 to 7.5/15/75/150/750/1500/7500. **A.C. VOLTS:** 0 to 15/30/150/300/1500/3000 Volts. **OUTPUT VOLTS:** 0 to 15/30/150/300/1500/3000. **D.C. CURRENT:** 0 to 1.5/15/150 ma.; 0 to 1.5 Amps. **RESISTANCE:** 0 to 500/100,000 ohms. 0 to 10 Megohms. **CAPACITY:** .001 to .2 Mfd., .1 to 4 Mfd. (Quality test for electrolytics.) **REACTANCE:** 700 to 27,000 Ohms; 13,000 Ohms to 3 Megohms. **INDUCTANCE:** 1.75 to 70 Henries; 35 to 8,000 Henries. **DECIBELS:** −10 to +18. +10 to +38. +30 to +58.

The model 670 comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions. Size 5½" x 7½" x 3". **$28.40 NET**

THE NEW MODEL 770 *An Accurate Pocket Size* **VOLT-OHM MILLIAMMETER**



(Sensitivity: 1000 ohms per volt)

Features:
Compact, measures 3⅛" x 5⅞" x 2¼". Uses latest design 2% accurate 1 Mil. D'Arsonval type meter. Same zero adjustment holds for both resistance ranges. It is not necessary to readjust when switching from one resistance range to another. This is an important time-saving feature never before included in a V.O.M. in this price range. Housed in round-cornered, molded case. Beautiful black etched panel. Depressed letters filled with permanent white, insures long life even with constant use.

Specifications: 6 **A.C. VOLTAGE RANGES:** 0-15/30/150/300/1500/3000 volts. 6 **D.C. VOLTAGE RANGES:** 0-7½/15/75/150/750/1500 volts. 4 **D.C. CURRENT RANGES:** 0-1½/15/150 Ma. 0-1½ Amps. 2 **RESISTANCE RANGES:** 0-500 ohms. 0-1 Megohm.

The Model 770 comes complete with self-contained batteries, test leads and all operating instructions. **$13.90 NET**

20% DEPOSIT REQUIRED ON ALL C. O. D. ORDERS

GENERAL ELECTRONIC DISTRIBUTING CO.

DEPT. RN-5, 98 PARK PLACE, NEW YORK 7, N. Y.

The Genescope

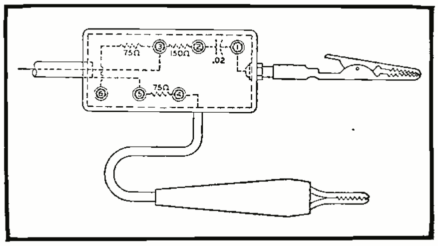
(Continued from page 62)

The ability of the Genescope to provide a zero or reference line is most appreciated when the FM sound discriminator is being adjusted. Consider the typical television sound i.f. system shown in Fig. 6. It consists of three i.f. stages and a discriminator. The 3rd i.f. tube serves as a limiter to reduce the effects of amplitude modulation. The output cable of the sweep oscillator is connected to the grid of the 3rd i.f. amplifier tube. The vertical input cable of the oscilloscope is connected between point *A* and ground. The sweep generator is set to sweep for approximately .5 megacycle above and below the sound i.f. frequency. The vertical gain control on the oscilloscope is now advanced until a response pattern approximately 1 inch high is obtained. The pattern will consist of two separate S-shaped response curves. Rotate the phasing control until the two curves blend as much into each other as possible. The result is shown in Fig. 7A. Now adjust the blanking control until a single curve appears with a base line through it. See Fig. 7B.

Adjust the primary of the discriminator transformer for maximum amplitude and linearity of the S-curve. Reduce the signal generator output as the height of the curve increases. The secondary of the discriminator transformer controls the centering of the S-curve and it is adjusted until there is as much of the curve above the base line as below. Feed in a 21.25 mc. marker signal. If the discriminator is properly adjusted, the pip will appear along the linear portion of the "S" curve. As a further test of the secondary alignment, set the AM signal generator to the sound i.f. value (21.25 mc.) and modulate it with the 400 cycle note. If the discriminator is not in perfect alignment, a 400 cycle modulation pattern should appear along the base line of the S-curve. See Fig. 7C. Adjust the discriminator secondary to the point where the 400 cycle disappears, then reappears if the adjustment is continued in the same direction. When the signal is kept as low as possible, this check is a very sensitive one.

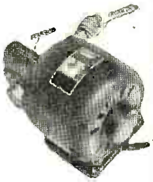
A common difficulty encountered by the service technician when attempting to align the r.f. end of a television receiver is the achievement of a prop-

Fig. 9. Impedance matching output cable.



—THE BEST IN ELECTRONIC SURPLUS—

12 V. DC HEAVY BEAM MOTOR



Rated at 1/12 horsepower at 1725 rpm, but actually with built-on reducing gears develops many, many times more power. Worm gear at end of reducer is 43 rpm. As is, can be used for hoisting, electric platforms, portable-electric trucks, conveyors, etc. Operates from 12 volts DC (two 6 volt storage batteries). Additional 7 inch heavy brass worm gear available to reduce rotation to 2½ rpm, for antenna rotator. NEW, unused surplus.

PRICE, EACH MOTOR **$11.95**

7-inch Brass Worm Gear, for 2½ rpm $1.50

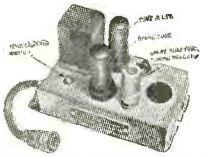
Hi-QUALITY COMPASS AND ADJ. TRIPOD

For orienting beam antennas, boat owners, hikers and many other useful applications where a real hi-quality compass is required. Compass is deluxe with ball and socket mount adapter, built-in levels, a zero set, a screw for locking needle when not in use, two vertical sights—folding type, 4 inch pointer on 5 inch compass, 0-360 azimuth calibration (counter-clock-wise). Tripod is exceedingly well made, telescoping from 20 inches to 47 inches, and can be adapted for camera work.

PRICE, Complete, as above, NEW, unused surplus.

EACH **$9.95**

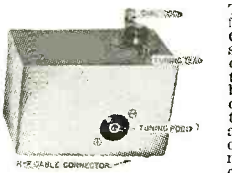
VARIABLE AUDIO OSCILLATOR



For service test bench, code practice (by keying), tone modulation of ham or commercial transmitters, or with oscilloscope for audio amplifier testing. Has 5-point switch to provide 5 different audio tones. Uses a 12A6 pentode to give plenty of audio power. Additional 12A6 in spare socket, for spare. No 1S4 spare as shown. With diagram.

PRICE, EACH **$5.95**

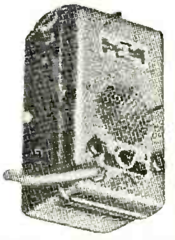
20-40 MC RESONANCE TUNER



This is a Handy item for hams to have around. Consists of an entirely shielded resonance circuit consisting of 4 turns No. 16 wire tuned by a 75 mmf variable capacitor. A 2 turn rotating link within the above coil, designed for connection to a transmission line or to link coil of plate tank. Useful as absorption wavemeter, harmonic or parasitic wavetrap, or for rotating beams to eliminate slider contacts or wire twisting. Hi-potential contact on polystyrene insulation provides for neon glow lamp tuning. NEW units.

PRICE, EACH **$4.95**

2-VOLT VIBRATOR POWER SUPPLY, PE-157



Designed for the "Horsy-Talky" or BC-745 Transmitter-Receiver, this unit can be adapted for supplying power to many other types of battery operated walkie-talkies. Also ideal for converting battery portable receivers to less expensive storage battery operation. Uses self-rectifying vibrator circuit, and self-contained 2-volt plastic storage battery (not supplied). Delivers approx. 125 volts at 80 ma. as well as 1.35 fil. volts, and 13.0 volts bias. Includes vibrator charging circuit, for recharging from another 6-volt (car) battery. Has speaker opening, speaker not included. NEW and Excellent condition units.

PRICE, EACH **$4.95**

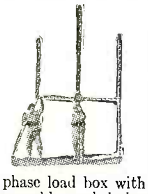
DECK ENTRANCE INSULATORS, bowl and flange type. 8⅞" dia. with heavy galvanized metal flange and bell. Top bell 6¼" dia. 11½" brass feed-thru rod. Very high voltage insulation. Individually packed in cartons, all NEW.

12 FOR $18.00

GENERAL ELECTRIC AMPLIDYNE M.G. SET, generator type #V-5875677, motor type #73AB58, Navy #CG-21ABU, 115/230V, 60c., motor rated at ¾ HP., generator output 250V. DC at 375W. NEW $60.00

GENERAL ELECTRIC AMPLIDYNE MODEL 5AM78AB47 MOTOR GENERATOR SET. Motor 3HP 440V, 3 phase. Output 250V. DC at 3 amps. and 60V. DC at 12.5 amps. Excellent Condition ... $85.00

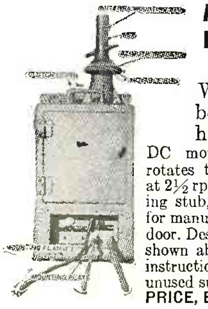
HAM & TELEVISION ANTENNA ARRAY



For the ham, experimenter, or commercial application where directive transmission and reception are desired. This array is designed for 20 to 40 mc coverage. Assembly is simple, and is easily changed to horizontal. Center supporting mast is vertical dipole, contains within an rf transmission line, and at top a phase load box with plug-in inductors. Elements are removable, and design is for both transmission and reception. Sturdy, and ideally adaptable for rotating beam array when used with motor-driven mount below. With instruction and diagram sheet. Shpg. wt. 75 lbs.

PRICE, COMPLETE ARRAY **$14.95**

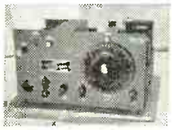
MOTOR-DRIVEN BEAM ANTENNA MOUNT



Weatherproof steel box, 12"x15¾"x20" high, with 1/12 hp 12V. DC motor installed within that rotates the heaviest possible beam at 2½ rpm. Includes antenna mounting stub, azimuth indicator, clutch for manual or motor rotation, hinged door. Designed to operate with Array shown above. Supplied with cables, instruction and diagram sheet. NEW, unused surplus.

PRICE, EACH **$19.95**

580-765 MC SUPERHET RECEIVER, WITH WAVEMETER



Easily modified for Citizen's Band reception, or for experimental use on VHF Television. Uses a 955 Autodyne detector-oscillator into 3-stage resistance-coupled IF amplifier. Output is for headphones. Includes VR-150 voltage regulator tube, 6E5 tuning-eye, and 5Y3 rectifier. For 110 volts, 50/60 cycles AC. Calibrated Wavemeter mounted as separate portion, with variable tuning rod and hand-plotted calibration curve for each, permits checking frequency of incoming signal. NEW unused surplus. With instruction sheets and diagram, plus calibration curve, and tubes.

PRICE, EACH **$75.00**

RADAR TRAINING SET—MARK V

For Student, Schools, Labs, or actual radar application. Operates in the 580 to 765 mc region, designed especially to illustrate how radar eqpt. functions, and permits making numerous experiments to put over radar fundamentals. Uses above described receiver; separate transmitter using 8025 triode with 1.5 watts at antenna, with 400 KC internal modulator using two 811 tubes; External modulator, generating audio frequencies of 16,000, 4,000, and 1,000 cycles, and RF at 750, 350, and 175 KC, with selection switch for modulation frequency and wave form control, using 3 tubes, 807, 6N7, and 6J5; set of Antenna Dipole rods. Supplies with full instruction sheets, diagrams, calibration curves, tubes, NEW unused surplus.

PRICE, Per Set **$175.00**

Technical Manual (Complete Instruction Book) for the BC-312 & BC-342 Receiver.
PRICE, Postpaid $1.50

"SNOOPERSCOPE" TUBE

Infra-Red Image Converter Tube (British) to make "Snooperscopes," "Sniperscopes," and other devices that see in the dark. Has many useful industrial applications. Operates with invisible infra-red rays, without scanning or amplifiers. Supplied with technical data and diagrams. Every tube **guaranteed! WE WILL NOT BE UNDERSOLD.**

EACH $5.00
6 for $25.00

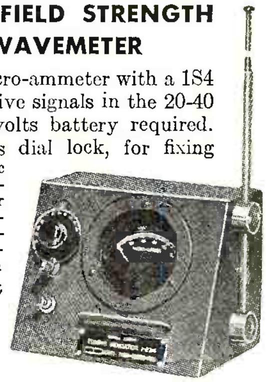
BAUSCH & LOMB Front-End Lens Assembly, for best images. F2.1. 3.5 in. E.F. **EACH** $10.00

MOUNTED LENS UNIT, also for front-end, results as good as B & L unit. Speed F1.9 f.1. 91.44 mm, outside dia. at one end 60 mm, length of mount 64 mm. **PRICE, EACH** $7.00

All Above Material Subject To Prior Sale. 25% Minimum Deposit With All C.O.D.'s. All prices F. O. B., N. Y. C.

—TELEMARINE—
COMMUNICATIONS COMPANY
280 Ninth Avenue
NEW YORK 1, NEW YORK

20-40 MC FIELD STRENGTH AND WAVEMETER

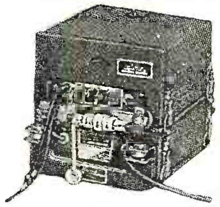


Uses a 0-100 Micro-ammeter with a 1S4 Pentode, to receive signals in the 20-40 mc range. 1.5 volts battery required. Tuning dial has dial lock, for fixing position, and telescopic Antenna permits adjusting for strong or weak signals. Calibration must be self-performed. With instruction sheet and diagram NEW, unused eqpt. Dim: 6½"x4¼"x5½" (less antenna).

PRICE, Each

$12.95

VEHICULAR FM TRANSMITTER-RECEIVERS, BC-620 & BC-659



Compact, almost portable, NBFM transmitter-receivers designed for vehicle installation. Provides instantaneous selection of either one of two channels, preset for both Xmttr and rcvr., crystal controlled. Uses 13 selected Loktal tubes in a highly engineered and efficient unit to give a 10 to 15 mile range with a minimum of power consumption. Operates from batteries, or with PE-120 or 117 or 97—from 6, 12 or 24 bolts DC. Includes built-in loudspeaker, meter for checking voltages or various circuits, external handset for talk-receive. BC-620 covers 20.0 to 27.9 mc, BC-659 covers 27.0 to 38.9 mc. Excellent communication eqpt. for industrial or commercial application. With all tubes, handset, less crystals. NEW, unused eqpt.

Either BC-620 or BC-659. EACH **$34.95**

PE-97, or 117, or 120, VIBRATOR POWER SUPPLY, for above. Operates from 6, 12 or 24 volts, by changing tap on transformer and vibrator. NEW, unused units. EACH **$16.50**

WESTERN ELECTRIC 500 WATT "HLAS" ANNOUNCING SYSTEMS

Gigantic Sound Power amplification for giant political rallys, airports, docks, stadiums, etc. 3-unit eqpt., with 120 db gain; automatic volume control and compression circuits; Speech, Phono, and wire or tape recording inputs; 20 KC erasing oscillator; 12-Speaker bank for handling full output. All in solid, splashproof cases. Operation from 115/3/60 AC.

WRITE FOR FULL DESCRIPTION SHEETS AND PRICES.

PORTABLE 250 WATT W.E. BEACHMASTER SOUND EQPT.

Super-Power 250 Watt Amplifier and Loudspeaker System for stadiums, ball parks, airports, etc. Complete pre-amp and power amplifier in water-tight case with internal blower. 9-Speaker horn assembly in similar case, making complete system portable. Operates from 110/1/60 AC. Complete with cables, tubes, dynamic microphone.

WRITE FOR DESCRIPTIVE SHEET AND PRICES.

— INVITATION —
TO COME AND GET THE BIGGEST BARGAINS IN ELECTRONIC HISTORY!

We invite you to come in and browse around, and see our terrific variety of electronic eqpt., all priced way down for quick sale. Intricate, expensive eqpt. costing hundreds of times our special low prices, just a few of each so that it doesn't warrant advertising or cataloging. You will find, at ridiculously low prices, Tuning Fork Oscillators, Time-Delay Relays, Power Transformers of all sizes for transmitters and receivers, an amazing variety of hi-quality audio components, variable condensers of all types and sizes, insulators for every purpose, test and measurement instruments; Commerical transmitters, from ½ watt to 300 watts which will make fine ham rigs, mine detectors, sonobuoy transmitters, radar, underwater sound devices, power supplies, metering panels, amplifiers, and hundreds of other devices and parts.

PLEASE DO NOT WRITE FOR CATALOGUES OR PRICES. All of this material is priced for immediate take away; no shipping or mail order.

Communication Companies and Governmental Agencies!

Do we have you on our mailing list? We have, for immediate delivery, some large hi-powered commercial transmitters, complete ship radar sets, 10 KVA Gas Engine Generator Sets that are NEW and Export Packed, and many other hard-to-get surplus items. Write us your requirements.

TERMINATION	CONNECTIONS	
300 ohms	Jumper 1-2	Jumper 5-6
150 ohms	Jumper 1-2 Jumper 5-6	50 ohms 2-3 75 ohms 4-5
75 ohms	Jumper 1-2-3	Jumper 4-5-6
50 ohms	Jumper 1-2 Jumper 4-5	30 ohms 2-3 50 ohms 1-5
Open Termination	Jumper 1-2-3	Jumper 4-5
Series Condenser .02 μfd. 400 v.	Jumper 2-3	Jumper 4-5

Table 1. Terminal box connections for the impedance matching output cable.

er match between the signal generator and the receiver input terminals. Any appreciable mismatch will act to alter the shape of the response curve, causing adjustments to be made which will not provide the proper response when the signal generator is removed and the regular set antenna is connected. In the Genescope, matching of impedances is specifically provided for by employing the output cable termination shown in Fig. 9. A variable matching network and a series of terminals are available at the end of the generator cable and by connecting the terminals as indicated in Table 1, impedance values of 50, 75, 150, and 300 ohms can be obtained. Information is also provided in the instruction booklet accompanying the instrument for matching to other impedances.

While not specifically outlined above, alignment of FM receivers would proceed in a similar manner.

The stress, thus far, has been directed toward alignment but the Genescope, through its separately contained oscilloscope, is equally valuable for servicing. Waveform checking and testing—which is a common practice for the video amplifiers and the vertical and horizontal sweep systems—can be accomplished by feeding whatever signal is present to the vertical amplifiers of the scope. Where signal tracing through the i.f. and r.f. circuits is required, recourse can be made to the high-frequency probe. This probe is essentially a high frequency detector and may be used to pick up the signal at any point in the receiver where high-frequencies exist. This applies with equal force to video signals received from a station or an r.f. signal obtained from the AM generator section of the Genescope.

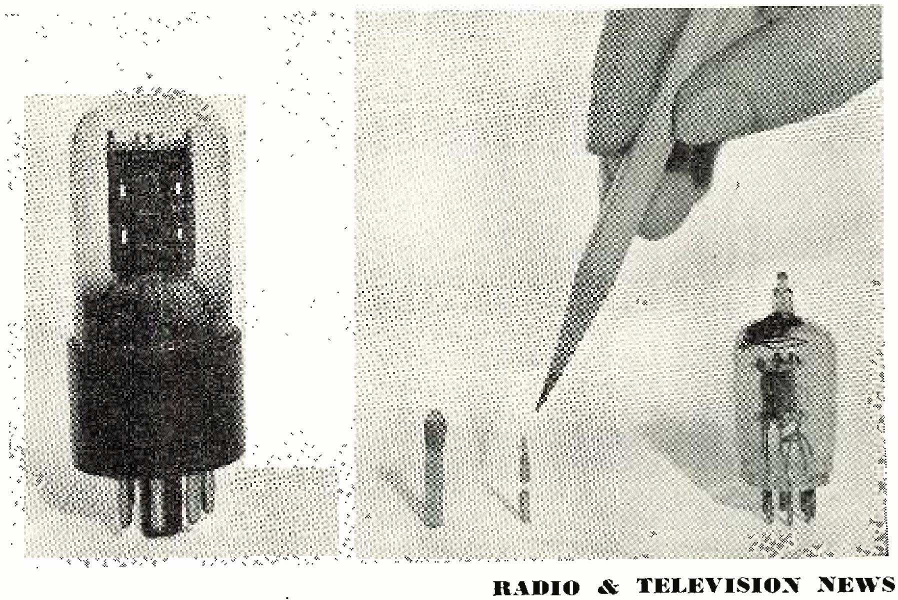
To trace a signal through the sound channel of a TV receiver, connect the output cable of the AM generator section to the antenna terminals of the receiver and set the AM generator to the sound r.f. carrier frequency of the channel being tested. Modulate this signal with the 400 cycle note.

Attach the high frequency probe cable to the vertical input jack and touch the probe to various points along the i.f. system. Starting with the converter grid the signal may be traced through the i.f. system to the discriminator.

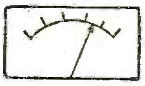
The same test may be applied to the video i.f. system by tuning the AM generator to the video carrier frequency and proceeding from the converter tube through the picture i.f. stages to the video detector. Further tracing of the signal beyond the video detector can be done with a pair of conventional leads.

Any single stage may be checked by connecting the h.f. probe across the output of the stage under test and injecting a signal of proper frequency to the input. When a received video (or audio) signal itself is being traced through the various stages, the AM generator is turned off and only the scope section is utilized. —30—

The Air Materiel Command at Wright-Patterson Air Force Base in Dayton has recently announced the development of a "Tom Thumb" synthetic radio tube, about the size of a match head, which may prove to be the Air Forces' answer to the problem of how to reduce the weight and size of its airborne electronic equipment. Named the "fieldistor", the sub-miniature tube is now in its early stages of development. The new tube is 1/90th the size of the standard radio tube shown at the left while a present-day electronic tube towers over it at the right. Ten of these units could be carried in an ordinary thimble. Another advantage claimed for the new "tube" is that it uses so little current that most batteries can be eliminated, thus reducing equipment size.



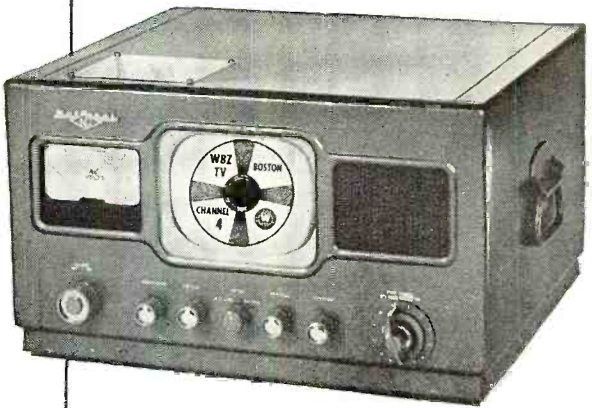
STOP MEASURING "GHOSTS!"



See WHAT YOU *Measure*

NEW NATIONAL VIDEOMETER ENDS ALL TV INSTALLATION GUESSWORK!

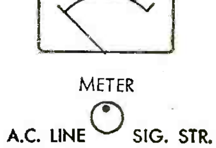
You can't see ghosts or noise on a meter. That's why field strength readings alone are unreliable in making TV installations. Now, the new National Videometer gives you *both* meter readings and a TV picture. You see just what you measure. No more trouble-making initial installations! No more costly call-backs!



$169.95
(Slightly higher west of the Rockies)

Meter Check on Both Field Intensity and Line Voltage

Set the meter switch to A.C. LINE and read the line voltage at the receiver input terminal directly on the 0-150 volt scale. Set the switch to SIG. STR. and read the field intensity on the 0-10 scale. A table is provided to convert directly to microvolts. Reading indicates field intensity at antenna input and is independent of contrast and brightness controls.



National
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NATIONAL COMPANY, Inc.
MALDEN, MASSACHUSETTS

Spot Radio News
(*Continued from page* 18)

private demonstration in the Hotel Statler, before a group of newspaper men and members of Congress, including the chairman of the Senate Interstate and Foreign Commerce Committee, Senator Edwin C. Johnson. The demonstration, which featured a new approach to the problem, involving a vertical shift rather than the horizontal method used previously, was applauded by the Senator, who declared that he was well satisfied with the system now.

THE HEARINGS disclosed that many of the questions which were puzzling the Commission, particularly those raised by Coy during his Oklahoma address, might have effective answers very soon. Dr. E. W. Engstrom provided the clue that solutions were perhaps not too far away, by declaring that *RCA* had reached the stage where it might be possible to begin probing color standards. Such a step could now be considered, he stated, because of the high-level sampling synchronization and color phasing techniques recently developed and particularly because of the new direct-view, tri-color tube, which would be demonstrated in Washington in the very near future.

Testimony revealed that the direct-view, single tube shows . . . "an attractive picture with good resolution and good color."

Engstrom reported that . . . "Experience in black and white television has shown that in order to realize consistent performance at the limit of system capabilities, it is necessary for the terminal units—pickup tubes and picture tubes—to have resolution capabilities in excess of those of the system itself. Since this requirement seems equally applicable to a color system, our work on the tri-color tube has as a goal, the attainment of such extra resolution capability. We know of no reason why this goal cannot be attained in the near future. . . . Our investigation of receiver circuits for use in connection with a tri-color tube have, of course, been carried out in parallel with the tube development. We feel that this circuit development is straightforward and will provide for further color-receiver simplification. For example, only one yoke and deflection system are used, just as in ordinary black and white receivers. In turn, the elimination of two of the three deflection systems required in the current three picture-tube assembly also reduces power-supply needs. . . . With a suitable tri-color tube incorporated in the simplified receiver, we may produce in the not-too-distant future a fully-electronic color television receiver, with but ten to fifteen tubes more than for a comparable black and white receiver."

Questioning by Commissioners Jones and Hennock, as to the use of the tri-color tube for other systems, brought the striking reply that the tube could be used with the *CBS* system, even though 405 lines were involved, but that performance might not be too satisfactory because of the reduced resolution afforded by the 405-line picture.

When queried about the size of the picture that the tri-color tube would provide, Engstrom declared that a sixteen-inch envelope was being used, with the viewing area masked down to about fourteen inches. The larger envelope had been selected because it simplified construction of the elements required for three-color presentation.

Dr. Peter C. Goldmark, the field-

The "electronic umpire" developed by the General Electric Company and used by the Brooklyn Dodgers during spring training. When a pitched ball passes through the strike zone, the shaded area, its shadow is seen by three electric eyes which look at the sky at the angles shown. If the pitch is a strike the ball is seen by the eyes in 1-2-3 order and electric impulses are created which light a "strike" indicating lamp. An inside or outside ball is not seen at all and a high or low pitch results in the ball being spotted in an improper sequence, and the lamp does not light, thereby indicating a "ball" was pitched. The strikes, as well as the speed of the ball, are registered on the recording machine shown in photo at the left.

sequential color disc exponent, indicated that he was delighted to hear of the tri-color tube, which he felt could be used in the *CBS* system at a much lower cost and without the addition of other receiver type tubes. He did not agree that the resolution problem was too acute. However, in an appearance before the Commission several weeks later, he described a modified system, using a sampling circuit based on the horizontal interlace principle, which provided a 525-line picture.

As soon as *RCA* had learned that *CBS* had outlined a method using sampling and horizontal interlace techniques, similar to what they had prescribed for their picture-dot interlace electronic system, headquarters issued a statement by *RCA Lab* Chief Dr. C. B. Jolliffe, which declared that: "At last *CBS* has admitted the weakness of its color television system. Because of lack of resolution in its system, *CBS* now states that it will now adopt the principles of sampling and horizontal interlace, developed by *RCA.*"

Shortly after the Jolliffe statement was released, *CBS* issued a biting reply. Prepared by Adrian Murphy,

NEW 500 KW. SUPER-POWER BEAM TRIODE

RADIO Corporation of America has recently announced the development of what is believed to be the world's most powerful electron tube, a high-vacuum "super-power beam triode" capable of 500 kw. continuous output and tested at one million watts input.

The new tube, RCA Type 5831, represents the first commercial attempt to build power output of this magnitude into a single tube. Despite its enormous power input capabilities, the new tube measures only 38¾ inches in length and weighs only 135 pounds.

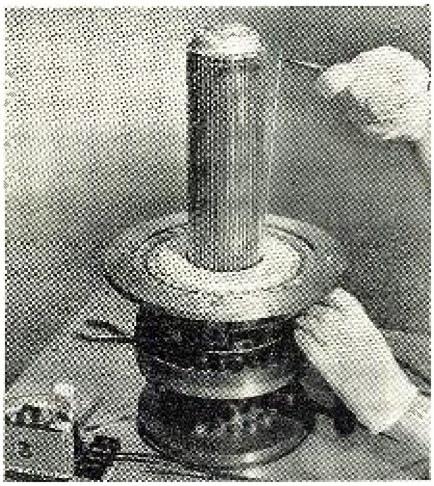
Applications of the new tube include high-power c.w. applications and international broadcast service. In unmodulated class C service, the 5831 has a maximum plate voltage rating of 16,000 volts, a maximum plate input of 650 kw. and a maximum plate dissipation of 150 kw. To provide 500 kw. output in unmodulated class C service, under typical operating conditions, the tube requires only about 900 watts grid drive. The tube can be operated with maximum rated plate voltage and plate input at frequencies throughout the standard broadcast band and much higher. The limitations for operation of the tube at high frequencies and at higher power have not been determined at present.

The outstanding structural feature of the tube centers around the "electron heart," an array of 48 independent unit electron-optical systems arranged cylindrically in the tube. Each of these systems consists of a filament in a slot in the beam-forming cylinder, grid rods, and the copper anode. Electrons leaving the emitting surface of the filament are beamed between a pair of grid rods to the anode by the focusing action of the beam-forming cylinder. Even though the grid may be positive, relatively few stray electrons strike it.

The individual filament and grid elements of the unit triodes in the array are tungsten rods 8 inches long, supported at both ends by means of knife-edge V-notch arrangements. Special feature of this design is the "pantographic mounting," consisting of a device with flexible spring-loaded fingers to which the filament rods are hooked. The pantographic device makes each filament strand and grid rod mechanically independent, and allows vertical movement without disturbing the precise alignments and spacings essential to effective electron optics. The filament strands are made of thoriated tungsten for economical operation, as well as for high emission capabilities.

The internal elements of the tube, including the cylindrical beam-forming structure, anode, and filament, are concentrically arranged, adding to the high efficiency of the design, and permitting the use of a simplified internal water-cooling system for the beam-forming cylinder and anode, with simple external hose connections. —30—

RCA's new "Super-Power Beam Triode" which is capable of 500 kw. output and which has been tested at one million watts input, is shown with Dr. L. P. Garner, head of the company's Advance Development Lab at Lancaster, Pa., where the tube was developed.



The "electron heart" of the new RCA Type 5831 tube consists of 48 independent unit electron-optical systems arranged cylindrically in the tube. Operator is shown mounting one of the 48 separate grid strands in place. The new tube is a water-cooled type.

Latest WELLS Tube Prices

Many Types Are Now Scarce At These Low Prices. Check your requirements at once for your own protection. All tubes are standard brand, new in original cartons, and guaranteed by Wells. Order directly from this ad or through your local Parts Jobber.

TYPE.	PRICE EA.
0A4G	.95
01A	.45
EL-C1A	3.95
1A3	.60
1A5GT	.65
C1B/3C31	4.85
1B4P	1.75
1B21A/GL471A	2.55
1B22	3.40
1B23	7.50
1B32/532A	1.85
1B42	5.25
1B48	9.90
EL1C	4.85
1C5GT	.65
1C6	.75
1C7G	.85
1D8GT	.95
1E7GT	1.95
1F4	.90
1G6	.65
1H4G	.80
1H6G	.80
1L4	.50
1LC6	.75
1LN5	.85
1N5GT	.75
1P24	2.50
1Q5GT	.85
1R4	.55
1S5	.70
1T4	.75
2A3	1.05
2A7	.75
2AP1	4.75
2B7	.75
2B22/GL559	3.25
2C22/7193	.35
2C26	.30
2C26A	.40
2C34	.40
2C44	1.25
2J21	10.45
2J21A	11.45
2J22	9.85
2J26	8.45
2J27	12.95
2J31	9.95
2J32	12.85
2J33	18.95
2J34	17.50
2J37	13.85
2J38	6.95
2J48	12.95
2J61	24.50
2J62	14.95
2X2	.55
2Y3G	1.20
3A4	.35
3A4/47	.45
3B7	.45
3B22	2.35
3B24	1.75
3BP1	3.75
EI-3C	3.95
3C21	5.00
3C24/24G	.50
3C31-C1B	4.85
3CP1-S1	1.95
3DP1	3.75
3D6/1299	.45
3FP7	1.85
3FP7A	4.95
3GP1	4.50
3H17	1.00
3HP7	2.95
3Q5	.90
3Q5GT	.90
3S4	.75
GA4	2.00
REL5	14.95
VT5/215A	1.20
5AP1	3.95
EI-C5B	4.25
5BP1	2.75
5BP4	3.95
5CP1	3.75
5D21	24.75
5FP7	2.75
5GP1	2.75
5HP4	4.75
5J23	14.25

TYPE.	PRICE EA.
5J29	13.45
5V4G	1.07
5W4	.76
5Z3	.80
5Z3G	.75
6-4	.35
6-7	.35
EL-C6A	2.00
6A3	.80
6A6	.65
6AB7	.95
6AC7	.90
6AE6G	.85
6AG5	1.20
6AH6	1.10
6AK5	1.20
6AK6	.80
6AL5	.95
6AU6	.95
6AV6	.81
6B4G	.95
6B7	.75
6B8	.95
6B8G	.95
6BA6	.95
6BE6	.65
6C4	.40
6C8G	1.05
6C21	19.25
6D6	.50
6F5	.85
6F6	.60
6F6G	.60
6F8G	.95
6G6G	.80
6H6	.45
6J6	.90
6J7GT	.70
6J8G	.95
6K6GT	.55
6K7	.80
6K7G	.80
6L6G	1.35
6L7	.75
6N7	.75
6N7/GT	.75
6Q7	.55
6R7G	.75
6SA7	.65
6SC7	.75
6SC7GT	.70
6SF7	.80
6SF5	.65
6SG7	.65
6SH7	.40
6SH7GT	.40
6SJ7	.60
6SJ7GT	.60
6SK7	.60
6SK7GT	.60
6SL7GT	.60
6SN7GT	.85
6SQ7	.60
6SQ7GT	.60
6SR7	.60
6SR7GT	.60
6SS7	.60
6U7G	.85
6V6GT	.75
6W5G	.80
6X5GT	.73
6Y6G	.65
7-7-11	.35
7A4/XXL	.60
7A5	.80
7A6	.75
7A7	.60
7B4	.60
7B6	.60
7B8	.60
7BP7	4.95
7C4/1203A	.35
7C5	.65
7C7	.65
7E5/1201	.60
7E6	.60
7F7	.70
7H7	.70
7L7	.70
7N7	.70
7T7	.90

TYPE.	PRICE EA.
7Y4	.90
9-3	.45
10	.55
10 ACORN	.65
10 (VT-25A)	.55
10E/146	1.00
10T1	.60
10Y (VT-25)	.45
12A6	.25
12A6GT	.25
12A7	.80
12AH7GT	1.12
12AU7	.96
12AX7	1.20
12BD6	1.20
12C8	.50
12F5GT	.65
12H6	.40
12J5GT	.40
12J7GT	.70
12K8	.65
12Q7GT	.75
12SA7	.73
12SC7	.75
12SF7	.60
12SG7	.68
12SH7	.40
12SJ7	.73
12SK7	.60
12SK7GT	.60
12SL7GT	.60
12SN7GT	1.10
12SQ7GT	.60
12SR7	.60
12X825-2AMP. TUNG.	1.95
12Z3	.90
13-4	.35
14A7	.90
14B6	.75
14F7	.90
14H7	.90
14Q7	.90
14R7	.90
15E	1.50
15R	1.20
16X879-2AMP. TUNG.	1.95
FG17/967	3.25
19	1.20
20-4 BALLAST.	.45
21-2 BALLAST.	.45
REI21	2.75
23D4	.45
RK24	1.75
24A	.75
RK25/802	2.85
VT-25-A/10	.55
25Z5	.73
25Z6GT	.55
25Z6G	.55
26	.65
27	.50
28D7	.40
30/VT-67	.75
30 (NOT VT-67)	.75
33	.75
34	.35
GL34	1.50
RK34/2C34	.45
35/51	.60
35L6GT	.73
35W4	.73
35Z5GT	.62
36	.40
37	.40
38	.40
39/44	.35
41	.55
42	.50
43	.50
45 SPEC.	.50
46	.75
EF50	.45
UH50	1.00
50B5	1.00
50L6GT	.95
56	.65
57	.45
58	.50
RK60/1641	.65
VT62 (BRITISH)	1.10
65	1.25

TYPE.	PRICE EA.
66B4	.90
VT67/30	.90
70L7	1.05
71A	.75
CEQ72	1.50
CRP72	.95
CYN72	1.75
RKR72	.90
RKR73	1.25
75	.89
76	.55
77	.55
78	.50
VR78	.65
80	.45
FG-81-A	3.95
83V	.90
89	.73
89Y	.40
VR90	.65
VT90 (BRITISH)	2.55
VR92	.65
FG95/DG1295	9.95
VT98/REL5	14.95
100R	2.75
100TH	11.50
101/837	1.65
102F	3.55
FG105	9.75
VR105	.85
VU-111-S	.55
114B	1.20
121A	2.65
122A	2.65
VT127 (BRITISH)	.35
VT127A	2.95
VR150	.50
VT158 (HK)	14.95
FG172	19.75
205B	1.45
211 (VT-4-C)	.60
215A (VT5)	1.20
CEP220	2.00
221A	1.75
227A	4.75
231D	1.20
RX233A	1.95
250R	9.00
257A	3.00
268A	2.95
282B	4.25
287A/722A	9.50
304TL	1.75
304TH	5.75
307A	4.25
316A	.55
327A	2.50
350B	2.55
354C	14.95
356B	4.95
368AS/703A	3.95
371A/VT62	.95
371B	.85
388A	3.95
393A	4.65
395A	4.95
MX408U-BALLAST.	.30
417A	14.50
434A	3.40
446A	1.55
446B	1.55
450TH	17.95
GL451	1.90
GL471A	2.55
SS501	3.00
527	9.95
WL530	5.00
WL531	12.95
WL532	1.85
532A/1B32	3.55
GL559	3.75
KU610	7.45
HY615	1.05
WL632A	8.75
700	7.95
700B	7.95
700C	7.95
700D	7.95
701A	3.00
702A	2.95
703A/368AS	3.95
704A	1.75

TYPE.	PRICE EA.
705A	1.55
706AY	17.50
707A	14.00
707B	15.00
708A	3.75
709A	4.75
710A	2.45
713A	1.50
714AY	3.75
715B	9.75
717A	.85
718BY	15.00
718EY	15.00
721A	3.75
721B	3.95
722A/287A	9.50
723AB	14.95
724A	4.25
725A	9.95
726A	12.50
726B	13.50
730A	9.95
801	.50
801A	.70
803	5.25
804	8.95
805	5.95
807	1.25
808	1.65
809	2.50
812	2.95
813	7.85
814	3.75
815	2.85
826	.75
830B	3.95
832A	7.95
834	5.75
835/38111A	1.10
836	1.35
837	1.65
838	3.25
841	.50
842	2.75
843	.50
851	39.00
852	6.25
861	29.45
864	.45
865	2.55
866-JUNIOR.	.85
866A	1.30
869	19.75
869B	27.25
872A	2.45
874	1.95
876	.50
878	1.95
879/2X2	.55
902	3.50
923 (PHOTO)	1.35
930	1.00
931A	3.95
954	.35

TYPE.	PRICE EA.
955	.55
956	.65
957	.45
958	.55
958A	.55
959	.55
967/FG17	3.25
991/NE-16	.24
1005	.35
1007	4.50
1148	.35
1201	.45
1203	.55
1203A	.65
1294	.55
DG1295	9.95
1299/3D6	.45
1613-SELECT. 6F6	.55
1616	1.25
1619	.35
1624	1.25
1625	.35
1626	.35
1629	.35
1630	3.95
1638	.90
1641/RK60	.65
1642	.50
1852/6AC7	.90
1853/6AB7	.95
1960	1.35
1961/532A	1.85
2050	.78
2051	.75
UX6653	1.20
7193	.35
8011/VT90. BRITISH	2.55
8012	3.25
8013	1.25
8013A	1.50
8019	1.75
8020	3.25
8025	6.75
9001	.65
9002	.45
9003	.60
9004	.40
9006	.40
38111A/835	1.10

XTAL DIODES

1N21	.65
1N21A	.95
1N21B	1.20
1N22	.80
1N23	.80
1N23A	.85
1N27	.85
1N29	.85
1N51 (GE)	.75
1N48 (GE)	.75
1N52 (GE)	1.00

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CBS vice-prexy, the text indicated that the *RCA* statement was a . . . "gross distortion of the facts."

To support its view that the pictures provided even by the original Goldmark approach were highly satisfactory, *CBS* offered the testimony of a parade of experts, one of whom was Dr. Jack W. Dunlap of a research organization in New York City. Reporting on a survey of doctors, who had viewed *CBS* color TV, he said that over 94 per-cent thought that the "over-all quality" was "excellent." Testimony offered by Oscar Katz, director of research for *CBS*, showed that only about 1.5 per-cent of close to 10,000 persons interviewed, found fault with the color wheel, a point which was disputed during a questioning period, some experts intimating that large-scale demonstrations do not provide a detailed evaluation of receiver operational features.

A BLANKET PREDICTION that the Commission would lift the freeze next fall was made by former FCC Commissioner E. K. Jett during a talk before a group of furniture dealers in Baltimore.

Jett, who also served as FCC's chief engineer for a long spell, declared that the ultra-high bands would be allocated, around September or October, for black and white service and that color may have to wait. None of the color systems demonstrated thus far, he added, showed promise of immediate adoption. It was his opinion that the Commission would not sanction any color system, unless it could be adapted to existing receivers at a very low cost.

RADIO AND TELEVISION will be used in quite a substantial manner by the Army and Air Force during their recruiting program, with about forty per-cent of the advertising budget set aside for the purpose. The news was revealed during testimony before the House Appropriations subcommittee. It is expected that over $600,000 will be spent for broadcasts, in an attempt to procure over a quarter of a million volunteer enlistments.

The campaign is expected to begin during the summer.

THE LONG-AWAITED designation of a chief engineer for the FCC has been finally made, with Curtis Plummer chosen to fill the important post. Plummer, who has served as chief of the television broadcast division of the Commission, joined the FCC in 1940 as a radio inspector at Boston. Shortly after that appointment he became an assistant monitoring officer, and in 1941 came to Washington as an associate radio engineer. In '42 he became a radio engineer for the Commission, after which followed service in the nonstandard broadcast section of engineering and then the TV division.

Congratulations, old man. We know that you'll be eminently successful in this key assignment. . . . . L. W.

What's New in Radio

PLAYBACK UNIT

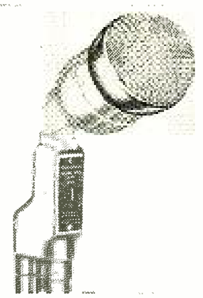
Ampex Electric Corporation of San Carlos, California, has developed a new continuous playback machine utilizing twin-track magnetic tape. It has been designed especially for continuous high-fidelity music or voice reproductions for use in entertainment, educational work, and other services.

Known as the Model 450, the new unit utilizes the special *Ampex* magnetic playback head. The machine uses a synchronous tape drive mechanism in which no part revolves at excessive speed. There are no gears, belts, or rim drives, and all rotating parts run on permanently lubricated, sealed ball-bearings. Operation is entirely automatic and requires no attention other than turning on or off of electric power.

Two separate playback heads are used, one for each of the two recorded tracks on the tape. The machine automatically reverses by means of a special thyratron circuit after playing for approximately one hour and reverses again at the end of the second hour.

BLAST FILTER

Electro-Voice, Inc. of Buchanan, Michigan has developed and is manufacturing a blast filter unit which



stops wind and breath blasts and prevents pop in dynamic microphones.

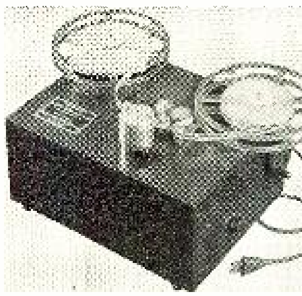
The Model 335 blast filter is said to stop breath blasts even when the speaker works extremely close to the microphone. In outdoor pickup it completely eliminates any interference from wind rumble.

The unit is designed to be used with *E-V* Models 640, 635, and 605 moving coil dynamic microphones. The blast filter is small in size and can be easily installed on the microphone without adjustments.

RADIO CODE MACHINE

Ultradyne Electronics of Oswego, Oregon has announced production on a new radio code machine, the Model RCM-2.

Priced to fit the pocketbook of the individual user, this new machine teaches the code by photoelectrically keyed inked code practice tapes. The tape is pulled through the machine at



a speed which can be increased a little at a time until the desired code speed is attained.

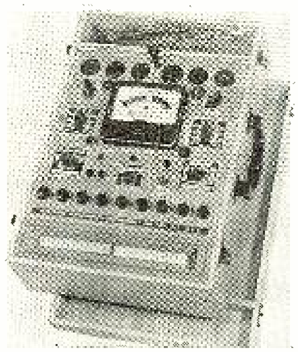
Sending practice is facilitated by using one of the beginners' tapes that has extra spacing between characters. The operator can then imitate, as closely as possible, using a hand key, the correctly sent character sounded by the machine.

The self-contained unit comprises a tape-puller motor, take-up reel, rewind and phototube keying circuit and has three controls—keying, speed, and rewind. A complete selection of practice tapes is available for use with the machine.

TUBE TESTER

A mutual conductance tube tester which reads on a calibrated micromho scale as well as on a "Reject-Good" basis has been introduced by *Electronic Measurements Corp.* of 423 Broome Street, New York 13, New York.

The new tester, the Model 201, also checks tubes for gas content and checks all tubes from .75 volt to 117 filament volts as well as all loctal, octal, 9-prong miniature and subminia-



ture tubes. Testing can be done on cold cathode, magic eye, voltage regulator tubes, and ballast resistors. Individual sockets for each type tube base eliminate possible errors.

The unit has a 4½ inch meter and is available in either a sloping counter case style or in a portable model in an oak carrying case.

For additional information on any of the items described herein, readers are asked to write direct to the manufacturer. By mentioning RADIO & TELEVISION NEWS, the page, and the issue number, delay will be avoided.

GOODELL AMPLIFIER

The Minnesota Eletronics Corporation of 97 East Fifth Street, St. Paul 1, Minnesota has introduced a new amplifier unit for home installation which will retail in the moderate price class.

Known as the *Goodell* "50," the new unit features continuously variable bass and treble control, 16 db. bass boost and bass attenuation at 40 c.p.s. and 16 db. treble boost and treble attenuation at 10,000 c.p.s. The amplifier has stabilized degenerative feedback, low internal generator impedance and the automatic switching of feedback resistors on each output tap.

A selector switch provides output impedances of 4, 8, 20, 250, and 500 ohms ganged to simultaneous switch-

ing of feedback resistors for optimum performance on each tap. A four-position switch provides radio, 78 r.p.m. phono, LP phono, and television, with automatic equalization inserted for LP and 45 r.p.m. records. A socket is provided for a plug-in phono preamplifier.

Frequency response is said to be 20 to beyond 20,000 c.p.s. within 1.5 db. Power output is rated at 8 watts. A data sheet listing all of the features is available on the *Goodell* "50."

SOLDERING FLUXES

A line of fluxes, recently developed in England, is now being distributed in this country by *Newage International, Inc.* of 521 Fifth Avenue, New York 17, New York.

These T.S.F. fluxes are self-cleaning, remove oxides and film from ferrous and non-ferrous metals, and are impervious to grease, according to the company. They do not corrode or rust and they do not leave corrosive residues.

The line includes various products for joining different types of metal. A consultant service on special metal joining problems is offered for those with difficult or unusual production requirements.

BOOM BRACKET KIT

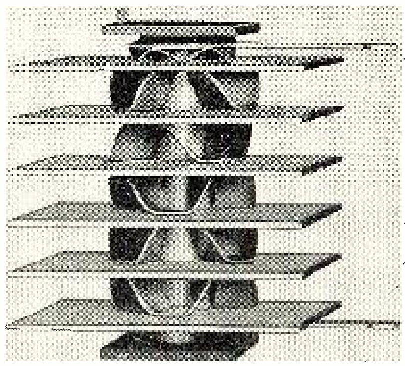
Of interest to hams, recording enthusiasts, and commercial broadcasters is the new boom bracket kit recently announced by *Atlas Sound Corporation* of 1449 39th Street, Brooklyn 18, New York.

Designed as an all-purpose support for microphones, the "set screw" assembly makes it possible to cut down any tubular section so that the support bracket can be custom built to meet specific requirements. The microphone cable feeds through the entire support arm as well as the adjustable elbow mechanism. All parts of the bracket are finished in opalescent bronze enamel. The boom is 23" long, maximum.

SELENIUM RECTIFIERS

A new line of selenium rectifiers has been introduced recently by *Sarkes Tarzian Inc.* of Bloomington, Indiana.

Designated the "Centre-Kooled" line, these units have been designed for use in radio, television, or electronic equipment.



The center-cooling feature is provided by a special spacer between the cells to insure lower over-all operating temperatures by allowing air to reach the portions of the cells in which the current density is the greatest.

Other features include constant assembly pressure under all operating conditions, easily identified color coding, universal locating lug, and constantly high resistance path to ground under all atmospheric conditions.

Sixteen models are currently available and complete data and engineering information on these rectifiers is available from the company.

TUBE CHECKER

Two new tube testers, designed for testing of radio, television, mobile transmitting, and industrial electron tubes, have been introduced by *Sylvania Electric Products Inc.* of 500 Fifth Avenue, New York 18, New York.

Available in either portable or bench models, the tester features an exclusive ohmmeter-type shorts and leakage test which indicates "Replace" or "Good" directly on the instrument's illuminated meter, direct meter indication for all other tests, an easy-to-

operate gas test, and a combined emission and transconductance test under dynamic operating conditions which takes relative tube life into account.

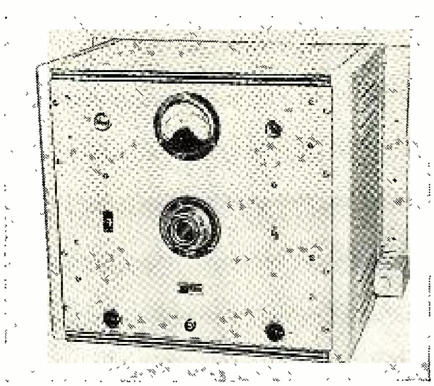
Twelve sockets provide for testing 4, 5, 6, 7, 8, and 9-pin tubes, octal and lock-in, miniatures, subminiature, acorn and hearing aid types, mobile and ruggedized tubes, and pilot lamps. Facilities for unannounced tube types are also included. Control settings are shown on a smooth, fast-running roller chart which is easily removable from the front panel for adding new tube settings as announced.

The portable unit has been designated the Type 220 while the counter model is Type 219. Both have identical electrical characteristics.

POWER SUPPLIES

A new series of electronically regulated and stabilized power supplies, utilizing a new type of direct-coupled amplifier to control a pair of thyratron rectifier tubes, is now in production at *Amplifier Corp. of America,* 398-2 Broadway, New York 13, N. Y.

Two separate series of 250 watt (output power) supplies are available. The standard series is stabilized against line changes of 90 to 130 volts within ± .5% and load regulated within ± .5% from no load to full load. The super series with a more sensitive



error control circuit is line stabilized and load regulated to well within ± .1%.

Units are available in each series in

the following voltages; 0 to 25 volts up to 10 amps; 0 to 50 volts up to 5 amps; 0 to 125 volts up to 2 amps; 0 to 250 volts at 1 amp; 0 to 500 volts at 500 ma. Each of the ten units has a continuously adjustable and smoothly controlled d.c. output to full voltage and current rating.

Full details are available from the company on request.

SUPERIOR'S TESTER

The Model TV-10 tube tester, which has been designed for checking AM, FM, and television tubes, is being marketed by *Superior Instruments Co.* of 227 Fulton Street, New York 7, New York.

The new unit uses self-cleaning lever action switches for individual element testing. Tubes having tapped filaments and filaments terminating in more than one pin can be tested because any of the pins may be placed in the neutral position when necessary.

Individual sockets are used for each type of tube, thus eliminating the customary practice of combination type sockets. The tester is housed in a hand-rubbed oak cabinet with a portable cover and measures 6" x 11½" x 12".

NEW V.T.V.M.

The Hickok Electrical Instrument Company of 10524 Dupont Avenue, Cleveland 8, Ohio has announced the availability of a new volt-ohm-capacity milliammeter, the Model 209-A, which has been designed especially to increase the speed and range in television servicing.

The new instrument measures any resistance, capacitance, voltage, or

current encountered in AM, FM, or TV receiver servicing. The unit features a 9" meter scale for easier readings of greater accuracy. The v.t.v.m. will measure resistance as low as 1/10 ohm and capacitance to 1μμfd. It permits peak-to-peak voltage measurements and contains a zero-center d.c. scale for increased accuracy in FM and TV servicing. The meter has a new a.c. range of 1200 volts and features flat frequency response to 300 mc.

Housed in a portable steel carrying case, the unit comes complete with low capacity, high frequency probes and all necessary test leads.

—30—

Within the Industry

(*Continued from page* 32)

of *RCA Victor* . . . **HARRY S. GOULD,** formerly merchandising executive for *The Magnavox Company*, has joined *John Meck Industries, Inc.*, as director of merchandising . . . **ERNIE KOHLER** has been added to the engineering-sales staff of the *Oak Mfg. Co.* of Chicago . . . **GERALD C. SCHULTZ** has been appointed chief electronics engineer for *Gibbs Manufacturing & Research Corporation.* He was formerly chief of the radar techniques unit at Air Materiel Command . . . The appointment of **GEORGE P. LOHMAN** as field sales representative of the *RCA Victor* Home Instrument Department in the northern part of the company's East Central Region has been recently announced . . . **CURTIS R. HAMMOND** is the new equipment sales manager of the Receiving Tube Division of *Raytheon Manufacturing Company* in Newton, Massachusetts . . . *Freed Radio Corporation* has named **JOSHUA SIEGER** to the post of vice-president in charge of engineering . . . **JOHN F. HERBST** has taken over the post of western regional manager for the receiver sales division of *Allen B. Du Mont Laboratories, Inc.* . . . **DR. ANTONIO R. RODRIGUEZ** now heads the new ceramic laboratory for *The Electrical Reactance Corporation* . . . **F. P. RICE** has been named executive assistant to the manager of the tube division of *Allen B. Du Mont Laboratories, Inc.*, while **JAY L. FISHER** has been named production control manager for the company's tube division . . . *Sentinel Radio Corp.* has named **DONALD G. HAINES** to the post of chief electrical engineer . . . *Hoffman Radio Corp.* of Los Angeles has named two new vice-presidents, **S. L. SPRAGGINS** to be in charge of plant operations, and **JOHN A. RANKIN** to serve as vice-president in charge of engineering . . . **HARRY SEELEN** is the new manager of the Lancaster Engineering Section of the *RCA* Tube Department. He succeeds Dr. Dayton Ulrey who retired recently.

* * *

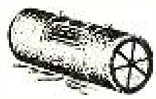
MORHAN EXPORTING CORPORATION of 458 Broadway, New York, has been named export sales representative for *Pyramid Instrument Company.* The concern will handle all export work with the exception of Canada . . . **W. B. PRAY** has been appointed sales representative in the six New England states for *Operadio Manufacturing Company* of St. Charles, Ill. . . . **PATTERSON & COMPANY** of Dallas and **MURPHY & COTA** of Atlanta are han-

LIKE MAGIC! PLATT'S PULLING 'EM OUT OF HIS HAT!

Yes, month after month Platt comes up with the items you want at the prices you want to pay! But everything is moving FAST—so ORDER NOW to be sure you get what you want.

YOU'RE INVITED TO VISIT PLATT'S NEW STORE AT
489 BROOME STREET, NEW YORK CITY

DYNAMOTORS

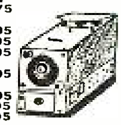


Dynamotor for DY-12 Power Supply for ART-13 ....Only $7.95
Type DM-33-A, in. 28 V, out. 540 VDC, 250 mills .....Brand New 1.95
(Excellent—Used $1.25
Type DM-53-A, 24 V, in. 220 V, 80 MA out ....Brand New 1.95
INVERTER—PE-206, 28 V, in. 80 V at 500 VA, 800 cy. out...............Brand New 4.95
(Used Excellent Condition 3.25
BD-77 ....NEW 5.95
DM-32 ....Used .75
PE-94C ....NEW 5.95
PE-73C ....NEW 3.95

BC-348 Receiver—NEW $165.00
BC-224 Receiver—Excellent Condition 135.00
BC-342 Receiver—Excellent Condition 135.00
BC-221 Frequency Meter—Excellent Condition 79.50
BC-939 Antenna Tuner for BC-610. NEW... 75.00
SCR-694 and SCR-284. Complete. New Conditioned. **Prices Sent Upon Request.**
MN-26C Compass Receiver. NEW 29.50
433G Compass Receiver—Excellent Condition. 39.50
ARN7 Compass Receiver—Excellent Condition. 49.50
733D Localizer Receiver—NEW 8.95

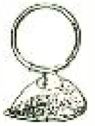
274-N COMMAND EQUIPMENT

Sensational Buys!



	USED	BRAND NEW
BC-442	$ 1.85	$ 2.75
BC-450, 3 Receiver Remote Control	.89	1.95
BC-453	12.95	21.95
BC-454	4.95	6.95
BC-455	6.95	
BC-456	1.95	2.95
BC-457	5.95	
BC-458	5.95	7.95
BC-459		24.95
BC-696	14.95	24.95
3 Receiver Rack	1.95	
2 Transmitter Rack	1.50	

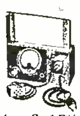
TYPE MN-20E ROTATABLE LOOP UNIT



8" diameter, used with MN-26 Compass and RA 10DB. Manufactured by Bendix.

A TERRIFIC BUY! ONLY **$11.95**

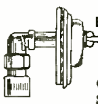
Multitester Foundation BIAS METER 1-97A



Contains a zero center 3½" round Marion voltmeter calibrated 0-100 volts each side. Movement is one mill each side of center. The unit is mounted in a steel box 7" x 5" x 4½" and contains 8 contact push button, line cord dual 100 MFD at 200 V DC condenser, a potentiometer 6 IRC 1% wire wound non-inductive resistors; one 400 ohm, two 2500 ohm, one 5000 ohm, one 10,000 ohm, one 15,000 ohm.

Excellent for building a zero center multitester with ranges of 1, 10, 100, 1000 volt.

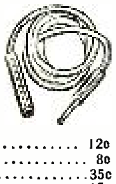
COMPLETE BRAND NEW **$3.95**



BC-645 ANTENNA.........only **39c**

BC-645 TRANSMITTER-RECEIVER ONLY. Brand New. ORIGINAL PACKING. Special **$12.95**

CORDS AND PLUGS



CD 508A Cord Assembly with SW 14-U Switch and 2 cord attachments with JK 48 Jack and PL 68 Plug. Value—$5.00. Our Special Low Price, Brand New 59c
CD 307A with PL 55 and JK New 59c
JK 26 Jack with cord, good condition........... 12c
JK 26 Jack only—Brand New.................... 8c
PL 55 Plug—NEW 35c
PL 68 Plug—NEW 15c

BC-223 TRANSMITTER

30 Watt Transmitter with crystal or MO control on four pre-selected channels, 2000 to 5250 KC, by use of three plug-in coils. Five Tubes: 2-801 & 3-46. With TU-17-18-25 Tuning Units. Tubes and mount included. Specially Priced.

BRAND NEW. Only **$25.95**

SPECIALS-OF-THE-MONTH CATHODE RAY TUBES

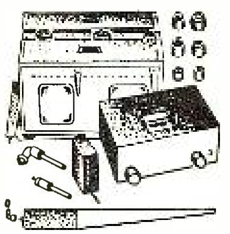
3CP1 .... **59c**
801A **39c**
211 .... **39c**
In lots of 10—10% off

TUBES

Standard Brands. All New Tubes.

304TL	$1.95	832A	$4.89
5BP4	2.45	725A	6.95
872A	1.19	726A	13.95
10Y	.39	316A	.39
4AP10	2.29	1625	.39
7CP1	2.95		

RECONDITIONED SCR-522



With New Components

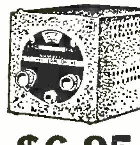
Very High Frequency TRANSMITTER-RECEIVER 100-156MC, 4 Channels, Crystal-Controlled, Amplitude Modulated Voice. Electrically Tested.

Complete as shown

Only $79.50

BEACON RECEIVER BC-1206-C

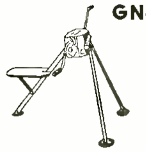
Manufactured by Setchell-Carlson



Frequency Range—195 KC to 420 KC, IF Frequency—135 KC, Receiver Sensitivity—3 Microvolts for 10 Milliwatts output, Output Impedance—300 Ohms and 4000 Ohms to be selected internally, Power Output—230 Milliwatts, Volume Control—RF Gain Control, Power Supply—24-28 Volts Aeroplane Battery. Current—.75 Amperes.

BRAND NEW—ONLY **$6.95**

GN-45 HAND GENERATOR



6 Volts, 3 Amps
500 Volts, 0.14 Amp

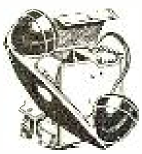
Used with Signal Corps Radio Set SCR-284. Has many applications. Brand New. Original Packing.

ONLY **$12.95**

FILTERS

FL5 Lazy Q Radio Filter Unit, high impedance, NEW $0.75
FL8 Filter. Good Condition.................. 1.29

FIELD TELEPHONES



Army surplus, completely reconditioned and electrically tested. **LIKE NEW.** Only **$8.95**

HEADSETS—Excellent Buys!

HS-33 with cord and plug, used, good condition $1.19
HS-23—Brand New with ear pads 2.75
HS-33—Brand New with ear pads, cord and PL54 plug.... 2.75
TH-37A—1200 ohms with dual plugs.......... 2.95
HS-16A—520 ohms 2.95

Minimum Order $2.00

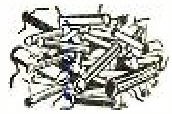
Immediate Delivery — Send 25% deposit on C.O.D. orders. All shipments F.O.B., N.Y.C. (N.Y.C. residents add sales tax to your remittance.)

PLATT'S BARGAIN COUNTER

20 POUNDS OF ASSORTED RADIO PARTS

Transformers, Chokes, Wire, Condensers, Knobs, Sockets, Switches, Dynamotor. ONLY **$2.39**

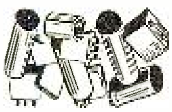
100 ASSORTED RESISTORS



Non-insulated, various ohmages and wattages.

SPECIAL **97c**

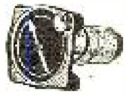
KIT OF 15 CONDENSERS



Bathtubs and Electrolytics.

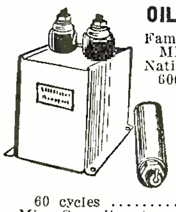
NOW **98c**

SELSYN INDICATOR



For use with beam antennas for indicating direction of antennas I-82-B, 5" type. Now **$4.95**

OIL FILLED CONDENSERS

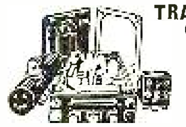


Famous Make TJH 50020, 2 MFD, 5000 VDC............$4.25
Nationally Advertised, 2 MFD, 600 VDC .... .29
Famous Makes, 4 MFD, 600 VDC .... .79
Highest Quality 23F47, 2 MFD, 4000 VDC.... 3.25
Highest Quality .25 Mu-f, 6000 VDC..... 1.95
Highest Quality 30 Mu-f, 90 V, 3 phase, 60 cycles 1.19
Mica Capacitor, type G1 ceramic .04 1000 Volts, 25 amps at 1000 KCS...................... 1.29
Type DT-4W1, CAP. 1 MFD, 400 Volts, Tubular, Box of 25........................... 2.98

MICROPHONES

T-24-G, 200 ohms, single button, 8 ft. rubber cord with PL-106 Plug and JK 38 Jack. BRAND NEW..$1.95
T-17-B, Hand-held carbon microphone for use in voice communication. Effectively covers the audio frequency range from 300 to 2600 CPS. 200 ohms, with press-to-talk switch, 5 ft. rubber cord and plug. NEW $1.95
T-30 Microphone suitable for aircraft use. Responds to frequencies in the range of 400 CPS to 2000 CPS. Complete with cord and plug. Original Packing. NEW........... 1.29
T-36-C Hand Carbon Microphone, 24 ft. cord, 3 contact amphenol plug.................. 2.95

TRANSMITTER-RECEIVER



Conversion of BC-645 Bringing Excellent Results.

Navy Model ABA-1 (CG-43AAG)
Army Model SCR-515A known as the BC-645

450 MC—15 Tubes

BRAND NEW—ORIGINAL CARTON. Can be easily converted for phone or CW 2-way communication. Covering for the following bands: 420-450 MC ham band, 450-460 MC for fixed or mobile, 460-470 MC for citizens, 470-500 MC television experimental. Size 10½ x 13½ x 4¾. Contains 15 tubes: 4-7F7, 4-7H7, 2-7E6, 2-6F6, 2-955, 1-WE-316A door knob. Complete as shown above...... ....only $17.95

PLATT ELECTRONICS CORP.
DEPT. A, 489 BROOME ST., NEW YORK 13, N. Y.
PHONES: RE 2-8177 and WO 4-2915

dling the *Alprodco, Inc.,* line of aluminum towers in their respective areas . . . *The Circle "X" Antenna Corporation* has named **HARRISON-REYNOLDS COMPANY** of Newton, Massachusetts, and **ROBERT MILSK** of Detroit to represent the company in those territories . . . **BRUNO NEW YORK, INC.,** has been appointed distributor for *Jerrold Electronics Corporation's* line of multiple television antenna systems . . . The New York City, Long Island and Northern New Jersey territory will be covered by **BEN JOSEPH** on behalf of *La Pointe-Plascomold Corporation's* "Vee-D-X" antenna line . . . **JACK C. GARDNER** is the new district merchandiser for *Bendix* receivers in the Maryland and southern Delaware area . . . **JACK WEBER ASSOCIATES** will cover the parts jobber accounts in New York State, New Jersey, Eastern Pennsylvania, Delaware, Maryland, and Washington, D. C. for *Odegaard Manufacturing Company,* producers of standoff insulators for TV installations . . . *Starrett Television Corp.* has appointed **JOEL B. GOODMAN** to act as its sales representative in Westchester and Putnam counties, New York . . . **NICHOLAS J. LAUB** is the new sales representative for *Oxford Electric Corporation* in the North and South Dakota and Minnesota territories . . . **LEONARD D. ALLEN, INC.,** will handle the test equipment and transformer line of *Freed Transformer Company, Inc.,* in the New York State area.

* * *

ROGER BOWEN, formerly associated with the U.S. Signal Corps, has been named to head the engineering department of *Cannon Electric Development Company* of Los Angeles.

During the war Mr. Bowen specialized in radar and general electronic equipment, serving for awhile in England and later at Red Bank, New Jersey where he was in charge of standardization of all electro-mechanical devices. After the end of the war he joined the Signal Corps at Ft. Monmouth where he headed the electronic component research and development division.

D. Frank Jackson who has been acting chief engineer of the company will continue as chief assistant to Mr. Bowen.

* * *

FRED ELLINGER, who heads his own firm in the Chicago area, recently rounded out a quarter of a century as a sales representative, handling the lines of several well-known companies in the component field.

Mr. Ellinger entered the field in 1925 as an original partner in the *R. F. Sparrow Company* and later, in 1933, organized the *Ellinger Sales Company.* He has been active in "The Representatives" of Radio Parts Manufacturers, Inc., and has served both as president and chairman of the organization. He still serves on the board of governors of "The Reps."

* * *

"THE REPRESENTATIVES" of Radio Parts Manufacturers, Inc.'s New England Chapter recently elected officers for 1950.

Arthur E. Akeroyd was named president of the group with Walter T. Hannigan serving as vice-president. Robert A. Waters is the new secretary-treasurer.

In addition to the officers, chapter members named three delegates and alternates to attend the annual convention of the association to be held May 22nd in Chicago in conjunction with the Radio Parts Show. Mr. Ackeroyd, Mr. Hannigan and former chapter president Glenn M. Hathaway will represent the New England Chapter with Henry Lavin, W. B. Pray, and Henry P. Segal acting as alternates.

—30—

George Sterling

(*Continued from page* 58)

cuits scheduled for inclusion. I wanted to be sure what I wrote was correct by personal check. My 'Radio Manual' had to be right!"

One of his first jobs at this time was to track down unlicensed radio transmitters used by gamblers to flash race results. Stations were concealed in buildings close to race tracks and the gamblers used high-powered glasses to observe race results which they reported by illegal radio. An automobile was fitted as a mobile detection and direction finding station. This and other measures soon made beating the races this way a hazardous gamble and the scientific pony players turned to personal sets that could be hidden on the body of a watcher at the track. Sterling promptly worked out his own "Dick Tracy" miniature detector which could be secreted in the hand. With this he could walk up to a perambulating radio bookie and give him the legal tap on the shoulder that said, "Stop violating radio laws!"

In 1935 he was appointed Inspector in Charge of the 3rd Radio District, and shortly after was called to the main FCC office in Washington, D. C., where in June, 1937, he was appointed Assistant Chief of the Field Division, Engineering Department. With the need to observe clandestine radio operations becoming of the utmost importance, he was made Chief of the newly-created National Defense Operations Section, Field Division, on July 1, 1940, and given a sum of $1,500,000 to organize and commence operations.

Immediately after Pearl Harbor, wartime protection of our country's interests started with the location and suppression of a trans-Atlantic transmitter which commenced operation in the German Embassy in Washington. This station was pin-pointed within

ORDER from ARROW!

TEN TUBE SUPERHET RECEIVER

with crystal controlled local oscillator. Has provisions for six crystal channels between 108 to 112 MCPS complete with tubes and crystals but less dynamotor............New $7.95
Like New 5.95
Less Tubes and dynamotor but New 3.95

RECEIVER—Easily Converted for Use in Citizens Band Crystal Controlled Local Oscillator. Broad Band Pass—20.7 MC IF.'s. Complete with 7-6AJ5, 1—12SR7, 2—12SN7, 1—28D7, relays, crystals. Schematic furnished..............**NEW $7.95**

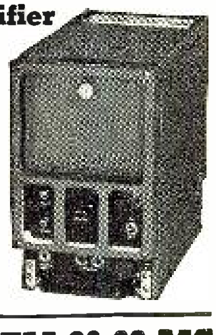
Westinghouse Auxiliary Relay Type MC

Style 423396 C—110 V 60 cycle 4 pole.
Enclosed in glass case......................New $7.50

HERMETICALLY SEALED CHOKES

10 H. 100 M.A..........**59c** **3.7 H.** 145 M.A..........**59c**
59 H. 100 M.A..........**95c** **10 H.** 20 M.A..........**39c**
.5x.5x1x1 H—4 winding layer wound.
.5 H at 3.56 A 140 ohms
1 H at 1.56 A 320 ohms...............New $0.49

BC-605 InterphoneAmplifier



Easily converted to an ideal intercommunication set for office—home—or factory.
Original—New.........**$4.95**
Like New...............**3.95**
(With Schematic)

All necessary parts and instructions to convert the above to AC operation with one remote station $8.25 additional.

BC-604 Transmitter FM 20-28 MC

11 and 15 meters. Can be operated on 10 meters—10 channel push button crystal. With all tubes and meter but less dynamotor. Excellent Condition....................**$12.95**
Crystals—
Set of 80..............................**14.95**
BC-603—Companion receiver to above with tubes but less dynamotor..................................Used $17.50

TUBES

Drastically Reduced from 10 to 50%
Nationally Advertised Brands

Type	Net Price	Type	Net Price	Type	Net Price	Type	Net Price	Type	Net Price
1A4P	$0.24	5FP7	$0.95	7C4/1203A	$0.24	304TL	$1.29	837	$1.49
1A6	.19	5J23	5.95	7E5/1201	.39	32L7GT	.39	841	.29
1B5/25S	.24	5T4	.49	10YVT25A	.19	33	.24	864	.29
1B22	1.49	5W4	.49	12A6	.34	34	.24	872A	.98
1B26	2.29	5Z4	.49	12A6GT	.34	35/51	.24	954	.19
1B29	.39	6AB7	.59	12A7	.34	36	.24	955	.34
1B32-532A	2.29	6AJ5	.89	12A8GT	.19	37	.24	957	.34
1C6	.19	6B8	.59	12F5GT	.29	38	.24	1625	.19
1C7G	.19	6C4	.29	12H6	.29	39/44	.24	1626	.24
1D5GP	.24	6D8G	.59	12J5GT	.24	49	.39	1629	.24
1D7G	.19	6F5GT	.39	12J7GT	.24	50	.39	1630	.29
1F4	.24	6F6G	.59	12K8GT	.24	56	.24	1636	2.95
1F5G	.24	6H6	.29	12Q7GT	.24	57	.24	1638	.69
1H4G	.24	6J7GT	.39	12SF5	.24	76	.24	1642	.29
1J6G	.24	6K6G	.59	12SF5GT	.24	77	.24	2050	.89
1J6GT	.24	6L5G	.39	12SF7	.24	211/Vt4L	.29	2051	.49
1P5GT	.24	6L7G	.39	12SH7	.24	316A	.34	7193	.19
1V	.24	6R7	.34	12SR7	.24	371B	.34	9002	.34
2A6	.39	6SF5GT	.34	12SR7GT	.29	700A	7.95	9003	.39
2A7	.24	6S7G	.39	12SN7GT	.89	703A	1.49	9006	.29
2C26A	.19	6S8GT	.59	12Z3	.29	705A	.79	GL4A21	.29
2V3G	.49	6SG7	.59	15R	.19	714AY	5.95	Amperite 10T1	.29
2X2/879	.25	6SF7	.39	19	.59	724B	4.95	Jan CRP72	.98
3FP7	.98	6SJ7	.69	2J22	.24	801A	.39	REL36	.69
4AP10	.98	6T7G	.39	28D7	.34	813	5.95	VR150	.39
5BP4	2.95	6U7G	.29	30SPEC (Vt67)	.59	829	6.95	VR105	.69
5CP1	2.95	6Z7G	.39	30	.24	832	4.95		
5D21	9.95	6ZY5G	.29						

WRITE FOR QUANTITY PRICES

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	Used	New
ID 6/APN 4 Scope, Excellent	$29.50	——
R 7/APS 2 Receiver-Indicator	——	$79.50
R 78/APS-15 Receiver-Indicator	34.50	——
BC 1287 A Scope	75.00	——
ASB 7 Indicator Scope	12.95	——
SCR 522 Transceiver 100 to 150 MC	34.95	75.00
BC 1206 Receiver, 200 to 400 KC.	3.95	5.95
MN 26 C or **Y** Receiver	17.50	24.95
RA 10 DA Receiver	17.50	24.95
T26/APT2 Transmitter	8.95	——
RT7/APN1 Transceiver	5.95	9.95
APN 1 Complete	——	24.50
BD 71 6 Pos. Switchboard	9.95	12.95
EE 8 Field Phones	7.95	——
BC 347 Interphone Amplifier	——	2.95
I-70 Tuning Meter	——	.89
AM 61 Indicator Amplifier	——	9.50
SCR 625 Mine Detector	——	39.50
PE 237 Power Supply	——	12.95
BC 461 Veeder Root Counter.	——	.59
BC 442 Less Condenser	1.49	1.95

BC 746—Bantam one watt foundation (See QST Jan. 1948). Contains 2 crystals, coil, tuning condensers, etc. Numbers 1-7-10-11-12-13-76. Each..............$0.95

	Used	New
A 27 Phantom Antenna	——	$0.98
APS 13 UHF Antenna, Pair	——	.98
Manual for **BC 312 & 342 J**	——	1.00
Manual for **SCR 269 G**	——	2.50
FL 8 Filter	$2.95	——
I-97 Bias Meter	4.95	3.95
RM 29 Remote Telephone Control	7.95	9.95
BC 602 Control Box	——	.98

One Tube Interphone Amplifier—Small compact aluminum case fully enclosed. 2¼"x3¾"x5¾". Less Tube...........**.79c**

BC 717 Transmitter, New but less Tubes..........................**$24.50**

96Q1 Complete Autotune assembly with motor and frame as used in **ARC-1** Transmitter...............New **$35.00**

BC 709 Battery operated lightweight interphone amplifier. Complete with tube and shock mount, but less battery New **$3.95**

SCR 183 Complete...........New **$49.50**

Motor—Universal Electric, 24 VDC, will also operate on 24 VAC Diameter 1⅝"; Length 2$\frac{9}{16}$", Shaft ¼"x¾"..New **$1.49**

BC 1291—Control box contains motor rheostat control rated 10 ohms at 3.88 amps. Brand new with cord and plug-in ventilated, mounted case..............**$1.95**

MC 385A—Headset Adapter...New **$0.49**

Information and Prices on Request

BC 639 Receiver with **RA 42** Rectifier
RTA 1B Transceiver
TA 2J24 Transmitter and **MP 10G** Power Pack
SCR 269 Compass Installation
R 5/ARN 7 Compass Installation
MN 26 Compass Installation
I. L. S. Installation (**R 89-BC733**)
SCR 584 Components
R-132/TPS 10 Radar Receiver
MD-22-URA/T1 Radar Modulator
AN APRI Receiver and Tuning Units
ASB7 Complete Radar Installation
TS-251 Test Set
BC 221 Freq. Meter

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DM-28—For BC-348 with Mount and Filter..........New $6.95
Used 3.95
DY-12—For ART-13 less filter and base.New 6.95
DM-36............................Used .95
New 1.95
BD-77............................New 5.95
PE-206...........................New 6.95
Used 2.75
PE-101...........................New 2.75
PE-73............................New 3.95
DM-53............................New 3.95
Used .95 (3 for $2.00)
DM-32............................New 1.95
Used .95 (3 for $2.00)

BEAM INDICATORS

I 82—5"...........................New $4.95
Transmitter Selsyn for above................ 2.45
both for 7.00
I 81—3"...........................New 3.45
Transmitter Selsyn for above................ 2.45
both for 5.25
I 81..............................Used 2.45

T-85/APT5 UHF TRANSMITTER

operating over a frequency range of 300 to 1400 MCPC with a nominal output of from 10 to 30 watts. Unit is equipped with 110 V 60 CPS filament transformer; blower; lecher wire test frequency set, and 8 tubes—1-931A; 2-6AC7; 2-6AG7; 1-6L6G; 2-829B; 1-3C22 (GL522) (oscillator).
New in original box with Operating Instruction Manual..............**$69.50**

All shipments FOB Chicago. 20% Deposit required on all orders. Minimum order accepted—$5.00. Illinois residents, please add regular sales tax to your remittance.

SURPRISE PACKAGE

20 lbs. Ass't radio parts. A $25.00 value for only......................**$1.95**

BC 620

Receiver-Transmitter—2 crystal channels—20 to 27.8 MC FM—13 tubes. Metered, Plate and Filament.......................New $14.95
Used 9.95
PE 97 Power Supply for above 6-12 volt vibrator type.
Used—complete.....................$6.95
Used less tubes, vib. & cond........... 2.95
FT 250 Mount for both BC 620 and PE 97 New $1.50

BC 223

Brand new Transmitter with all three tuning units, two tuning unit cases, spare tube carrying case, shock mount and brace; but less tubes at new low price of..............................$19.95
Set of 5 tubes.........................$3.95
Tuning units are available separately at..Ea. $2.50
Cases at...............................Ea. .95
PE 125—12-volt Vibrator Pack.......New $12.95
Used 8.95
Spare parts kit for PE 125 containing 2 tubes; 2 vibrators and 13 fuses in metal container with handle and clasp (BX 41)...........New $2.95

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	Used	New
BC-453	$12.95	——
BC-454	4.95	$6.95
BC-455	7.95	9.95
BC-456	1.95	2.95
BC-457	5.95	——
BC-458	5.95	8.95
BC-459 (or T22)	9.95	——
BC-696 (or T19)	14.95	24.95
BC-450—3 Receiver Remote Control	.89	1.95
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3 Receiver Rack	1.95	——
2 Transmitter Rack	1.50	——

Complete Command set as removed from aircraft—3 receivers—2 transmitters—Relay unit—control boxes—mounting racks—plugs—modulator and dynamotors—crated. Set **$34.50**

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HS-23 Hi Imp Headsets................New $2.95
HS-33 Lo Imp. Headsets...............New 2.95
HS-30 Hi Imp. Headsets...............New 1.50
Used .79
T-17D Carbon Mike....................New 2.75
T-24 Hi Imp. Carbon Mike.............New 1.19
T-30 Throat Mike.....................New .98
T-45 (or Navy) Lip Mike..............New .98
CD-307 Extension Cord for Headsets....New .59

CODENSERS

Each
2 mfd. 4000 VDC. OIL FILLED $2.95
4 for 10.00
1 mfd. 6000 VDC. OIL FILLED 1.98
.25 mfd. 15000 VDC. OIL FILLED.......... 4.95
.00025 mfd. 25000 VDC. OIL FILLED....... 2.95
.4 mfd. 1500 VDC. OIL FILLED............ .29
10 for 2.49
2 mfd. 600 VDC. OIL FILLED............. .39
3 for 1.00
1 mfd. 600 VDC. OIL FILLED............. .24
5 for 1.00
.1x.1x.1—1200 VDC. OIL FILLED.......... .59
2 for 1.00
50 mmfd—5KV—5 Amp. Vacuum Cond..... 1.19

hours after its first attempts to contact Germany. It was actually closed down before it had succeeded in establishing the desired contact!

The increasing size and importance of this work resulted in his promotion to Assistant Chief Engineer and Chief, Radio Intelligence Division, on June 1, 1942. On December 19, 1945, he was made Assistant Chief Engineer in Charge of Field and Research Branch; and on May 1, 1947, he was promoted to Chief Engineer of the Commission.

He is probably proudest of his work as organizer and wartime head of RID. Testifying as head of RID before a Congressional Committee in 1944, he said, "I readily admit that this country has been practically free of espionage radio activity and I am extremely proud of that fact. . . . The success of RID, like the success of any police organization, is properly measured, not by the amount of crime which is detected, but rather by the organization's success in preventing illegal conduct and maintaining order." The final score: no enemy spy ever successfully established clandestine radio operations from the U.S.!

George Sterling today is still an active ham operating as W3DF. He has two transmitters, a 600 watt phone rig for 75, 20, and 10 meters and a 400 watt c.w. rig, mostly on 40. Receivers are an SX-42 and an SX-71. Separate dipoles are used on each band, with a three element rotary beam for 10.

The family car includes a ten meter ham rig; it also carries a v.h.f. job on 152.03 mc. used under the "Common Carrier Service."

He also has such things as a 16 inch TV set for family use (FCC Commissioners are not permitted to touch its insides); a 10 inch TV set with a jury-rigged color adaptor; a commercial color receiver on temporary loan for test by the Commissioner and his friends, non-technical as well as technical; a basement workshop which he uses as much as a hurried, crowded official life will permit; and the walls of his ham-shack den are covered with photographs, diplomas, QSL cards and other mementos of a long association with the radio industry.

Commissioner Sterling is the author of the well-known and authoritative "Radio Manual," a text and reference work for radio operators, engineers, and amateurs. First published in 1928, it has been kept up-to-date and the postwar edition has just become available.

Sterling is also a Fellow of the Institute of Radio Engineers and on the Board of Directors of the Veteran Wireless Operator's Association. The Marconi Medal for Public Service was recently awarded by the VWOA. He enjoys attending on-the-air meetings of the Old Old Timer's Club, an amateur organization whose members must have been hams at least forty years ago and must refer to "wireless" instead of "radio" or "electronics" in their sessions. He is an honorary member of the Baltimore Amateur Communications Society; and the Quarter

Century Wireless Association of New York: the Chicagoland Mobile Club; and the Puerto Rico Amateur Radio Club.

As Chief Engineer of FCC, he participated in preparatory work and assisted at the Atlantic City Telecommunications Conference of 1947. In late 1947, he was Chairman of the Broadcast Engineering Conference under the North American Regional Broadcasting Agreement (NARBA), a most vital safeguard to American broadcasters. Commissioner Sterling was co-chairman of the U.S. delegation at the 1948-49 Mexico City International Short Wave Broadcasting Conference, which worked out the Mexican Plan for high-frequency broadcasting.

Queried as to the future prospects of Amateur Radio in the face of tremendous competition for all available frequencies, he made this statement for RADIO & TELEVISION NEWS' amateur readers:

"There are not enough channels altogether to satisfy more than a small part of the demand. This is particularly true in the high frequency region, which includes the 3.5, 7, 14, and the proposed 21 mc. ham bands. Those who are assigned frequency space must make the fullest possible use of it; and in the public interest. Each of the various services, of which the Amateur Radio Service is one, must justify the precedence and scope of its claim with relation to all others. Naturally, this must be in the terms of the present and the future worth of the service concerned.

"We know that the frequency allocation picture is unsettled and that there are powerful groups who would divert amateur frequencies to other uses. The amateurs should consider how to better justify and support their service—both within this country and in the international field. Under the conditions of today, there is indeed cause of concern. Amateurs must gird their loins for the battle of 1952 scheduled to take place in Buenos Aires, Argentina!"

—30—

PRSMA CHANGES NAME

THE country's oldest service technicians' association, the Philadelphia Radio Service Men's Association, has recently announced that the organization will henceforth be known as the Electronic Technicians' Guild.

The new name was adopted to reflect the new and wider scope of the organization than was implied by the former designation. The Guild membership will now include radio and television dealers, distributors, distributor sales personnel, and independent radio and television service shop owners and their employees.

In addition to renaming the organization the Guild Committee Chairman Karl Vogelsang presented a new plan of operation for the approval of the membership which will increase membership benefits and services.

—30—

International Short-Wave

(*Continued from page* 54)

Listeners are reminded that Brazilian stations likely will change schedules from around May 1 when that country *returns to Standard Time from Summer Time* and they should adjust the listed programs to conform to the new times which are, or will be in effect very shortly.

Our best wishes go to all radio outlets in our neighboring country to the South—Brazil!

* * *

New Allocations

Regarding the possibility of new high frequency allocations, I have received this information, on request, from T. G. Slewie, Secretary of the Federal Communications Commission:

The Mexico City Conference, which adjourned in April 1949, formulated one phase of a plan for high frequency broadcasting for the June season, sunspot number 70. This phase has not been accepted by the United States. It will be subject to modification, along with addition of phases formulated by the Technical Plan Committee at Paris in the fall of 1949, when the work of the Mexico City Conference is resumed in Florence, Italy, this spring. (The Florence meeting was to have begun April 1. —KRB) Those phases of a plan approved at Florence then will become a part of the draft International Frequency List covering all services—except amateur—which have been allocated frequencies below 27,500 kc. in the Atlantic City Radio Regulations. The whole draft List will be considered by the Extraordinary Administrative Radio Conference, scheduled to convene September 1 at Geneva, Switzerland.

The date and the method for implementing any List approved by the Extraordinary Conference have not been determined as yet—but these matters will be considered at that conference.

"It appears at this time that no one service, such as high frequency broadcasting, will be able to implement its portion of the List in advance of the other services because of the inter-related problems of all of the services," Mr. Slewie points out. "It appears doubtful, also, that the Extraordinary Conference can complete its work in time for implementation of the new List to begin during this calendar year."

* * *

Portuguese List

Revised call letters for Portuguese stations, from ITU frequency List Supplements, are—Emissora Nacional, Lisbon, 10 kw., CSA38, 6.360; CSA21, 6.374; CSA22, 7.260; CSA23, 9.635; CSA24, 9.670; CSA25, 9.680; CSA26, 9.727; CSA27, 9.740; CSA28, 9.940; CSA29, 11.027; CSA30, 11.040; CSA31, 11.840; CSA32, 11.995; CSA33, 12.749; CSA39, 15.100; CSA35, 15.110; CSA36, 15.120; CSA34, 15.160; CSA37, 15.320. Private Stations—CSB53, 3.960, 10 kw., Lisbon; CSB56, 6.003, 200 w., Lisbon; CSB52, 6.154, 2 kw., Lisbon; CSB54, 6.185, 350 w., Lisbon; CSB55, 9.650, 2 kw., Lisbon; CSB57, 12.130, 2 kw., Lisbon; CSB51, 12.865, 500 w., Parede. Ponta Delgada, Azores, 1 kw., CSA93, 4.845; CSA91, 7.018; CSA92, 11.090. (Legge, N. Y.)

* * *

World Listening Guide

O. Lund-Johansen, Copenhagen, Denmark, who compiles *World Radio Handbook,* informs me he is preparing a *World Listening Guide.* He says:

"In order to promote interest in listening to broadcasts from foreign countries—particularly on short-wave —and to give short-wave listeners all over the world a chance to share each other's experiences, *World Radio Handbook* has planned the production of a world listening guide. In this booklet, short-wave listeners the world over will be writing about their experiences, practical handling of the receiver, giving reception reports, technical tips about aerials, and many other matters."

I hope soon to have further information on this project.

Mr. Johansen's QRA is 1, Lindorffsalle, Hellerup, Copenhagen, Denmark.

* * *

Club Notes

England—Frank Baldwin is now General Manager for the International Short Wave League, and Mrs. Baldwin operates the club's QSL Bureau.

* * *

This Month's Schedules

(*NOTE:* At this season many short-wave stations will be going on *Summer Time;* in such cases, schedules may be changed to *one hour earlier* than listed herein.—KRB)

Albania—ZAA, 7.852, Tirana, is now scheduled daily 1230-1600. (Radio Sweden)

Anglo-Egyptian Sudan—Verification and schedules received from Omdurman Broadcasting Station, Khartoum, listed frequencies of 5.000 (temporary), 9.770, and 572.5 kc. Station

Leader, composer, and arranger Radames Gnatalli conducts Radio Nacional's orchestra.

has *English* on Fridays 1230-1300.

Angola—CR6RL, Radio Clube Angola, Luanda, is testing on a *new* channel of 5.096 at 1320-1600, according to Stephan, South Africa; is heard better than dual CR6RN on 9.469, Stephan reports. A station heard on 7.590 in Portuguese to closing around 1510 has been identified as Silva Porto, Radio Clube DB, CR6RO; however, according to its QSL card, CR6RO is on 7.582. (Radio Sweden) Reports on the *new* Nova Lisboa outlet on 11.925 should be sent to P. O. Box 125, Nova Lisboa, Angola, according to *Radio Australia*. This one has been heard by Stark, Texas, to 1700 when closed with "A Portuguesa." *Radio Sweden* reports the outlet heard in Portuguese around 1300-1640, identifying as Radio Clube de Huambo, Nova Lisboa.

Argentina—LRM, measured 6.1806, Mendoza, noted 2320 with music. (Treibel, Washington)

Australia—Current *Radio Australia* transmissions to North America are 2330-0045 to West Coast, VLC9, 17.84, VLA6, 15.20, VLG6, 15.32; 0700-0900 to East Coast, VLC5, 9.54; 0900-1000 to Central and Mountain States, VLC5, 9.54; 1000-1115 to West Coast, VLC5, 9.54, VLA8, 11.81; 1643-1815 to East Coast, VLA6, 15.22.

Austria—Blue Danube Network, Salzburg, logged 0900 on approximately 9.530, apparently is still moving around the 31-m. band. (Pearce, England)

Belgian Congo—OQ2AB, *Radio Elisabeth,* Elizabethville, operates on 7.150 and 11.900 on Sunday 0800-1000; OQ2AC, *Radio College,* Elizabethville, operates on 3.390, 4.980, 7.200 daily 1130-1215, Sunday 0200-0300. (Nordh, Sweden, via Radio Sweden)

Brazil—PRL5, 11.95, Rio de Janeiro, good level in Newfoundland from 1630 to after 1730. (Peddle)

British Guiana—Grove, Ill., says ZFY, 5.985, Georgetown, has announced expansion of its service to 0545-1145, 1445-2045.

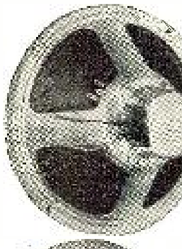
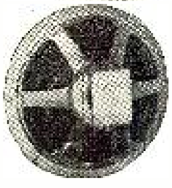
Cameroons—FIA6, 9.145, is very poor at 1430-1500. (Peddle, Newfoundland)

Canada—Anyone interested in the attractive monthly program booklet issued by CBC's International Service may get on the mailing list by sending his request to CBC International Service, P. O. Box 7000, Montreal, Province of Quebec, Canada. For each of the main areas—Europe and Latin America (including the Caribbean)—CBC publishes a separate booklet each month. Listeners should specify which booklet they want—European or Latin American. Latest schedules are —to Europe, CKNC, 17.82, 0915-1615 (Sunday from 1035); CKCX, 15.19, 0915-1128 (Saturday from 1020); CKCS, 15.32, 1130-1855; CHOL, 11.72, 1630-1855. To Caribbean and Latin America—CKRX, 11.76, CKCX, 15.19, 1910-2200; CKCS, 15.32, 2200-2230. To Australasia (United Nations Service) —Mon.-Fri., 2320-2400, CKLX, 15.09,

SPEAKER SPECIALS

FAMOUS BRANDS

GE–MAGNAVOX–CAPEHART–JENSEN

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Round 10″ PM Alnico V 4.16 oz. Magnet.................. **3.75** each
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4″ 500 ohm field...... **$1.50** each
4″x6″ 85 ohm field (TV). **1.95** each
4″x6″ 500-800 ohm field. **1.95** each
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8″ Speakers Your Choice $2.25 ea. 60 ohm (TV) 675 ohm 750 ohm 900 ohm 1000 ohm 1300 ohm 1800 ohm fields.

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425 ohm 600 ohm 650 ohm 1000 ohm 1800 ohm 2700 ohm fields.

15″ Jensen JAP 60 Coax Some with networks...... ....Special **$29.95**

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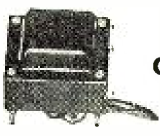
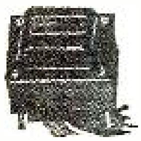

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POWER

50 MA. PRI. 115V. sec. 600 VCT 6.3V 3 Amp. 5V. 2.5 Amp............ **$1.95** each
80 MA. PRI. 115V. sec. 700 VCT 6.3V 3 Amp. 5V. 2.5 Amp............ **2.35** each
100 MA. PRI. 115V. sec. 600 VCT 6.3V 3 Amp. 5V. 2.5 Amp............ **2.95** each
150 MA. PRI. 115V. sec. 700 VCT 6.3V. 4 Amp. 5V. 3 Amp............ **3.95** each
150 MA. PRI. 105-120V. sec. 700 VCT 6.3V. 5A6.33A 5V. 3A............ **4.95** each
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60 MA. PRI. 110-220V. sec. 600 VCT 6.3V. 3 Amp............ **2.75** each
50 MA. PRI. 110-260V. with Switch sec. 600VCT 6.3V. 3 Amp............ **3.25** each
125 MA. PRI. 110V. sec. 750V. 6.3V. 5 Amp. 5V 3 Amp............ **3.50** each
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50 MA. PRI. 6V. Vibrator sec. 600V............ **1.75** each
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60 MA. 300 ohm 10HY.......... **45c**
80 MA. 150 ohm 10HY.......... **75c**
185 MA. 60 ohm 4HY.......... **95c**
50 MA. 100 ohm 20HY AC-DC... **35c**
20 MA. 2000 ohm 50HY Plate..... **35c**

SPECIAL PHONO SCRATCH FILTERS 29c

OUTPUT TRANSFORMERS

2500 ohms 50L6............... **$0.39**
5000 ohms 6V6............... **.49**
8000 ohms 3Q5............... **$0.49**
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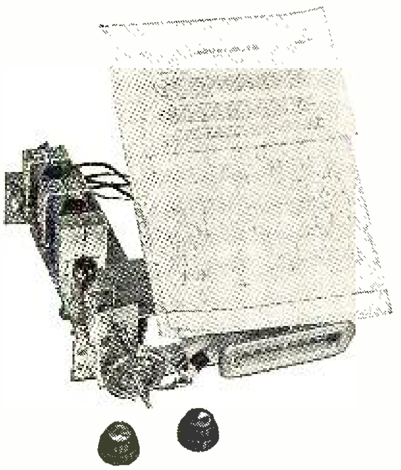
SPECIAL FILAMENT AND ISOLATION TRANSFORMER

PRI. 115 Volts sec. 120V. and 6.3V. 3 Amps........................ **$1.45** each

AM-FM TUNER

Famous Brand but because of price we agreed not to disclose the name. You will recognize it! With 5 band switch for On-Off-TV-AM-FM-Phono Control. Designed for use with standard TV chassis and any amplifier. Complete with dial-hardware-dual knobs—complete hookup instructions—schematics.

Compact for installation with TV. Chassis size—8½″w 10L 4½H.



4 tube complement
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30x20 MFD 150V	10x10 MFD 450V
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50x50x15x20 150V 25V	10x10x20 450V 25V
30x30 MFD 250V	40x40 MFD 450V
80x10 MFD 350V	10x10x10 MFD 450V
15x10x20 MFD 400V 25V	16x16x16 MFD 450V
10x10 MFD 400V	16x16 MFD 450V
20x20 MFD 400V	30x20x10 MFD 450V x 150V
25x10 MFD 400V	40x30x30 MFD 450V
20x10x20 MFD 400V 350V X 25V	60x50 MFD 450V x 50V
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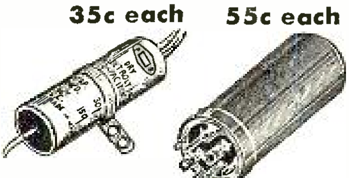
80 MFD..**45c**	20 MFD..**35c**
	30 MFD..**40c**
	40 MFD..**45c**
	80 MFD..**50c**



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CHOL, 11.72. To Australasia (Sunday *only*)—0340-0530, CHOL, 11.72, CKLO, 9.63.

Cape Verde Island—CR4AA, 5.92, heard in Pennsylvania 1650 with music, heavy CWQRM. (Slutter)

Ceylon—*Radio Colombo,* 4.900, noted 1115 following BBC news to give local time as 9:45 p.m.; had music 1130-1200 closedown. (Pearce, England)

Cyprus—ZJM7, 11.72, Limassol, fair 1200-1230 in Newfoundland. (Peddle) ZJM3, 4.06, heard in Stockholm around 1200. (Radio Sweden)

Czechoslovakia—Balbi, Calif., reports OLR3A, 9.55, Prague, from 0000; is QRM'd at 0030 by Paris opening on this channel; also heard in Texas.

OLR4B, 11.76, Prague, noted 0120 with Spanish news at dictation speed. (Treibel, Washington)

Improved signals are widely reported in the 1900-2000 daily beam for North America over OLR4A, 11.84; news at start.

Denmark—OZU, 7.26, noted with relay of Home Service to closing 1730; news in Danish 1300, 1600; QSL card received. (Pearce, England) Copenhagen lists current s.w. schedules as 2100-2230, OZF, 9.52, to Greenland and North America (may be off Sunday); 0500-0600 on Tuesday, Thursday, Saturday, OZH, 15.165, to the East; 1900-2000 on Monday, Wednesday, Friday on OZH, 15.165, to South America; daily 0040-1730 on OZU, 7.26, with Home Service for Europe; transmitter is listed as located at Herstedvester, with 50 kw. (Klein, N. Y.)

Ecuador—HC2CA, measured 6.8852, Salinas, noted 2130 with Latin American music (Treibel, Washington)

Ethiopia—A letter from ETAA, Addis Ababa, verified reception of the 19-m. outlet; gave *English* program schedule as daily 1020-1100, Sunday 0945-1115; no frequency was listed but said was operating in the 19-, 31-, and 49-m. bands. The 19-m. outlet appears to be on approximately 15.032, although most overseas sources list it around 15.050 to 15.075. *Radio Sweden* says ETA, 9.62, is audible in Sweden around 0600.

Finland—Verie from Helsinki listed OIX1, 6.120; OIX2, 9.555; OIX4, 15.190; OIX5, 17.800. Stated daily program times for 15.190 as 2200-0000, 0700-0800, 1145-1245, 1600-1700; card had photo of the 100 kw. transmitters. (Hankins, Pa.) OIX5, 17.80, noted 0715-0730 with news for North America. (Peddle, Newfoundland)

Formosa—See *Taiwan.*

France—Paris noted signing off on 6.145 recently 2445. (Stark, Texas)

(*Continued on page* 159)

PRECISION SPONSORS SERVICE MEETINGS

DURING 1950 television technicians throughout the country will have the opportunity of participating in a series of lecture-discussions being sponsored by Precision Apparatus Co., Inc., of Elmhurst, New York.

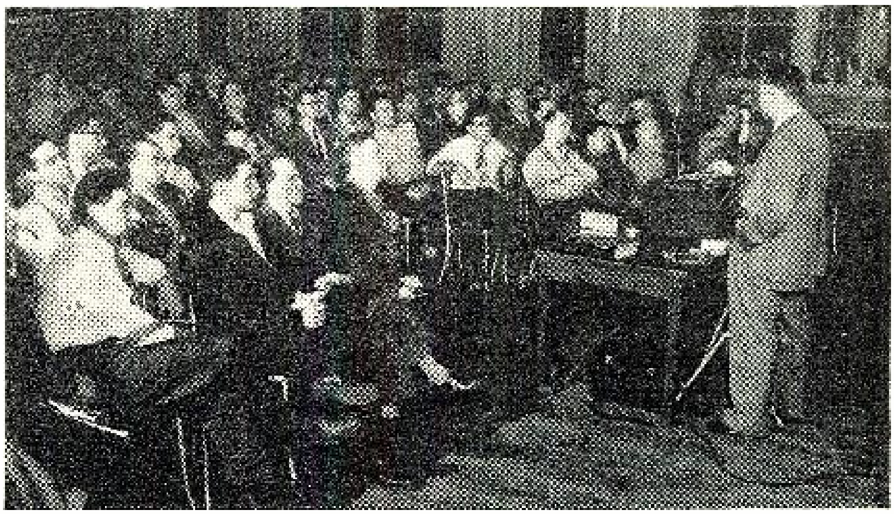
Designed to assist the television technician solve his servicing problems, this series of practical lecture-discussions has been tailor-made and is being presented under the general title of "Television Circuitry, Video I.F. Alignment Practice, and Troubleshooting." The sessions are being conducted by R. G. Middleton, Senior Engineer of the Precision Design and Application Engineering Section.

Each lecture-discussion is broken down into two periods. The first half of the session is devoted to a circuit analysis of the television high voltage power supply and how it works, followed by an open floor question and answer period. After a short intermission the second half of the program covers video i.f. alignment procedures including troubleshooting, short cuts, and efficient test equipment applications. An actual TV alignment demonstration follows the lecture with the lastest test equipment being featured.

The company's plans now call for lecture-discussions in every primary TV area in the United States during 1950.

—30—

R. G. Middleton addresses his audience of over 300 television technicians who gathered recently at Queens Village, Long Island, for the first of a series of nation-wide lecture-discussions sponsored by Precision Apparatus Co. and its distributors.



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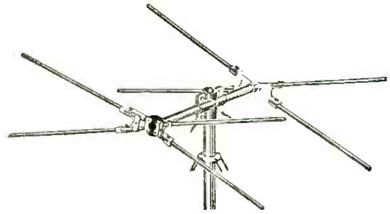

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18-Watt Kit

6 tubes: 1—6SQ7, 1—6SC7, 2—6V6, 1—6SN7, 1 — 5Y3GT. Mike and phono input. Separate Bass and Treble controls, Heavy steel chassis and cover. Frequency response 50-17,000 CPS & 1DB. Output impedances 4-8-16-500. Hum level 65DB below rated output. Complete, with tubes..............**$18.95**

25-Watt Kit

6 tubes: 2—6SJ7, 2—6L6, 1—6SC7, 1—5Y3. 2 mike, 1 phono input. Separate bass and treble controls. Output impedance 2-4-8-16-500 ohms. Frequency response 30-17000 CPS & 1DB. Attractive heavy steel chassis and cover. Push pull phase inverter driver for hum level.
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PM Replacement Speakers—Finest made.
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Radio Parts Company, 614 RANDOLPH ST., CHICAGO 6, ILL.

Fan Type Antenna

(*Continued from page* 67)

and therefore, all radiation is cancelled. However, when the conductors are bent out to form a dipole, the cancellation can no longer take place and the dipole antenna will either radiate or receive.

This dipole has an impedance of approximately 73 ohms. Now if the diameter of the dipole is increased after a right angle bend so that it constantly increases as we get farther from the point of the bend, a three dimensional cone is formed. This cone will still radiate or receive energy. However, its impedance characteristics are different. In this case, as the transmission line has been fanned out, the diameter of the conductors has been increased. The result is that the impedance remains constant over a wide band of frequencies. In other words, by the use of conical elements, a broadband antenna has been secured. In summarizing the previous two paragraphs, it can be seen that by veeing an antenna forward very narrow horizontal lobes and patterns can be obtained over a relatively wide band of frequencies.

In the case of the conical antenna, by the use of this uniform impedance conical element, it will work over a wide band of frequencies with a low standing wave ratio.

It must be borne in mind that the above description pertains only to driven or receiving elements and does not pertain to reflectors. The requirements of a reflector are such that it must re-radiate energy to the driven element in such a relationship that reinforcement or addition occurs. To fulfill these requirements, a straight reflector is as effective as a conical reflector or a fan shaped reflector provided that it is cut and spaced properly. In the laboratories, the above considerations were given careful thought. It was obviously not feasible to make a three dimensional sheet metal cone or even a wire cage type cone element. Previous conical antennas had simulated this cone by running two dipoles from a common apex producing a cone in two dimensions. It was further observed that in the case of a "V" antenna as the diameter of the legs of the "V" was increased, the antenna would become increasingly uni-directional in the direction of the enclosed part of the "V." It was then reasoned that if the conical element which operated effectively over the entire low band were bent forward so that it formed a "V" on the high band, it would provide an efficient all channel antenna. However, two shortcomings were observed. Veeing forward the antenna reduced the amount of energy intercepted on the low band because the distance across the front was decreased and secondly the two element conical antenna did not have an effective diameter large enough to pro-

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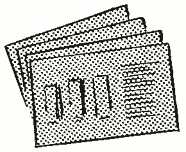

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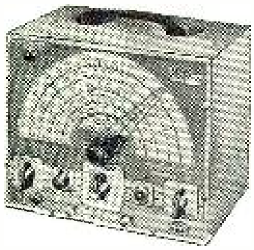

EICO Model 360-K

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Crystal marker oscillator with variable amplitude. Covers all TV and FM alignment frequencies between 500 kc. and 228 mc. Sweepwidth variable from 0-30 mc., with mechanical inductive sweep. Extremely wide sweepwidth allows gain comparison of adjacent RF TV Channels. Provides for injection of external signal generator marker. Phasing control included. Vernier dial calibrated in frequencies. Complete with tubes (6X5GT, 12AU7, 2—6C4). In sturdy steel case. Less Crystal. Size: 10 x 8 x 6¾". 110-125 v., 60 cycle AC. Shpg. wt., 12 lbs. IN KIT FORM.

No. 32P24370: Concord's Price $29.95
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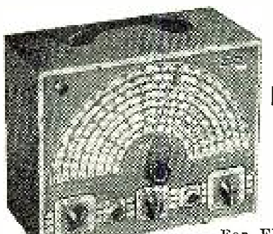

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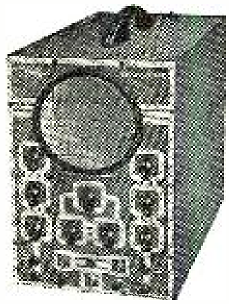

EICO Model 425-K

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All-new laboratory precision scope has Push-Pull deflection and .05 to .1 volts per inch sensitivity. Wide range, flat from 5 cps to 500 kc. with full gain setting, useful to 2½ mc. Wide-range, multi-vibrator, sweep circuit from 15 cps to 75,000 cps. Direct connection to plates of CRT available at rear of cabinet. Z axis intensity modulation feature included. Size: 8½" x 17" x 13" high. Complete with 3—6SN7, 2—6J5, 2 of 5Y3, 5BP1 CRT. 110-125 v., 60 cycles AC. Shpg. wt., 30 lbs. IN KIT FORM.

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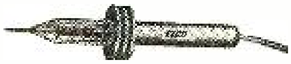
HIGH VOLTAGE PROBE

(Not a Kit)

EICO Model HVP-1 $6^{95}



Measures up to 30,000 volts. Special HV Multiplier Resistor for all 20,000 ohms per volt meters with 1000 or 5000 volt scales and most VTVM's. Lucite head, plywood bakelite handle, large flash-guards for additional safety. Assembled, ready to use. Supplied for 221-K VTVM unless other instrument is specified. Shpg. wt., 1 lb.

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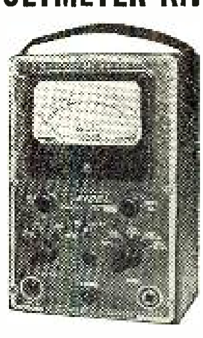
VACUUM TUBE VOLTMETER KIT

EICO Model 221-K

$23^{95}



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Germanium crystal probe for visual RF signal tracing and measurements to over 200 megacycles. 6½" long, 12" O.D. Shpg. wt., 8 oz. IN KIT FORM.

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duce a workable front-to-back ratio on the high band. A third element was added. This element overcame these two shortcomings. On the low band, the third element meant that more energy was being intercepted and therefore the narrowing of the space aperture was overcome. On the high band, the effective diameter of the legs of the "V" was increased so that a high front-to-back ratio was realized. As a matter of fact the same front-to-back ratio was realized on the high band after the inclusion of the third element, with or without reflectors. In addition, to these two improvements, it was found that the third rod made the elements more closely resemble a three dimensional cone and a more uniform impedance was realized. Therefore, a better match was made to the transmission line over the entire range of frequencies. The impedance was found to lie in the neighborhood of 150 ohms so that good matches were available at 72 ohms and at 300 ohms. The finished antenna is shown in Fig. 1. Horizontal polar diagrams at Channels 2 and 7 are shown on Fig. 5. Gain curves for the single, double, and four-bay arrays are shown graphically and tabulary in Fig. 6.

—30—

AN ELECTRICAL LOCK

By WILLIAM K. COOPER

THERE is an easy way to prevent meter movements from being damaged by jars and rough handling when making outside service calls. The tester is often bounced around in the car and accidentally bumped into things when carried on such trips. This can damage the bearings of the movement due to the sudden jars and the needle hitting the "stop" at the low end of the scale. Meters that are lightly damped need the most precautions in handling since they are most susceptible to damage caused by jars.

After having a meter damaged in this way, I found a simple means of preventing this trouble by simply using an "on-off" toggle switch. Drill a hole for it on the panel as near as practicable to the meter. If there is no room on the panel, mount it on the meter case. Before drilling a hole in the panel, the meter must be disconnected and taken out of the tester to prevent damage from vibration. Care should be taken that no circuit components are damaged by the drill. When the switch is mounted, the meter is replaced in the panel.

The switch is wired directly across the terminals of the meter itself and the meter reconnected to its circuit as before. With this switch "on" the moving coil is shorted. Then any motion of this coil as the tester is carried generates a current of such direction that it opposes the coil motion. This is in accordance with Lenz's law, remember? Thus there is dynamic braking of the meter movement. With the switch "on", the needle will barely move no matter how one moves the tester around. When ready to use the tester, turn the switch "off", and proceed as usual.

—30—

Triode Amplifier
(*Continued from page* 57)

inverse feedback for improving linearity, etc. In addition the circuit lends itself readily to direct coupling from the preceding stage. The positive voltage from the preceding plate circuit is more than offset by the high bias voltage developed across the cathode resistor, so that both tubes operate properly. The direct coupling permits extension of the low-frequency response to d.c. and eliminates coupling networks which can cause phase shift and low frequency attenuation. It will be noted from the schematic of Fig. 2 that in the "radio" channel there are only four coupling condensers in the entire amplifier, two on each side of the push-pull system. As both of these are of generous capacity, and the frequency response of the output transformer specified is no more than ½ db. down at 20 c.p.s., the low frequency response is very good.

The phase inverter is resistance-capacity coupled to a type 6SN7 tube connected in push-pull. A fairly high load resistor is used in order to increase the voltage output and the cathode resistor is not bypassed to take advantage of inverse feedback action in balancing the push-pull system. The stage is resistance-capacity coupled to a type 6SN7 tube used as a cathode follower driver.

The cathode follower is direct coupled to the push-pull power amplifier through an ingenious circuit. Each cathode is directly connected to a power stage grid. The cathode current flows through each side of a center-tapped choke, which has low d.c. resistance so that no d.c. biasing voltages are developed. The choke has sufficient inductance so that its inductive reactance, which is the cathode follower load, is high, even at 20 cycles. The cathode currents from both sections of the cathode follower flow through R_{27} which develops the bias voltage for V_5. The opposite end of R_{27} connects to the grid return of V_5 and the negative end of R_{28}, which is between the power transformer high-voltage center tap and ground, providing fixed bias for the power stage.

The power amplifier consists of a pair of 6A5 tubes coupled to the loudspeaker (see page 56) through the output transformer, T_2. As the tubes are operated with fixed bias, the cathodes are grounded. The 6A5 is very similar to the 2A3 and 6B4 in characteristics and application, but is equipped with a cathode which is internally connected to the center point of the heater. The heater-cathode construction results in a considerably reduced hum level over the directly-heated tube types and, in addition, the internal connection provides a center tap ground for the heaters. No balancing arrangement for d.c. plate currents in the output tubes was provided because

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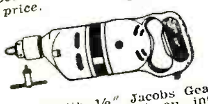

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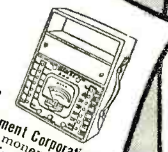

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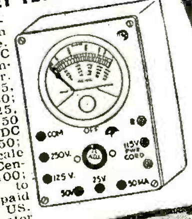

Sensitive repulsion meter in bakelite case. Specs: AC-DC Model Volt-Ohm-Milliammeter. AC Volts—0-25, 50, 125, 250; DC Volts—0-25, 50, 125, 250 Ma. AC and DC Ma. 0 to 50; Ohms Full Scale —100,000; Center Scale—2,100; Capacity—.05 to 15 mfd. Prepaid anywhere in US. $7.00. DC meter lacking AC range. $5.50.

RT1463 12 Stage Electronic Brain containing 3-7F7, 1-7Y4, 3-7N7, 4 potentiometers, numerous resistors, filter and bypass condensers, filter chokes, power and audio transformers, and six sensitive plate relays. A military development that provided amazing stepless control proportional to correction required for ailerons, rudder and elevator, in the original application. A control amplifier of the ordinary type would deflect the rudder by some arbitrary amount when the ship was blown off the course to port or starboard. The result would either be that the correction was insufficient and the plane continued off course, or the correction would be too great, starting a series of tackings that would greatly increase fuel consumption and elapsed time in reaching the objective. This phenomenal unit, with its 3 amplifiers and six 5,000 ohm relays in bridge circuits, will accurately control any 3 operations, related or unrelated, in minutely adjustable uniquely quantitative variations in either forward or reverse directions. 9"x7"x8" black crackle aluminum case. Brand new in original carton, **$9.95**.

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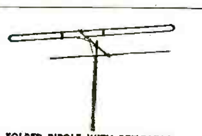
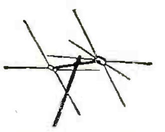
(The FCC announced that effective June 1, any American over 18 years of age may be eligible for a 5 year station permit. In the "Citizens" band, no code test or technical knowledge are necessary for voice transmissions.)
GENERAL ELECTRIC 15 TUBE TRANSMITTER-RECEIVER SET. This brand new 15 tube transmitter-receiver was designed for mobile storage battery powered service. Properly modified, it will operate on voice in the Citizens Band. It's a cinch for the experimenter to connect this unit for 110-volt a.c. operation by following the instructions and diagrams supplied, which cover numerous applications, including FM and amateur television transmission and reception. For those intending to use on car or boat, a new dynamotor, exactly as originally supplied, costs only $15.00. Don't fail to write for FREE descriptive bulletin. Order our RT-1248 for only **$29.95, or two for $53.90.**



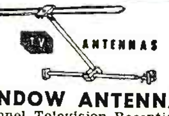
FOLDED DIPOLE WITH REFLECTOR

Full size folded dipole with reflector and mast. Stand-off insulators included. $4.75 complete. $40.00 per dozen. **Order No. 6430.**



Latest model fan type conical with reflectors. Better on all channels, but superiority is most terrific on higher channels. A year ago we advertised an antenna that sold for over $100.00. This antenna is hotter. **$4.75** each. In lots of 10—**$40.00. Order No. 6491.**

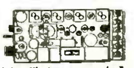
Connector bars for double stacking either antenna. $1.00 per pair.



WINDOW ANTENNA

For All-channel Television Reception. Precision engineered, featuring ease of installation; maximum adjustable dipole for best all-channel reception; durable aluminum and steel construction; excellent reception. Special adjustable base to fit window frame. Skillfully designed support permits horizontal or vertical positioning for maximum directional response. **No. 6450—$6.95 or 3 for $20.00**

RT1655



ONLY **$14.95** with Tubes. 11 Tube crystal controlled superhet receiver. Covers the FM band. Ultra modern circuit. Latest type tubes. Diagram included.

SINGLE-GANG CERAMIC INSULATED-VARIABLE CONDENSERS

Ideal for high-frequency applications in receivers and low power transmitter stages. All types.

		10 for	100 for
10 mmf	$.35	$2.90	$23.00
15 mmf	.35	2.90	23.00
25 mmf	.35	2.90	23.00
35 mmf	.40	3.40	28.00
50 mmf	.45	3.70	30.00
79 mmf	.50	4.40	38.00
100 mmf	.55	4.50	39.00
140 mmf	.80	7.40	64.00
160 mmf	1.00	8.50	70.00
140-140 mmf	1.60	12.50	100.00

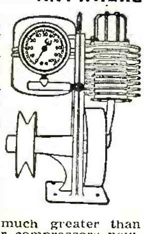
SPECIAL
50 MMF, 24 plate variable cond., 29c or 5 for 99c

Universal 4 lead broadcast band oscillator coil (can be converted to 3 lead type by addition of jumper). Ten for **$1.00.**

NEON RADIO TESTER

60 to 550 Volt. Selectively indicates AC, DC or RF. Instruction booklet outlining various tests on radio sets, including the location of fading, dead stages, shorts, and making screen grid and plate circuit tests. Attractive display. **$4.00.**

COMPRESSED AIR INSTANTLY ANYWHERE



Portable Air Compressor and storage tank. Ruggedly built of best materials. Connecting rod ball bearing lifetime lubricated. Main shaft bearing oil impregnated. Unusual design forever eliminates valve trouble, the common fault in air compressors. PATENTED unique air intake system increases efficiency tremendously over other compressors.

Air output is much greater than that from larger compressors powered by heavier motors. Delivers approximately 3500 cu. inches of air per minute at maintained pressure of 30 lbs., or will inflate a 90 lb. truck tire in less than one minute. Complete with 100 lb. gauge. Finger-tip adjustment allows setting of output pressure at any value, which will automatically be maintained. Works from any 1/4 H.P. motor. Sprays paints or lacquers, insecticides, anneals or brazes with natural gas, inflates tires, etc. **$14.50** postage prepaid anywhere in the U.S. Efficient, completely adjustable syphon type spray gun complete with 12 ft. of 100 lb. tested hose for only **$7.75** with pint container.

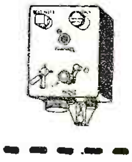
3-FOR-1 SALE
ALL 3 ITEMS ONLY $7.00

ALUMINUM GEAR BOX 18x8x7 contains two powerful electric motors and two matched gear trains, 62 gears in all varying in size from 1/2 to 4 inches in diameter. Readily converted to rotate a beam antenna or any other similar use. **$5.00.**

SIGNAL CORP INTER-CONNECTOR RELAY BOX 730A

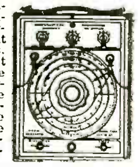
This valuable unit, BC616, made by Bell, is encased in a highly polished aluminum case 6 1/2 x 5 1/2 x 2 1/2. and contains 150 mfd. of condenser capacity, sensitive relays, resistors, and terminal strips. Order several at the giveaway price of only **$1.95.**

REMOTE CONTROL UNIT—Aluminum case 4 x 3 x 2 containing revolution counter, 2 potentiometers, triple pole switch, 4 knobs, phone jack, and gear mechanism. Including 8 prong JAN connector to fit box—**$1.39.**



SIGNAL GENERATOR

Genuine Laboratory-type precision signal generator. Manufactured and sold for $68.00 each in large quantities during the war by Northeastern Engineering Corp., one of the top manufacturers of electronic equipment for the U.S. Govt. Five fundamental bands starting at 150 KC. Strong harmonics up to 120 MC. Five step ladder type attenuator as well as potentiometer output control. Regular 1000 cycle audio oscillator using vacuum tube, not a cheap neon saw tooth audio oscillator. Audio output separately available externally. Weight without packing material 16 lbs. which should show what a world of difference exists between this signal generator and the ordinary cheap oscillator used by the average serviceman. Complete with fused plug and coaxial output lead. Super Special, **$38.75.**



SCR—274N Command Set
The greatest radio equipment value in history **$59.95**
A mountain of valuable equipment. Made by Western Electric. 3 receivers covering 190 to 550 KC, 3 to 6 MC, and 6 to 9.1 MC. Receivers use plug-in coils and can be changed to any frequencies desired without conversion. Included are two 40 Watt V.F.O. transmitters, usable in ham bands, 29 tubes, crystals, and all accessories supplied.

Brand New General Electric BC-375 or BC-191 transmitters, export packed, absolutely complete and including additional complete set of spare tubes as well as 10 and 20 meter conversion instructions. **$100.00.** BC-312, BC-348 or BC-224 receivers sold only with the above transmitters (unit for unit), **$125.00.**

SCR-522 Transmitter-receiver in guaranteed condition with remote controls, antenna and mike. No conversion to license for taxicab use. A natural for 2 meter use. **$100.00.**

AUDIO AMPLIFIER

Push-Pull stage triode amplifiers having 2 of the valuable and scarce ouncer type audio transformers that sell for over $10.00 each. Neat aluminum case, fully enclosed. Perfect for intercom system, phono, mike or signal tracer amplifier for testing radio. A $25.00 bargain at only $3.40 each.

AC-DC Superhet Radio Kit

Extra high quality standard production line radio in kit form with complete instructions. Features 2 iron core I.F. transformers, 2 gang condensers, and polyethylene insulated edgewise wound antenna loop. Tubes include 12AT6, 12BE6, 50B5 & 35W4. Receives broadcast band from 550 to 1700 KC. Kit form **$8.75** or 2 for **$17.00.** Assembled, wired and tested **$12.95 or 2 for $25.**

1000 CYCLE AUDIO FILTERS

Sharp Cut-Off • Compact
High Stability • Highest "Q"
Low Insertion Loss • Hum Proof

Navy PD52010 low pass audio filters that are the exact electrical and physical equivalent of commercial audio filters selling for $35.00 wholesale. Far superior to surplus Radio Range Filters now being offered. Twice as selective as Q-fiver section of 274N, which has previously provided the amateur's highest standard of interference elimination. With diagram, $2.

Splatter Chokes
These Tapped "Splatter Chokes" are used between Class C stage and Modulator to eliminate objectionable side band splatter. DC resistance 50 ohms. Our Part No. 8660, $1.00.

SELL OUT
26th Edition of Radio Amateur's Handbook. Tells all, shows all. 700 pages of valuable information. $1.50 each.

SAFETY SWITCHES SAVE LIVES
G.E. Interlock Safety Switches eliminate fatal shocks. 40c each or 7 for $1.00.

HURRY
2 gang midget super het tuning condensers with 1/4" shaft and trimmers. Reg. $1.25 each, now 5 for $2.00.

WORLD-WIDE MAIL ORDER SERVICE!

BUFFALO RADIO SUPPLY, 219-221 Genesee St., Dept. RN-3, BUFFALO 3, N. Y.

the unique circuit and the latitude possible in the output transformer made it unnecessary.

It will be noted that inverse feedback is included in the amplifier. Inverse feedback is usually thought of as being used with beam power amplifiers, but the circuit is not confined to beam tubes. The benefits of inverse feedback are just as real with triodes. Approximately 7 db. of feedback is used, the feedback loop including five stages and the output transformer. More than this amount of feedback could have been used, but it was found that this amount produced optimum results. It should be pointed out that the value of the feedback resistor, R_{29}, must be changed should the output transformer be strapped for other secondary impedances.

When the output transformer is strapped for a 16 ohm load, the internal impedance, looking back into the winding, is approximately 2 ohms. Thus the damping factor, the ratio of load impedance to internal impedance, is 8 and thus the amplifier will adequately damp a high efficiency loudspeaker.

The power supply is conventional, using two high capacity filter condensers and a resistor to provide humfree power. The resistor is used in the negative lead to provide, at the same time, grid bias for the power amplifier stage. (See schematic diagram, page 56.) The type 5V4 rectifier tube was used as it has a low internal resistance resulting in an increased d.c. plate supply voltage.

Another effect of primary concern to the user is hum. Assuming that the high voltage winding is properly center-tapped, hum can be produced by the stray magnetic fields from the power transformer. In some shell type designs, utilizing a single coil, the stray magnetic field may extend to audio transformers as far as three or four feet away, producing a hum that all the power supply filtering in the world will not eliminate. While the power transformer used in the A-100A Amplifier is of this shell type construction, it does have interesting features. The core operates normally at a flux density of 10,500 gausses and the cross sectional area of the core is uniform. The exception, of course, is at the joints where only one-half of the core is continuous. It is the concentration of flux at these points which contributes so greatly to the large external field normally encountered in small transformers of this type. Here though, the interleaving of the laminations is in a 2x2 arrangement so that the transverse flux path resistance is increased to the same order as that of the air gap between the single layer E and I pieces.

While this arrangement reduces to some extent the structure permeability and increases the reactive exciting current, it also produces a more uniform flux distribution in the core, particularly at the joints. The reduction of flux "hot spots" reduces the external field. It also reduces the in-phase exciting current by an amount greater than the increase in reactive exciting current.

Therefore, two advantages result: (1) The external field is more uniform and less intense and (2) the over-all I^2R losses (in *both* core and copper) are reduced.

The completed amplifier performs exceptionally well when tested with square waves, the square waves showing at a glance the frequency response, phase distortion, and transient response. Fig. 5 shows traces of square waves passed through the entire amplifier. At 20 cycles the square wave shows some linear tilt which is caused by a slight phase shift. This tilt must not be confused with the exponential decay caused by lack of primary inductance often observed in inferior output transformers. The good high frequency response is confirmed by the fine square waves at fundamental frequencies up to 20,000 cycles. There is no transient oscillation and only a little phase shift up to almost astronomical frequencies, as the square wave covers frequency and phase characteristics up to at least 20 times the fundamental. Square wave testing is becoming increasingly important as the performance of audio equipment is continually improved and has been widely publicized in connection with output transformer performance. —30—

HAMFEST

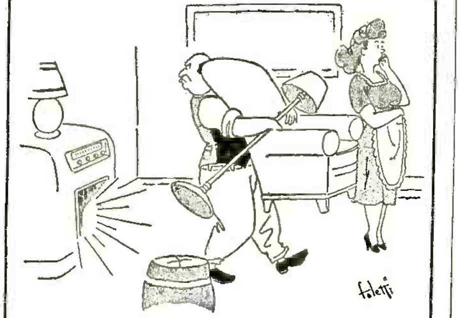
THE Starved Rock Radio Club of Utica, Illinois, has planned its annual Hamfest for Sunday, June 4th.

The event will be held at Boy Scout Camp Ki-Shau-Wau like last year's hamfest. The usual arrangements are being made to assure an interesting time for all. Mobile operation will be stressed and those operators who keep a good log of their mobile work enroute to the meet will be rewarded for their trouble.

Registration is $1.00 in advance or $1.50 at the gate. Lunch will be available at the camp or those attending can bring their own lunches. Advance registration should be in the mail on or before May 25th to insure return of registration tags.

Registration requests should be sent to George E. Keith, Secretary, The Starved Rock Radio Club, Box 22A, Utica, Illinois.

—30—



"Tote that barge. Lift that bale . . ."

AFCA NEWS

ARMED FORCES COMMUNICATIONS ASSOCIATION

This Association is a patriotic non-profit organization, with chapters in most of the larger cities, dedicated to developing and maintaining efficient personnel, commissioned, enlisted, civilian, for the supply (including design and development), installation, maintenance, and operation of communications and electronic equipment for Army, Navy, and Air Force and their supporting civilian activities. It publishes a magazine "SIGNALS" at its national headquarters in Washington. Every American interested in any way in communications is eligible and invited to join. Dues are $5.00 per year. Application should be submitted to the secretary at 1624 Eye St., N. W., Washington 6, D. C., who will furnish details upon request.

CHAPTER NOTES

Augusta—Camp Gordon

On March 3rd the chapter celebrated the 87th anniversary of the founding of the Signal Corps with a dinner-dance at the Camp Gordon Officers' Club. In keeping with the occasion the principal address, given by Lt. Col. Royal S. Copeland, was devoted to a review of the history of the Signal Corps and current developments.

Prior to the meeting, members availed themselves of the opportunity to review the exhibits and parade at Camp Gordon which marked the anniversary.

Baltimore

The Baltimore Chapter featured a talk on "Frequency Resources and National Policy " by Federal Communications Commissioner E. M. Webster at its February 23rd meeting. This was Commissioner Webster's second appearance before an AFCA chapter this year, having addressed the New York Chapter in January.

The meeting took place in the auditorium of the Pythian Building and was presided over by Chapter Chairman E. K. Jett of the *Baltimore Sunpapers* Station WMAR. He introduced Col. George P. Dixon, AFCA's new Executive Secretary, who spoke on "AFCA Present and Future."

Chicago

The Chicago Chapter's March meeting was held at the *Motorola Inc.* plant with Robert W. Galvin, executive vice-president of the company acting as host.

In the absence of Oliver Read, the Chapter's 1st vice-president, Dwight Brown, presided during the meeting.

D. E. Noble's speech on "Motorola's Program for Decentralization of Facilities" was read for him as Mr. Noble was detained in Phoenix. Henry Magnuski spoke on the company's microwave equipment and John Doremus discussed "Recent Developments in Mobile Communications and Selective Signalling." A tour of the *Motorola* plant followed the talks.

Far East

Despite the handicaps of a widely scattered area and a transient membership, the Far East Chapter is carrying out a program which is receiving the enthusiastic support of its entire membership. Activities are conducted by the individual posts and are climaxed by an annual meeting of the entire chapter each spring.

The following is a round-up of post news:

Okinawa Post: New officers were elected at a meeting held at the Ryukus Command Signal Office on November 25th. Col. Joy T. Wrean, commanding officer of the 97th AAA Group, was unanimously elected president. Other officers elected were: 1st vice-president—M/Sgt. Royle E. Morris; 2nd vice-president—Lt. Col. Clarence H. Lewis; Secretary—Capt. J. A. Beauregard; Treasurer—DAC Carl P. Dunkel.

Maj. J. W. Powers, outgoing chapter president, then introduced the Army and Air Force Military Amateur Radio System directors, and Capt. George H. Schmidt, of the 11th Signal Service Battalion, MARS director in Rycom, explained the proposed activities of his organization in the command.

The program closed with the film "The Battle of Okinawa."

On February 14th, members of the Okinawa Post toured the communication center of the Rycom Signal Section. After an explanation of visual screen teletype messages, the group sent and received teletype messages to and from the Tokyo Post of the Far East Chapter, AFCA.

Following this, visits were made to the ship-to-shore radio station, the center's terminal and relay section, the facilities control operations room and the Rycom telephone exchange.

Philippine Post: The Philippine Post was organized at Clark Air Force Base during the fall of 1949. Officers of the post are: Chairman—Maj. Forrest V. Diehl; 1st vice-chairman—Manuel A. Vargas; 2nd vice-chairman—1st Lt. Wyatt L. Law; Secretary—Capt. Bernard R. Grossman; Treasurer—SFC William A. Finney.

Tokyo Post: At a meeting of the Tokyo Post on January 10th, the following new officers and directors were unanimously elected: Chairman—Lt. Col. R. H. Mapes; 1st vice-chairman—Lt. Col. Jamie L. Wicker; 2nd vice-chairman—C. B. Allsopp, vice-president of the *International Tel & Tel Corp.;* Secretary—Miss Nina Jo Culver; Treasurer—Capt. D. V. Mayer.

Approximately 125 members and guests were present at the meeting. Entertainment featured showing of the film, "The Battle of Okinawa," and a social hour afterwards.

Yokohama Post: Grouped around the Headquarters Eighth Army at Yokohama, the Yokohama AFCA Post provides a fine medium for the acquaintance and association of the numerous communications personnel of the Army, Navy and Air Force in that area. Present officers of the post are: President—Lt. Col. Robert B. Tomlinson; 1st vice-president—Mr. Frank Hagen; 2nd vice-president—Capt. David M. Uhler; Secretary—Maj. Edgar DuBois.

Fort Monmouth

Although busy with arrangements for the national AFCA convention to be held there on May 13th, the Fort Monmouth Chapter took time out on February 9th to hold a chapter meeting at the Noncommissioned Officers' Club. In the absence of the president and vice-president on temporary duty, the meeting was conducted by Maj. J. D. Evans, Jr., senior member of the board of directors.

Short talks were given by S/FC Albert Cohen on the "Army Career Plan" and by M/Sgt. Pat Mulcahy on "Benefits of AFCA."

The main speaker was Capt. Henry E. Bernstein, USN, Director of the Armed Services Electro Standards Agency, who gave an interesting talk on the problems in connection with the operation and plans for the future of ASESA and the results being accomplished on a joint basis in standardizing the component parts of electronic equipment.

After the meeting, a program of entertainment was presented by the Special Services School of Fort Monmouth.

New York

Admiral Thomas C. Kinkaid, Commander of the Eastern Sea Frontier, was the guest speaker at the February 23rd meeting of the New York Chapter. The gathering was held at the Third Naval District's Officers' Club in the New York Naval Shipyard, Brooklyn, and was attended by 100 members and guests.

Admiral Kinkaid discussed the growth of communications in the Navy from the use of flag and blinker signals to modern radio and radar systems, and told a number of anecdotes about his experiences with Naval communications over a forty-year period. He described a few incidents in the Battle of Leyte Gulf, where he commanded the Pacific 7th Fleet, in which efficient radio communications played a most important part in the defeat of the Japanese fleet.

Sacramento

The Sacramento Chapter held its regular monthly meeting at the Sacramento Signal Depot on January 18th. Over 200 members and guests assembled to honor Brig. Gen. A. M. Shearer, Chief Procurement and Distribution Division, OCSigO, and former commanding officer of the Sacramento Signal Depot, and the conferees of the Depot Commanders' Conference (in progress January 16-20). The list of conferees included technicians, statisticians, engineers, supply officials, and key personnel from all Signal Depots and Signal Sections of General Depots within the United States, as well as top military personnel from the Office of the Chief Signal Officer in Washington. General Shearer was instrumental in the establishment of the Sacramento Chapter in November 1946 and served as its first president.

Chapter President Milton G. Mauer of the *Pacific Tel & Tel* presided and introduced the distinguished guests. Col. Harry L. Vitzthum, commanding officer of the Depot, welcomed the gathering and General Shearer delivered an impressive message on AFCA affairs and urged all in attendance to become members of the association. Murle C. Schreck, President of the Sacramento Chamber of Commerce, welcomed the visiting guests to Sacramento. Mr. Paul Shaad, Program Chairman, discussed plans for the next monthly meeting.

The main speakers for the evening were Major Joyce B. James and Major T. A. Pugh, respectively Executive Officer and Supply Office of the Alaska Communications System. The topics presented dealt with the operation and supply of the Alaska Communications System. The selected subjects were most timely and actual photographs were shown to emphasize the difficulties and problems encountered.

San Francisco

Members and prospective members of the San Francisco Chapter met on January 27th at the Don Lee Building to discuss plans for the reactivation of the chapter. The meeting was conducted by Harry E. Austin, local manager of *RCA Communications, Inc.*, who is serving as president pending formal election of new officers.

In attendance were representatives of the local telephone company, point-to-point radio companies, broadcasting companies, and communications, electronic and photographic industries.

The meeting was addressed by Col. Lloyd C. Parsons, Signal Officer of the Sixth Army, Capt. C. C. Ray, Communications Officer of the 12th Naval District, and Col. G. B. Hoffman, Director of Communications for the 4th Air Force, each of whom presented the views of their service on the necessity for an organization such as AFCA and the active participation of the communications, electronic, and photographic industry.

Washington

Major General Spencer B. Akin, Chief Signal Officer of the Army, was the guest speaker at the Washington Chapter's luncheon meeting on March 7th at Fort Myer, Va., which commemorated the 87th anniversary of the founding of the Signal Corps.

During its 87 years of existence, and particularly during the last war and the postwar period, the Army Signal Corps has accomplished notable progress in communications operations, research and development, and procurement, distribution and training, because it is a member of a "team composed of science, industry and armed services," General Akin declared.

After the luncheon, which was attended by 150 members, the group toured the Signal Corps station WAR, and the mobile communications center at Fort Myer and the Army Communications Center at the Pentagon.

—30—

TRANSMISSION LINE

A revolutionary telephone and television transmission line has been developed by the U. S. Army Signal Corps and dubbed the "G-String" in honor of its inventor, Dr. Georg Goubau.

The line, which is simple, highly efficient, and costs little to make, promises to open up wholly new possibilities in microwaves and home TV. It is a single wire with special insulation and funnel-shaped terminals.

The Signal Corps expects that the new line may eventually replace the more costly coaxial cable for transmission of television programs. —30—

SIGNAL CORPS PROGRAM

WHAT promises to be the most elaborate communications and electronics program in Signal Corps history will be presented at Fort Monmouth, New Jersey, on Saturday, May 13th under the sponsorship of the Fort Monmouth Chapter, Armed Forces Communications Association and the Signal Corps.

The Fort Monmouth program is scheduled for the day following the annual National AFCA convention at the Commodore Hotel, New York, under the auspices of the New York Chapter.

The scheduled all-day program at Fort Monmouth will be highlighted by the presence of leaders in the communications and electronics fields and high-ranking officers from all branches of the Armed Services.

Convention delegates will be transported from convention headquarters in New York to Fort Monmouth in chartered buses. The program will feature elaborate displays from the Signal Corps Engineering Laboratories, the Armed Services Electro-Standards Agency, and The Signal School of Fort Monmouth; parachute drops by the 82nd Airborne Division; wire laying demonstrations by helicopter and bazooka; and a combat communication problem in which 82nd Airborne troops will figure, weather permitting. —30—

Electronic Metronome

(*Continued from page 45*)

or when room noise is high, a larger speaker may be used.

The power supply consists of the rectifier section of the tube and two filters. The first filter is comprised of resistor R_6 and the dual 40 μfd. condenser, C_4-C_5. Voltage supplied to the oscillator is regulated by the OC3/VR105 tube. The second filter, consisting of resistor R_2 and condenser C_1, delivers plate and screen voltage to the pentode section of the 117N7-GT. This type of power supply enables operation on either a.c. or d.c.

Construction

Fig. 1 shows the external appearance of the complete metronome removed from its cabinet. Fig. 3 is an under-chassis view, showing placement of components. In Fig. 1, the tubes (left to right) are neon lamp, 117N7-GT, and OC3/VR105. The left-hand shaft is the volume control (R_3), the right-hand shaft the speed (frequency) control (R_4).

The instrument is built on a box-type metal chassis; 6¼" long, 3½" wide, and 2" high. The entire device can be housed in a small radio or intercom cabinet.

The wiring is simple and straightforward. Keep all leads as short as possible. For safety to the operator, do not connect any part of the circuit to the chassis.

Adjustment

If the wiring is done correctly, the speaker will begin clicking off beats as soon as the 117N7-GT has come to operating temperature and the VR105 has started to glow. The lowest setting of the volume control will reduce the beats to the below-audible level. The beat speed will be found to vary smoothly as rheostat R_4 is rotated.

A dial plate, graduated directly in beats per minute or per second should be attached to rheostat R_4. This dial may be calibrated by means of a stop watch or any other watch having either a sweep second hand or an easily-read conventional second hand.

Fig. 3. Under chassis view of the metronome.

It is also possible that the calibration might be made with the aid of a variable-speed recorder (wire, tape, or disc). Place the metronome speaker before the recorder microphone and record a full minute of operation at a given speed. Then play back the recording at a slower speed and count the beats per minute (sum total of the recording). —30—

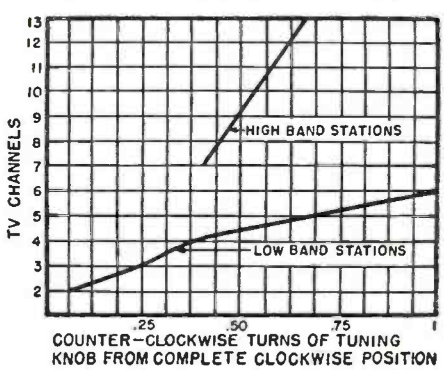
Built-in Antenna
(*Continued from page* 59)

able matching device the maximum amount of signal can be transferred into the front end. As can be seen from Fig. 1, the *Philco* built-in antenna is shaped in a tapered form with the narrowest part in the center. This form allows for a relatively broadband response over both the low and high bands. The antenna itself is made of two sections of aluminum foil 0.005″ thick, which are attached to the tunable matching device. The foil is mounted to the underside of the top of the cabinet, and its ends are folded over. This folding has the effect of adding capacity and thus lowering the natural resonant frequency of the dipole. This increases the electrical length of the antenna.

Tuning this system consists simply of tuning a variable condenser connected across the terminals of a hairpin coil which has two shorter loops attached to it at the antenna end. A long wooden rod is attached to this condenser and projects through the cabinet front so that it can be adjusted.

To understand just how this system is tuned it is necessary to fall back on resonant circuit theory. The dipole may be represented as a series resonant circuit. This is shown simply in Fig. 2. As is known from resonant circuit theory, a series resonant circuit will look inductive below resonance and capacitive above resonance. The tunable matching network may be represented as a parallel resonant circuit. This is also shown in Fig. 2. It can be seen that, above resonance, the circuit is inductive; below resonance, it is capacitive. If we draw a curve for this effect and plot reactance (X_L and X_C), against the frequency, we obtain Fig.

Fig. 4. Position of Philco's built-in antenna tuning knob in relation to the twelve assigned video channels.



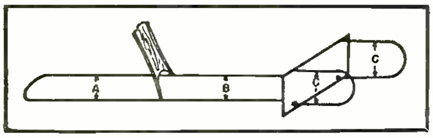


Fig. 5. Simplified sketch of the coils used for tuning the Philco electronic built-in antenna. A and B point to the long "hairpin" coil to which is connected the 300 ohm line and the two shorter loops (C).

3. To make the entire antenna system resonant and thus effect maximum transfer of energy into the receiver, it is necessary to cancel out the reactance of the antenna with a reactance of equal amount but of opposite sign. Thus by tuning the parallel resonant matching system, the relative position of the curve for reactance for the parallel resonant circuit is shifted in respect to the series resonant curve, so that the reactance of the antenna to load is matched throughout the band. A hairpin loop containing an inherent amount of inductance resonates with the tuning condenser to form the parallel resonant circuit.

The built-in antenna system is tuned for each channel to an approximate impedance of 1500 ohms, with the actual variation being from approximately 1200 to 1500 ohms. The 300 ohm impedance of the line is matched by tapping on to the proper feed point on the long loop. See Fig. 5.

Essentially the advantage of such a system over an untuned type consists of a higher signal input to the receiver. Besides this, tuning the system will eliminate standing waves and prevent their effect on the picture. It has been reported that it will also provide a means for "tuning out" interference of various kinds, such as adjacent receiver radiation and some types of FM interference.

The result is better reception generally with this type of tunable or "electronic" antenna system. —30—

CORONA AND ARCING

By MATTHEW MANDL

ELIMINATING corona or arcing in television high voltage power supplies often is a time-consuming process because it may require complete removal of the high voltage shield casing and several components before the place where the leak occurs is accessible. In many cases considerable time can be saved by using celluloid or mica strips because these can often be inserted between points of arcing more easily than moving components farther apart in an effort to reduce high voltage leakage.

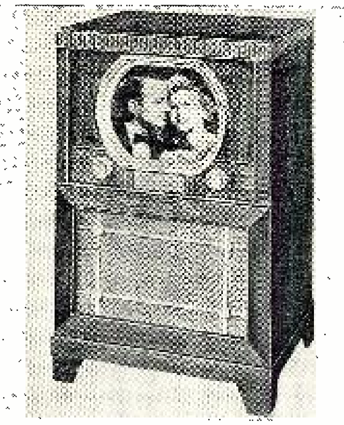
When the corona or arcing in the high voltage system has been located, only one panel section of the high voltage shield compartment need be removed and the strip of mica can usually be inserted by means of thin-nose pliers. The insulating strips should be cut so that they fit snugly between the parts where the arcing occurs. Thick celluloid or mica is preferred and the latter can be salvaged from the heating elements of old toasters or electric irons.

—30—

NEW TV PRODUCTS on the Market

19-INCH CONSOLE

Among the television receivers unveiled by *Motorola, Inc.* recently is the



Model 12K2 console which retails in the moderate price class.

Featuring a furniture-styled cabinet and simplified controls, this 22″ wide, 36″ high, and 18⅜″ deep set is available in either mahogany or limed oak finishes.

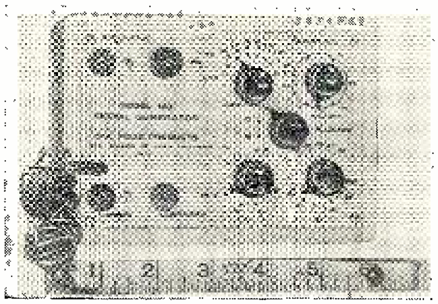
The receiver has the new "flywheel" a.f.c. circuit which keeps the picture clear and steady despite noise and changes in signal strength, according to the manufacturer. A built-in antenna and target tuning are also features of this receiver.

The sets are being manufactured at the Company's plant at 4545 Augusta Boulevard in Chicago, and further information may be obtained from this address.

SIGNAL GENERATOR

A miniature TV-FM signal generator for the service technician has been put on the market by *Oak Ridge Products,* 239 East 127th Street, New York 35, N. Y.

The new model "103" is said to pinpoint any signal failure from antenna to cathode-ray tube or speaker in less than two minutes. Incorporating three



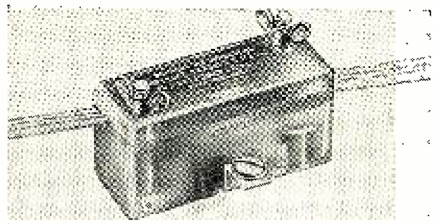
separate tuning bands and modulation output and attenuator for TV and FM, the unit generates a signal to perform as a complete r.f., oscillator, and mixer tester, video i.f. tester, audio i.f. tester, and as a checker for the video and audio second detector, the video and audio amplifiers, sound traps, adjacent picture traps, and as a marker generator, antenna orientation and sensitivity tester.

TV ACCESSORIES

The *LaPointe Plascomold Corporation* of Unionville, Conn., has added two new items to its line of television accessories.

Production is under way on a lightning arrester for use with the four-wire control cable employed with antenna rotators. Designated the Model RW 204 arrester, the new unit is designed to serve dual purposes in that it may also be used for standard 300 ohm ribbon transmission line. It is supplied in a low-loss polystyrene case which will not absorb moisture nor deteriorate from weather. Pin point contacts eliminate the need for wire stripping.

The second item recently introduced is a three-way antenna switch for multiple antenna installations. The new unit allows the use of a separate transmission line for each antenna in



such installations and provides maximum performance from each antenna. By a simple turning of the knob the viewer can change over instantly from one antenna to another. The switch is also suitable for television dealers when demonstrating more than one receiver from a single antenna.

MATCHING TRANSFORMER

To prevent mismatch between a folded dipole antenna and the coaxial lead and to prevent loss of signal, *American Phenolic Corporation* of Chicago 50, Illinois, has recently developed a new matching transformer.

The new unit employs *Amphenol* four-conductor twin-lead specially connected to provide a transformation in impedance from 300 ohms down to 75 ohms. It is particularly useful in matching 300 ohm transmission line to 72 ohm or 75 ohm input television receivers or providing an efficient match between any 300 ohm antenna and a coaxial 75 ohm line such as might be used in an area of high noise level.

The terminals on the transformer are spade type lugs at each end of the

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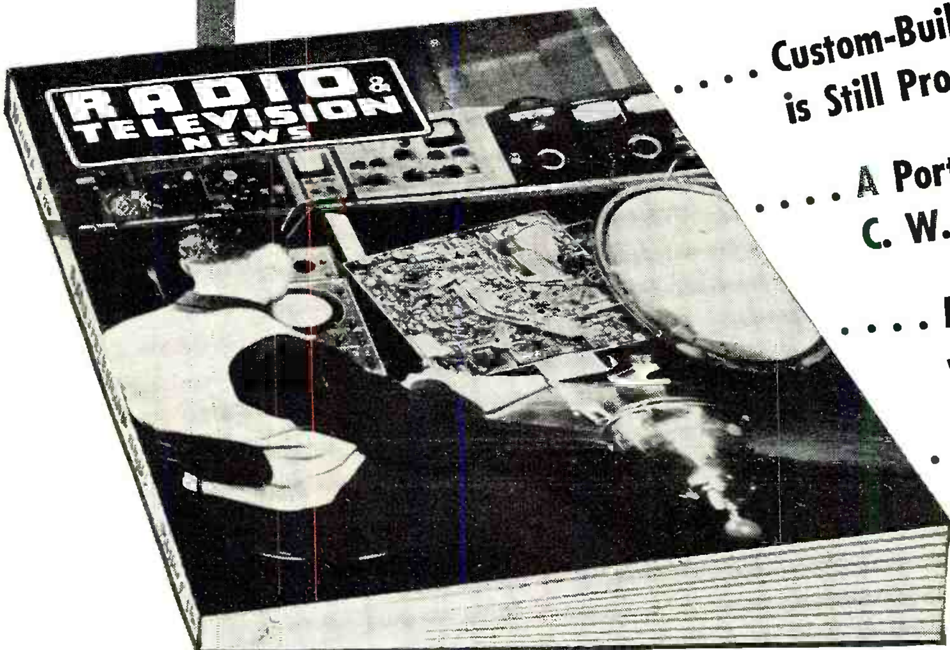

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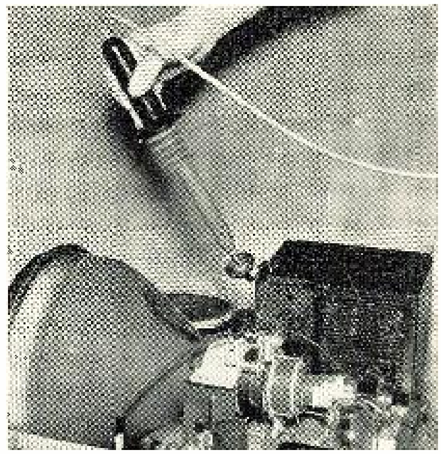
PUBLISHERS ALSO OF RADIO-ELECTRONIC ENGINEERING EDITION OF RADIO & TELEVISION NEWS • POPULAR PHOTOGRAPHY • FLYING • MODERN BRIDE transformer section which should be operated fully open or in a very loose coil. Tight coiling is unnecessary, according to the company.

HIGH-VOLTAGE PROBES

Two new high-voltage probes, designed for use with popular low-current voltmeters to provide safe, convenient and accurate means for measuring high voltages in high-im-



pedance circuits such as those found in television receivers and broadcast transmitters, have been announced by the Tube Department of *Radio Corporation of America.*

The two probes, Types WG-289 and WG-290, are identical except for their connectors. The WG-289 is designed for use with electronic voltmeters and is equipped with a microphone-type connector. The WG-290, for use with non-electronic voltmeters, has phone-type connectors. To adapt the probes to various popularly-used makes of voltmeters, five types of multiplier resistors are available separately.

The probes are being handled by *RCA* test equipment distributors.

BOOSTER KIT

Tech-Master Products Company, 443-445 Broadway, New York 13, New York, is marketing a television booster kit, the Model 3375.

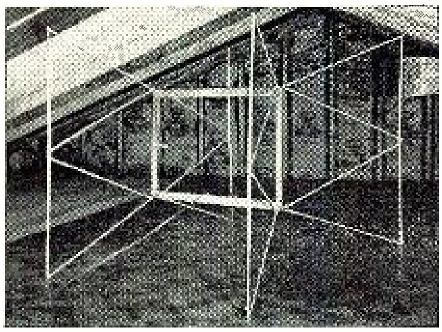
The unit, which is easily assembled, features fixed grid and variable plate tuning, separate coils for low and high channels, a tunable high channel input coil, pre-stamped chassis for ease in mounting parts, wood cabinet, simplified step-by-step wiring instructions, and adaptability for either 300 or 72 ohm lines.

The booster kit comes complete with the 6AK5 and pre-aligned coils. A data sheet on the kit is available.

ATTIC BEAM

Telrex, Inc. of Neptune Highway, Asbury, Park, N. J., has just introduced a new television receiving antenna expressly designed for indoor installation. Known as the Attic "V" Beam, the new unit may be easily and quickly installed. It requires no masts, towers, or guy wires and is free from all hazards.

The entire assembly folds into a compact package for easy handling and placement and then opens up completely assembled into a full two-bay Conical "V" Beam array, complete with transmission line. The array is



extremely light and entirely self-supporting. It may be suspended or rested on flooring, beams, or rafters.

DISTRIBUTION UNIT

Lynmar Engineers of 1721 Delancey Street, Philadelphia 3, has developed a new distribution system for multiple television receiver operation from a single antenna.

Designed for apartment houses, showrooms, and service shops, the new unit covers both high and low bands without switching. Feedback from one television receiver to another through the equipment is said to be negligible.

The standard unit for feeding six television receivers is composed of three coupling units, each of which feeds two television sets, a power supply, and a mounting cabinet.

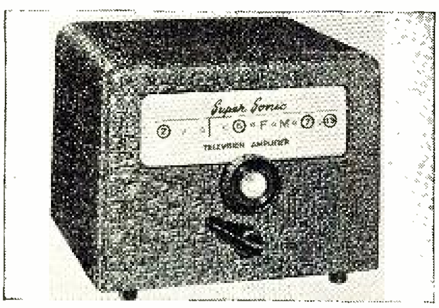
More than six receivers may be operated from the same antenna by connecting additional assemblies in series. The equipment has been standardized for 52 ohm antenna input coaxial transmission line. An impedance matching transformer is available for use with installations where a 300 ohm input line is used.

A flyer on the #PD-16 is available on request.

TV-FM AMPLIFIER

Sonic Industries, Inc. of 221 West 17th Street, New York is producing a new "Super Sonic" TV-FM amplifier, the Model IT4.

Designed to provide high gain preselection for any television or fre-

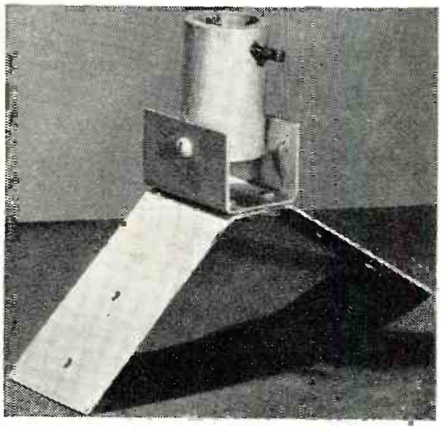


quency modulation receiver with adequate bandwidth to pass all desired modulating elements and provide adequate selectivity to reject unwanted off-carrier signals and noise, the new unit has one continuous tuning control and one off-on switch, without any verniers or Hi-Lo switching.

Balanced input and output circuits provide for minimum noise pickup. Versatility in application has been provided by both 72 ohm and 300 ohm input and output matching impedances. An isolating power transformer is used to keep input and output circuits above the power line circuit.

ROOF BRACKET

A low-priced roof bracket which may be adjusted to hold television antennas on the peak of a roof, on the



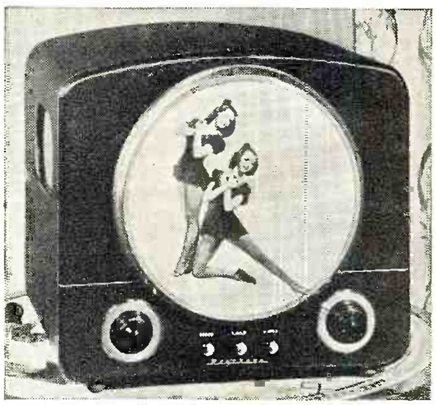
slope, on the flat, or on the side, is currently being offered to the trade by *TV Accessory Engineering Co.,* of 2105 Lagrange St., Toledo 8, Ohio.

The bracket comes prepared for use as a roof saddle but may be bent into any necessary shape to permit its use in other locations.

RAYTHEON'S "ROVER"

As one of the company's "Silver Anniversary" line of television receivers the *Belmont Radio Division* of *Raytheon Manufacturing Company* has introduced "The Rover," a compact table model video set.

Housed in a maroon tooled leather-



ette cabinet, "The Rover" (Model M-1106) carries a 12½-inch, glare-free, black picture tube which provides a full 110 inches of viewing surface. The set uses a built-in antenna.

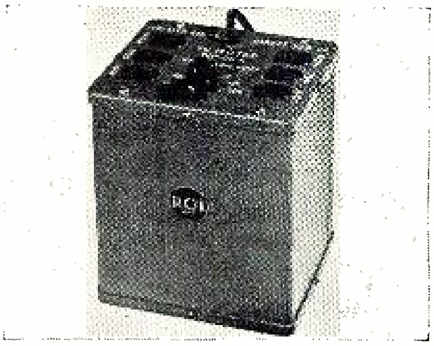
The cabinet measures 19" wide, 18" high, and 19" deep.

TV ISOTAP TRANSFORMER

In an effort to promote safety and efficiency in the testing and servicing of television and radio receivers and other electronic and electrical equipment, the Tube Department of *Radio*

Corporation of America has announced the availability of the "Isotap," a unique test instrument.

Combining in one compact unit an autotransformer and an isolation



transformer, the new television "Isotap" is designed to speed up television receiver service, minimize shock hazards, cut down service returns, and prevent damage to costly shop test equipment.

TV FILTER

Norval H. Copple, of 3701 North Broad Street, Philadelphia 40, Pa., is handling the distribution of a new television filter which has been trade-named "Nutro-Lite."

An optically correct filter, the new unit was developed by *Kern-Moss Optical Co.* According to the company, the filter rests the eyes while viewing and eliminates all chromatic distortion and reflections to give a clear, sharp, flickerless, and easy-on-the-eyes picture. The filter is said to work equally well on both the conventional and black tubes with no additional brightness being required.

The "Nutro-Lite" filter is available in two types. A single clip-on lens which is placed against the outside of the safety glass and held there by inserting small metal clips between safety and frame and the type whereby the filter lens is incorporated into the laminated safety glass which replaces the plain safety glass supplied by the set manufacturers and is known as a custom-made installation.

MATCHING TRANSFORMER

An impedance matching transformer which can match a 70-95 ohm coax line to a 300 ohm input has been developed by *Lynmar Engineers* of 1721 Delancey St., Philadelphia.

The unit may be used to match a 300 ohm antenna to a receiver made for 70-95 ohm coax. In receivers with both coax and 300 ohm twin-lead connections, improvement in reception is possible when the input is connected through this transformer.

—30—

ZENITH TO TEST PHONEVISION IN CHICAGO

HAVING received FCC authorization to conduct a series of Phonevision tests in the Chicago area, Zenith Radio Corporation is currently setting the stage for the 90 day test.

A group of 300 families, representing a cross-section of the community and selected by the National Opinion Research Center of the University of Chicago, have been named and currently television receivers equipped with Phonevision and the necessary telephone facilities are being installed in these homes.

As to the operation of this new type of television, the company explains that in this system the Phonevision-television transmitter codes, or scrambles, the television picture. The receiver, with the key signal provided over a telephone wire, decodes or unscrambles it. A Phonevision receiver is a standard television receiver with a decoding unit built in or added to the original receiver. It will receive any of the desired "free" programs that are within range in addition to the subscription programs if it is set up to receive the key signal over the telephone wire.

When a television broadcaster wishes to transmit a subscription program and prevent its unauthorized reception he merely throws a switch which connects a special unit into the circuits of his transmitter. From that moment on, the subscription program is broadcast with certain variations which produce a jumpy, uncertain image shifting back and forth across the television screen at a rapid but entirely random rate. In this form the picture has no entertainment value and cannot be watched for more than a few seconds without eye-strain.

To make the program available to those set owners who wish to pay for it, the transmitter generates a key or decoding signal which passes over the telephone wire to the telephone exchange. From the exchange, this signal can be sent over the regular telephone wire that serves any home and delivered to the television receiver of any subscriber who has asked for the service. In the television set the key signal actuates a decoder which automatically corrects the broadcast signal sent to the television set over the air. The random shifting of the image on the screen is stopped and the picture becomes clear.

If commercial Phonevision is established it will operate as follows. The set owner consults his daily newspaper or program booklet to select the subscription program scheduled for that day. Next he contacts the Phonevision operator to request the key signal for the program of his choice. The operator then makes a record of his telephone number and makes the connections which will send the key signal over his line at program time. Shortly before the scheduled hour the set owner tunes his receiver to the proper channel. When the subscription program begins, it is received in clear form. At the end of the month the set owner is billed for the fees for each picture he has ordered.

According to Zenith, Phonevision will not interfere with the normal use of the telephone. A filter arrangement added to the telephone wire stops the TV signals from getting into the telephone, prevents the key signal from reaching the telephone, and blocks telephone impulses for disturbing the television sets. In cases of party line telephone service, different frequencies will be used for transmitting the key signals to the two different subscribers on the party line.

—30—

Extra Income

(*Continued from page 47*)

The recording turntable, cutter head, and playback table can be inexpensive "mail order" types; occasionally a bargain can be found in the "swap" sections of catalogs and trade magazines. More professional-type equipment can be added later as your recording business grows.

Improving Receivers

Have you ever serviced a receiver, completely aligned all stages, replaced all defective parts, and still were not satisfied with its performance or sensitivity? This is more common in receivers several years old, particularly the a.c.-d.c. type. (In many cases this is a result of poor design and not much can be done.) Sometimes, however, a simple circuit change or part replacement will help. Here are a few things you can try: (1) If the set is worth the cost, replace the i.f. transformers with iron-core units. (2) The "Q" of the oscillator and r.f. coils may be low, too, due to absorption of moisture, high coil form loss, etc. Replace with improved types recommended by the manufacturer. (3) Decrease the value of the a.v.c. return resistor. (Try paralleling a ½ megohm resistor from the r.f. end of the a.v.c. filter resistor to ground.) This reduces attack time and raises the gain. (Avoid this change if strong local stations tend to overload or distort.) (4) Performance in some sets can be improved by raising plate and screen voltages. (Keep within tube ratings; be sure bias voltages are correct.) (5) In some a.c.-d.c. sets, there is excessive interaction between the chassis and the unshielded loop antenna. Move the antenna farther away if possible or insert a thin sheet of copper between loop and chassis, and ground the sheet to chassis. (This increases the "Q" of the loop.) (6) On receivers having no trimmer on the detector section of the tuning condenser, try adding one. (Use a surplus unit or a trimmer from a discarded i.f. transformer.) (7) In extreme cases, try leaving the tube shield off in the converter or one of the i.f. stages. This amounts to increased interstage coupling and controlled regeneration up to a certain point. If receiver oscillates, detune one of the i.f. stages slightly or discard the idea. (8) Some owners of well-designed receivers prefer hi-fi local reception to sharp DX tuning. Try "flat-topping" the i.f. stages to give a 10 kc. bandwidth; note the improvement in tone quality and reduction in noise. (A scope will be needed for symmetrical $\pm$ 5 kc. alignment.)

Battery Set Conversion

Converting battery sets to a.c. operation is a relatively simple operation. The simplest method is to install a power supply or converter whose "A" and "B" voltages correspond to those of the battery set. Commercially-built battery eliminators are available for less than it would cost to construct a similar supply in the shop. Straight battery-operated sets are relatively few in number and can usually be traded in on a new a.c. receiver more economically than converted to a.c. operation.

Rectifier Applications

Much has been published about selenium-cell replacement of rectifier tubes. Here are a few additional uses for selenium cells which may be helpful around your shop: (1) As a.c.-d.c. radio power supplies, (2) battery chargers, (3) battery eliminators (automobile radio testers or demonstrators), (4) coin-operated machines (quite a few service technicians work on these units), (5) electrical musical instruments (guitar amplifiers, etc.), (6) exciter lamps (theaters, home-movies), (7) farm radio converters, (8) field supply for speakers, small d.c. motors, etc., (9) filament supply (battery and portable radios, a.c. amplifiers, etc., where a.c. hum component must be kept very low), (10) hearing aid battery chargers, (11) high-voltage power supplies for p.a., TV testing, condenser breakdown tester, etc., (12) model trains and other electrically-operated toys, (13) motion-picture projectors (carbon arc lamps, etc.), (14) polarized relays (battery chargers, current-limiting devices), (15) rectifier-type instruments (test equipment, a.c. meters), (16) relay operations, (17) scientific instruments (ore locators, Geiger counters, seismographs), (18) therapeutic equipment (heat lamps, machines), (19) Time clocks (in factories, business offices, plants), (20) Tone generator (in p.a. systems used by factories, schools, large offices, etc.), (21) vibrator-type supplies (rectifiers in auto sets, testers, etc.), (22) voltage regulators (a.c. and d.c. circuits), (23) spark quenchers on motors, d.c. commutators, etc. (for eliminating arc-quenching resistors and condensers; also protecting and minimizing arcing across d.c. contactors. Acts as interference filter).

Custom Building

It is nice to think of the profit in one deluxe FM-TV custom-built installation. It is also nice to remember that contracts for such installations are often the result of having done a good job on lesser installations, radios, and even appliances.

Possibilities in your community are better right now for custom-built systems than ever before. More new homes and apartments are being constructed every day, and a large percentage of these will definitely be prospects for some type of built-in or custom-built system. (Custom building need not be overly expensive to the customer, nor does it necessarily apply to new equipment alone. The customer's old radio, record-changer, etc., may be used if he wishes. Here again the demonstrator idea in Fig. 1 will help the customer decide which course to choose.) There are many good FM-AM tuners, amplifiers, speakers, and record-changers on the market, and a combination of any of them will work well.

Placement of each unit depends on the customer's wishes and the arrangement of the home. The tuner can be mounted in a bookcase, special cabinet, in a closet, or any convenient place, while the speaker can be concealed beneath a stairwell, behind false pictures, etc. A few typical installations can be seen in Altec Lansing's special demonstration room (see Fig. 2). In (a), the tuner is built into a chairside cabinet. The record changer has been mounted in the front portion of the cabinet and pulls forward. In (b), a duplex speaker is installed in a false corner built into one corner of the room. The speaker is located at an optimum level of about 5 feet above the floor. (The false corner provides a rear cavity in excess of 10 cubic feet for proper loading of the low-frequency cone.) It can be constructed in any room, and can be designed to hide vertical steam pipes, water pipes, wires, etc. (The tuner and record player can also be located in this false corner if desired.) In (c), the speaker is mounted in the wall behind the knick-knack shelf. The back of the shelf is a porous fabric (selected to match the wall) which totally conceals the speaker. Optimum tone quality will result if the back of the speaker can radiate into a large closet of several hundred cubic feet. The speaker in (d) is installed in a bass-reflex cabinet which acts as a functional piece of furniture. Another good installation is shown in (e). The entire system is mounted behind a closet door. This type of installation is particularly suited to apartments and small homes where space is at a premium. The speaker is mounted in the top half of the door and covered with porous cloth; the tuner, amplifier, and record changer are mounted behind the center panel. (This panel opens forward to give access to the controls without the necessity for removing the cabinet.)

In clothes closets, no sound-insulation material need be provided, since the sound absorbing qualities of the clothing will usually suffice. In installations where bare surfaces exist behind or to the side of the speaker, sound treatment must be applied. Fiberglas (available at refrigeration supply houses) or rock wool (found in hardware stores and lumber yards) are very good sound-deadening materials.

The sidelines mentioned in this article are only a few of the means which can be used to expand shop income. Their use has been the difference between success and failure of more than a few shops. The door to success can be opened—all you have to do is push!

—30—

D.C.-A.C. Inverter
(*Continued from page 65*)

amplifier having considerable voltage gain, it will be desirable to regulate the a.c. supply voltage. A simple way to do this is to connect a ballast unit in one of the supply leads.

For best results, the output load device operated from the inverter should be of high enough impedance to offer negligible loading. Operation of each of the inverter circuits given in this article is not noticeably affected by impedance of the d.c. signal source.

Outlook

We believe that the saturable reactor-type of d.c.-a.c. inverter and the magnetic amplifier merit consideration as useful components in amateur experimental circuits. Many interesting experiments and much practical development work can be carried on with these units. The units shown in this article have utilized readily available transformers having easily saturated cores. However, the power-handling ability of these simple units is not great. Other experimenters may elect to build saturable reactors with high-permeability core materials and thus obtain power amplification in addition to voltage amplification. —30—

SYNC LOCK FREQUENCY CONTROL

By MATTHEW MANDL

TELEVISION technicians often find that they are called to service sets which only require readjustment of rear panel controls because the latter had been tampered with by the set owner. The control which has the most serious effect on the picture is the horizontal sync lock frequency control because a maladjustment of this will result in loss of sync to such an extent that the horizontal hold control is no longer able to bring the picture back into lock. On modern receivers this control is recessed or located in such a position that it is not easily accessible to indiscriminate handling by the set owner. On many of the older sets, however, the frequency control is located on the rear panel of the chassis and can be turned without the necessity for special aligning tools. Typical receivers are the Admiral 30A-1 chassis, the RCA 630TS receiver, and the many kits and modifications of the popular 630-TS.

When servicing such receivers the technician can reduce the danger of tampering by covering this control with several strips of Scotch tape after he had made the proper adjustment. Inasmuch as the inherent stability of the sync lock system is high, this control will not need readjustment again unless a tube or component part of the horizontal sync system is changed. Some technicians use a pair of diagonals to cut off the knurled end of this control so that subsequent adjustment would require the use of a pair of pliers. This procedure will also tend to discourage tampering and help in cutting down on the number of unnecessary calls on the technician's list. —30—

Manufacturers' Literature

Readers are asked to write directly to the manufacturer for the literature. By mentioning RADIO & TELEVISION NEWS, the issue and page, and enclosing the proper amount, when indicated, delay will be prevented.

WOODEN BEARINGS

A new engineering manual which covers the principles and applications of "oilless" wooden bearings in modern machine design has been released by the *Paramount Oilless Bearing Co.* of Worcester, Massachusetts.

The booklet discusses the application of wood bearings in certain electrical and electronic situations where no other type of bearing can serve as well. Typical applications include their use where the dielectric qualities of the bearing itself are important, where oil drip or spatter from conventional surface-lubricated bearings would injure the efficiency of surrounding circuit components, use in locations of difficult or impossible access, where surrounding high voltages prohibit lubrication maintenance, and where elimination of noise is paramount.

Copies of the manual will be loaned to accredited engineers and machine designers. Application for a copy of the manual should be made, on business letterhead, direct to the company.

ELECTRICAL CONDUITS

An elaborate, 30-page catalogue, the No. 603, covering the various types of electrical conduits manufactured by the company has recently been issued by *National Electric Products Corp.*, Chamber of Commerce Bldg., Pittsburgh 19, Pa.

The first half of the new booklet is devoted to Sherarduct, Xduct, and Economy rigid steel conduits and their accessories. The electrical metallic tubing produced by the company is next listed along with related accessories. A line of flexible steel conduit for branch circuit wiring and the company's non-metallic tubings are also described and illustrated.

AMERTRAN BULLETIN

A bulletin describing a redesigned and improved line of air-cooled transformers has been announced by *American Transformer Co.*, of 285 Emmet Street, Newark 5, New Jersey.

Designated bulletin No. 110-02, the publication contains 8 pages of information and data, including tables which list standard ratings with dimensions, weights, list prices, and wiring diagrams of transformers in capacities up to 200 kva., single phase, and 300 kva., three phase.

TRANSFORMER DATA

An 8-page folder containing 36 photographs and corresponding specifications on auto and insulated transformers has been released by *Nothelfer Winding Laboratories* of Albemarle Avenue, Trenton, N. J.

Illustrated and described are open frame, cased, channel, and end bell cased electrical transformers from .01 to 300 kva., 25 to 400 cycles, in 1, 2, or 3 phases.

In writing for copies, please specify *NWL* Bulletin No. 150.

POWER SUPPLIES

A new 4-page booklet describing its line of electronically-regulated power supplies has been issued by *Furst Electronics* of 12 S. Jefferson Street, Chicago 6, Illinois.

Various units are pictured and described in tabular form. In addition, details on the Model 910 klystron power supply are given. Copies of this pamphlet are available on request.

PARTS CATALOGUE

Radio Shack Corporation of 167 Washington Street, Boston 8, Massachusetts, has announced its new 152-page parts catalogue for the trade.

Covering the fields of industrial electronics, communications, television, high-fidelity music systems, recording, testing, and research, the new catalogue lists complete equipment, kits, components, hardware, tools, test equipment, and technical books.

Copies of the catalogue are free of charge on request.

TV SERVICE DATA

A series of technical bulletins designed to assist the television technician has been issued by *American Phenolic Corporation* of 1830 South 54th Avenue, Chicago 50, Illinois.

One set of data sheets discusses the television antenna in some detail and provides valuable information on installation and orientation. The second booklet, entitled "Sell a TV Picture" is designed as a guidebook for personnel selling television receivers.

Copies of these helpful publications may be secured from the company on request.

MEISSNER KITS

A 4-page illustrated folder covering five new radio kits recently introduced by the company is now available from *Meissner Mfg. Division, Maguire Industries, Inc.*, Mt. Carmel, Illinois.

The booklet describes the T8CK FM receptor, the T4AK 20-watt amplifier kit, the T2BK 2-tube battery trainer kit, the T3BK a.c.-d.c. trainer kit, and the T6BK 6-tube a.c. superheterodyne kit for instructional purposes.

A copy of the new publication may be secured by writing the company and requesting the "New Radio Kits Folder."

WIRED TELEVISION

A booklet describing the operation and application possibilities of the "Utiliscope" has been issued by *Diamond Power Specialty Corporation* of Lancaster, Ohio.

The photographs and text material point out the varied ways in which wired television may serve industry and trade. The equipment is described as being particularly suitable for locations where the operation to be observed is inaccessible due to dangers involved, poor location, or adverse atmospheric conditions.

A brief description of the equipment required for the closed circuit television setup is given in the folder, copies of which are available on request.

AUDIO EQUIPMENT

The Electronic Workshop, Inc. of 351 Bleeker Street, New York 14, is currently offering two data sheets to persons interested in audio equipment.

One sheet covers the company's amplifier Models S-20 and A-20-5 while the second sheet describes the Series 510-A miniature audio oscillator. Performance features and technical data are provided on both of these units.

"DATALOG"

Electrical Reactance Corporation of Franklinville, New York has recently issued a "Datalog" covering its line of "HI-Q" capacitors, resistors, and choke coils.

Designed for the television and radio manufacturer and the producer of electronic devices, the new publication provides technical data in addition to the usual product information found in catalogues.

The "Datalog" carries 32 pages and is available on request from the company.

EQUIPMENT CATALOGUE

A catalogue covering the company's line of equipment has been issued by *Approved Electronic Instrument Corp.* of 142 Liberty Street, New York 6, New York.

Included are the company's 15" custom built TV receiver chassis, television field strength meter, sweep signal generator for TV and FM, marker generator, a signal generator kit, a sweep generator kit, FM tuner kit and tuner, a TV tuner, a 4 watt amplifier, and a 4 tube miniature broadcast superhet tuner.

"HAM NEWS"

As a service to radio amateurs throughout the country, the *General Electric Company* has announced that "Ham News," a bi-monthly publication currently being distributed to 65,000 amateurs and experimenters through the company's tube distributors, will now be available on subscription to those who find it difficult to obtain copies each month.

The publication will still be free to those getting copies from their tube distributors.

Subscription blanks are obtainable from any *G.E.* tube distributor. The subscription price is $1.00.

PYRAMID CAPACITORS

Pyramid Electric Company of 155 Oxford Street, Paterson, New Jersey, has announced the availability of copies of its new 1950 catalogue which has been designated J-6.

The capacitors listed in the catalogue have been chosen as representative of the company's line and those which will adequately meet most of the technician's replacement requirements.

Units for both radio and television applications have been included.

"HISTORY REPEATS"

The Espey Mfg. Co., Inc. of 528 East 72nd Street, New York 21, New York, is now offering a new brochure, entitled "History Repeats," to counter salesmen and sound salesmen of radio parts distributors and dealers.

Designed to familiarize sales personnel with the types of high quality sound equipment available for custom installations and the latest AM-FM radio receiver combinations, this publication lists a tuner, recorder, record changer, speaker, television chassis, and cabinet. The products of six companies are represented and are available as a "package" for custom jobs.

ANTENNA BOOKLET

An informative 16-page booklet on television and FM antennas, entitled "The Story of the Magic Wand," has just been released by *Ward Products Corporation* of 1523 East 45th Street, Cleveland, Ohio.

The new publication, which tells about the development and application of antennas, is available to television technicians and the general public.

Copies of the booklet are available without charge from the company.

INSTRUMENTS MANUAL

A new and revised edition of the "Manual of Electric Instruments" has been issued by the *General Electric Company's* Meter and Instrument Divisions.

The manual describes the fundamentals of construction and operating principles of all major types of electric instruments. Written primarily for use in schools, the manual may be used by men in the industry who wish to gain familiarity with the electric instruments with which they work. The thirteen chapters of the book explain the fundamentals of such instruments as thermocouples, synchroscopes, frequency meters, and electric telemeters.

The book contains 150 pages and the text material is lavishly illustrated with photographs and diagrams. Copies of the publication, GET-1087A, are available from *General Electric Company,* Schenectady 5, New York. The price is $1.00 a copy. —30—

International Short-Wave
(Continued from page 130)

French Equatorial Africa—Pearce, England, says *Radio Brazzaville,* 11.972, 9.440, now has news for Europe at 1315-1330; at close announces *English* daily at 0115, 0510 in the 19-m. band, and 1315 and 1550 in the 25- and 31-m. bands.

French Indo-China—Balbi, Calif., reports the "Voice of Vietnam" now heard on 9.670 and (*new*) 7.265 from 0500; news 0615.

Although Saigon was to have moved some time ago from 11.78 to 9.524, the station has not been reported to me recently as heard on either of these channels; should have news 1845, 1945, 0500, 0900.

French Morocco—Rabat, 6.006, noted 0200-0230 in French; man announcer identified as "Ici Radio Maroc" at 0230; music followed. (Cox, Delaware) Peddle, Newfoundland, confirms overseas reports that Rabat also is being heard on approximately 8.190 afternoons (EST); spurious?

French West Africa—According to its verification card, *Radio Dakar* now operates on 11.895 at 0200-0330, 0700-0830, 1320-1800, and on 15.340 at 1400-1530 daily. (Radio Sweden)

Galapagos Islands—The Swedish Fan DX Club reports a *new* station giving location as Santa Maria, Ecuador; language is Spanish but often has *English* announcement; operates on approximately 4.960; it is believed this may be a *new* outlet on Santa Maria Island, located approximately 800 miles west of Ecuador in the Galapagos Group. (HC5HP, Riobamba, Ecuador, is listed on 4.960 with 250 watts.—KRB)

Germany—The two short-wave transmitters of *Der Deutschlandsender,* according to announcement, are operating on 6.115 and 7.150; schedule appears to be 0400-1800 daily. (Radio Sweden) The 6.115 outlet is heard at good strength in Britain; news in German 1500; appears to be Soviet-controlled, and is believed to be *"Rundfunk, Berlin."* (Pearce)

Hamburg, 7.29, sends a strong signal to the British Isles; noted with news in German 0645 (except Sun.), also at 0245, 1345, 1800; sends usual letter in German and view of transmitters, lists power 50 kw. (Pearce)

Greece—*"Free Greek Radio"* has been widely reported daily 0045-0100 on 9.460; language is Greek; since this is a clandestine outlet, definite location is not known but it is believed to be behind the Iron Curtain. The station is now in its third year of operation and formerly was in the 6- and 7-mc. bands. A late report from Stark, Texas, indicates the station may have moved or left the air, since he had not heard it more recently at 0045-0100.

Bluman, Israel, has checked a number of Greek regional s.w. outlets with these results—6.345, a station relaying Athens II on 1550 kc., at 0000-0200, 0500-0800, 1100-1545; 6.530, Janina, at 0000-0030, 0700-0730, 1200-1500; 6.745, Larissa, at 0000-0200, 0430-0800, 1000-1500; 7.020, *Radio Peloponesos,* at Tripolis, at 0000-0200, 1100-1430, barely audible 0700; 7.050, Athens, Forces Station, at 0000-0230, 0430-0730, 1000-1500; 9.607, a station relaying Athens I on 601 kc., at 0030-0230, 0500-0630; these are weekday schedules, additional transmissions are carried by *all* stations on Sunday. (Radio Sweden)

Guatemala—At the time this was compiled, TGWA, 15.17, and 9.763, was still announcing as "La Voz de Guatemala." Press dispatches early in the year indicated that the country's name was being changed to Isthmania. Is still verifying with an "ancient" QSL card, almost 20 years old.

TGWB, Guatemala City, noted moved back to measured 6.4396 from 6.07; signal reported good evenings except for some QRN. (Treibel, Washington)

Haiti—At the time this was written, 4VRW, Port-au-Prince, was using approximately 10.207, but still announced 10.130; it is possible that the English announcement is a recording. (Hankins, Pa.) On Friday nights at 2000-2030, 4V2S, 5.951, Port-au-Prince, has an *English* session with tourist information. (Ferguson, N.C.)

Hawaii—KRHK, 15.25, Honolulu,

has replaced KRHO, 9.65, to Far East 0400-0900. (Balbi, Calif.)

Hong Kong—ZBW3, 9.525, is heard to closing 1030 with playing of *"God Save the King."* (Radio Australia)

Indonesia—Direct from Djakarta, it has been confirmed that the station heard 1115-1400 on 11.785 is YDF2; this is the *new* 100 kw. transmitter which should be testing soon on 9.520, probably at 1000-1100. (Moore, Calif.) By this time the 11.785 channel may have added *English* for Europe at 1400-1500; and the English period (on YDF, 6.045, when this was compiled) may have moved by now to YDF2, 11.785, or possibly to 9.520 (on which tests were to be effected soon).

Fuller, R. I., is hearing the old outlet on 19.345 (formerly Batavia, now Djakarta) at 1130-1200.

A station heard recently by Stark, Texas, on approximately 9.665 at 0800 in Dutch may be Menado, Celebes. *Radio Australia* reports this station, YDS, on a *new* channel of 9.680, heard with weak signal as early as 0530, but at sufficient strength by 0600 to read announcement, "Hier ist Menado, Radio Indonesia"; orchestral items 0530-0600, then news in Dutch.

NNRC reports YDQ3, 11.084, Makassar, Celebes, heard 0745 with recorded dance music and with *English* announcement 0800, followed by news in Dutch.

Iran — Radio Teheran, 9.66, noted 1345 with *English* announcement, playing classical selections; news in French 1400-1407, then back into *English,* playing popular music. (Boice, Conn.)

Iraq—Baghdad II, 7.063, signs on 0830 with program in Kurdish, which sounds like Persian; at 1115-1200 has *English* program. (Bluman, Israel, via Radio Sweden)

Ireland—At the time this was written, *Radio Eireann's new* 100 kw. transmitter had not yet been reported as testing. When the opening date is known, schedules will be released through Irish Legations; recently listed s.w. schedules for the low-powered (1.5 kw.) transmitter at Athlone were for news at 1330-1350 on 17.840, and at 1710-1730 on 11.760 (officially listed 11.74); the 25-m. band outlet is not heard in America as far as I know, but occasionally I have heard the 17.840 outlet through terriffic QRM from *Radio Brazzaville.*

Israel—Tel Aviv's listed 9.000 outlet recently has been measured 9.010. (Ferguson, N. C., others)

Japan—AFRS, 9.605, Tokyo, noted in Delaware 0300-0330. (Cox) WLKS, measured 6.115, Kure, noted 0600 with BBC news relay. (Triebel, Washington)

Lebanon — Radio Liban (formerly *Radio Levant*), Beirut, is scheduled daily 0000-0130, 0600-0730, and 1000-1535 on 8.036. The station says the name change was effected when the station was handed over to Lebanese authorities on April 1, 1946. (Radio, Sweden)

Madagascar—Radio Tananarive,

9.695, noted 2300 with news in French. (Stark, Texas) Heard in Ohio as early as 2230. (Sutton)

Malaya—Radio Malaya, 9.712, noted to closing 1030, good signal in Calif. (Rosenauer) The Blue Network is now heard in dual on 7.200 and 7.250; news 0900. (Dilg, Balbi, Rosenauer, Calif.) While broadcasts are in Malay and Chinese dialects, the stations can be identified when they announce "Radio Malaya." (Radio Australia)

Malta — The Forces Broadcasting Service, Middle East, is being heard well in East from 2330 sign-on on both 4.965, 7.270. Verification card lists frequencies allocated as 7,220, 7.270, 4.965, 11.785, 6.140, all 7.5 kw.; former 4.782 channel is crossed out; hours of broadcast are listed 2330-0200, 0430-1700.

Mauritius — V3USE, approximately 15.050, is being heard erratically in the Eastern U. S. at 2159-2315 (approximately), and in both East and West USA around 0930-1200; has BBC (*English*) news relay 2200, and sometimes carries *"English by Radio"* shortly after the end of the news; most other items are in French; frequency seems to vary.

Mozambique—At the time this was compiled, Lourenco Marques seemed to be experimenting in its *English* language program—was being heard weekdays from 2300 and Sunday from 0000 on 11.764, 9.763, 6.137 (all approximate). August Balbi, Calif., reports this is the first time Lourenco Marques has been noted in the 25-m. band since 1937; widely reported; announces that the 25-m. outlet is for "listeners in the Cape." This outlet has been measured 11.7692 by Treibel, Washington. More recently the 31-m. outlet has been on approximately 9.755, probably having dropped to avoid QRM from TGWA and Leopoldville.

The Portuguese program was noted recently in Pennsylvania coming on the air 2300 on approximately 9.705, 9.660, 9.568; 9.660 was best level. (Hankins, Pa.)

Peddle, Newfoundland, says the best signal from Lourenco Marques is now over CR7BG, 15.196, heard first testing on Thursdays to 1500; later has been heard on other days; some days may run to 1530. Announces as beamed "regularly" to Europe and Portugal and Portuguese Colonies; always gives program preview for the following day. I have heard this one at good level here in West Virginia as early as 1400. Noted in England by Pearce on occasion after 1505 with messages addressed to Lisbon, Angola, and other Portuguese possessions; signed off 1525 with the Portuguese National Anthem, "A Portugesa"; Pearce says this appears to be the same program as radiated on 4.825 and also sometimes on approximately 9.670.

New Caledonia — Slutter, Pa., is hearing a station on 6.000 signing on 0230 with "La Marseillaise"; probably is Noumea; has music to 0245.

New Zealand—ZL3, 11.78, ZL4, 15.28, now parallel at 2300-0635 sign-off; ZL7, 6.080, is now off the air. (Balbi, Calif.)

Nigeria—A station heard by Dilg, Calif., on approximately 9.655, with irregular program format, may be *Radio Nigeria*, Lagos. Noted with native singing both *before* and *after* 1100.

Radio Nigeria verified by airmail from the Director of Post and Telegraphs, P&T Headquarters, Catholic Mission St., Lagos, Nigeria. By now should be operating 0100-0215, 0600-1700 on 7.255 with 1 kw.; 0100-0215, 0600-1300, on 9.655, 300 watts, 1300-1600, on 4.990, 300 watts; on Sunday should operate 0100-1700. The "morning" sessions are relayed from the BBC's General Overseas Service; native programs are radiated "evenings." Broadcasts are still experimental, quality is not the best. Transmitters are Air Ministry T1509, 300 watts, and RCA 4331, 1 kw. Nigeria plans new stations at Ibadan, Kaduna, and Enigu for 1951. (Cushen, N. Z., via URDXC)

Outer Mongolia—Ulan-Bator, 8.400, noted with oriental-type program to 0800, then with Moscow relay. (Rosenauer, Calif.) Noted from 0400, fair to excellent. (Balbi, Calif.)

Pakistan—Radio Pakistan, Lahore, has been radiating on 6.075 since November 1, 1949. (Sampat, India)

Frequencies and schedules of *Radio Pakistan* seem to be irregular, but at the time this was compiled *English* news periods appeared to be radiated on 9.646 at 2145 and 1015; on 11.885 at 0210; on 11.845 at 0700 and 0820; on 17.825 at 0110 and 0210; on 11.548 at 0700, 0820, 1015; Dacca was using 7.635 for *English* news at 0700 and 1015, and may use 15.335 for *English* news at either 2100 or 2145; however, there is a possibility that the 15.335 outlet heard evenings (from around 2045) may be Karachi. There definitely are *two* 50 kw. transmitters now operating from Karachi. It is possible, also, that at times Dacca may be using its old channel of 15.27. (Hankins, Pa., Morris, N. Y., Sampat, India)

Panama—A station announcing *"Radio Continental,"* located in Panama City, has been heard with news in Spanish ending 1930 on 6.0445; also noted at 0630. (Oskay, N. J.) Noted in Washington signing off 2400. (Treibel) *Radio Sweden* says this station's QRA is believed to be Radio Programas Continental, S. A., Apartado 1795, Panama City, Republic of Panama.

Peru — OAX5C, measured 9.4776, Ica, noted 2315 with classical music. (Treibel, Washington)

Philippines — Balbi, Calif., is still hearing DZH7, Manila, on 9.730, where it is QRM'd by BEA8, 9.735, Nanking; noted in *English* 0400-0500, news at start. Balbi notes that DZH3, 9.50, Manila, has news 0400, 0500.

According to the "Philippines Free Press," weekly news-magazine, the Bacolod Broadcasting Corporation is operating DYBR, 1120 kc., and DYB2, 4.985; this is Bacolod's first station and was formally inaugurated December 25, 1949, although had tested from October 13, 1949. Geographically, Bacolod is 300 miles SSE of Manila. (Loboyen, Ill.) Cushen, N. Z., says DYB2, "The Voice of Bacolod," 4.985, operates with 250 w., and is heard to 0900, but has bad CWQRM; that Davao is on 3.950 with no call yet assigned, and that another station DXAW, "The Pioneer of Davao," operates on m.w. 1180 kc., only, as yet; that DYRC, 600 kc. and DYH2, 6.140, "The Voice of Cebu," 151 Colon St., Cebu City, operates 1600-1100, station being owned by the Cebu Broadcasting Co., operated by the *Manila Broadcasting Co.*, and affiliated with *NBC;* DYH2 is heard on Sundays at 0530 with a "Voice of America" transcription, "Make Believe Ballroom," Cushen says.

Pitcairn Island — Overseas sources report vaguely that a station, XKG, is operating from this island on 8.290; no other details.

Portuguese Guinea — CQM7, 6.993, Bissau, excellent in Newfoundland 1630-1800 closedown. (Peddle)

Portuguese India—Radio Goa, 9.610, now broadcasts in *English* daily; the schedule over-all is 2030-0640; 0730-0930; program consists of light and classical music on records and request program. It also uses Portuguese, Konkani, Hindi, Urdu, Sindhi, Marathi, and Gujarati. On Wednesdays carries *English* religious program ("Bringing Christ to the Nations").

Roumania—Radio Bucharest, 9.252, usually is readable, fair level, 1500-1530 in *English.*

In verifying for Ferguson, N. C., *Radio Bucharest* listed channels of 823 kc., 5.990, 6.205, 9.250, 11.900.

Saudi Arabia—A Danish DX-er reports Mecca on 11.950 at 1200-1317; a German listener has measured frequencies as 5.976, 9.652, and 11.750, heard in Arabic 1200-1300. (Radio Sweden) Cushen, N. Z., has heard Mecca testing 1300-1315 in *English* on 3.950, and then on 3.060 when changed from rhombic to doublet antenna; also heard on 5.990, 9.650, and 11.750, according to announcements, these are tests for reception in Cairo; tests 1200-1300 in Arabic. (Radio Australia)

South Africa — The South African Broadcasting Corporation is to have a new transmitter in service from May 1. (Radio Sweden) Other sources indicate that perhaps more than one *new* transmitter will be put in operation. The new installation is for the "C" (commercial) program to be called "Springbok Radio." The service will operate on s.w. in the 31-, 40-, 60-, 90-, and 120-meter bands daily at 2345-1600 and Saturdays to 1200; exact frequencies to be used were not known at the time this was compiled.

According to *Short Wave News,* London, ZRB, Air Force Station at Pretoria, now operates on *only* 9.110 on Sunday-Thursday at 2345-1015 and Friday 2345-0500; verifies with card; QRA is Officer Commanding No. 64 Air School, P. O. Odonata, District of Pretoria, Transvaal, South Africa.

ZRB, measured 6.1096, noted 0020

with popular recordings. (Treibel, Washington) Usually is good level here in West Virginia from 2345 sign-on, and normally has news 2400, BBC news relay 0100.

Spain—Sutton, Ohio, says Madrid's 15.620 outlet appears to be scheduled 0955-1220, at times to 1230.

Suez Canal Zone—"Your Forces Broadcasting Service, Fayid," is heard testing on 7.220 at 0200-0230 and some days at 0300-0330 by Bert Bluman, Israel. (Radio Sweden)

Surinam—PZC, measured 15.4058, Paramaribo, noted 1755 with popular recordings, announcements in Dutch. (Treibel, Washington. Had improved signal past month or so, 1645-2030; on rare occasions has opened 1630 and signed off 2055; no *English* noted. (Grove, Ill.)

Switzerland—Aberg, Sweden, reports *United Nations Radio* heard 1045 on 11.725 with news in Hebrew.

United Nations Radio, 6.672, now has *English* weekdays 1420. (Pearce, England)

Berne noted using HE17, 15.320, instead of HER6, 15.305, in the 1730-1815 transmission to North America. (Cox, Delaware)

Syria—Damascus, 11.750, is fair level in Newfoundland 1315-1345. (Peddle)

Taiwan—*"Voice of Free China,"* Taipeh, appears to be scheduled 2300-0100 (first hour in *English*) to the West Coast USA over BED4, 11.725; and 0500-1130 (from 0600 on Sunday) over BED7, 7.1505, with news around 0610. In a letter to Moore, Calif., Chang Shui-yu, Head, Audience Service Section, Taiwan Broadcasting Station, Taipeh, Taiwan, China, stated that "the Taiwan Broadcasting Station is situated in Taipeh, Taiwan, and is of course anti-Communist. All the calls of the station are BED's, no matter what number affixes them. You also may hear station BCAF which is the broadcasting outlet of the Chinese Air Force, situated in Taiwan also, operated on 910 kc. in the 329-m. band." BCAF at last report was using the s.w. frequency of approximately 8.996.

During most of the *English* period 2300-2400 on 11.725, there is terrific QRM from CHOL, 11.72, Canada. (Treibel, Washington) BED4 is seldom audible here in the East.

Tangiers—Latest schedules of the "*Voice of America*" relay station at Tangiers are Tangier I, 7.220, at 1500-1730 to Europe; Tangier II, 11.710, at 1130-1730 to Europe, Tangier I, 15.240, at 1130-1500 to Europe.

Thailand—While "Down Under" sources insist that HS8PD, Bangkok, is operating on 6.235, it has been measured consistently within a few cycles of 6.2408 by Oskay, N. J.; has news 0515, 0615.

Tibet—Although press dispatches from New Delhi reported some months ago that a station calling itself *"Radio Tibet"* had been heard on approximately 7.200, I have received word from Sampat, Bombay, that he has been unable to hear any such station. *If anyone has actually "heard" this outlet, please let me know.*

According to Lowell Thomas, the American newscaster, *"Radio Tibet"* is being operated by Reggie Fox, AC4YN in *English,* Chinese, Tibetan. Fox, formerly a representative of the British Political Mission, resigned his post, married a Tibetan girl, now holds a high post in the regime of the Dalai Lama, and is now considered a native of Tibet, it is reported. According to Mr. Thomas, Fox expects to spend the remainder of his life in Tibet. Two of his four children are now attending school in India; they are being trained to fill high government posts in Tibet. (DeMyer, Mich.)

USSR—A Soviet outlet noted in Russian on 7.93 from 0600, powerful signal; the 9.48 outlet heard with Home Service from 0200, strong signal in California. (Balbi)

Vatican—HVJ, 7.28, noted in Sweden with Spanish 1500. (Aberg)

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Last Minute Tips

A station reported earlier by *Radio Sweden* as "unknown" has now been identified as *Radio Euscari,* "La Voz de la resistencia Basca"; this clandestine outlet operates on 6.090 at 0200-0230, and on 6.525 at 1600-1630. (Radio Sweden)

A transmitter heard by Bluman, Israel, on 7.075, is probably Bahrein Island in the Persian Gulf; heard before 1050 when the station is blotted out by Ramallah's carrier. (Radio Sweden)

At the time this was compiled, Boice, Conn., reported Paris, 9.55, 9.68, had discontinued the *English* beam to North America 1945-2000.

Radio Sweden says the Lisbon outlet formerly on 15.160 has now moved to 15.147; also reports Portuguese Radio Clube, Oporto, on 7.530 at 1300-1800.

A station heard by Peddle, Newfoundland, on 11.950 at 1230-1300 is believed to be Mecca, Saudi Arabia; poor level. Pearce, England, is hearing this one at 1200-1300, but occasionally continues to test to around 1315 when announces "This is Saudi Arabia Broadcasting System."

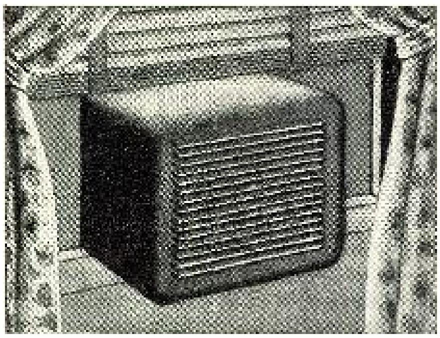
A strong station heard on 7.906 at 1200-1300 is presumed to be a *new* Greek outlet. (Radio Sweden)

The Forces Station, Central Greece, Larissa, noted back on approximately 6.745 from 6.770; sent QSL card; listed *English* program for Thursday 1530. (Pearce, England) Gives schedule as 0000-0200, 0500-0800, 1100-1545. (Radio Australia)

PRL8, 11.72, Rio de Janeiro, Brazil, now heard with fine level to 0355 sign-off; this transmission is relay of m.w. *"Radio Maua."* (Worris, N. Y.)

I recently noted *Radio Brazzaville,* 11.972, on a Sunday at 1100 with news for the Far East; fair level; announced was operating in the 25-, 31-, and 48-m. bands.

According to *Radio Sweden,* FBS, Middle East, Malta, has been heard



on a *new* channel of 9.925 around 1500.

Fargo, Ga., recently heard a station on approximately 8.87 with news 1530 announcing as Jerusalem, Israel.

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Press Time Flashes

Direct from Leslie Knight, Chief, Forces Broadcasting Service, Middle East, Malta, I learn that later in the year FBS may inaugurate a special weekly program for SWL's; if so, most likely will be around 1715 EST (2215 GMT). For the present, schedules are 4.965, 2300-0200, 0830-1700; 7.270, 2300-0200, 0900-1700; 11.895, 0430-0830.

YDC, 15.15, Djakarta, noted good level 0900-1000 in *English* to China and Burma; announces YDB2, 4.91, in dual; same channels are used for 0600-0700 *English* period; during each *English* session has news at start and just before close. *Radio Sweden* confirms that European beam from YDF2, 11.785, has been extended to 1115-1500 and that last hour is *English.*

Verifying for DeMyer, Michigan, Mauritius, listed frequency of 15.075 (actually heard on approximately 15.05) and schedule with 1.5 kw. as 2200-2315, 0300-0430, 0930-1200; is best here 2300, usually leaves air around 2310 to 2320 with playing of *first half* of "God Save the King"; stated antenna is delta-type; uses both French, *English.*

Boice, Conn., reports *Radio Pakistan,* 11.885, Karachi, with news at dictation speed for Middle East at 1330; confirmed here, good level; seems daily feature now.

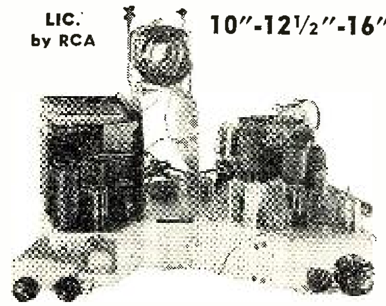
QRA for "Radio Elizabeth," OQ2AB, 11.900, 7.150, is A.F.M. Schovens, Box 1039, Elizabethville, Belgian Congo; QRA for OQ2AC, 3.390, 4.980, 7.200, is College des Francaise, De Sales, Elizabethville, Belgian Congo; both send excellent QSL cards. (Nordh, Sweden, via ISWC, London)

BCAF, 8.996, Teipeh, Taiwan, noted in Australia 0630 with *English*-Chinese lesson; Western music 0715. Bangkok, 6.24, 1591, noted both 0515, 0615, with news. DYB2, 4.985, Bacolod City, Philippines, heard 0530 with world and local news, then music. ZJM7, 11.72, Cyprus, noted 1600 with Arabic news, then music. (Sanderson)

Short Wave News, London, has announced it shortly will publish a successor to its "Short Wave Listeners' Annual" under the title, "The Op-Aid"; will include prefix lists, both by country and by prefix, zone boundaries, time tables, postage and mileage data, and much other essential information in a form which will aid ready reference. But will *not* include s.w. broadcast station lists "as this section is so well covered in the *World Radio Handbook for Listeners.*"

The Overseas Broadcasting Station, Bangkok, Thailand, verified for Bellington, N. Y., with attractive card.

Serrano, Brazil, flashes that Lourenco Marques, 15.196, has news in Portuguese 1320, 1450; last news is followed by program preview; schedule seems 1300-1500 although some days runs as late as 1530.



DUH5, 11.84, Manila, heard weak around 0230 in Oregon. (Callarman)

Radio Brazzaville now has news 1745 on 11.972 to North America; on 9.440 and 9.987 to South America; first two best here in W. Va.; seems to have dropped newscasts formerly at 1900 and 0030.

A station reported widely on approximately 9.530 around 0000-0130 is believed Warsaw.

OXI, 5.940, Greenland, noted 1735 in Danish; off 1748. (Bromley, Ontario)

A station that may be DYH3, Manila, noted by Dilg and Balbi, Calif., on approximately 6.11; announces as "largest station in the Philippines"; good 0500.

Saigon, French Indo-China, noted by Balbi, Calif., on 11.84, a *new* channel, from 0355; confirmed here in W. Va. at 0500 with news by woman; at 0515 was buried by LRT, Argentina, same frequency. Noted by Balbi on "old" 11.78 channel at 1015 with French news relay from Paris, signed off 1030. I cannot find it anywhere at 1800—former opening time on 11.78.

The Radio Club of Sweden says Damascus, 6.000, Syria, now has news 1530.

CR6RO, 7.582, Radio Clube do Bie, Silva Porto, Angola, says power soon will be increased from 400 w. to 1 kw.

Radio Omdurman, Anglo-Egyptian Sudan, is on 6.115 now in addition to 9.747; has *English* on Friday 1230-1300. (Radio Club of Sweden)

YDQ3, 11.084, Makassar, Celebes, noted 0745; announced in *English* 0800. (Sutton, Ohio)

Fargo, Ga., flashes he has picked up Israel on 9.000 with news 1700, then a question-and-answer program about Israel; gave QRA as P.O. Box 754, Jerusalem, Israel, Station IBX; excellent level, in clear.

Moscow announced current daily schedules to North America are 1820-1930, 15.23, 11.88, 9.72, 9.67, 7.36, 7.29; 2000-2100, 15.23, 11.88, 9.72, 9.67, 9.60, 7.36, 7.29; 2200-2255, 15.41, 15.23, 15.10, 11.78, 9.72, 9.67, 7.29; however, 11.96 is also used in *each* of these transmissions. (Lane, South Dakota) The 11.96 channel is best here in West Virginia most evenings.

Radio Clube de Huambo, 11.925, Nova Lisboa, Angola, is scheduled weekdays 1300-1700, Sunday 0600-0745, 1100-1200. (Radio Sweden)

Radio Sweden reports Mafeking, Bechuanaland, has moved from 5.900 to approximately 8.230; on air daily 1200-1430.

Radio Tananarive, 6.160, Madagascar, heard in Calif. 0815-0915; music with announcements in French; call "Ici Radio Tananarive" is given irregularly; good level. (McPhadden)

Both Ferguson, N. C., and I recently heard a Chinese station on approximately 15.050 from tuning around 0610 to sign-off 0930; had Peking news relay 0830; good level; may have been testing.

Many thanks for the continued FB cooperation! . . . . KRB.

The June issue of RADIO & TELEVISION NEWS will be on sale May 30.
Be sure to reserve your copy with your Newsdealer.

Aligning TV

(*Continued from page 44*)

with the proper channel setting the raster should be observed on the screen. At this point the focus must be properly adjusted. Focus will vary with the position of the scanning spot on the screen although electromagnetic deflection exhibits less tendency to this than electrostatic. The trouble is nonetheless prevalent and must be constantly anticipated. The best picture focus is obtained when the scanning line is of the sharpest definition and the minimum width. This can only be observed upon close scrutiny of the face of the cathode-ray tube. Since focus also varies with grid voltage it is sometimes necessary to adjust the tube focus under conditions of extremely strong video signals which tend to defocus the beams.

At this point it is necessary to describe the correct determination of the proper number of lines in the vertical wedge. A proper wedge pattern terminates where the sharp definition between the lines and spaces of the wedge become soft or greyed in character. Slight readjustment of the focus control often proves that the trouble lies in the focus of the beam in that area. This is very important in determining the correct i.f. alignment.

Linearity

Vertical and horizontal linearity may be adjusted by observing the circularity of the test pattern's outer rings. Remember that both complete circles must be round. Adjustment of the linearity controls will compensate for any deviations from normal. If it is not possible to achieve a perfect circle then it is best to leave the setting at that point where the best figure is obtained. Nonlinearity will cause the test pattern to appear egg shaped. Failure to adjust for proper linearity will cause distortion of the wedges and less accurate setting of the video i.f. may result. The picture size should be adjusted for the correct height and width before checking linearity.

The brightness affects the picture focus and contrast. To adjust this control properly turn the brightness up until retrace lines appear, then decrease the brightness just to the point where they disappear. Too much brightness spoils the contrast effect and defocuses the beam.

Proper Video Bandpass

By carefully observing the test pattern the set can now be aligned. First observe the pattern. If, for example, the horizontal wedges are clearly visible only to the mark of 100 lines on the vertical wedge, it will be necessary to adjust the last i.f. to lower the i.f. frequency. Next the focus should be adjusted until the greatest number of vertical wedges can be seen. If no change is perceptible it is advisable to let the i.f. remain in its original position and go on to the next stage. It may be noticed that although good vertical wedge information is present, the horizontal wedge information is smeared and very poor. This could be due to improper load resistors in the plates of the video amplifiers or improper setting of the i.f.'s controlling the low video frequency. Low video frequency means high frequency i.f.'s, therefore, the iron core slugs should be pulled farther out of the coil. When the bandpass is properly adjusted the vertical and horizontal wedges will appear in the same blackness and in sharp definition. The horizontal wedges will extend into the very center of the pattern and down to the inner circle whereas the vertical wedge may cut off at something greater than 300 lines.

It is a common receiver fault to receive a signal which at first appears as a ghost followed by other lighter ghosts which cannot be removed by orientation of the antenna. This may be caused by overpeaking the video i.f.'s. Further separation of the low frequency i.f. slugs will minimize this condition and even eliminate it in most cases. This condition is undesirable and is indicative of misalignment. It usually appears after a black line and the black line is followed by a white line which in turn is followed by a grey line, etc. These lines are caused by the damped oscillations set up in the video amplifier with a strong signal and the two i.f.'s too close together in frequency, permitting oscillation.

Low frequency distortion is caused by improper values in video amplifiers and results in blurring of horizontal lines even under fine-focus conditions. This condition is generally accompanied by excessive phase shift. If changing the frequency of the high frequency i.f.'s (low frequency video signals) does not correct this condition the video amplifiers should be checked since the r.f. head is not passing the 6 mc. required for good television reception. Alignment must be performed in the r.f. section of the head by adjusting the r.f. slugs in the coils for low frequency video.

As the vertical wedges become more sharply defined, sound bars will appear on the raster. These are usually horizontal grey bars which travel vertically across the raster. Elimination of these bars is necessary in order that the best bandpass may be selected. Adjustment of the sound trap is necessary. The bars may be eliminated by tuning the sound trap until they disappear or by presetting the sound trap by means of a signal from a signal generator tuned to the audio i.f. frequency. The same vertical bars will appear on the raster if the signal generator is modulated with 400 cycles. The sound trap is in tune when these bars disappear from the raster. It is obvious upon careful study of the r.f. bandwidth picture that as a higher and higher video response is approached the more sound will be allowed to enter the video i.f. The sound trap tunes very sharply but careful adjustment will always eliminate the sound bars from the picture.

Audio

The television audio uses a bandpass of 50 kc.—25 kc. on either side of the audio carrier. It is advisable to align a television receiver using audio as a basis for determining the best alignment point. The reason for this is that the video is 5.25 mc. wide and is difficult to set accurately even with a trained eye. However, it can be set within a few kc. by means of the audio since the greatest possible error with the audio is only 25 kc. or an error of less than .01 per-cent!

First align the audio i.f.'s by turning the slugs an equal number of turns until the audio is present in the speaker and the picture is visible on the screen. Next while observing the r.f. variable condenser or fine tuning control note the point at which the best picture is received and also the point at which the sound is heard best. If the capacitance or inductance increases its value the sound is below the picture by too great an amount and the audio frequency must be increased, *i.e.*, the slugs must be pulled out of the coils. If the capacitance or inductance decreases when bringing in the best sound, the audio i.f. frequency must be lowered. After each adjustment check again with the highest definition picture to determine the new audio position and verify whether the point of best picture performance has been reached. Do not expect good sound until the discriminator has been properly balanced for each new setting.

The discriminator is balanced if the noise is at a minimum and the sound is not distorted on loud signals. This is important. Since the FM frequency bandpass governs the sound intensity, if only a weak signal is judged, very little can be determined about good FM balance. Test the audio on both weak and strong signals. It should handle both with no distortion and no noise. Although it may seem as if there were a loss in gain remember that a properly balanced discriminator has little or no background noise and handles full signal intensity without distortion. This point should also be the point of greatest video definition. When the audio and video are prealigned with a standard signal generator very little audio-video juggling is necessary. Remember that in using a standard signal generator the discriminator must be detuned and the i.f.'s lined up for greatest audio signal, then the discriminator is adjusted for weak or no audio signal.

Bandpass

At this point the receiver may be checked for bandpass. If the best possible picture has been achieved it may be assumed that the greatest available video band is being passed. Trouble may be present in the video amplifiers or the r.f. assembly. A simple tuning tool may first be tried by placing it at the peaking coils of the video amplifiers. There should be no change for the worse when the tool is brought near these coils. Another simple tuning tool may be constructed by fastening a peaking coil of 200 μhy. to a tuning tool. This coil may be used to shunt the peaking coils in the video amplifiers. This should reduce the picture resolution. If it increases the picture resolution the video coils are not properly designed or have changed value. A peaking coil of less inductance than was originally used in the video should then replace the present one if this effect is noted.

Usually, however, the trouble lies in the r.f. assembly. The bandpass of the r.f. assembly may be less than 6 mc. This is evidenced by good sound, good vertical wedges, but poor horizontal wedges. This may be checked by observing the test pattern as the fine tuning is varied. If the test pattern increases in vertical or horizontal resolution as the audio disappears or becomes louder, then all the required band is not reaching the i.f. amplifiers. This band may be increased by adjusting the r.f. trimmer slugs or condensers. Increasing the inductance for increased low video response and decreasing the inductance for increased high video response is the procedure to be followed. Remember that a good test pattern will show very clearly and have sharply defined lines and spaces of equal intensity both horizontally and vertically with no ringing evident and no phase distortion present.

The well designed receiver will produce over 300 lines vertically and horizontally. When this is achieved the receiver is properly aligned. All of this can be accomplished satisfactorily without employing elaborate test equipment—just the intelligent use of the video test pattern on the cathode-ray screen.

The cathode-ray tube is the handiest possible test instrument since it is always available during servicing procedures.

—30—

LETTERS *from our readers*

MORE FORGOTTEN MEN

"PLEASE add my name to the list of those in 100 per-cent agreement with the sentiments voiced so ably by Mr. Van Slyck (February issue). Last November I became a charter member of the 'Forgotten Men' fraternity.

"I have handled the receivers of a prominent manufacturer for over three years. I have built them up to a position at the top of the customer acceptance list in this territory. Suddenly—no more radio sets. I lost about $450.00 at Christmas and will lose much more in the months to come. I have written to nearly every vice-president they've got and the best I have had is the wish that I will be able to hold out until 'television gets to Mena.' Mena, Arkansas, has a population of 5000 and is 85 and 95 miles respectively from the nearest FM stations!

"In the last three years I have sold nearly $25,000 (list) worth of this manufacturer's products. They won't sell that much TV in the whole dadburned state of Arkansas in the next five years!

"I don't know what is going to happen to the organization of once-loyal dealers which has been built up so laboriously over the years. Certainly the companies are going to have to start all over again to get any goodwill out of us, if the rest are like me. My contention is this. Radio has a large listening audience. What percentage of these use a $19.95 midget or $39.50 table model? How many years will it be before TV advances to the point where they can provide the mass market with a table model selling for less than $50.00? Einstein's new theory may provide the answer—I certainly can't."

Jack Darr
Ouachita Radio Service
Mena, Ark.

* * *

THE GAIN SET

"I READ with a good deal of interest the article on the audio oscillator and gain set in the January issue but would like to make a point.

"Mr. Bumbaugh leaves the impression that no matter what his gain set is terminated into, beyond the loading resistor, that he need not bother to include the loss of the termination in the total loss of the input attenuator. In other words, no mention is made when referring to Fig. 6, that when building out to high impedance, one must add the loss of the pad thus created to that of the gain set. He is not wrong, true, but too many people don't know the difference.

"In the case cited, adding the 100,000 ohms to an assumed 100,000 ohm grid (itself assumed as a pure resistance which is not so since there is always an appreciable capacity at audio frequencies in the measure band) would create an impedance ratio of 200 to 1 or an additional bridging loss of 26 db. This additional loss must be added to that of the gain set before we can evaluate the single frequency gain of the equipment under test. The same thing applies to the matching network for the low impedance case cited. I will say, however, that the low impedance case is a lot easier to evaluate than the high.

"Conventional practice uses two methods. One, a matching transformer of good design and two, the matching pad, a variation of which Mr. Bumbaugh has shown. I would like to see a clarification of the added loss made public just in order to keep a lot of well-meaning radiomen from running into trouble over something which is far from well-known even in the broadcasting industry.

"As a sidelight, I might add that I seriously doubt if there are more than two per-cent of the engineers presently using audio measurements in the broadcast industry who actually know how to use the decibel properly. Call any Master Control you like, even here in Chicago, and two-to-one when you ask for a level you will be told 'It's leaving here at 0 db.' Now you know that doesn't mean a darn thing. What is the reference point for such a statement? Take it further and ask the same engineer what reference he is using and I'll bet again he doesn't know. That has been my experience for years and I have fought it like mad. The average radio engineer has an idea that the db. is an actual value of voltage. That is the big reason for going to the v.u. system where the reference is part of the definition of the v.u. and where a reading of so many v.u. means what it says."

Hilton Remley
Station WGN
Chicago, Illinois

* * *

TV IN HIGH SCHOOLS

"WE FEEL that you may be interested in knowing that television is definitely spreading into the high schools.

"Our senior class play was televised and aired on our local outlet, WTTV. The televising was accomplished with one *RCA* camera located in our auditorium balcony where the cameraman was able to traverse the entire stage. The image orthicon tube used required no extra light or makeup. The camera was connected to the transmitter by a coaxial cable—the same one used to carry our athletic events. The cable has been permanently installed and is being used to carry special programs in addition to a regular weekly telecast produced by students of the radio classes.

"Technically these telecasts are proving to be no problem at all to school officials or to WTTV engineers."

Wm. T. Voorhies
Dir., Radio & Dramatics
Bloomington High School
Bloomington, Indiana

* * *

ANOTHER PLEA FOR HELP

"I HAVE read with interest Donald Chadwick's letter in the December issue.

"I, too, am working for my ham ticket and looking forward to the day when I shall be able to pump some r.f. up the feeder lines, but like Donald, do not seem able to go past the 8-10 w.p.m. level. Anyway, on thinking of the many other fellows who have, I am encouraged to continue fighting. I am 20½ years old and shall be pleased to correspond with other prospective hams in any part of the world, 'CQ Jamaica.'

"Your magazine is always interesting to me, especially the 'Letters from our Readers' page and I'll close by saying 'Keep up the good work'."

Garnett W. Green
40 Arnold Road
Cross Roads P.O.
Jamaica, B.W.I.

* * *

NO SPACE

"IN THE March issue I missed the 'Letters from Our Readers' department. Could I have been so blind as to overlook it? Or can it be that the readers have not been writing? In case it is the latter, I am sending along my letter for next month's column as I enjoy the department very much.

"I get a big kick out of reading 'Mac's Radio Service Shop' by John T. Frye. As well as pointing out some very good ideas about the radio service shop he also adds a lot of humor to his story which makes it all the more interesting.

"I also like the editorial in the March issue warning people about the care needed in handling television picture tubes and about the high voltages involved in television.

"I also found in the March issue (at the bottom of page 158) a little item on checking voice coils that I would like to comment on. I would suggest to the writer to first place the ohmmeter test leads across the primary circuit of the output transformer. If the click is then heard it would indicate that the primary and the secondary circuits of the output transformer are OK as well as the voice coil circuit. This way all three circuits can be checked in one operation!"

Paul Anderson
Ah-Gwah-Ching, Minn.

—30—

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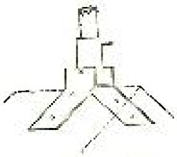
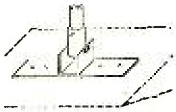
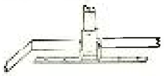


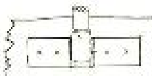
ON THE PEAK



ON THE SLOPE



ON THE FLAT



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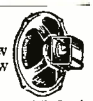

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LANCASTER. Allwine & Rommel Registered Patent Attorneys. Patent practice before U.S Patent office. Validity and Infringement investigations and opinions. Booklet and form "Evidence of Conception" forwarded upon request. Suite 414, 815 15th St.. N.W. Washington 5, D.C

HERMAN Lewis Gordon, Registered Patent Attorney. Patent Investigations and Opinions. Warner Building, Washington, D. C.

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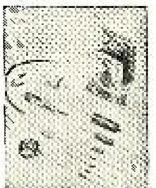

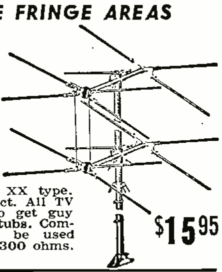

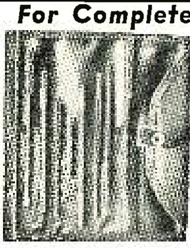

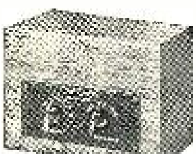

INDEX OF *Advertisers*

MAY 1950

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

DOCKET 9295

A MEETING of the Federal Communications Commission held March 21, 1950 discussed the various developments in connection with the proposed new amateur regulations. Comments filed by interested parties included requests for a formal hearing, oral argument, and a poll of amateur licensees. The Commission decided that a formal hearing would not be warranted in view of the comments filed. It appeared to the Commission that little evidence would be adduced at such a hearing to aid the Commission in resolving the issues at stake. Accordingly the requests for a formal hearing were denied along with the request for a poll of the amateur licensees.

A general oral argument on the subject of the proposed rules has been set for May 19, 1950 in Washington, D.C. All interested parties who desire to participate in the General Oral Argument should notify the Commission in writing to that effect not later than May 10, 1950. The notification should consist of an original and three copies and refer to Docket 9295. The specific sections of the proposed rules to be discussed should be mentioned, together with an estimate of the time required for the presentation. —30—

S.T.E.N. HAMFEST

THE annual convention of the South Texas Emergency Net will be held in Cuero, Texas, on May 27th and 28th.

The event is a real hamfest with emphasis on emergency and net operation. All amateurs, XYL's, and interested parties are invited to attend. There will be a transmitter hunt as part of the program.

Registration will begin at Legion Hall in Cuero at 9 a.m. and the program will begin at 1 p.m. On both days there will be entertainment as well as technical information interspersed with contests. The YL's and XYL's will have special programs arranged for them.

Tickets may be obtained in advance from Robert Crossman, W5OUA, Box 214, Rockport, Texas.

—30—

ERRATUM

The following resistor values were inadvertently omitted from the parts list accompanying the circuit diagram for the article "A Versatile Recording and Playback Amplifier" by Glen Southworth appearing in the March issue of the magazine. R_{28} is a 5000 ohm, 10 w. unit, R_{29} is a 25,000 ohm, 2 w. resistor, and R_{30} is a 50,000 ohm, 2 w. unit.

* * *

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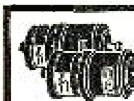
G-E 2J1G1 SELSYNS



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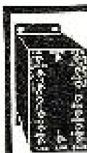

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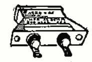

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6R7	.77
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6SB7Y	.81
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6SF5	.48
6SF7	.58
6SG7	.57
6SH7	.35
6SJ7GT	.45
6SK7GT	.40
6SL7GT	.58
6SN7GT	.59
6SN7WGT	.89
6SQ7GT	.43
6SR7	.56
6ST7	.57
6SU7GTY	.75
6SV7	.75
6T7G	.84
6T8	.89
6US/6GS	.63
6U6GT	.48
6U7G	.48
6V6GT	.52
6V6GTY	.90
6V6M	.98
6V7G	1.18
6W4GT	.59
6W7G	.87
6X4	.52
6X5GT	.42
6Y5	1.85
6Y6G	.65
6Y7G	.98
6Z7G	1.08
6Z5/12Z5	1.18
6ZY5G	.67
7A4/XXL	.57
7A5	.65
7A6	.56
7A7	.65
7A8	.69
7AF7	.70

7AG7	$0.69
7B4	.55
7B5	.70
7B6	.58
7B7	.57
7B8	.70
7C4/1203A	.36
7C5	.44
7C6	.69
7C7	.57
7C23	69.00
7E5/1201	.65
7E6	.57
7E7	.59
7F7	.58
7F8	1.03
7G7/1232	.98
7H7	.64
7J7	.98
7K7	1.05
7L7	.67
7N7	.65
7Q7	.57
7R7	.63
7S7	.89
7T7	1.03
7V7	.85
7W7	.85
7X7/XXFM	.85
7Y4	.44
7Z4	.55
10Y	.60
12A6	.17
12A7	.96
12A8GT	.48
12AH7GT	.99
12AL5	.72
12AT6	.43
12AT7	.70
12AU6	.52
12AU7	.62
12AV6	.50
12AX7	.63
12BA6	.55
12BA7	.56
12BD6	.75
12BE6	.59
12BF6	.54
12C8	.32
12E5	.98
12F5	.55
12H6	.27
12J5GT	.33
12J7GT	.52
12K7GT	.57
12K8	.59
12L8GT	1.59
12Q7GT	.55
12S8GT	.79
12SA7GT	.55
12SC7	.55
12SF5GT	.54
12SF7GT	.50
12SG7	.52
12SH7	.58
12SJ7GT	.45
12SK7GT	.51
12SK7M	.52
12SL7GT	.54
12SN7GT	.47
12SQ7GT	.45
12SR7	.48
12X3	.90
12Z3	.72
14A7/12B7	.67
14AF7	.86
14B6	.65
14B8	.77
14C7	.86
14F8	.75
14H7	.63
14J7	.80
14N7	.86
14Q7	.55
14R7	.65
14X7	.98
15E	1.44

15R	$0.75
FG17	3.98
RK18	.98
19	.95
19BG6G	1.98
19T8	.89
20	1.17
RK20A	6.98
PJ21	4.98
REL21	4.85
RX21	3.20
PJ22/CE1C	1.49
24A	.40
24G/3C24	.45
25A6	1.04
25A7	2.98
25AC5GT	1.08
25B5	1.39
25B6	1.49
25C6	1.18
25BQ6GT	.89
25L6GT	.49
25W4GT	.70
25N6	1.69
25Y5	1.08
25Z5	.40
25Z6GT	.47
26	.42
FG27A	9.50
28D7	.35
30	.39
31	.49
32	.89
FG32	4.98
32L7GT	.85
33	.69
FG33	8.49
34	.33
35/51	.59
35A5	.65
35B5	.54
35C5	.49
35L6GT	.38
35W4	.38
35Y4	.49
35Z3	.61
35Z4GT	.49
35Z5GT	.49
REL36/6J4	.54
36	.61
37	.36
38	.34
39/44	.25
CRC40	.54
41	.49
43	.49
45S/VT52	.27
45Z3	.54
45Z5	.51
46	.65
48	1.56
50	1.49
EF50	.40
50A5	.73
50B5	.54
50C5	.59
50C6	1.18
50L6GT	.52
50X6	.98
50Y6	.63
53	.84
57	.47
58	.53
59	.84
RK61	1.98
RK65	24.95
HY69	2.29
70A7	1.49
70L7GT	1.10
71	.65
72	.95
CRP72	1.37
73	1.67
NR74	.29
75	.53
76	.38
77	.45
78	.45

79	$0.84
80	.35
81	1.29
FG81A	4.45
82	.84
82V	.95
83	.99
83V	.89
84/6Z4	.56
85	.57
89	.32
VR92	.25
FG104	14.98
FG105	10.75
VU111	.49
HY114B	.81
HY115/145	.80
117L7	1.23
117N7GT	1.36
117P7GT	1.20
117Z3	.49
117Z6GT	.77
117Z7GT	1.49
F127A	16.95
CV148	7.90
155	.98
FG166	49.00
FG172	19.50
FG190	12.98
205B/VT2	1.69
211/VT4C	.42
RX215	9.95
WE215A	.25
227A	2.90
231	1.20
250TH	24.98
250TL	24.49
282B	8.49
304TH	3.70
304TL	1.39
307A/RK75	3.60
316A	.49
327A	2.70
350	1.23
350B	1.88
355A	14.15
368AS	3.75
371B	.84
380A	.79
388A	.89
393A	3.65
394A	3.65
395A	4.75
417A	19.95
GL434	2.90
446A/2C40	1.17
446B	1.80
450TH	17.75
450TL	49.95
GL451	1.90
460/HF200	9.98
WL468	6.75
CK506AX	1.29
RH507	9.98
527	12.95
530	12.95
531	1.80
WL531	1.95
CK533AX	1.49
GL534/1S21	1.95
544	4.98
GL546	1.69
550P1	19.95
CK551AXA	1.69
575A/975	12.65
601B	.19
HY615	.24
WL619	19.75
KU627	1.49
631P1/SN4	3.98
WL632A	8.98
701A	2.90
702A/702B	2.75
703A	3.75
704A	1.08
705A/8021	1.05
707	7.98

710A/8011	$0.65
713A	1.49
715B	6.95
717A	.61
721A	2.65
722A/287A	9.95
723A	6.95
723A/B	14.95
724A/B	3.90
725A	6.90
726A	4.98
726C	29.98
730A	10.90
801A	.45
802	4.15
803	3.45
804	6.90
805	3.59
807	1.49
808	1.25
809	2.70
810	7.90
811	2.45
812	2.98
813	8.90
814	2.61
815	2.40
816	1.05
826	.39
SD828	2.98
829B	7.29
832A	4.87
836	.98
837	2.35
838	3.20
842	2.75
843	.39
845	3.95
851	13.95
860	2.98
861	10.79
864	.45
865	1.90
866A	1.04
866Jr	1.00
868/PJ23	1.90
869	30.00
872A	1.49
GE872A	2.98
874	.55
876	.36
878	1.95
884/6Q5G	1.59
885	.87
920	2.70
922	1.19
923	.85
927/CE25	1.26
930	.80
931A	3.95
954	.18
955	.24
956	.24
957	.20
958	.35
SD968	2.95
991	.23
1000UHF	59.95
FM1000	.95
CK1005	.18
CK1006	.64
CK1089	3.98
CK1090	2.69
R1100	5.00
R1130B	12.00
1603/6C6	1.39
1609	5.98
1613/6F6X	.45
1614	1.42
1616	.75
1619	.16
1620	4.95
1622	1.75
1624	1.25
1625	.33
1626	.35
1629	.23
1632	.89
1633	.97
1635	1.49
1641/RK60	.48
2050	.93
2051	.36
R4340	36.00
5514	4.85

5516	$5.85
5517/CK1013	1.39
UX6653	.69
8012A	1.35
8013A	2.50
8020	.97
9001	.34
9002	.23
9003	.30
9004	.34
9006	.17

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3AP1	4.63
3BP1	2.55
3BP1A	7.98
3CP1	2.65
3CP1-S1	2.49
3DP1	3.75
3EP1	2.65
3FP7A	.98
3GP1	8.95
3HP7	4.80
3HP14	9.98
4AP10	4.70
5AP1/1805	3.75
5BP1	1.98
5BP4	4.50
5CP1	1.75
5CP7	3.70
5FP5	6.49
5FP7	1.26
5FP14	18.95
5GP1	6.95
5HP1	4.95
5HP4	6.75
5JP2	11.75
5LP1	18.00
5MP1	4.75
7BP7	4.65
7CP1	12.95
7HP7	5.95
9GP7	12.33
9LP7	18.00
10BP4	20.95
10FP4	24.50
10HP4	27.50
12DP7	12.49
12GP1	49.98
12GP7	18.00
12JP4	27.00
12KP4	34.00
12LP4	27.45
12QP4	32.00
12RP4	36.00
15DP4	56.00
16AP4	55.00
16DP4	49.98
16FP4	57.50
16RP4	49.98
16TP4	49.98
19AP4	96.00
19CP4	85.00
902	3.15
905	2.90
910/3AP1	4.63
912	89.98
914	45.00

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6-11	.49
PM5	.98
PM6	.98
PM7	.98
PM8	.98
9-3	.49
10-4B	.49
13-4	.49
20-4	.49
K49A	.36

K55B	$0.36
M55B	.36
L62A	.49
K80B	.36
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49, Box 10	.60
55, Box 10	.50
64, Each	.07
S6/T4/3W.	.18
100W/20V.	.25
291, Box 10	.36
311/28V.	.15
313/28V.	.15
323/3V.	.10
Sylvania S6/6W/120V.	.15
Wstghs C7/7W/120V	.09

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15W/125V	$ .08
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NE32	.35
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1N22	1.39
1N23	1.39
1N23A	1.50
1N23B	2.49
1N25	2.69
1N26	2.69
1N27	1.75
1N32	18.00
1N34	.67
1N35	2.79
1N48	1.15
1N51	1.08

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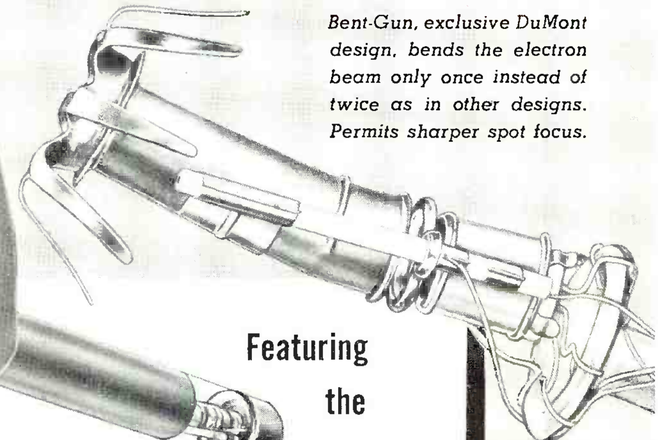
the new DUMONT type 12LP4A TELETRON*

New Du Mont gray face plate



Bent-Gun, exclusive DuMont design, bends the electron beam only once instead of twice as in other designs. Permits sharper spot focus.

Specifications

Overall Length	18¾"
Diameter of Bulb	$12\frac{7}{16}$"
Useful Screen Diameter	11"
Base	Duodecal 5-Pin
Bulb Contact	Recessed Small Cavity Cap
Anode Voltage	11,000 Volts D. C.
Grid No. 2 Voltage	250 Volts D. C.
Focusing Coil Current	110 Approx. Ma D. C.
Ion Trap Current	120 Approx. Ma D. C.
Grid No. 1 Circuit Resistance	1.5 Max. Megohms

Featuring the

BENT-GUN

For the first time this popular tube type is offered with all the refinements of the Du Mont design.

Modification of the Bent-Gun makes possible the use of single or double magnet beam-benders thus assuring direct interchangeability with other 12LP4's, yet assuring that extra sharpness possible only with the Du Mont gun structure.

An ideal tube for improving the performance of existing receivers, using the Type 12LP4, or for incorporation in new receiver design.

Literature and quotations on request

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