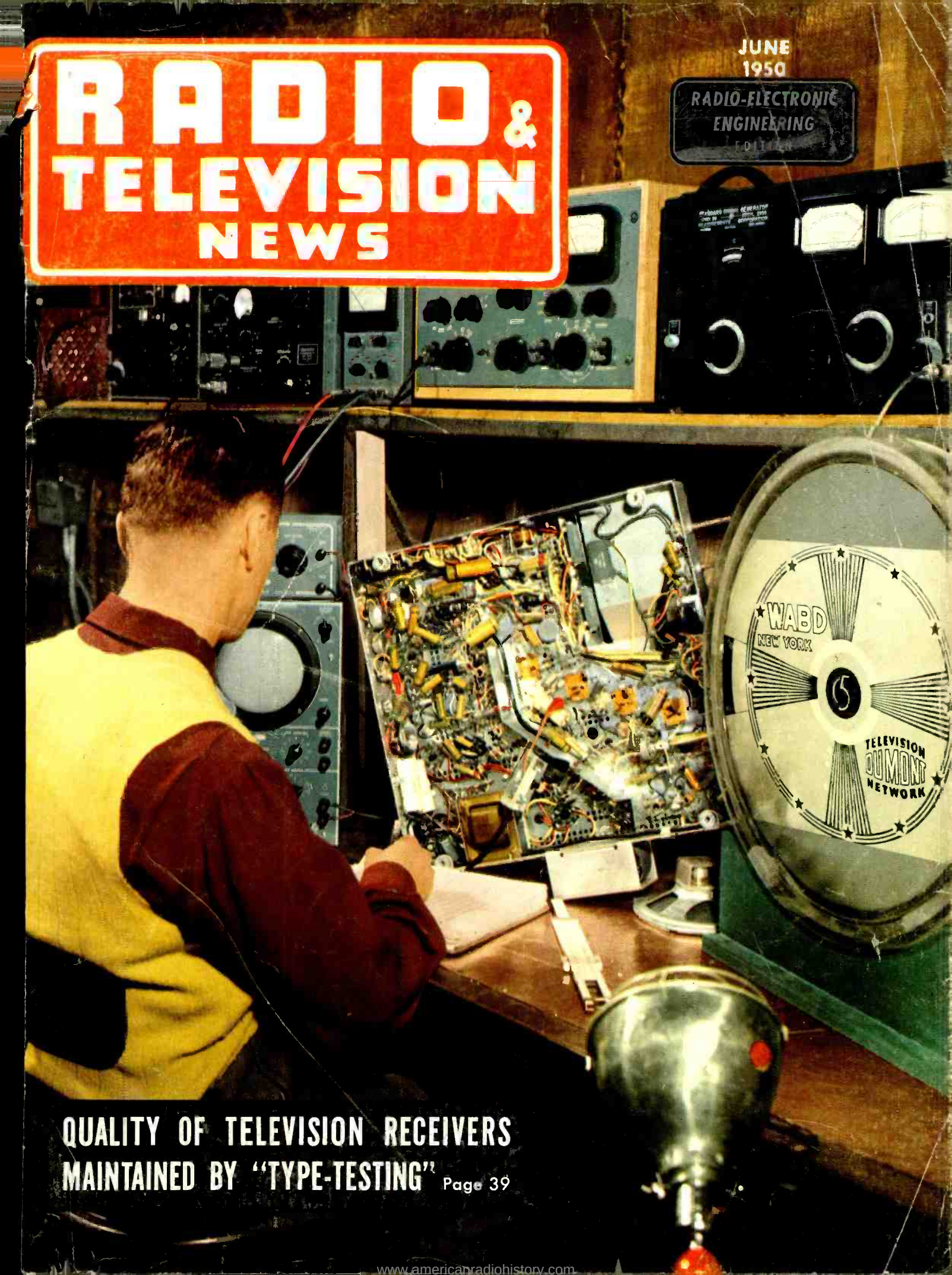
JUNE
1950

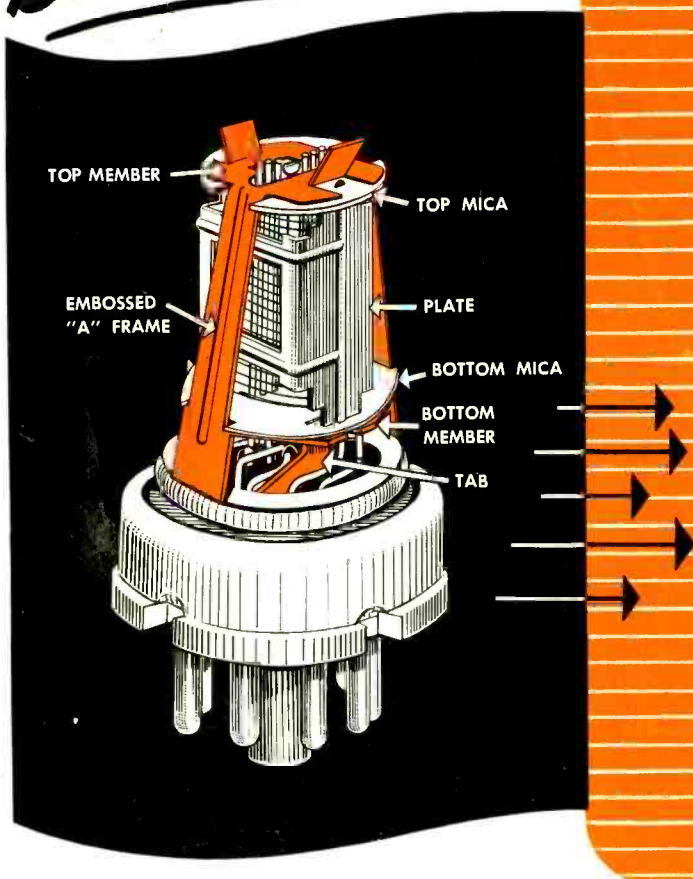
RADIO & TELEVISION NEWS

RADIO-ELECTRONIC ENGINEERING EDITION



QUALITY OF TELEVISION RECEIVERS MAINTAINED BY "TYPE-TESTING" Page 39

Built for Service ... SINCE 1950



The inside story of Cunningham quality

2. How the Cunningham "A" Frame Minimizes Vibration. The unflagging search for ways to make Cunningham tubes ever better accounts for their *first-line* quality. A case in point is the RCA-developed "A" frame construction used in 6 of the metal-type r-f amplifier tubes.

The "A" frame—shown in color—consists of a top member, two vertical members, and a bottom cross member. The ribbed uprights are welded to the cross member; the feet of the uprights are welded to the grounded metal header. In effect a truss, this rigid "A" frame acts as the supporting member for the tube elements. Its increased resistance to vibration reduces the possibility of electrode displacement due to wear on the holes in the mica spacers . . . and thereby plays an important role in reducing microphonics and maintaining uniform tube characteristics.

In addition to imparting rigidity to the tube elements, the top and bottom members of the "A" frame serve as shields. The two ears on the top member add to its effectiveness in reducing grid-to-plate capacitance; the tab on the lower member—which extends down to the stem—provides additional shielding between grid and plate leads.

• • •

The "A" frame construction is but one of many improvements that contribute to the dependability and long life of Cunningham tubes. Its use explains why more and more servicemen are placing their confidence in Cunningham.

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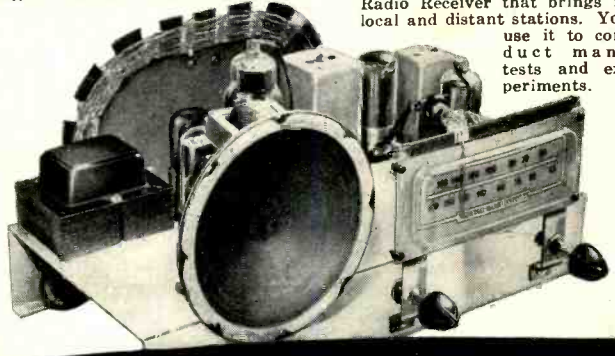

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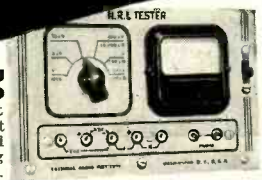

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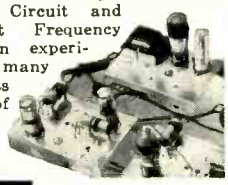

YOU BUILD this Signal Generator as part of my Servicing Course for more valuable experience. It provides amplitude-modulated signals for many interesting tests and experiments.

VETERANS

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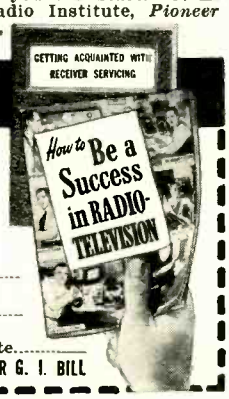

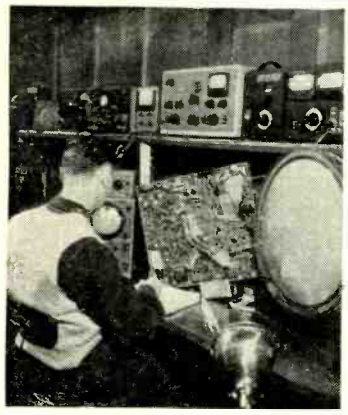

COVER PHOTO: John J. Mihalik compiles performance data on a production model television receiver at Allen B. Du Mont Laboratories, Inc. (Kodachrome by V. Stack, Du Mont)

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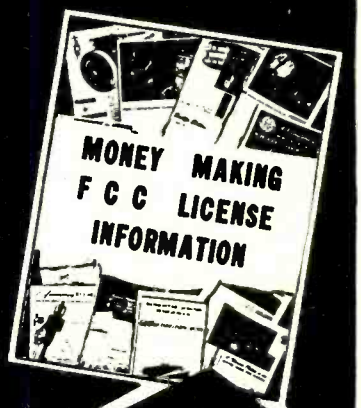

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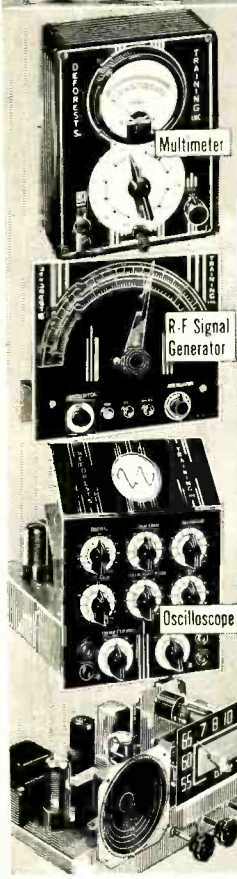

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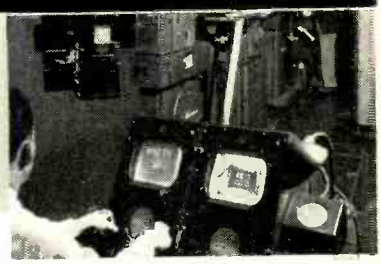

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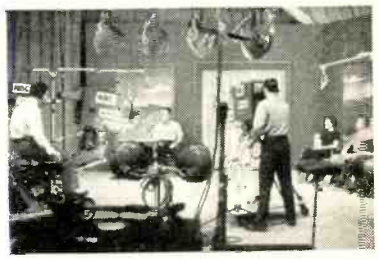

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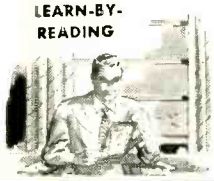

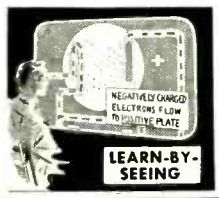

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For the RECORD

BY THE EDITOR

TELEVISION ANTENNA INSTALLATIONS

IN THE not too far distant future will emerge a vast u.h.f. television system comprising hundreds of transmitters and many millions of u.h.f. receivers. Television will be available for all to see and viewers will have a choice of black and white or color for their entertainment. These sets will probably be greatly simplified and channels will be restricted to those required in the area in which the set is designed to operate. Channels not needed probably will be eliminated from the circuitry. New audio circuits will be developed and special attention given to the matter of stability, which will be most critical in the u.h.f. region.

It is highly probable that these sets will, except in remote cases, employ built-in antenna systems and will be capable of interference-free reception in practically every town and hamlet in the United States.

In the meantime, however, there exists a situation which is preventing many set owners, particularly in fringe areas, from enjoying their television programs. We refer to sloppy and inadequate outside television antenna installations. Common sense tells us, after seeing typical television arrays, that many customers are literally being robbed of precious signal strength.

We had an occasion recently to drive through several suburbs and cities in the Chicago area. These were industrial centers for the most part and workers lived in modest homes, situated near oil refineries, steel mills, railroad yards, and other manufacturing centers. Hundreds of television antennas were to be seen, many of them close enough for inspection. We paid particular attention to approximately 200 such installations and it became quite obvious that in most cases the antennas and lead-ins were placed at random with little apparent concern or consideration for good engineering practice.

The great majority of those we saw were mounted to chimneys or on poles and many of these arrays were completely enveloped in clouds of smoke. However, the worst examples were to be seen in the manner of connecting the twin-lead from the antenna to the receiver. A great many of these lead-ins were tacked directly to the roof shingles for stretches up to 100 feet in length. Most of these twin-leads lay flat and did not employ a recommended twist which is considered, by most television technicians, as essential.

Many of these twin-leads were casually draped over rain gutters and others were seen twisted around downspouts before entering the building.

It is amazing how little regard is given by some television technicians to the tremendous loss in signal strength that results from such careless installation. There is apparently no regard given to the leakage to ground of weak signals. Not only does the customer wind up with only a small percentage of the available signal, but the technician is often called in to trouble-shoot unnecessarily. The time to make a happy customer is right at the time of installation. A few cents' worth of stand-off insulators can do wonders to improve signal strength, make for a better and neater job, and result in an all-around good installation. Needless to say the inclusion of a lightning arrestor is a *must* and any good technician will make sure that he includes one with every installation.

It is common knowledge that in industrial areas there is a high content of carbon deposit from smoke. Considerable conductivity exists on roof tops in such areas. If precautions are not taken to keep transmission lines free of contact with these surfaces, there will naturally be considerable leakage to ground of high frequency signals. By the same token, contact between gutter pipes and transmission lines, particularly twin-leads, can result in severe loss of signal strength, due to the fact that such gutter pipes are grounded. On the other hand, it is highly desirable to ground all metal masts used for supporting television arrays. It affords further protection against lightning and reduces interference caused by the building up of static electricity on antennas, due to high wind velocity.

Another common source of trouble encountered in television antenna systems is contact resistance developed by using regular iron bolts for making electrical connections of the antenna to the lead-in. It is far better to use non-ferrous bolts for such applications, or if these are not available, to use aluminum or other non-rusting materials. All of the above becomes of prime importance when we consider the fact that many television sets are not capable of producing quality pictures unless the input section is provided with adequate signals. Any precautions that can be taken to insure maximum signals from the antenna system are certainly worth-while and will result in better performance to the customer and will alleviate many headaches for the television technician. . . . . O.R.

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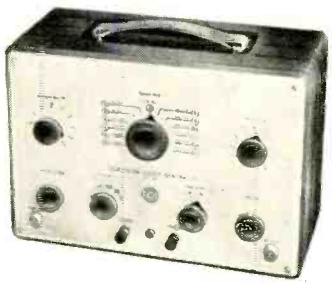

RCA WR-39B TV MARKER GENERATOR. Crystal-calibrated variable frequency signal generator plus 2 built-in crystal oscillators. Provides *dual* markers with WR-59B or any sweep generator when measuring receiver bandwidth on scope. Ranges: 19-110 mc in 4 bands: 170-240 mc in 2 bands—all on fundamentals. Variable 100:1 attenuator. Output, 0.1 rms v, 100 ohms. Permits TV set linearity adjustments in absence of test pattern when variable oscillator is modulated by internal crystal or external oscillator. Serves as heterodyne frequency meter; has detector audio amplifier with speaker. Markers removed 4.5 mc and 250 kc from main marker for TV IF and sound discriminator alignment. Provision for external marker injection. Has crystal-controlled 4.5 mc output for alignment of sets with intercarrier sound. Complete with all tubes, 3 crystals and leads. Blue-gray Hammeroid case, 9¾x13½x7½". For operation on 105-125 v, 50-60 cycles. Shpg. wt., 22 lbs. 84-072. NET **$224.50**

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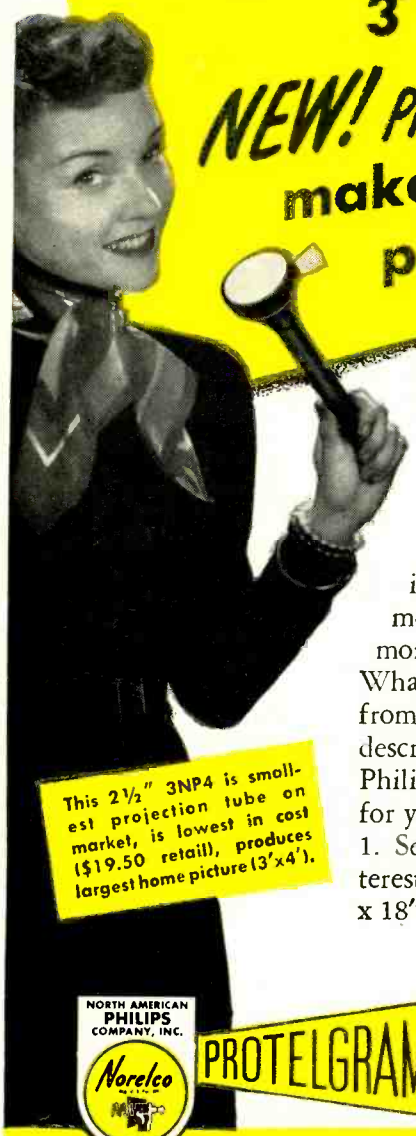

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3. Sell NORELCO DUO-VUE, television's newest, finest and biggest picture used with the customer's direct-view table set to produce 3′ x 4′ pictures on a home-movie screen. A flip of a switch selects either picture, and you can connect DUO-VUE to almost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

Prices slightly higher west of Rockies. Connection charges extra.

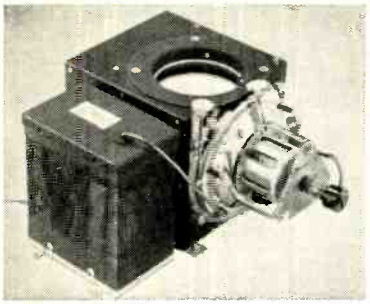
NORTH AMERICAN PHILIPS COMPANY, INC. Norelco PROTELGRAM

NORTH AMERICAN PHILIPS COMPANY, INC.

100 E. 42nd Street, New York 17, N. Y.

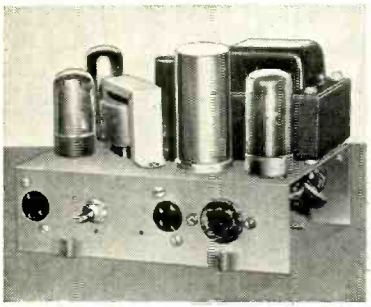
16" Sets to BIG PICTURE TV

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".

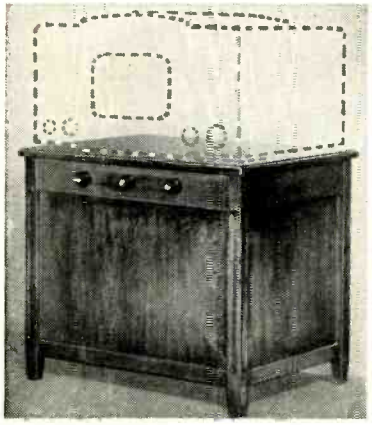


AUXILIARY CHASSIS

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

PROTELGRAM sells itself to customers who want bigger pictures, but are reluctant to take a trade-in loss. You can now use their present TV chassis, connect it with PROTELGRAM in a cabinet such as shown at (3) left. They get a 234 square-inch picture, 13½" x 18".

Sell NORELCO DUO-VUE for largest home-TV pictures

Only with NORELCO DUO-VUE can you offer both direct-view and 3' x 4' movie-size TV . . . and at a reasonable price. This is the *newest thing in television* for your customers who want the best. Lots of sales opportunities in bars, clubs, institutions and hospitals, too.

CONTACT YOUR DISTRIBUTOR OR SEND COUPON TODAY

NORTH AMERICAN PHILIPS COMPANY, INC.
Dept. PK-6, 100 East 42nd Street, New York 17, N. Y.

Gentlemen: Please send full information as checked

- ☐ PROTELGRAM SYSTEM
- ☐ PROTELGRAM SYSTEM with auxiliary chassis
- ☐ NORELCO DUO-VUE unit
- ☐ PROTELGRAM SYSTEM for conversion console

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BM 313 SERIES

• STRENGTH • RIGIDITY • SENSITIVITY

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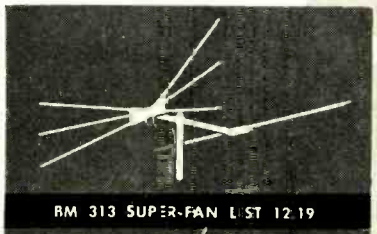
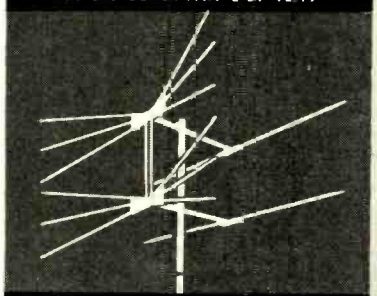
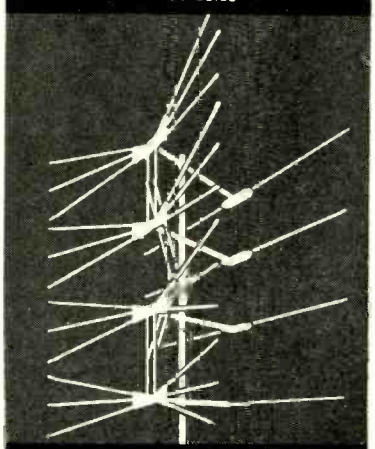


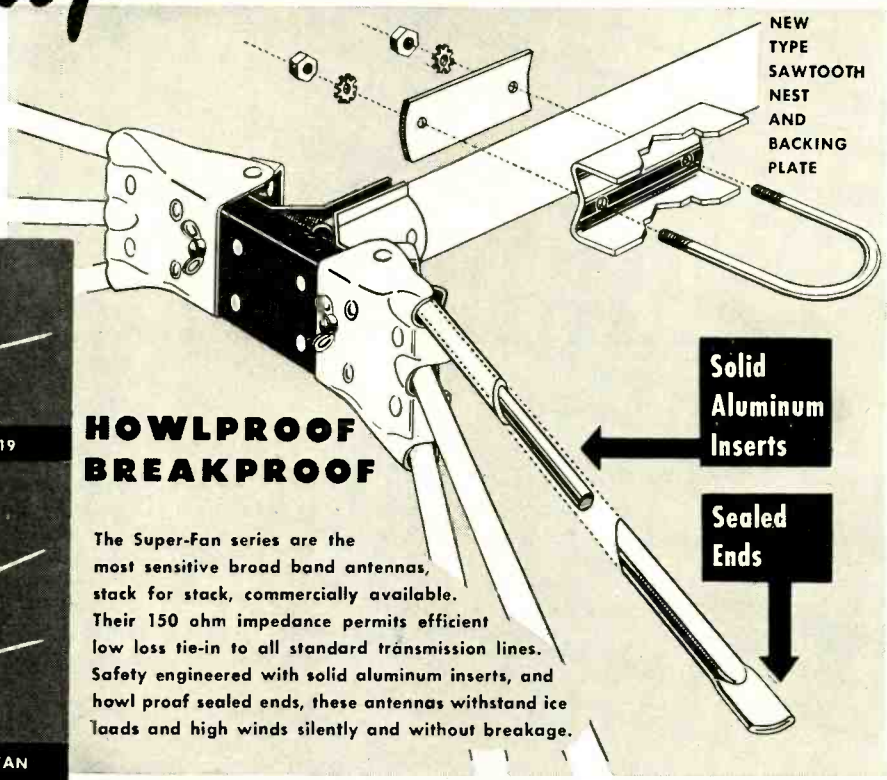
BM 313 SUPER-FAN LIST 12.19



BM 313X2 STACKED SUPER-FAN
LIST 26.25



BM 313X4 DOUBLE STACKED SUPER-FAN
LIST 57.10



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- SMALLER BOX
- SUPERIOR PREASSEMBLY

HOWLPROOF BREAKPROOF

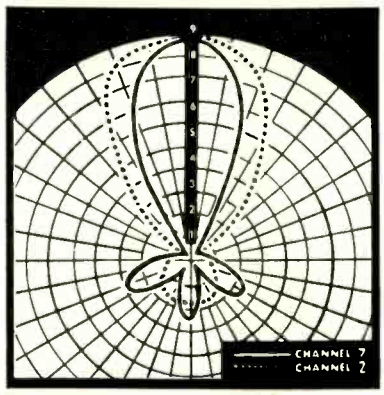
The Super-Fan series are the most sensitive broad band antennas, stack for stack, commercially available. Their 150 ohm impedance permits efficient low loss tie-in to all standard transmission lines. Safety engineered with solid aluminum inserts, and howl proof sealed ends, these antennas withstand ice loads and high winds silently and without breakage.

These models also feature *Swing-Lock-Action,* the patented preassembled feature of all Channel Master antennas. Just swing out elements and lock them in place — as easy as that.

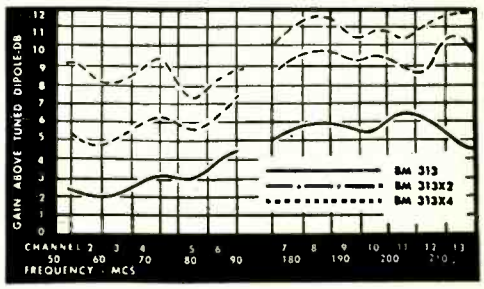
A TELEVISION SET IS NO BETTER THAN ITS ANTENNA
THERE IS NO BETTER ANTENNA THAN THE SUPER-FAN

Send for FREE Technical Literature

GAIN OF THE SUPER-FAN SERIES



HORIZONTAL POLAR DIAGRAMS



GAIN CURVES

CHANNEL	2	3	4	5	6	7	8	9	10	11	12	13
313	2.1	2.2	3.0	3.0	4.0	5.5	5.8	5.8	5.7	6.5	6.0	6.7
313X7	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	11.2	11.9

GAIN IN DB. ABOVE TUNED DIPOLE

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IF IT'S NEW...

KEN-RAD DEALERS HAVE IT!

THE way to get ahead, stay ahead, in radio-TV servicing, is *stock and install Ken-Rad tubes!* New types—because Ken-Rad designing sets the pace—come to you ahead of time. As 1950 home receivers appear in your neighborhood, G-E and Ken-Rad tube research enables you to service new sets with the ultra-modern types they require, whether TV-picture, metal, glass, or miniature. Ken-Rad tubes you receive today, fill tomorrow's needs!... 6AV5-GT is one of many advanced types you will find in modern TV circuits. Your Ken-Rad distributor has this new tube, and others, that will give you rail position in the race for more service business. Phone or write him at once!

6AV5-GT BEAM POWER TUBE

With its companion type the 25AV5-GT (heater requirement 25 v as against 6 v), this new tube serves as a horizontal-deflection amplifier in TV. Operating direct from a 125-v power supply, accessories such as a transformer and high-voltage filter capacitors can be done away with, which adds to circuit simplicity and economy. Design of the tube gives it the ability to withstand high surge plate voltages.... By stocking the Ken-Rad brand, you will have the 6AV5-GT and 25AV5-GT—and other important new types—*now*, when required to service late-model receivers!

KEN-RAD *Radio Tubes*

PRODUCT OF GENERAL ELECTRIC COMPANY

Schenectady 5, New York

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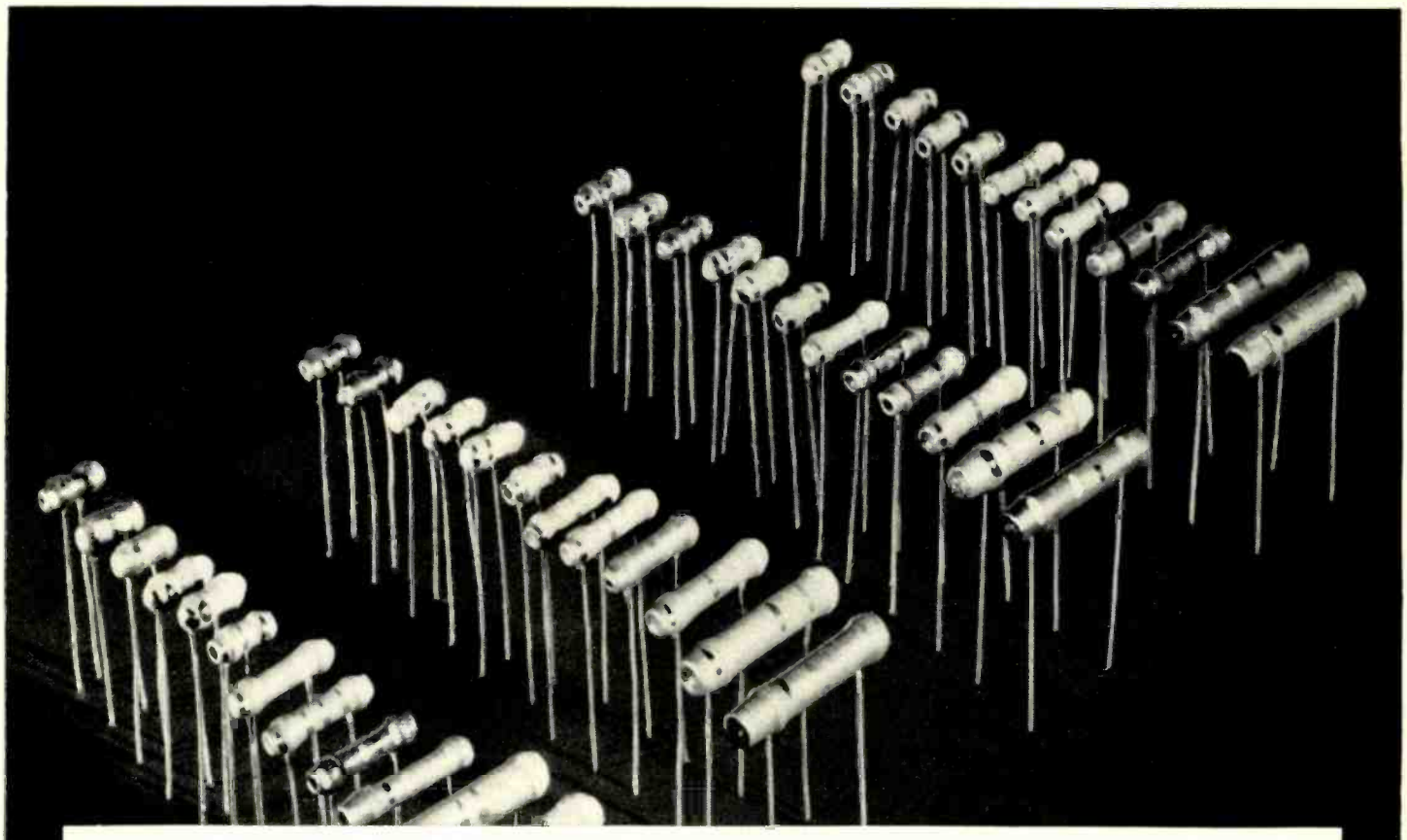
NOW COMPLETE!

The Ken-Rad TV-service course is ready from A to Z—eight helpful lessons packed with down-to-earth instruction in how to service TV receivers successfully... and profitably. See your Ken-Rad distributor for your income-building copy!

NOW..A NEW, WIDER LINE



Choose from this Complete Ceramic Capacitor Line

Your radio parts distributor can supply you with these BC HI-KAP Tubular Ceramic By-pass and Coupling Capacitors in the following values — all rated at 600 WVDC, flash tested, 1000 VDC. Packaged in cellophane envelopes, 5 of one value per envelope.

Capacity	CRL Cat. No.	Capacity	CRL Cat. No.	Capacity	CRL Cat. No.
10MMF	D6-100	120MMF	D6-121	1,000MMF	D6-102
12MMF	D6-120	150MMF	D6-151	1,200MMF	D6-122
15MMF	D6-150	180MMF	D6-181	1,500MMF	D6-152
18MMF	D6-180	200MMF	D6-201	1,800MMF	D6-182
20MMF	D6-200	220MMF	D6-221	2,000MMF	D6-202
25MMF	D6-250	250MMF	D6-251	2,200MMF	D6-222
27MMF	D6-270	270MMF	D6-271	2,500MMF	D6-252
33MMF	D6-330	300MMF	D6-301	2,700MMF	D6-272
39MMF	D6-390	330MMF	D6-331	3,000MMF	D6-302
40MMF	D6-400	390MMF	D6-391	3,300MMF	D6-332
47MMF	D6-470	400MMF	D6-401	4,700MMF	D6-472
50MMF	D6-500	470MMF	D6-471	5,000MMF	D6-502
56MMF	D6-560	500MMF	D6-501	5,600MMF	D6-562
68MMF	D6-680	560MMF	D6-561	6,800MMF	D6-682
75MMF	D6-750	680MMF	D6-681	7,500MMF	D6-752
100MMF	D6-101	750MMF	D6-751	10,000MMF	D6-103

For other ceramic capacitor replacement needs, use CENTRALAB's line of TV HI-VO-KAPS, KOLORDISKS and TC capacitors.

OF TUBULAR BC HI-KAPS!

Mr. Service Engineer . . . If your profits and reputation depend on guaranteed repairs, then this message is for You! Centralab . . . the First name in ceramic components . . . gives you famous ceramic tubular BC Hi-Kaps in 48 different and many new values. Check their advantages . . . see why CRL BC Hi-Kaps are absolutely safest for guaranteed repairs.

The present trend to *guaranteed service policies* demands that service engineers take no profit-risking chances with replacement parts of doubtful performance and durability.

Chart below gives you the facts. Read them. See why we say *no other tubular by-pass and coupling capacitors made will outperform or outlast CRL Tubular Ceramic BC Hi-Kaps!*

Centralab

DIVISION OF GLOBE-UNION INC., MILWAUKEE, WIS.

Check these Features . . . See for Yourself why CRL BC Hi-Kaps are "safest"

"HI-KAP" FEATURES	DESCRIPTION	WHAT IT MEANS TO YOU
1. Impervious to moisture	Ceramic-X is non-hygroscopic. Moisture absorption is .007% or less.	No deterioration, no shorting. Longer life even under the most adverse conditions of humidity.
2. Low mass weight 3. Small Size 4. High capacity	AV. WT. / DIMENSIONS / VALUES .029 oz. — D— .260" L— .530" — 10—390 mmf. .044 oz. — D— .260" L— .810" — 400—3000 mmf. .050 oz. — D— .280" L— .900" — 3300—5000 mmf. .082 oz. — D— .330" L—1.200" — 5600—10,000 mmf. Ratings: 600 WVDC — 1000 flash test.	For unit size and weight, Centralab BC "HI-KAPS", made with Ceramic-X, are the only capacitors on the market which provide these voltage ratings.
5. Special insulation	Low power factor resin and high temperature wax coatings, with an additional special phenolic jacket.	Prevents any possibility of shorting to adjacent leads, chassis or components.
6. Convenient side leads	Heavy No. 22 gauge tinned copper, silver soldered to electrodes.	Permit rapid, close-coupled connections. No tricky bending or fitting required.
7. Low power factor	Initial — .6%. After 100 hours, 95% humidity test — 3.0%.	More efficient circuit operation, fewer failures.
8. High leakage resistance	Initial — 5000 megohms. After humidity —500 megohms.	Long life, more efficient performance.
9. Maximum dependability	Pure silver electrodes, electro-bonded to Ceramic-X dielectric. Protected against oxidation or mechanical damage by coatings of electrolytic copper and solder.	Moisture and puncture proof. Will not short or become intermittent.
10. Factory tested	For your protection, all units 100% factory tested before packaging and shipping.	Your guarantee to your customers of reliable service and performance.

Spot Radio News

★ *Presenting latest information on the Radio Industry.*

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

COLOR DOTS, three hundred and fifty-one thousand of them on the face of a picture tube, paraded before the anxious eyes of officialdom and the press, during what it was expected would be the *cleanup* hearings on color by the Commission, as the first direct-view color TV tube made its debut in studios in downtown Washington, with a gala show from WNBW to spark the occasion.

Three receivers were employed for the demonstration, picking up the colorcasts from the Wardman Park Hotel, three air-miles away over the standard black-and-white channel four. In two of the receivers the color tubes had been installed, while the third was a run-of-the-mill black and white model. On view was a festive affair, *Pan Americana,* with strikingly garbed Latin-American singers and dancers, and quite a large orchestra, whose members were attired in plenty of reds, greens, and blues.

In one of the receivers was a single-gun picture tube, while a three-gun picture tube was featured in the second set. *(Editor's Note: For a complete discussion of the technical details of the new tubes see page 46 of this issue.)*

While members of the Commission were hesitant to voice their opinions about the new-tube results, there was a general air of optimism about the studios among the specially-invited audience, some frankly declaring that the pictures were the best they had seen in any color test.

Dramatic single-color-tube developmental news also hit the hearing rooms, from another source, about a week before the elaborately-prepared demonstrations. Testifying in what appeared to be a routine manner, *Philco's* research head, David B. Smith, suddenly declared that his company was developing a direct-view tube, which was, as he described it, in the research stages. The Commissioners perked up when they heard this report, and began peppering him with questions. Commissioner George Sterling wanted to know if the tube might be installed in present receivers, through some modification. Smith replied that it was feasible, although he wouldn't recommend the step. Further questioning revealed that it was his opinion and that of his company that direct-view color tubes were the answer to the eventual color receivers, but no standards should be set until the tubes had been field tested thoroughly, and the variously described systems had been subjected to exhaustive tests, under all types of conditions. Madame Commissioner Frieda Hennock quizzed Smith, asking when commercial color TV might be available, and when the test period might be over. And, as in earlier sparring sessions on the witness stand, Smith declared that he didn't know the answers, and then repeated that standards should wait until we know more about the art.

The explosive testimony period continued, shortly after the special tests, with both *NBC* and *CBS* contributing to the fireworks. In one session *NBC* Prexy John H. McConnell told the color judges that if the *RCA* system received their blessings and standards were prescribed for it, WNBW would extend its color programming to a twelve-hour schedule, and that WNBT, in New York, would receive equipment to inaugurate colorcasts.

Describing the possibilities for transmissions from other cities, McConnell said: "Our stations in Chicago and Cleveland would receive color over a relay of the telephone company, which has said that such facilities would be available this summer. . . . Thus these stations would be able to transmit in color before they had their own facilities for originating color broadcasts."

Detailing the extent of the relays which would be available for service to other stations, McConnell noted that he understood such intermediate points as Providence, Philadelphia, Pittsburgh, Toledo and Davenport-Rock Island, would be linked before the summer was over.

The *CBS* front lines were buzzing as the *NBC* executive left the witness box, and soon after *CBS* Prexy Frank Stanton began explaining what his network would do with color. He declared that within three months, *CBS* would be able to present twenty hours of color programs, emanating from both studio and remote spots. An extremely revealing analysis of the costs *CBS* has had to meet in evolving color was also placed in the record by Stanton, who stated that over four million dollars had been spent thus far, with

This picture was taken in the Bridgeport office of The Southern New England Telephone Company, one of the 22 operating telephone companies which the Laboratories serve through the Bell System.

Cutting Board for Telephone Costs

Few of these tools have sharp edges. But they are powerful cost cutters. Whenever a telephone craftsman reaches for one, he finds the right tool ready to his hand. There's no time wasted trying to do a complicated job with makeshift equipment.

Most telephone tools are highly specialized. 90% of dial system tools were designed by Bell Laboratories. Each saves time in maintenance, installation or construction.

There are tools with lights and mirrors to work deep within relay bays; tools to brush, burnish and polish; tools that vacuum clean—even a tool to weld on new contact points without dismantling a relay. There are gauges to time dial speeds, others to check spring tension. Some look like a dentist's instruments. Some you have never seen.

Keeping the telephone tool kit abreast of improvements is a continuing job for Bell Telephone Laboratories. It's another example of how the Laboratories help keep the value of your telephone service high, the cost low.

BELL TELEPHONE LABORATORIES

WORKING CONTINUALLY TO KEEP YOUR TELEPHONE SERVICE BIG IN VALUE AND LOW IN COST

two-and-a-half million for the old 12 megacycle system and the remainder for the present 6 megacycle development.

The possibilities of multiple standards, offered as a means of solution during earlier hearings, received quite a beating from both the *CBS* and *NBC* headmen, with McConnell declaring that only a compatible system would be suitable, since a dual setup, involving converters and adapters, would upset program scheduling. Broadcasters would be unable to transmit color during the choice evening hours because, he declared, they would lose a large part of the black-and-white viewing audience.

Stanton didn't think the multiple idea would work out either, because he felt that industry would not cooperate voluntarily on standards, and the *CBS* system could not be made to operate on a completely compatible basis.

The compatible headache was bounced around by others who came to the stand, as the days went on, particularly during the reappearance of David Smith, who during a cross examination session, on behalf of *Philco* and an RMA committee, said that the selection of a non-compatible system could put manufacturers out of business. He pointed out, too, that a change in the present standards, which would prompt the need for attachments, would cause a public reaction that could seriously affect receiver sales.

The double-standard idea was also riddled by criticism from Smith who indicated that his company probably would not produce sets for testing during a limited commercial trial period.

Blistering remarks seemed to be the order of the day, with even mild-mannered FCC Lab Division Chief E. W. Chapin striking out with some bold commentary. Reviewing a series of tests completed at the Laurel, Maryland labs, Chapin said that from the data available, it appeared as if the *RCA* color system may require some 2 db. more protection from offset cochannel interference than the *CBS* system. Observations indicated a figure of near 30 db. for both of the systems for offset operation, and it was believed that such a value would be sufficiently accurate for allocation purposes. These values, Chapin said, were tolerable for satisfying only fifty percent of the listeners in a given region and higher values will be required, depending on the percentage which it is decided to protect in a given region. The *CTI* system did not fare too well in the Chapin report, the review revealing that *CTI* pictures, as received on an ordinary monochrome receiver, were so degraded that it was not possible to attempt to determine interference ratios.

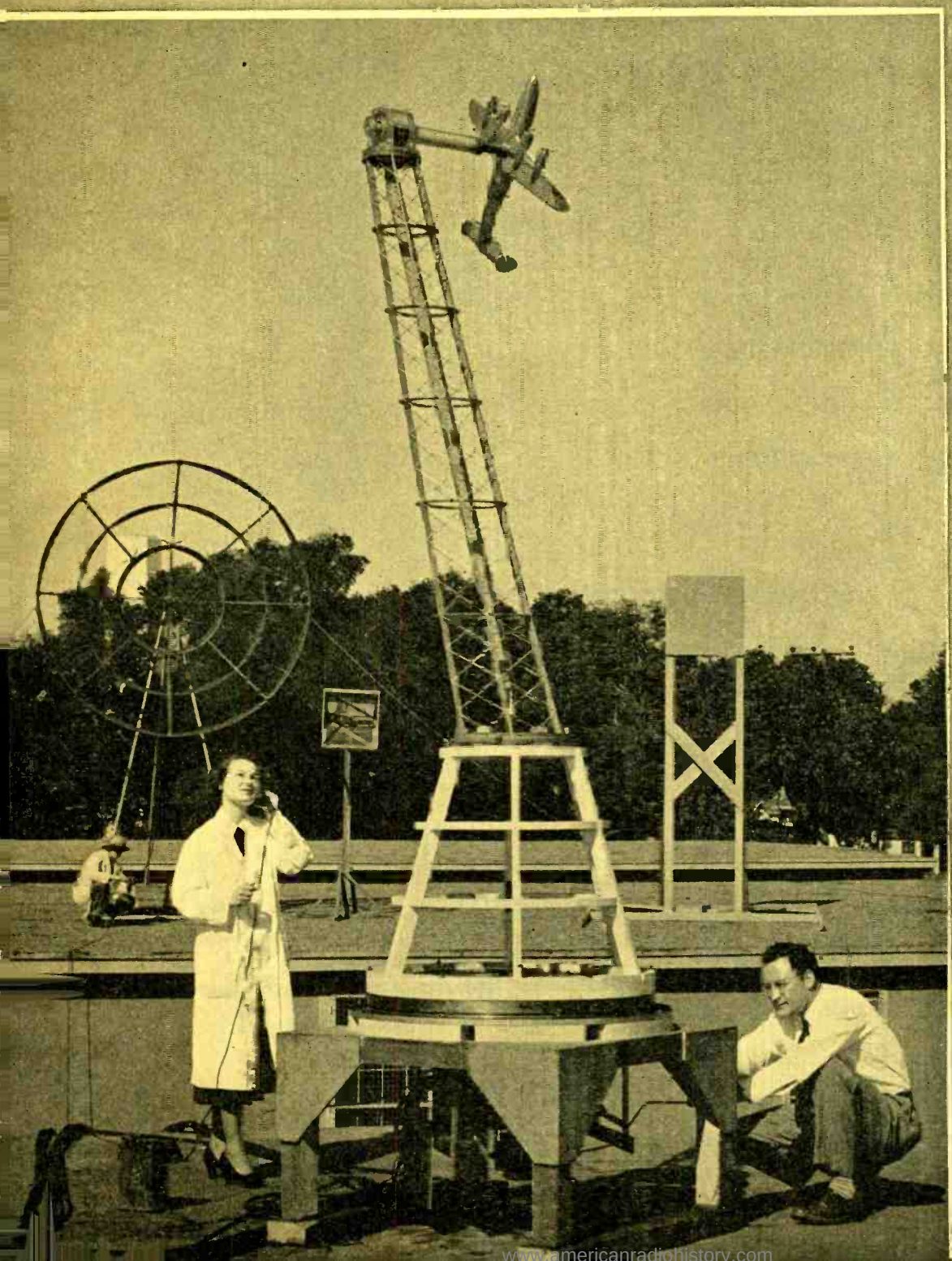
Commenting on the subject of interference, Chapin said that with either the *CBS* or *RCA* transmission in black and white there was no significant

(*Continued on page* 128)

JUNE, 1950

RADIO & TELEVISION NEWS

RADIO-ELECTRONIC Engineering



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RADIO & TELEVISION NEWS

RADIO-ELECTRONIC Engineering

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JUNE, 1950

RADIO-ELECTRONIC ENGINEERING is published each month as a special edition in a limited number of copies of RADIO & TELEVISION NEWS, by the Ziff-Davis Publishing Company, 185 N. Wabash Avenue, Chicago 1, Illinois.

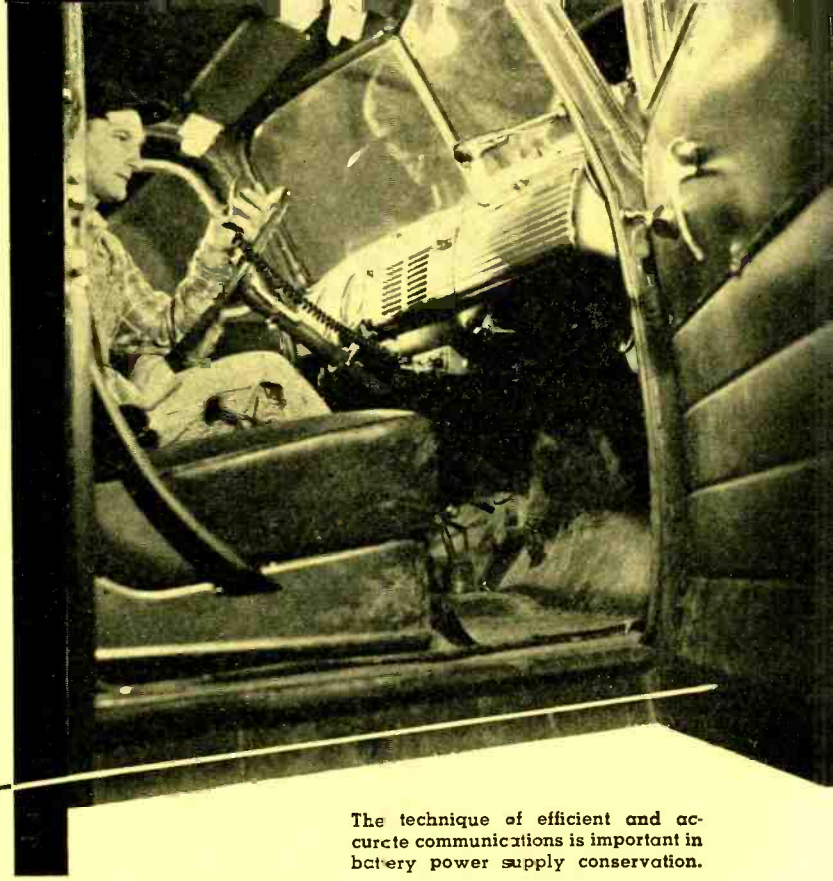
COVER PHOTO—Courtesy of Stanford Research Institute

Irene Reese, junior research engineer, and Robert DeLiban, research engineer of the Aircraft Radio Systems Laboratory, Stanford Research Institute, studying an experimental antenna on a 1/43rd-scale model of a Lockheed Constellation to determine the manner in which the antenna characteristics depend upon the angular heading of the aircraft.

FM in the POWER INDUSTRY

By P. M. OHLINGER
Design Engineer

Equipment and techniques used in both fixed and mobile installations for communications and control purposes.



The technique of efficient and accurate communications is important in battery power supply conservation.

"THE power is off." This phrase used to mean only the inconvenience of hunting up the old lamp or candle, but now, with the ever widening application of electrical power to daily life, serious problems are presented when service is suddenly interrupted.

Outages are bound to occur and the only thing to do is to cut their duration. Lines and equipment are being constantly improved but Mother Nature can be quite rough at times. It is at these times, when outages occur simultaneously over a widespread area, causing maintenance crews work which seems to be set at them as though by a well-planned diversified attack, that the most efficient use of man power and equipment is urgently needed.

FM two-way radio communication is now being employed by the REA and private power companies as a means of shortening outage time while materially cutting maintenance costs and providing better service.

In this article, the equipment and installations in use by REA and private power companies will be discussed. Illustrations are of the Nishnabotna Valley Rural Electric Cooperative, Harlan Iowa. This REA installation has been in successful operation for over a year. Field experiences, problems, operating procedures, maintenance, licensing, system planning and costs are very similar whether the installation be for the REA or a private power utility. The equipment used in the illustrations of the installation to be described was manufactured by *Motorola, Inc.*

The electrical and operational characteristics of two-way radio equipment of different manufacturers are similar although physically and mechanically the equipment may be different.

Since the opening of this field of communication, sales competition has increased sharply and customer's prices and manufacturer's service have been to the advantage of the customer.

Planning the System

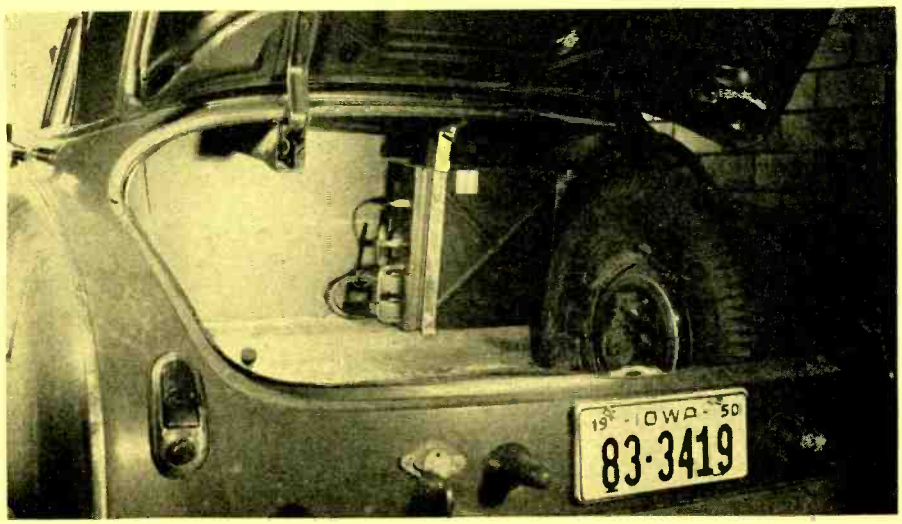
After it has been decided that two-way radio communication is needed for better system operation, there are several things which must be considered in planning the system:

1. *Area to be covered.* The equipment to be installed must be that which will do the job. Equipment size and type, antenna installation, terrain, boundary pattern of the area to be covered and the frequency to be used are all factors to be investigated.

a. Equipment size and type. The area to be covered, the antenna installation to be used, the terrain and the noise levels where the receivers are to be used dictate the size and type equipment which must be used. The installation may be made with equpiment having either 30, 60 or 250 watts r.f. power output.

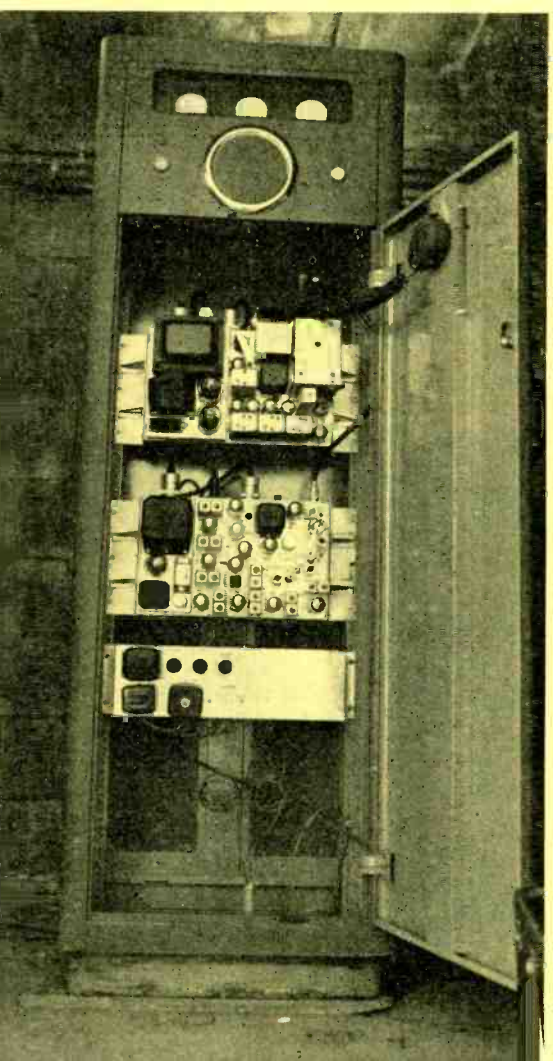
b. Terrain. The power of the transmitter and antenna installation in the Central or Land station is always important, but more so when the type of terrain is such that receiving conditions

Compactness, making for space conservation, features the transmitter-receiver installation in the manager's car.



Antenna, atop a water tower, is fed by coaxial cable from the central station transmitter at the base.

Central station installation has both front and rear cabinet door openings to permit easy access for maintenance.



are spotty. If the sending range of the central station is increased by either a power increase or more efficient antenna installation or both, satisfactory one-way sending may result and then it is possible for mobile units to maneuver into favorable positions for returning calls that ordinarily would not be possible. If there are hills and valleys in the area, the mobile unit moves to the top of a nearby hill where communication can be established.

c. Boundary pattern. If the area to be covered forms a long and narrow pattern, or if the central or land station and antenna installation are at one extreme end of the area, satisfactory coverage is more difficult.

An increase of transmitter power may not be economically feasible, whereas increasing the height of the antenna or a directional antenna installation may be the answer at a less cost than a power increase.

In a situation such as this, noise levels are going to be much higher because of the added receiver sensitivity needed. However, if the boundary forms a long and narrow pattern, it is very probable that additional substations are in operation in these outlying districts to insure satisfactory voltage regulation out on the far ends of the power lines. In this case, pole mounted antennas located at these substations or other well-chosen points can be connected too by the mobile units to maintain communication with the central station. It is sometimes necessary to install remote receivers in locations where noise levels are very low, and then bring their output back over land lines to the central station and office which may be necessarily located in a very high noise level district.

d. Frequency to be used. Frequencies in the 30-40 megacycle and 152-162 megacycle bands are in theory strictly "line of sight" as far as range is concerned. Both bands are being used at the present time. The 30-40 megacycle band is very crowded and considerable sky wave interference is resulting in this band. The 152-162 megacycle band, while more reliable, is slightly shorter in range than the 30-40 megacycle band. The 152-162 megacycle band has been recommended by the FCC as a result of its field tests. If the 30-40 megacycle band is to be used, it will probably be necessary to supply the FCC with data to show that the 152-162 megacycle band cannot be satisfactorily used.

The REA Cooperatives like to have their adjoining neighbors on the same frequency so that they can form a network to be used in an emergency. It is true that transmissions from neighboring two-way radio systems break through that of adjoining systems, but they say that after they become familiar with voices and styles of transmission, they experience little trouble from this factor. Recently, a cyclone swept through an REA district. Very shortly after, the Nishnabotna Valley REA had their trucks and crews down in their neighbor's district helping him restore his lines. Immediate intercommunication between districts paid off in this instance.

2. *First cost, operating costs, and benefits.* In estimating costs of equipment needed in an installation the following items must be considered, although they will not all be required for the average installation:

Central station transmitters and receivers.

Central station remote control console.

Mobile transmitters and receivers.

Antenna systems.

Test equipment and freq. monitor.

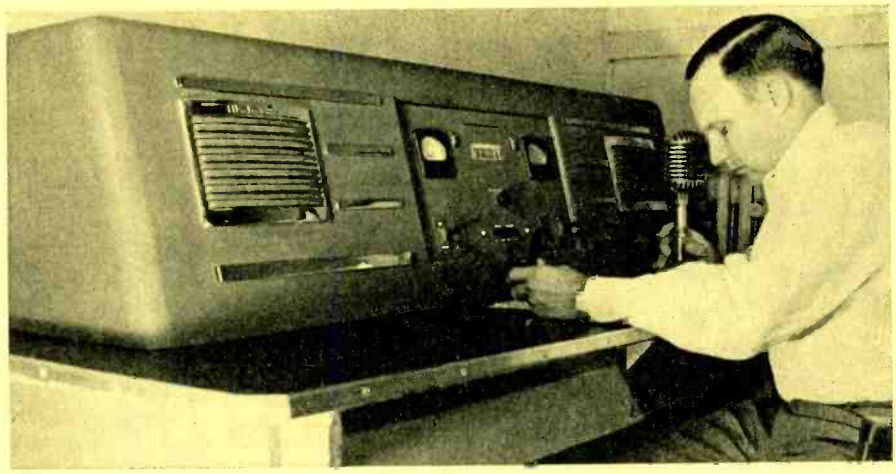
Facilities for housing central station equipment.

Heavy duty batteries and oversize automobile generators.

Spare parts and units.

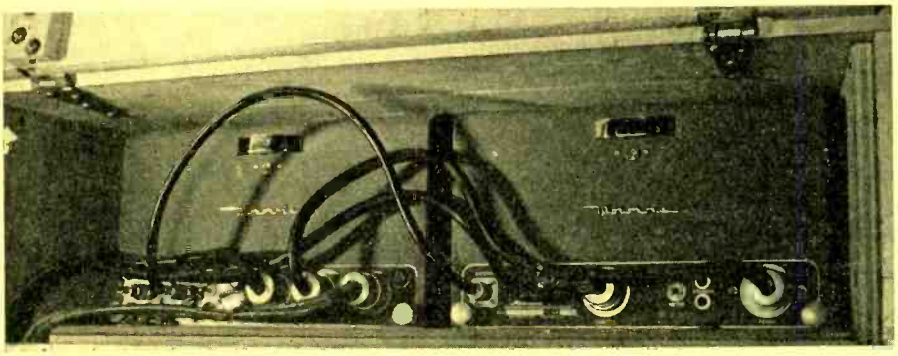
Land lines for remote controlled central station equipment.

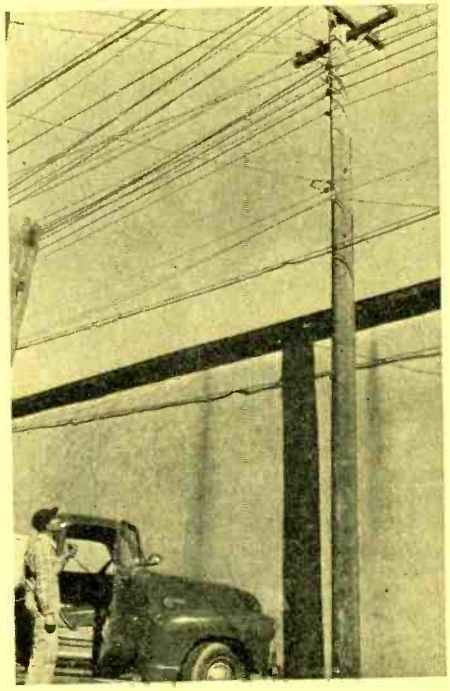
← Under chassis view of mobile receiver. Power supply is self contained on a separate removable chassis.



By means of the remote control console, Dean Jorgenson, REA Manager, has his maintenance crews at his fingertips. →

↓ A wood housing is constructed for the transmitter-receiver installation directly back of the cab of the truck.





Where joint construction is involved, multi circuits are quickly checked.

A.c. power line to remote controlled central station equipment.

An auxiliary power supply.

Purchase, lease, or rental of sites necessary for the remotely operated equipment.

Any taxes that may be applied.

Installation and engineering cost.

If the installation is such that terrain or geography provide an unusual problem the following equipment may become necessary:

Either automatic one-way or two-way repeaters.

Remotely operated receivers.

Additional antenna installations.

The construction, purchase, lease or rental of land lines and necessary sites and power supplies for remotely operated equipment.

In the average size two-way radio system used by the REA, the equipment cost can be estimated at $6000.00 which would include 6 mobile units, one fixed central station, remote control console and the antenna less the antenna tower.

If oversize generators and batteries are required in the trucks, an additional $90.00 will be needed for each installation. The installation cost of a system of this size can be estimated at $25.00 per mobile unit.

In the installations for the larger power systems, the equipment cost and installation should be proportionately greater, about $525.00 per mobile unit.

It is hard to fully evaluate the benefits received from an expenditure such as this in monetary terms because two-way radio is a very important "good will" ambassador. Some examples of savings to be made are:

A maintenance crew may be in some remote corner of the district and a trouble call received from a location near where they are working. To either have the crew in this location make the trip back to the office for instructions or to send another crew out on this call will cost approximately $25.00 per trip. Two-way radio gives the crew in the locality all the information they need, saves another trip and allows more efficient use of manpower. Again, a crew may be out to locate a certain geographic point. When customers' names are similar, it is sometimes difficult to pin down locations exactly, but help from the dispatcher greatly assists in this matter. It has been found that when, as is the custom in some power companies, customers read their own meters and mail them in, a fictitious looking reading can be immediately checked by the maintenance crew in that locality.

One of the largest public power utilities in Iowa is using two-way radio in conductor stringing and sagging. Because of the high construction cost, high voltage transmission lines usually follow a direct line and cut across country over private right of way. This means that to patrol them, the maintenance man must walk the distance. The larger power companies are now using "walkie talkie" type radio for this purpose. The "walkie-talkie" radio is also a great time saver for the surveying crew.

3. *Maintenance cost.* The large power companies generally maintain their own radio service departments. REA power companies usually have a service contract with a company or individual calling for a definite time of inspection of the equipment. The maintenance cost is determined by the type and manufacture of the equipment, the amount and severity of the usage and the quality of the maintenance and inspection work. An estimate of the average over-all maintenance cost per month could be approximately $10.00 for each mobile installation and $17.00 for each central or fixed station. However, it is reasonable to expect that in the first 5 years of operation these estimates will not be approached as the normal replacements should be tubes and vibrators during this period. Reports so far bear out this replacement record.

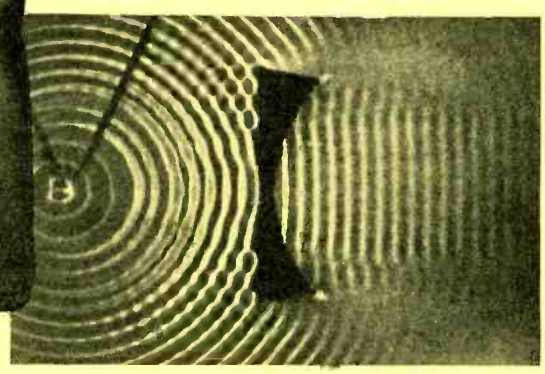
3. *Licensing.* All radio stations in the

(*Continued on page* 28)

Electronically Driven RIPPLE-TANK*

Water ripples and synchronously chopped light may be used for the qualitative and semi-quantitative study of phase fronts near models of antenna structures.

A scientist studies a radar antenna model in the ripple tank.



Wave pattern produced by a wave guide lens with water ripples.

by
ALLEN H. SCHOOLEY
Naval Research Laboratory

IN electronics work it is not unusual to have an antenna aperture across which the phase of radiation should be constant or vary in a particular manner. Often, in scanning systems, the beam tilt and the deviation from phase-front linearity with various placements of the feed point are of interest. Also it is desirable to know how the phase fronts are affected by changes in the excitation frequency. Since the calculation or experimental determination of phase-front patterns is usually a tedious operation, it appears that there is a need for a simple analog device to aid visualization of such patterns.

Since the ripple-tank is a device that has been used extensively to demonstrate most of the two-dimensional phenomena of physical optics,[1] it appeared suited for solving some problems of phase-front visualization met by electronics engineers. New techniques in the operation of the electronically driven ripple-tank were devised and applied to antenna problems, and photographs of phase-front shadow patterns near two-dimensional models of a few familiar antenna configurations were made.

Basic components of the electronically driven ripple-tank include an audio oscillator to drive a synchronous motor which has a slotted (light chopper) disk attached to its rotor. The light from a lamp is projected through the slotted disk and through the glass ripple-tank to a ground glass screen. The oscillator also drives an electromechanical transducer. A probe attached to the transducer touches the surface of the water contained in the tank and excites ripples in synchronism with the pulses of light coming from the lamp. Thus, the ripples, acting like cylindrical lenses, cast stationary light and shadow patterns upon the ground glass screen in accordance with the phase-front pattern set up in the ripple-tank.

The 11-inch square ripple-tank has beveled glass sides high enough to contain about ¼-inch of water. Two electromechanical transducers are used, one of which has a probe vibrator at the focus of a small parabola.

The light consists of a 50 candlepower automobile headlight bulb, beneath the light chopper disk. The disk is usually cut with the required number of slots to show one phase front for each cycle. However, for some demonstrations it may be advantageous to use one-half this number to spread out the pattern by showing every other phase front. On the other hand, twice the normal number of slots may be used to reduce the light flicker. In so doing the number of phase fronts in the pattern is doubled.

Intelligent use of the ripple-tank requires some knowledge of the techniques and limitations of ripple-tank operation. It is usually disturbing to note that the velocity of water-ripple propagation is dependent on wavelength, which is not the case for electromagnetic waves. However, the variation in velocity with wavelength is unimportant in most two-dimensional antenna model work because the basic scaling relationship that should be maintained is:

$$d_m/\lambda_m = d_a/\lambda_a$$

were d_m and d_a are corresponding dimensions of the model and antenna, respectively, and λ_m and λ_a are the wavelengths for the model and the antenna, respectively. Since most work requires the use of only one frequency at a time, it makes no difference what the velocity of propagation may be as long as the relationship in Eqt. (1) is maintained. All the measurements should be made in terms of wavelength and not in terms of frequency. It is interesting to note that the velocity of ripple propagation is less than the velocity of electromagnetic waves by a factor of the order of 10^9.

The increase in the phase velocity of ripples passing through a wave guide may be demonstrated by means of the ripple-tank. This suggests that some aspects of Kocks[2] wave guide antenna may be simulated by the ripple-tank. Such a lens, shown above, was designed for an index of refraction of about 0.55, and was made of ¼-inch thick brass, milled with 32 slots spaced

(*Continued on page* 27)

**Exhibited by the Naval Research Laboratory at the 1950 National Convention of the Institute of Radio Engineers.*

FREQUENCY DIVIDERS

By HAROLD E. BRYAN

The design of circuits which will produce accurate submultiples of a given frequency.

FREQUENCY dividers have not enjoyed the popularity that they deserve, due in part at least to a lack of understanding of their capabilities. To many people the term *frequency divider* means *multivibrator*. The latter is capable of very reliable operation as a frequency divider, but has a bad reputation because of many improperly designed circuits. There are in addition a number of circuits other than multivibrators available for divider service. All of these have individual advantages and disadvantages; which type is to be preferred depends on such factors as waveform, stability requirements, etc.

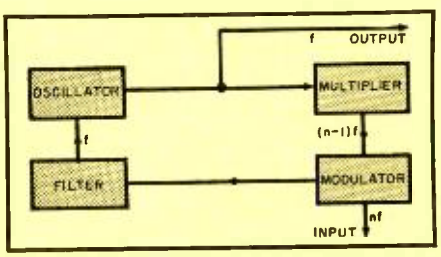
Frequency division has essentially the same applications as multiplication —production of signals controlled by and definitely related to other signals of different frequency. In most applications the output of the divider is harmonically related to the driving frequency, although this is not always true. It is possible to construct dividers which will divide by fractional as well as integral ratios. Equivalent results can usually be obtained otherwise, although probably at greater cost economically and operationally. The use of dividers is essential to the operation of such devices as crystal savers*, which would not be economically feasible without them.

Generally speaking, there are two types of frequency dividers—those that deliver sinusoidal signals without external filters, and those that don't. Aside from the waveform requirements, the divider must be sufficiently stable that tube and voltage changes normally experienced do not change the division ratio. It must also be easy to synchronize so that it is not affected by changes in the driving signal.

Dividers with sinusoidal waveform may be used when it is not necessary to have exact control of the relative phases of the driving and output signals. Since many of the applications which have pushed the development of dividers have been those that require phase control, like radar and television, not much information is available on the sinusoidal type.

One of the simplest sinusoidal dividers is the synchronized oscillator, illustrated in Fig. 2A. Harmonics in the output of an oscillator produce instability. At the same time, these harmonics are necessary to the synchronization process. Therefore, if the oscillator is quite stable, it is hard to synchronize. Synchronization in this type of circuit occurs due to interaction of an oscillator harmonic with the driving frequency. Since the effective synchronizing signal is the result of modulation in the oscillator itself, the driving signal must usually be quite large in order to obtain the necessary control. The higher the Q of the circuit the harder it will be to drive and therefore the easier it will be for it to drop out of sync without notice. Also, the higher the grid excitation, the greater will be the driving signal needed for control. If excitation is reduced, instability may result due to partial or almost complete loss of modulation action. Thus, although this type of divider has its place, due to its simplicity, it does have serious disadvantages.

Fig. 1. Disadvantages of Fig. 2A are partially overcome in this circuit by separating oscillator and modulator functions.



One way of overcoming some of the disadvantages of the simple circuit is illustrated in Fig. 1. Although this still uses a free running oscillator with its disadvantage of continued operation with loss of signal, the oscillator and modulator functions are separated. The oscillator output feeds a multiplier, generating a frequency at $(n\text{-}1)f$, where f is the synchronized oscillator frequency. The difference frequency in the output of the modulator is f (driving signal $= nf$) and this is selected and used as a synchronizing signal for the oscillator.

Elimination of the major disadvantage of the above (continued operation without controlling signal) is easy—eliminate the oscillator, as shown in Fig. 3. We saw above that the output of the modulator driven by signals of nf and $(n\text{-}1)f$ contains the frequency f, and this is the desired output frequency. The signal at $(n\text{-}1)f$ is supplied from the output itself through a frequency multiplier. If the gain around the loop containing the modulator and frequency multiplier is equal to or greater than one, the circuit will operate just like any regenerative oscillator, provided the driving signal is present. The loop gain is made less than one at all other frequencies to prevent improper operation. High ratios may be obtained with this type circuit, although high selectivity is necessary in the multiplier to prevent change in the ratio.

The discussion so far assumes the use of square-law modulators. Higher orders may be used to obtain different results. By selecting a harmonic in the frequency multiplier as an output frequency, it is theoretically possible to multiply or divide by any rational ratio.

This type of circuit is not all advantage. It is relatively complex and may not be self-starting. Sometimes it is necessary to supply a starting signal by means of thyratrons or similar devices. These dividers are limited in operating frequency only by the limitations of the modulators and frequency multipliers employed, and therefore may be used in many radio frequency applications.

An interesting application of this type of circuit is shown in Fig. 5. Here the input frequency is divided by two and then multiplied, providing outputs at $f/2$ and $nf/2$, where n is an odd integer. This is accomplished with one modulator and one tube.

Dividers With Non-Sinusoidal Output

Of the relaxation types of frequency dividers, the multivibrator is the best known. A free running type may be used if continuous division is desired, although the same disadvantage is ex-

*Bryan, Harold E., "Crystal Savers", RADIO-ELECTRONIC ENGINEERING, *March*, 1950.

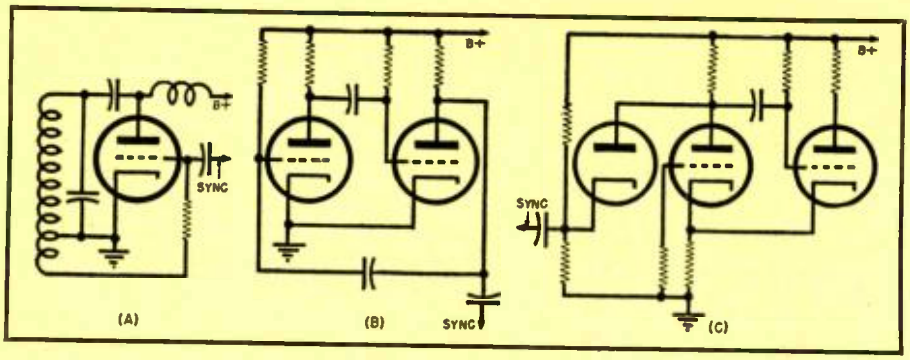


Fig. 2. (A) Synchronized oscillator. (B) Free-running multivibrator frequency divider. (C) Frequency divider which oscillates only when triggered.

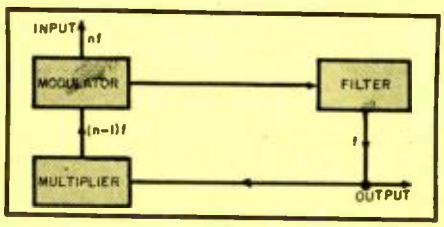


Fig. 3. Circuit resulting from eliminating the oscillator in Fig. 1.

perienced here as in the previous types, since oscillation continues in the absence of synchronizing signal. All of the relaxation types of oscillators are easy to synchronize, however, and simple in construction.

In the free running multivibrator, proper design is important; otherwise unsatisfactory operation is certain. In the preferred design the unsynchronized portion of the period is slightly less than half the total, and the synchronized part thus a little greater than half. Grid resistors should be large, at least one megohm if possible, and plate resistors used should provide large plate swing. If these factors are considered, the divider will be very stable under synchronized conditions, and quite tolerant of driving waveform. Synchronizing signals are applied to the grid or plate of one tube. A multivibrator of this type is illustrated in Fig. 2B.

A more desirable type of multivibrator oscillates only when triggered. It has one stable and one unstable state, and depends for its action on the fact that when it is in its unstable state synchronizing signals have no effect. As seen in Fig. 2C, this type multivibrator is maintained in the stable condition by cut-off bias on one grid, and zero or low bias on the other tube. A trigger signal cuts off the originally conducting tube and opens up the other. Since there is nothing but a time constant to maintain this condition, it returns to the original state when the charge has leaked off the grid enough to allow conduction to again take place. Because the tubes are connected in a regenerative manner, the change from one state to the other is abrupt rather than gradual. The cathode coupled circuit is popular, the cut-off tube being maintained so by the current from the conducting tube through the cathode resistor. This resistor should be relatively large in value. The plate resistor of the cut-off tube should also be large, in order to provide a large plate swing and supply a maximum of signal to the following grid. The negative trigger required is usually fed to the plate of the cut-off tube through a biased diode. The diode insures that no triggering signals are applied during the unstable period, since it is cut off during this time. Satisfactory operation is obtained with almost any kind of triggering signal of sufficient amplitude, and the division ratio will be quite stable with respect to voltage and tube changes.

Blocking oscillators may be used as frequency dividers where pulsed output is desired. A typical circuit is shown in Fig. 4A. Since the blocking oscillator presents a very low impedance to the driving signal, it is difficult to synchronize. Triggering from a high impedance source is possible through a shunt feed sort of circuit, but there may be severe reaction on the driver. The blocking oscillator is more sensitive to voltage, tube and signal changes than the other types so far discussed.

Operation is normally such that the free running frequency is slightly lower than the synchronized frequency. A positive signal voltage is applied to the grid, driving the plate in the negative direction. Due to the regenerative connection between the plate and grid, the drop in plate voltage causes a rise in grid voltage, driving it still more positive. When plate saturation is reached, the plate voltage begins to rise and the grid voltage to drop. Again the regenerative action takes hold and the grid is rapidly driven beyond cut-off. After the tube has been cut off, nothing can happen until the grid voltage leaks off to the point where a trigger pulse can start conduction again. The signal pulses are ineffective while the tube is conducting and when the grid bias in the quiet period is greater than the trigger amplitude. The trick is to get the circuit constants and driving signal so adjusted that the tube will fire on the *nth* but not on the $(n\text{-}1)th$ pulse. Any variation in these values will tend to produce a change in the division ratio.

The blocking oscillator has the same major disadvantage, also, as the other types of free running dividers—continued operation without driving signal—and so gives no warning of trouble in previous stages. Its principal use is in the production of very short pulses. These dividers can be stabilized to some extent through the use of resonant circuits in the cathode lead. The voltage developed across this circuit so modifies the timing waveform on the grid that the *nth* trigger pulse is accentuated with respect to the others. Sometimes more than one such circuit is used, each with different resonant frequency. Frequency for the resonant circuits is usually chosen such that it is $(A + \frac{1}{2})$ times the output frequency, where A is an integer.

The phantastron may be used as a divider, and in such service offers a high ratio of utility to cost. This circuit, developed during the late war for use in gate and sweep generators, is very stable and reliable, and requires a minimum of parts. The division ratio is

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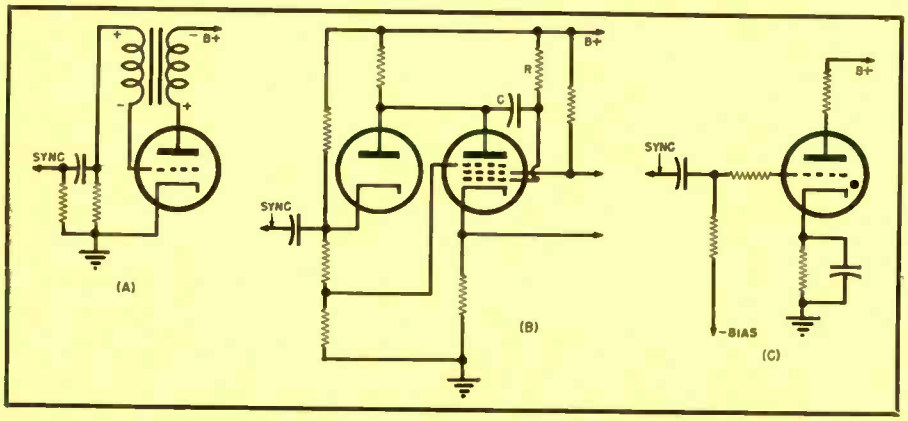
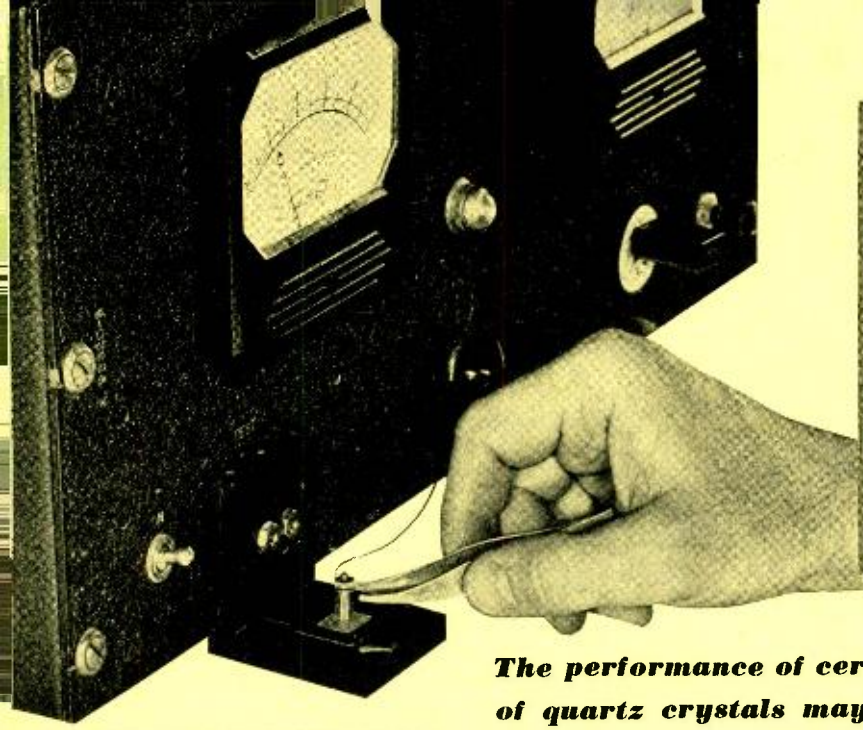
Fig. 4. (A) Blocking oscillator circuit. (B) The phantastron circuit used as a frequency divider. (C) Thyratron used for frequency division.





Experimental arrangement used at NBS to investigate a phenomenon associated with wedge-shaped crystals.

LOADING QUARTZ CRYSTALS

The performance of certain types of quartz crystals may be improved in some instances by loading with inert materials.

THE ERRATIC performance of piezoelectric plates has long been a problem in the production of oscillator units, and many investigations have been undertaken to determine the causes of instability. Experimental results obtained by Leland T. Sogn of NBS over the past few years show that it is possible to improve the performance of certain types of thickness-shear quartz plates by coating their surfaces with some inert material. Two distinct effects have been noted: first, that produced by an amount of the loading material so small that the resultant frequency change is as little as 0.03% of the crystal fundamental; and, second, that produced by a much larger mass of the loading material properly distributed over the central area of the crystal. The latter seems to have the beneficial effects now achieved by contouring, a difficult and expensive process. The potential usefulness of loading thin crystals to improve performance as well as to recover plates ground too thin in the production stage should encourage further research on the various aspects of quartz-crystal loading.

A phenomenon associated with a wedge-shaped 0.5 x 0.6-inch BT oscillator plate (width parallel to the x-axis) prompted the present investigations. When the electrodes coupling the oscillator plate to the electronic circuit were placed over the thicker portion of the plate, the frequency was not only lower, as anticipated because frequency is inversely proportional to thickness, but the activity was considerably higher, shown by the magnitude of the grid current. Lower frequency was associated with higher activity or amplitude of vibration, and vice versa.

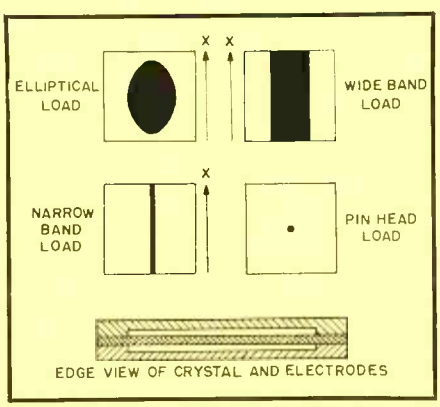
To investigate this phenomenon a small ¼-inch probe electrode was employed. With this electrode, it was possible to confine the energy fed back from the electronic circuit to a small area of the plate and thereby obtain a series of frequencies and activities as the electrode was moved in short steps from the thick to the thin portion of the plate. In "flat" plates the frequency fluctuated about a mean value as the electrode was moved over the plate surface, and it was found that activity measurements as well as frequency measurements can be used to detect minute differences in thickness which were not disclosed even by instruments sensitive to differences of less than 20 microinches. Activity readings were actually used to check and control the contour of plates during the process of hand-grinding.

In most of the hand-finished plates used in these experiments, positions determining a certain frequency were found to be scattered indiscriminately over the surface although some oscillator plates had contour and edge conditions such that only a few, nearly equal frequencies could be obtained. For example, in an 8.7-mc. plate with only two frequencies about 5 kc. apart, the frequencies would alternate from one to the other as the electrode was moved across a line roughly parallel to the x-axis, which divided the plate into two approximately equal areas. This plate apparently was composed of two approximately equal flat areas which differed in thickness by the equivalent of a 5 kc. difference in frequency. The balance between the two frequencies was so delicate that a rapid alternation between the two frequencies could be obtained by adjusting the temperature or circuit constants, resulting in an audible "motorboating" effect in the measuring equipment. Changing the length, or z dimension, by alternately grinding opposite edges (parallel to the x-axis) produced anticipated results. When the edge bounding the thick end of the plate was ground, the higher frequency became dominant because the area of the thin, high-frequency plateau became relatively larger. Subsequent grinding on the other edge reversed the effect: when the thicker area was relatively larger, its lower frequency was dominant. This procedure was repeated several times with identical results.

Experiments were also carried out using machine-lapped convex crystals. Results were similar, but one new fact was disclosed. The lowest frequency, excited when the small electrode was placed at the exact center of the plate,

(*Continued on page* 24)

Schematic representations of the various "load patterns" applied to quartz plates in an investigation of the effects of loading on performance.



AUTOMATIC ANTENNA PATTERN RECORDER

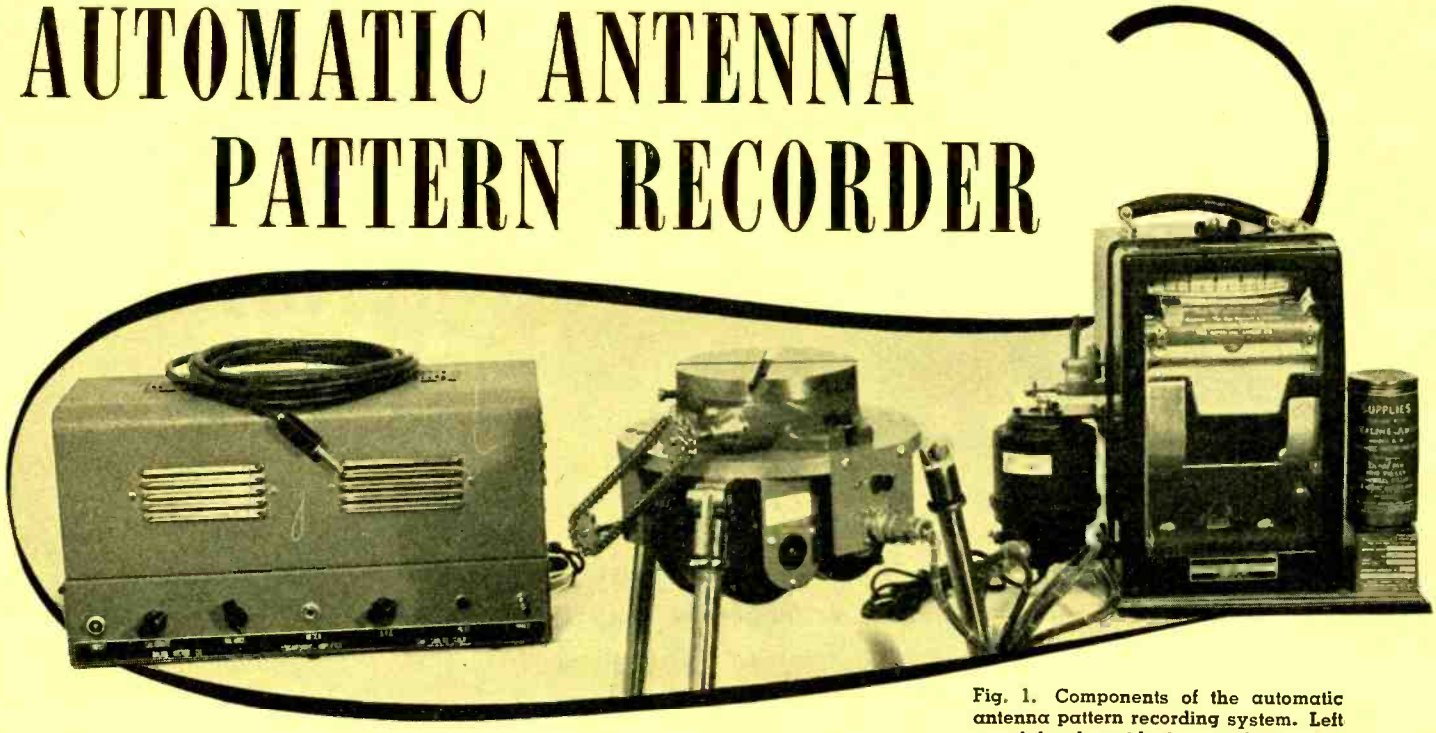


Fig. 1. Components of the automatic antenna pattern recording system. Left to right—logarithmic amplifier, antenna mount, and graphic recorder.

By SAMUEL FREEDMAN

Details of a system for determining antenna radiation patterns rapidly and accurately.

THE efficient transmission and reception of electromagnetic waves in the radio portion of the frequency spectrum is primarily dependent on the utilization of antennas of proper shape and dimension to provide the best radiation patterns.

This has made necessary the development of facilities for checking antennas and equipment performance into antennas. Such checking of performance and radiation patterns is necessary in any phase of the radio art whether it corresponds to basic research, development, prototype or quantity production. It is particularly true for microwave equipment where the smallest dimensional design or manufacturing discrepancy, or a deformation, of the antenna system is appreciable with respect to the operating wavelength.

Consequently, throughout the nation today, hundreds of laboratories, manufacturers and field parties are engaged in antenna radiation pattern studies. Offshoots of this work include checking ship radar antenna behaviour as influenced by ship structural work, checking GCA (Ground Controlled Approach) equipment on runways, the efficiency of surveillance radars, and the beamwidths of microwave relay systems. Invariably, much time and expense is lost in setting up for such measurements with manual recordings and arrangements. Under such conditions, as little as two patterns per day are obtained.

When the radar antenna firm of *Dalmo Victor* in San Carlos, California, had the problem of taking hundreds of antenna radiation patterns, quicker and simpler means of setting up for each pattern was imperative. Furthermore, these had to be extremely precise and permanently recorded since one-half of the value of any radar is its ability to get precise angle or directivity information; the other half being the range or distance.

Accordingly, there was developed the "Automatic Antenna Pattern Recording System" for presenting the antenna pattern on a recorded sheet. On this sheet, rectangular coordinates are used with the abscissa representing angle in degrees, and the ordinate the log of the power and the intensity.

Fig. 1 shows the three basic units comprising the entire automatic antenna recording system. From left to right these are:

1. Logarithmic amplifier to amplify the signal picked up from the antenna.
2. Tripod antenna mount to support and change the angle of the antenna under test.
3. Graphic recorder to record the information.

The system is unique in the use of an extremely universal antenna mount, ability to take readings or recordings in three minutes per pattern instead of up to half a day as in the past, ability to reproduce the pattern and provide a permanent record, and the equipment is simple enough to be operated by untrained personnel.

Antenna patterns can be taken in any arbitrary plane through a full rotation of 360 degrees, or any fraction thereof, over a power range of 0-50 db. to an accuracy of plus or minus 1 db. The equipment is connected together by means of cables. A common ground wire connects all the units together.

For ease in adjustment, an antenna reversing switch is provided at the antenna mount while the on-off switches and the 115 volt a.c. cords are on the graphic milliammeter and the logarithmic amplifier. Antenna position is transmitted to the recorder by means of a selsyn system and it is so adjusted that 10 degrees of rotation causes a movement of 1 division on the graph paper. The antenna patterns are recorded in only one direction. A small throwout gear is provided for disengaging the recorder while the antenna is being adjusted or reversed in direction. This same gear also makes it possible to properly engage the selsyn system so that the zero degree reference point falls upon a given line of the graph paper.

The additional equipment required for pattern measuring work consists of a suitable transmitter and receiver system with a square law detector. Sufficient amplification should be available to present the logarithmic amplifier with 100 volts at the zero db. level.

Antenna Mount

The antenna mount (center of Fig. 1) consists of a tripod stand which is adjustable in height from 42" to 60"

and will support a top load of 150 pounds. The antenna may be mounted by means of a suitable bracket to the "T" slots of the rotary head which is fastened to the mounting plate of the tripod. The rotary head is in turn driven by a 115 volt a.c. 1/70th horsepower reversible motor at a rate of 60 degrees per minute. This motor also drives the transmitting selsyn at 60 times the speed of the rotary head or 10 r.p.m. Selsyn inaccuracies resulting from slip torque are thereby reduced since a high selsyn speed to recording speed ratio is maintained by this arrangement. The antenna position can be read directly off a scale placed on the rotary head in degrees of rotation. A vernier is provided by which accuracies to greater than 1/10th degree can be read. By approximation, this can be further read to 1/100th of a degree.

Below the mounting plate are mounted the selsyn, driving motor, reduction and coupling gears, motor reversing switch and the cable connector. The driving power from the motor is transferred to the rotary head by means of a sprocket and chain link.

The control system can be separately used, either by use of the chain link as is, or by using an additional length of chain to the rotary head. This can take care of installations or occasions where it is desired to dispense with the tripod mount in favor of some other particular mounting. Should the installation or occasion require a completely separate antenna mount, an additional selsyn can be provided. It is desirable, however, that the rotary speeds of such systems be limited to a maximum of 60 degrees or one-sixth revolution per minute. This maximum rotational speed is governed by the rate of response of the graphic milliammeter recorder. It has been found that for speeds in excess of 1/6th r.p.m. the recorder will fail to faithfully reproduce quick power changes in the antenna pattern. It is further necessary to maintain the selsyn's speed to the antenna speed at 60-to-1 for proper recording relationship. This is 10 degrees per division on the recording paper.

The total power consumption to motor and selsyn is 48 watts at 115 volts.

Graphic Recorder

The graphic milliammeter employed is the *Esterline Angus* Model AW illustrated to the right in Fig. 1. It has a 0-1 ma. movement and 1250 ohm d.c. resistance. The information records on a strip graph using standard graph paper.

The meter movement results from power obtained at the motor jack of the logarithmic amplifier. The graph paper is driven directly by the receiving selsyn through a 20-3 gear reduction system. By this means, one division on the graph paper represents 10 degrees of rotation of the system under test.

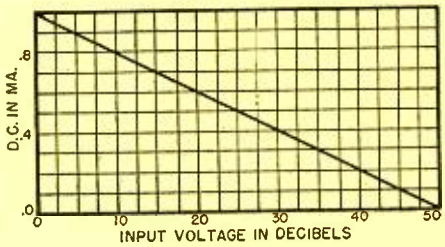


Fig. 2. D.c. output current in ma. vs. input voltage in decibels.

The gear drive for the drum of the graphic recording instrument may be disengaged by means of the lever on the mounting so as to allow the selsyn to turn freely or as required to position the chart strip. It is recommended that the gears be disengaged at all times except when recording. The antenna information can be recorded in one direction only. The unidirectional drive feature allows the chart drum to be driven only in the forward direction.

When turning the equipment on, the receiving selsyn will tend to hunt or rotate if an off-phase position combination of the selsyn link exists as current is applied. In such cases, the current needs to be immediately removed. Such hunting or rotation can then be prevented by damping the movement of the selsyn with one's finger and reapplying the current to the system.

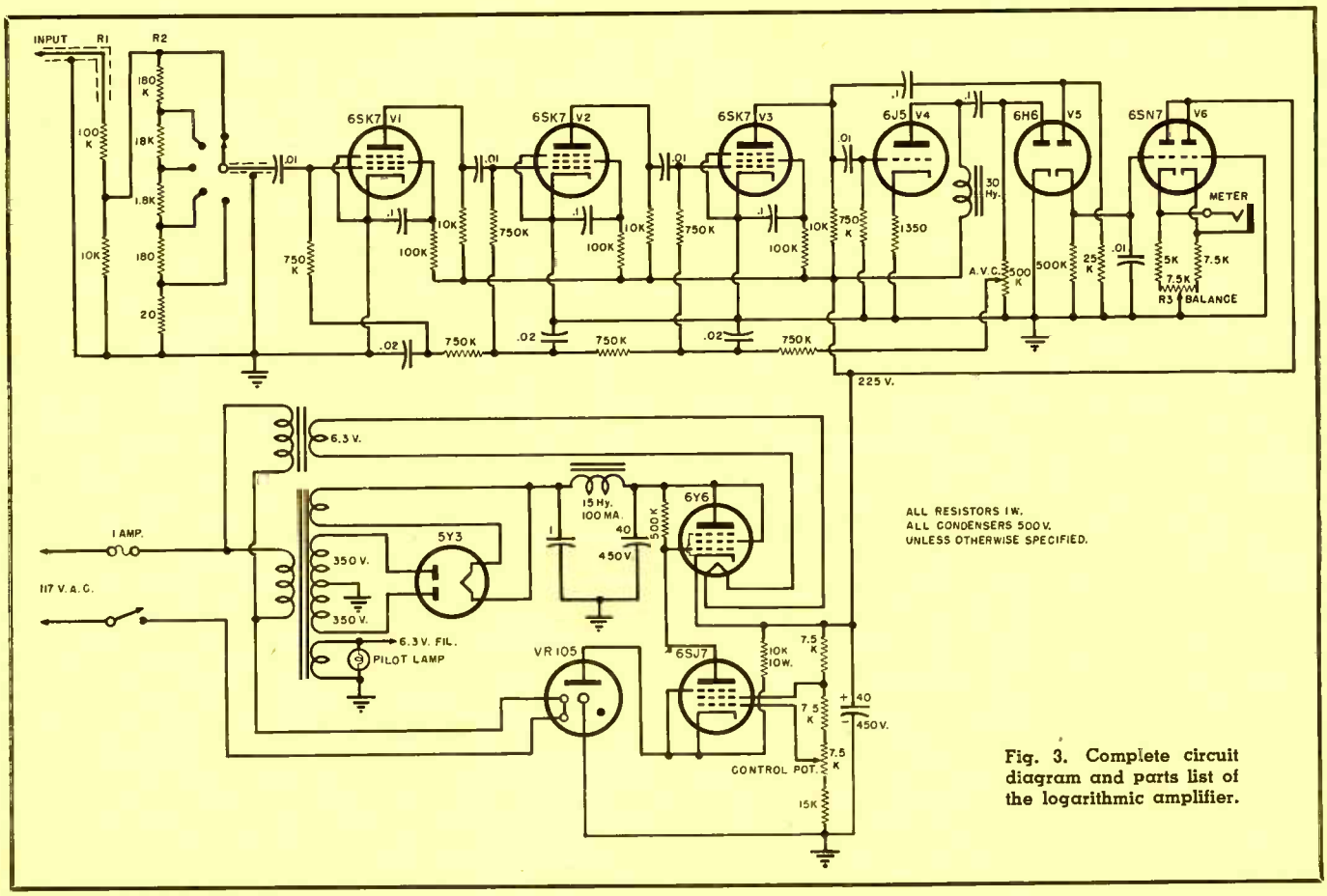


Fig. 3. Complete circuit diagram and parts list of the logarithmic amplifier.

Fig. 4. Antenna pattern penthouse test shacks atop the Dalmo Victor plant.

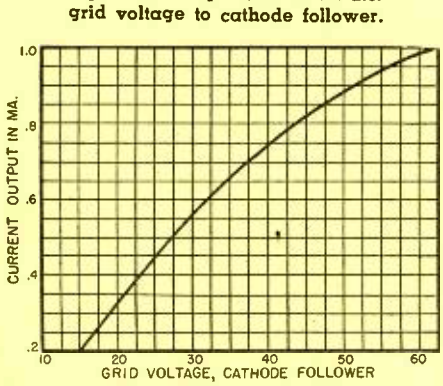
Should noise or other reasons make it necessary in a particular installation to ground the instruments, the grounding of either the tripod or graphic recording milliammeter should suffice since a ground connection between the two sections has already been provided.

Logarithmic Amplifier

The use of a logarithmic, rather than linear, amplifier is desirable where large variations in output are involved as in the case of automatically recorded antenna patterns. While there have been many methods described for obtaining a logarithmic response, no circuitry of a usable logarithmic amplifier over a range as great as 100 db. has been previously described to the best knowledge of the authors or their associates.

A logarithmic response from an amplifier is readily obtainable through the use of remote cut-off tubes, whose characteristics are inherently logarithmic. Such tubes can be used either in tandem or cascade. In a tandem circuit, the tubes are connected in parallel, with the control grid of each successive tube biased at a different level. Each tube then works between cut-off and saturation with its grid voltage-plate current characteristics operating over a given portion of the logarithmic output range. By proper overlapping of the working characteristics of the successive stages, a rather good logarithmic response can be obtained. The cascade amplifier as described in this article consists of several stages of amplification connected in series in a conventional manner. By applying the output of such an amplifier as negative bias voltage to its grids, it is possible to obtain a non-linear amplifier whose output is proportional to the logarithm of the input. This approach has been found preferable even though greater ranges may be obtained from the tandem circuit at a cost of less stability and having its response dependent upon individual tube characteristics.

Fig. 5. D.c. output current vs. d.c. grid voltage to cathode follower.



It can be used over a frequency range of 200 to 20,000 cycles per second between 0-100 db. to an accuracy of plus or minus 1 decibel. The a.v.c. circuit, however, will not faithfully respond to frequencies above 200 cycles per second. As used in practice, with a square law detector such as a bolometer or crystal, the effective range of this amplifier is reduced by a factor of two. Therefore, in antenna recording equipment, it can be thought of as having an effective range of 0-50 db.

Fig. 3 shows the circuit diagram and parts values of the logarithmic amplifier with cascade amplification as successfully employed in this automatic antenna pattern recording system. Tubes V_1, V_2 and V_3 are three 6SK7 amplifiers in cascade. The type 6SK7 tube is an extended cut-off pentode. Its grid voltage-plate current characteristics are approximately logarithmic in nature.

The output of the last stage of 6SK7 cascade amplification (V_3) drives a rectifier circuit (one-half section of type 6H6 tube V_5) which in turn directly drives a 6SN7 d.c. output stage (V_6). A balance circuit has been placed in the cathode circuit of the 6SN7 stage to account for unbalance caused by tube differences and the emission potential of the 6H6 rectifying circuit. The meter is driven directly by the difference in potential existing between the two cathodes of the 6SN7 tube with various input voltages applied.

The a.v.c. voltage needed to obtain logarithmic response over a 100 db. range is approximately 15 times greater than the voltage available from the last 6SK7 tube. This deficiency is taken care of by having the last cascade stage (V_3) drive a 6J5 a.v.c. amplifier (V_4) which has a constant gain exceeding 15. This in turn drives the other section of the 6H6 tube which supplies and rectifies the a.v.c. voltage and feeds it back to the grids of the cascade amplifier.

It can be observed in the graph of Fig. 5 that the d.c. amplifier characteristics tend to level off toward the high end of the scale. This tends to flatten out an opposing characteristic of the 6SK7 cascade amplifier, producing an improved logarithmic response over the entire range.

Best results are obtained from the amplifier in the 10-.001 volt range. Since standard bolometer and crystal amplifiers most used in the field are designed for a maximum output of 100 volts, a 10:1 voltage divider (R_1) has been placed in the input circuit of the amplifier. This voltage divider needs to be changed if the amplifier is used in an application that differs in this respect, so that a maximum signal of 10 volts will be applied to the grid of the first 6SK7 at the 0-db. level.

A calibration switch has been included at the input of the amplifier for R_1. This switch controls a calibrated attenuator having five positions in steps of 20 db. each. When used with a square law detector, it can be considered to be in steps of 10 db. each. It is used for calibration purposes and as a step gain control.

The logarithmic amplifier can be best calibrated as follows:

1. With the calibration switch at the 0 db. position and 100 volts input to the amplifier, adjust the a.v.c. potentiometer until a 1 milliampere movement is noted on the graphic recorder.

2. Change the calibration switch to its lowest position (80 db. down) and adjust the balance adjustment (R_3) so that a 0.2 ma. movement is noted on the graphic milliammeter. Repeat this procedure until these two positions are in full agreement.

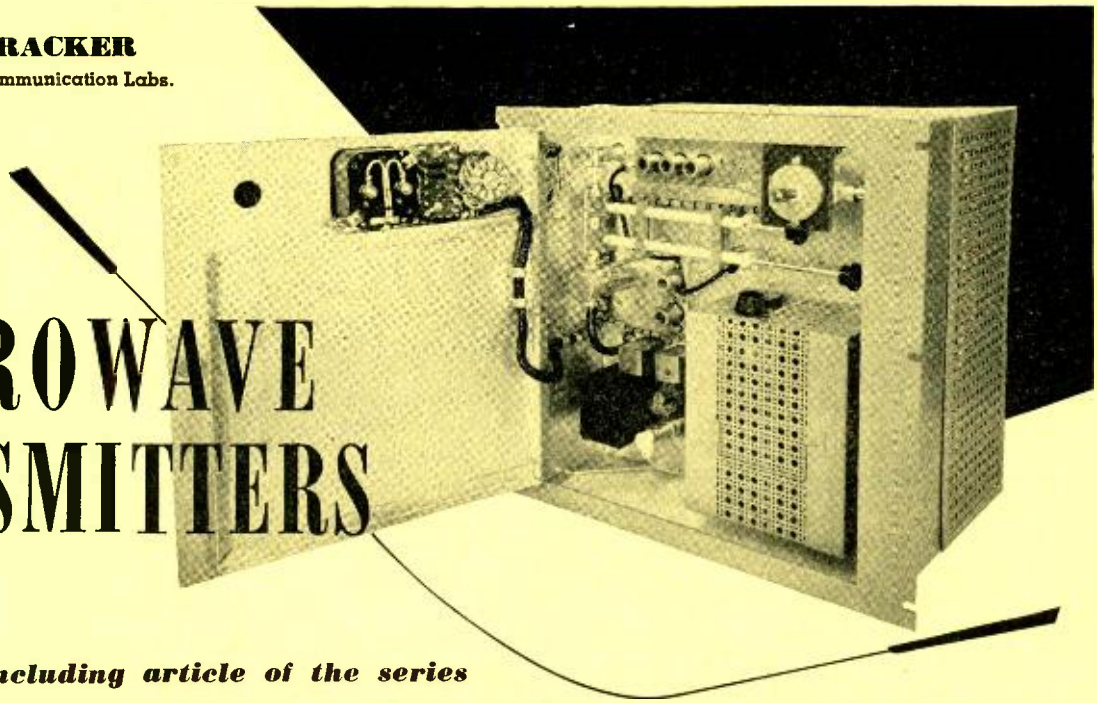
For high stability and low noise, the amplifier is supplied with a low impedance regulated power supply. The voltage of this supply can be regulated for values between 200 and 250 volts and will maintain a given voltage for changes in a.c. voltage from 90 to 135 volts. Its internal resistance is approximately 25 ohms. For best logarithmic results, the voltage should be maintained at 225 volts d.c.

The manufacture of this amplifier requires all of the finery normally encountered in high gain amplifier design, particularly in this case where the

(*Continued on page* 28)

By J. RACKER
Federal Telecommunication Labs.

MICROWAVE TRANSMITTERS



Part 2. The concluding article of the series on microwave transmitters includes a discussion of positive-grid oscillators, klystrons, and magnetrons.

Microwave transmitter operating in the 952 to 960 mc. band. Klystron is located within shield on righthand side of chassis.

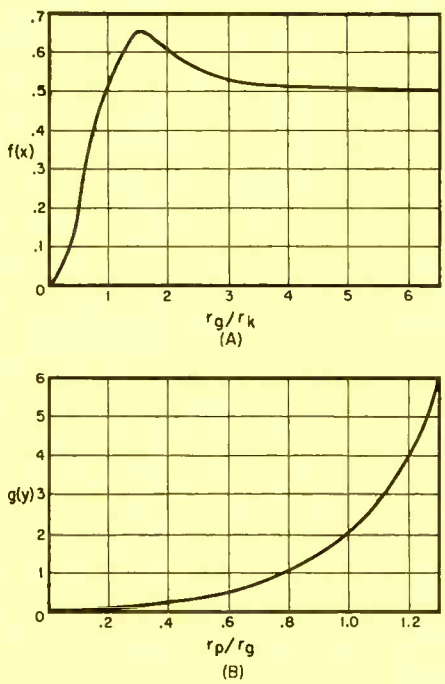
IN THE first article on Microwave Transmitters[1], it was shown that in order to employ standard negative-grid oscillators at microwave frequencies it was necessary to develop special triodes in which the electron transit time was small compared to a period of oscillation. In this case the effects of electron transit time were considered detrimental to the power output and efficiency of the circuit. In this article we shall consider microwave transmitters which depend upon the finite period required for an electron to travel between plate and cathode to effect oscillation. These oscillators, sometimes referred to as transit time oscillators, include positive grid oscillators, klystrons, magnetrons, traveling wave tubes and resnatrons.

Positive-Grid Oscillators

The simplest and earliest type of transit time oscillator is the positive-grid oscillator. This type of oscillator is not used very often today because of its low power output and efficiency. However, for the purpose of this article, it has more than historic importance since it clearly demonstrates the basic principles upon which all later type oscillators operate. A clear picture of the operation of this circuit would greatly help the reader to understand the principles of the more complicated tubes.

Consider the motion of an electron leaving the cathode of the simple circuit shown in Fig. 3 in which the grid is positive with respect to both cathode and plate (with plate and cathode at same potential). The electron emitted from the cathode is accelerated as it approaches the grid plane. Passing between the grid wires, the electron enters the grid-plate region where it is decelerated. It comes to rest momentarily in the vicinity of the plate, reverses its direction of travel, and is accelerated towards the grid plane, which it then "overshoots" and the process is repeated. The phenomenon is very closely parallel to that of the oscillation of a damped pendulum (damped due to the fact that the electron loses some energy during each cycle). Eventually the electron will strike a grid wire and be absorbed in the grid circuit.

Fig. 1. Plot of (A) f(x) and (B) g(y) for Eqt. (2).



If no other parameters were introduced in the circuit, many individual electron oscillations would occur in the space between cathode and plate; the exact phase and amplitude of oscillation between any two electrons would depend upon the time at which the electrons were emitted and space charge at that time.

Now assume that an alternating voltage is superimposed on the grid potential whose frequency is double that of the natural oscillation of the electron stream as shown in Fig. 2, and maximum amplitude very much smaller than the d.c. voltage V_o. Let us define the velocity v_o as the velocity of the electron at any point in the cathode-plate space with the grid potential at the d.c. value V_o.

Consider the relative velocities of electrons leaving the cathode during grid a.c. potential of A, B, and C shown in Fig. 2. An electron leaving during time A, travels at a velocity less than v_o in the cathode-grid plane because during this time the grid is always at negative a.c. potential. It loses more velocity between grid and plate since during this time the grid is positive. Thus, its over-all velocity is less than v_o.

An electron leaving the cathode with grid at time B will travel at about v_o since both during its cathode-grid and grid-plate paths the grid is positive half the time and negative half the time. Finally an electron emitted at time C

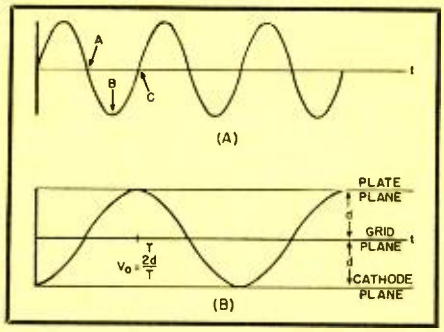


Fig. 2. Graph of (A) grid a.c. voltage and (B) electron transit with frequency double that of the natural frequency of a positive grid oscillator.

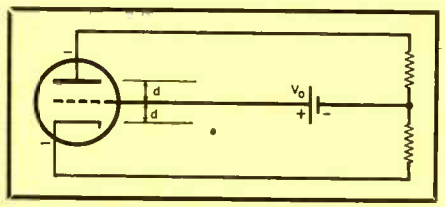


Fig. 3. Simplest positive grid oscillator.

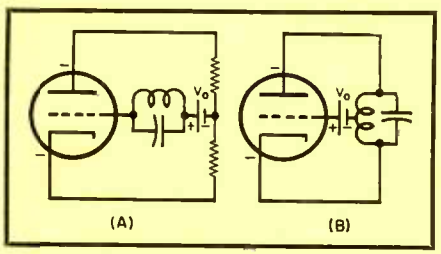


Fig. 4. Schematics diagrams of two different types of positive grid oscillators.

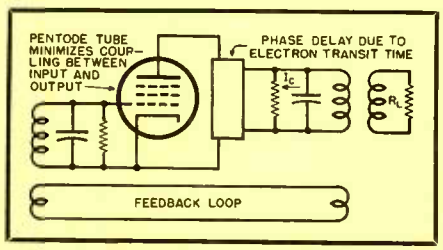


Fig. 5. Equivalent circuit diagram for a double resonator klystron oscillator.

will travel at a velocity greater than v_o, since grid is positive when it is in grid-cathode plane and negative in the grid-plate plane. It is readily seen that electrons emitted at time C tend to catch up to electrons emitted at time A, so that electrons will tend to oscillate in "bunches" instead of completely at random. Of course this analysis is very approximate assuming that no space charge exists to vary the progress of the electron stream and that a.c. variation is very small compared to the d.c. so that an electron leaving the cathode at time A arrives at the grid at time B although grid a.c. potential has been negative.

To obtain the desired a.c. potential on the grid, two circuits may be used as shown in Fig. 4. The tuned circuits shown in this figure would be either a resonant line or cavity depending upon frequency of operation. These circuits operate in the following manner: The oscillating electron space charge induces an alternating component of current in the external circuit. The resulting voltage drop across the load impedance produces an alternating field in the interelectrode space of the tube. Those electrons which oscillate in this field in such a phase as to be retarded by it transfer a portion of their energy to the resonant circuit during each cycle of operation.

The frequency of the circuit shown in Fig. 4A, for V_m (maximum value of a.c. component) much smaller than V_o, is given by the following relationship[5]:

$$f = \frac{148 \times 10^7}{V_o\, d} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where d is in cm.

Eqt. (1) indicates that the frequency of oscillation is completely independent of the resonant frequency of the external circuit and depends only on V_o and the distance between cathode or plate and grid. In practice it has been found that oscillation can exist even though the resonant frequency of the external circuit differs from the fundamental frequency or a harmonic of the frequency of electron oscillation. However, an abrupt change in wavelength and pronounced increase in power output occurs when the external circuit is tuned to the fundamental or a harmonic frequency. A possible explanation for this is that when the external circuit is tuned to the electron oscillating frequency, it absorbs more power. This increases the a.c. potential amplitude V_m—which causes a shift in frequency.

The frequency of the circuit using cylindrical-electrodes shown in Fig. 4B, which acts in much the same manner as far as its external circuit is concerned as the circuit discussed previously, is given by[5]:

$$f = \frac{1.5 \times 10^7 \sqrt{V_o}}{[f\ (x) + g(y)]\ r_g} \quad . \quad . \quad (2)$$

The quantities $f(x)$ and $g(y)$ are function of the cathode radius r_k, grid radius r_g, and plate radius r_p. These functions are plotted in Fig. 1.

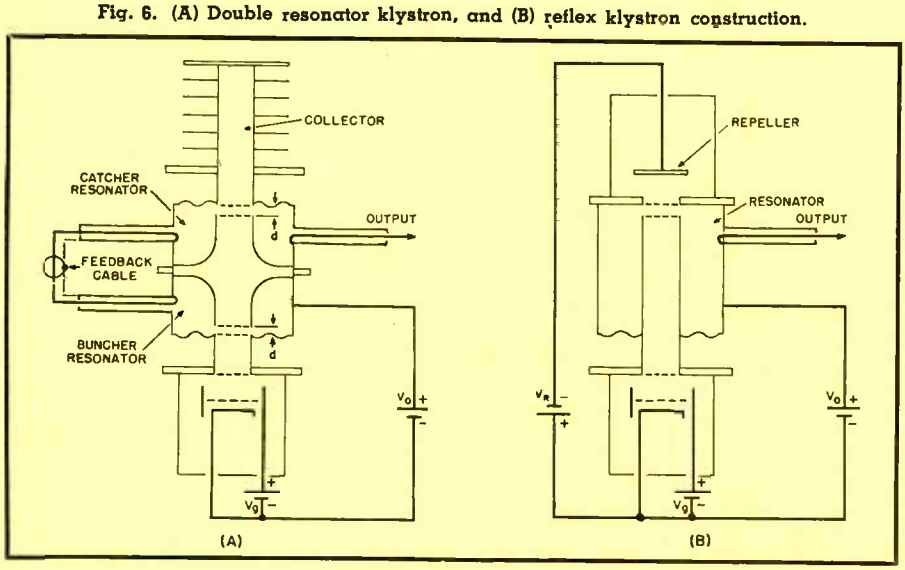
Klystron Oscillators

A tube that utilizes the basic principles of the positive-grid oscillator with greater efficiency and power output is the klystron. It is apparent that the more effectively the electrons are "bunched" the higher the frequency stability, power output and efficiency. Three conditions are necessary to achieve optimum bunching and they are: 1) The velocity of the electrons must be very large compared to the change in velocity caused by the a.c. voltage for reasons previously outlined. 2) The change in velocity due to the a.c. voltage must be great enough for the faster electrons to catch up to the retarded ones, and 3) space charge must be negligible.

The klystron tube is designed to optimize each of these conditions as much as practical. Two types of klystrons, shown in Figs. 6A and B, are available. Consider the klystron shown in Fig. 6A, known as the double-resonator klystron. The cathode and grid of this tube comprise an electron gun which accelerates the electron stream to a very high velocity. This permits condition 1 mentioned above to be satisfied with relatively large a.c. amplitudes.

This electron stream is further accelerated by a "buncher" grid which is at high d.c. potential and—due to the action of the buncher resonator—contains an a.c. component. The frequency of this a.c. component—determined by the cavity resonance frequency—should be the same as the desired "bunching" frequency. This a.c. component will retard or further accelerate the electrons, depending upon its instantaneous value,

Fig. 6. (A) Double resonator klystron, and (B) reflex klystron construction.



and cause bunching as accelerated electrons catch up to retarded ones.

The electron stream then passes through another grid known as the "catcher" grid. Immediately behind this grid is a collector. Both "catcher" grid and collector are at the same potential as the bunching grid. The catcher grid is tuned to the bunching frequency through another resonator, known as the catcher resonator. The phase of this grid a.c. is such as to retard the beam during the periods that the "bunched" electrons are passing so that energy is transferred from the beam to the resonator circuit. The collector carries off the excess electrons so that the space charge will be minimized.

It should be noted that a traveling wave effect occurs across each grid, i.e., the instantaneous voltage is not constant over the entire grid but varies sinusoidally as a function of distance. If the grid length is large compared to a wavelength, many harmonics will be set up. This is indicated graphically by the Applegate diagram shown in Fig. 7. It is therefore possible to use the klystron as a frequency multiplier by feeding in a signal and tuning the catcher cavity to a harmonic of the input signal. Similarly it is possible for one klystron to operate over a series of harmonically related frequencies—all other parameters remaining constant.

Fig. 5 is a schematic diagram of the equivalent circuit of a klystron oscillator. The multigrid tube emphasizes the isolation of catcher and buncher circuits. The two tuned circuits represent the two resonators. The current I_c is the induced current flowing in the catcher resonator. The output to input coupling represents the feedback circuit. The resistance R_L represents the load.

Using this equivalent circuit and the Applegate diagram shown in Fig. 7 as a basis, it is possible to derive a relationship between the voltage stability of the double resonator klystron and the accelerating voltage, the harmonic at which the klystron is operating, and the Q of the tank circuit. This relationship is

$$\frac{\Delta f}{f} = \frac{N}{2Q} = \frac{d V_o}{V_o} \qquad . \; . \quad (3)$$

where N is the harmonic of operation, and Q is the loaded Q of the resonator (catcher).

Two characteristics of the double resonator klystron are apparent from Eqt. (3). One is that the frequency stability is proportional to the voltage stability and the Q of the resonant circuit. The second is that it is possible to frequency modulate or tune a klystron by changing the accelerating voltage.

Another form of klystron oscillator, shown in Fig. 6B, utilizes the reflex principle for obtaining feedback. The

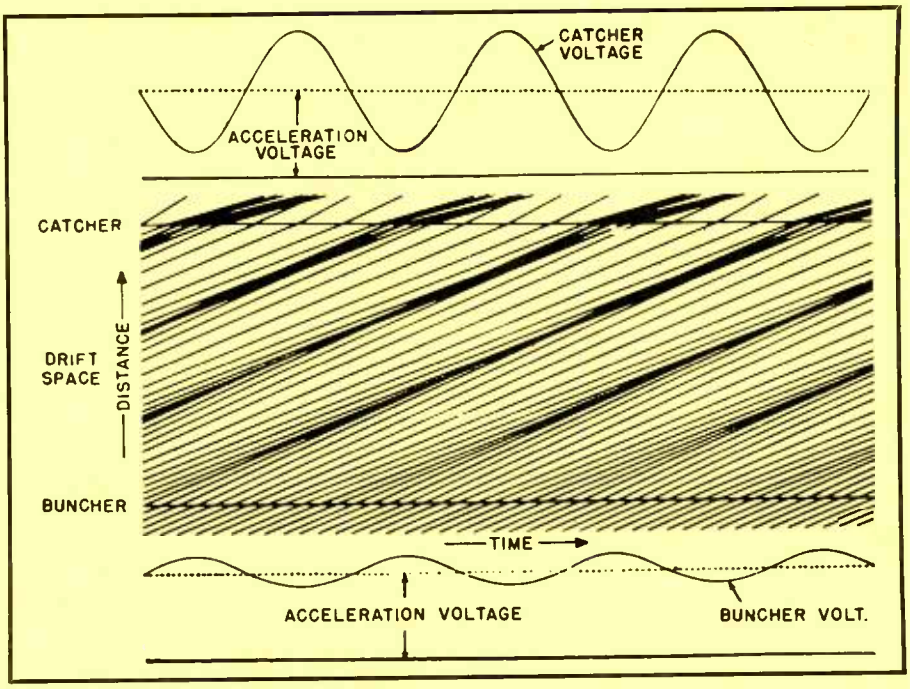


Fig. 7. Applegate diagram showing electron bunching in a klystron.

electron beam is velocity modulated as it passes between the resonator grids. A retarding electric field beyond these grids due to the repeller which is operated at a highly negative voltage causes the beam velocity to decrease to zero and reflects the beam back through the resonator grids. Bunching occurs during the transit interval during reflection. The reflector distance may be much shorter than the drift space in a double resonator klystron because the electrons travel the distance twice and their velocity is nearly zero during a part of the transit time.

The reflex klystrons are used for low power (of the order of up to 10 watts) oscillators. They are more convenient to use because only one resonator must be tuned rather than two. As in the double resonator klystrons harmonics are set up within the tube so that it may be operated at a number of harmonically related frequencies.

The frequency of a reflex klystron is primarily dependent upon the reso-

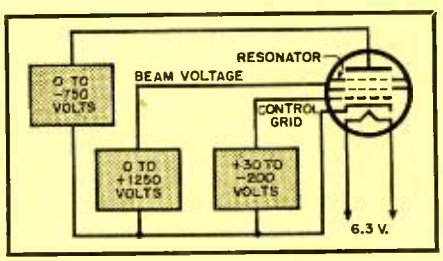


Fig. 8. Block diagram of basic oscillator circuit for a reflex klystron.

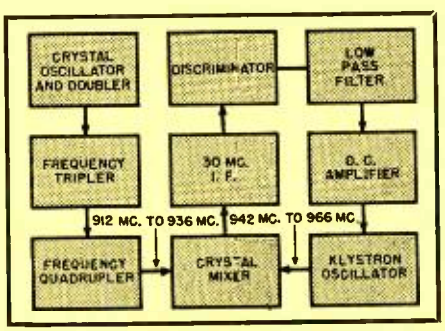
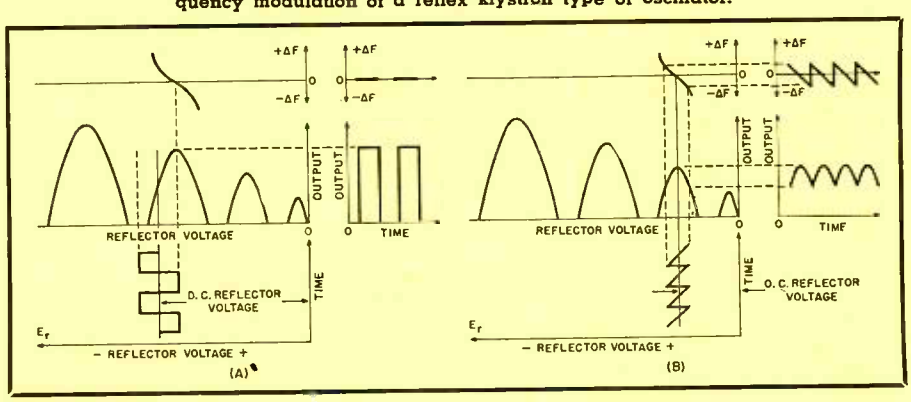


Fig. 9. Typical crystal controlled center frequency stabilization system.

Fig. 10. (A) Typical pulse modulation and (B) typical frequency modulation of a reflex klystron type of oscillator.



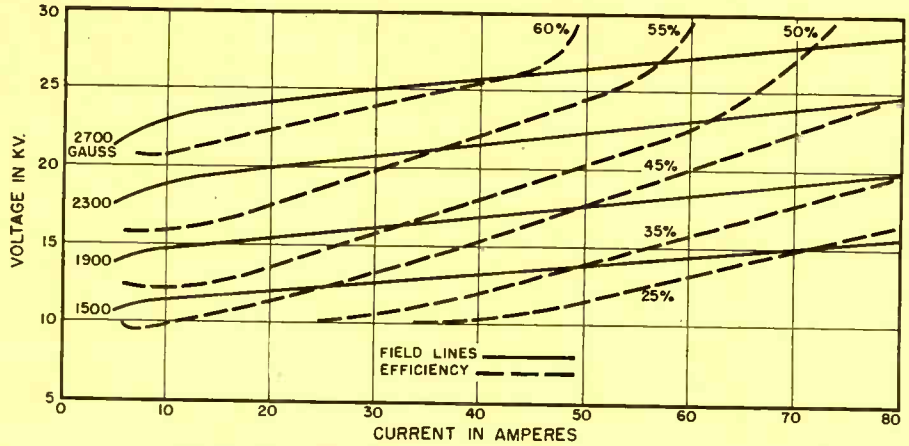


Fig. 11. Typical performance chart of magnetron including plots of voltage, current, magnetic field and efficiency.

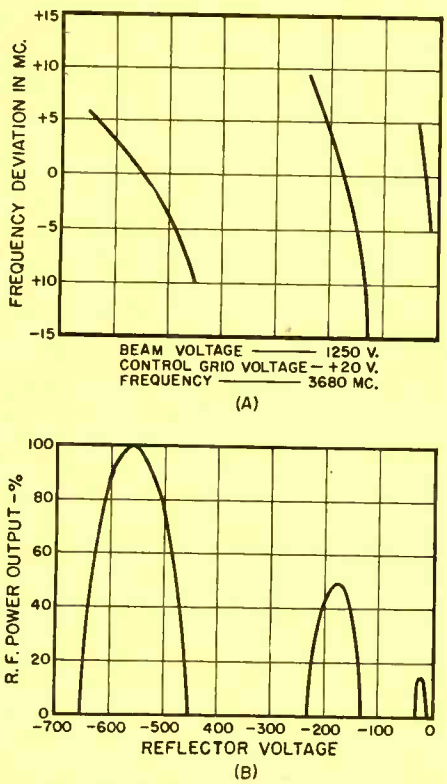


Fig. 12. Typical reflector characteristics for reflex klystron oscillator.

nant frequency, the accelerating voltage, and the repeller voltage. The most sensitive of these parameters is the repeller voltage—i.e., a small change in repeller voltage causes a relatively large change in frequency. Consequently it is this voltage that is usually varied for tuning or frequency modulation purposes.

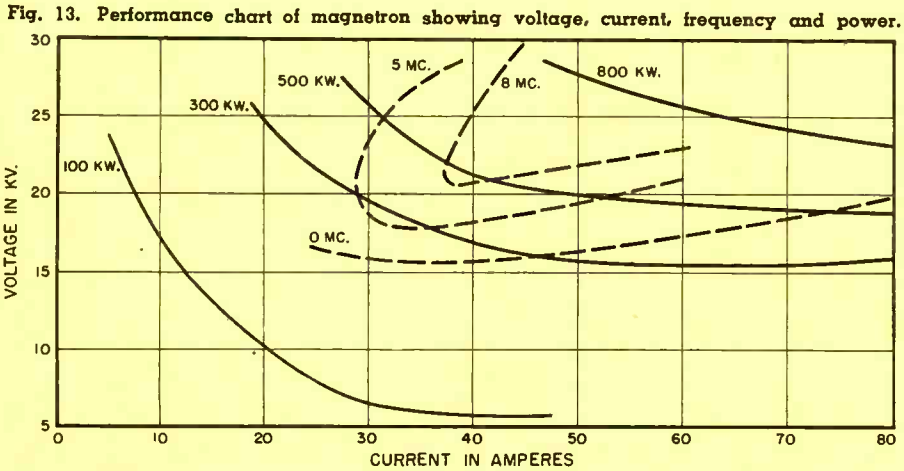
Power Output and Efficiency

The ideal theoretical efficiency of a klystron is 58 per-cent for a double resonator type operating at its primary mode. At higher modes this theoretical maximum decreases, as shown in Table I. The reflex klystron theoretical maximum efficiency is somewhat less than those given for the double resonator type.

Several factors prevent attaining this ideal value of efficiency. The usual beam efficiencies are of the order of magnitude of 50 to 75 per-cent—meaning that the energy of only part of the electrons is available for conversion to r.f. power. Debunching, secondary electrons, resonator losses and other factors reduce the efficiency. Reflex oscillators are usually more efficient than double resonators at low voltages because their starting currents are lower and they oscillate with less power. Increasing the current beyond the starting current—by raising beam voltage—increases the output rapidly at first, then a saturation effect occurs due to over-bunching in the single resonator (space charge effect) and best efficiency may occur with rather low beam current in the reflex klystron. This behavior also explains the inability to obtain an output comparable to that possible with a double resonator klystron when operated at high voltages and high starting currents.

Reflex klystrons now manufactured have a maximum power output rating of the order of 10 watts and an efficiency of about 5 per-cent. The double resonator klystrons operate somewhat more efficiently at rated maximum outputs as high as 200 watts.

Fig. 13. Performance chart of magnetron showing voltage, current, frequency and power.



Practical Problems in Design

When the evaluation of the various methods of microwave generation for an individual application dictate the use of a klystron (the considerations involved will be covered in a later article on "Systems Planning for Microwave Links"—usually klystrons are used in low power frequency modulation systems), the engineer proceeds in the following fashion.

From manufacturer's catalogs, the klystron which most closely meets the requirements of the system, i.e., the power output, frequency range, tuning range, efficiency, frequency stability, etc., is selected. From the characteristic curves given with the klystron selected, the design of the oscillator can be undertaken.

Fig. 12 is the repeller characteristic curve of a typical reflex klystron used in circuit shown in Fig. 8. Curves at left in this figure represent the r.f. power output as a function of repeller voltage and with the resonator set for $f = 3680$ mc., beam voltage at 1250 volts, and control grid at 20 volts. The other curves indicate the frequency of operation for different repeller voltages. For example, with the repeller voltage equal to −600 volts, the frequency of operation will be 3682.5 mc. at 90 per-cent of peak r.f. output for these conditions. It should be noted that these values given assume a matched load. To effect matching, principles discussed in previous articles should be utilized.[2, 3]

The klystron may be frequency or pulse modulated by superimposing a modulation voltage on the d.c. voltage of either the beam control, or repeller sources. The highest degree of sensitivity and linearity can usually be obtained by modulating the repeller voltage. Fig. 10 indicates typical pulse and frequency modulating conditions. When frequency modulating it is important to operate over the linear portion of the repeller voltage versus frequency curve to minimize distortion.

The frequency stability of the oscillator is a function of the three d.c. supplies mentioned above as well as the

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Bring it to Helipot

For many years The HELIPOT Corporation has been a leader in the development of advanced types of potentiometers. It pioneered the *helical* potentiometer—the potentiometer now so widely used in computer circuits, radar equipment, aviation devices and other military and industrial applications. It pioneered the DUODIAL*—the turns-indicating dial that greatly simplifies the control of multiple-turn potentiometers and other similar devices. And it has also pioneered in the development of many other unique potentiometric advancements where highest skill coupled with ability to mass-produce to close tolerances have been imperative.

In order to meet rigid government specifications on these developments—and at the same time produce them economically—HELIPOT* has perfected unique manufacturing facilities, including high speed machines capable of winding extreme lengths of resistance elements employing wire even less than .001" diameter. These winding machines are further supplemented by special testing facilities and potentiometer "know-how" unsurpassed in the industry.

So if you have a problem requiring *precision potentiometers* your best bet is to bring it to The HELIPOT Corporation. A call or letter outlining your problem will receive immediate attention!

*Trade Marks Registered

In this panel are illustrated standard models of HELIPOT multi-turn and single-turn precision potentiometers—available in a wide range of resistances and accuracies to fulfill the needs of nearly any potentiometer application. The Beckman DUODIAL is furnished in two designs and four turns-ratios, to add to the usefulness of the HELIPOT by permitting easy and rapid reading or adjustment.

A B C

MODELS A, B, & C HELIPOTS
A—10 turns, 46" coil, 1-13/16" dia., 5 watts—resistances from 10 to 300,000 ohms.
B—15 turns, 140" coil, 3-5/16" dia., 10 watts—resistances from 50 to 500,000 ohms.
C—3 turns, 13-1/2" coil, 1-13/16" dia., 3 watts—resistances from 5 to 50,000 ohms.
—Ask for Bulletin 104—

D E

MODELS D AND E HELIPOTS
Provide extreme accuracy of control and adjustment, with 9,000 and 14,400 degrees of shaft rotation.
D—25 turns, 234" coil, 3-5/16" dia., 15 watts—resistances from 100 to 750,000 ohms.
E—40 turns, 373" coil, 3-5/16" dia., 20 watts—resistances from 200 ohms to one megohm.
—Ask for Bulletin 104—

F G

MODELS F AND G PRECISION SINGLE-TURN POTENTIOMETERS
Feature both continuous and limited mechanical rotation, with maximum effective electrical rotation. Versatility of designs permit a wide variety of special features.
F—3-5/16" dia., 5 watts, electrical rotation 359°—resistances 10 to 100,000 ohms.
G—1-5/16" dia., 2 watts, electrical rotation 356°—resistances 5 to 20,000 ohms.
—Ask for Bulletin 105—

LABORATORY MODEL HELIPOT
The ideal resistance unit for use in laboratory and experimental applications. Also helpful in calibrating and checking test equipment. Combines high accuracy and wide range of 10-turn HELIPOT with precision adjustability of DUODIAL. Available in eight stock resistance values from 100 to 100,000 ohms, and other values on special order.
—Ask for Bulletin 106—

R W

MODELS R AND W DUODIALS
Each model available in standard turns-ratios of 10, 15, 25 and 40 to 1. Inner scale indicates angular position of HELIPOT sliding contact, and outer scale the helical turn on which it is located. Can be driven from knob or shaft end.
R—2" diameter, exclusive of index.
W—4-3/4" diameter, exclusive of index. Features finger hole in knob to speed rotation.
—Ask for Bulletins 104 and 114—

The versatility of the potentiometer designs illustrated above permit a wide variety of modifications and features, including double shaft extensions, ganged assemblies, the addition of a multiplicity of taps, variation of both electrical and mechanical rotation, special shafts and mounting bushings, high and low temperature operation, and close tolerances on both resistance and linearity. Examples of potentiometers modified for unusual applications are pictured at right.

B F

MULTITAPPED MODEL B HELIPOT AND 4-GANGED TAPPED MODEL F
This Model B HELIPOT contains 28 taps, placed as required at specified points on coil. The Four-Gang Model F Potententiometer contains 10 taps on each section. Such taps permit use of padding resistors to create desired non-linear potentiometer functions, with advantage of flexibility, in that curves can be altered as required.

A C

3-GANGED MODEL A HELIPOT AND DOUBLE SHAFT MODEL C HELIPOT
All HELIPOTS, and the Model F Potentiometer, can be furnished with shaft extensions and mounting bushings at each end to facilitate coupling to other equipment.
The Model F, and the A, B, and C HELIPOTS are available in multiple assemblies, ganged at the factory on common shafts, for the control of associated circuits.

THE Helipot CORPORATION, SOUTH PASADENA 4, CALIFORNIA

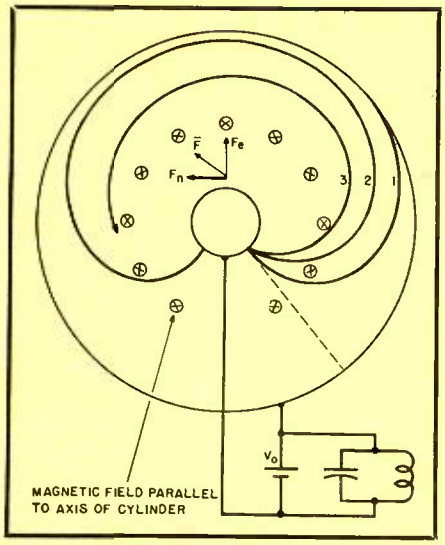


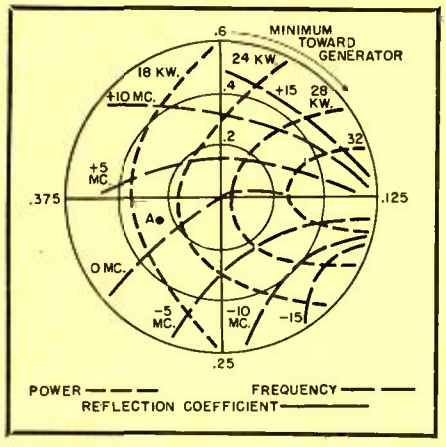
Fig. 14. Simple magnetron showing trajectories of electron with (1) a.c. voltage in phase with d.c., (2) a.c. voltage zero, (3) a.c. out of phase with d.c.

cavity used within the klystron (and the load—but matching has been discussed in previous articles). Electronically regulated power supplies are usually employed to minimize the first effect and automatic frequency control circuits used to compensate for the other factors.

The a.f.c. circuit shown in Fig. 8 of the previous article[1] can be used with the discriminator output used to either operate a motor or electronically tune the oscillator by varying the repeller voltage. This latter method can readily be employed by operating on the electronically regulated power supply which inherently contains a d.c. amplifier. The disadvantage of the electronic system is that it may swing the repeller voltage beyond the linear portion of the repeller-frequency curve. This factor becomes important only where large frequency deviations are used.

Instead of checking the frequency of the klystron against a reference cavity, it is possible to compare it with a crystal oscillator. A crystal oscillator a.f.c. system is shown in Fig. 9 in which the output of a crystal operating in the 38 to 39 mc. range is frequency multiplied to 912 to 936 mc. The klystron normally operates in the 942 to 966 mc. range—the crystal frequency selected so that a difference of 30 mc. exists between klystron and crystal multiplier frequency—this difference is then fed to a discriminator so designed that it presents a zero output with a 30 mc. input, and an either positive or negative output when the i.f. frequency deviates above or below 30 mc. This output is then fed to the frequency regulating circuit.

Fig. 16. Typical Rieke diagram.



Magnetron Oscillators

Magnetron oscillators are widely used when high power output and efficiency are primary design factors. In its simplest form the magnetron, as shown in Fig. 14, is a diode, usually cylindrical, with a magnetic field parallel to its axis and a tuned circuit applied between plate and cathode.

The magnetron shown in Fig. 14 operates in the following manner: An electron leaving the cathode is driven by

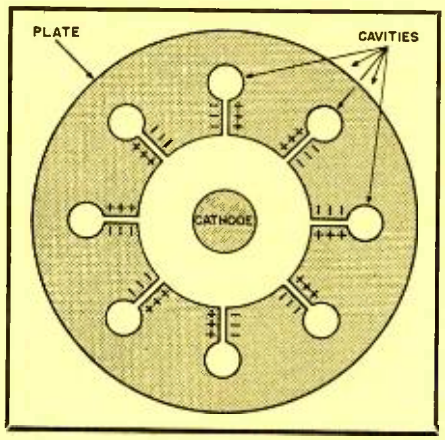
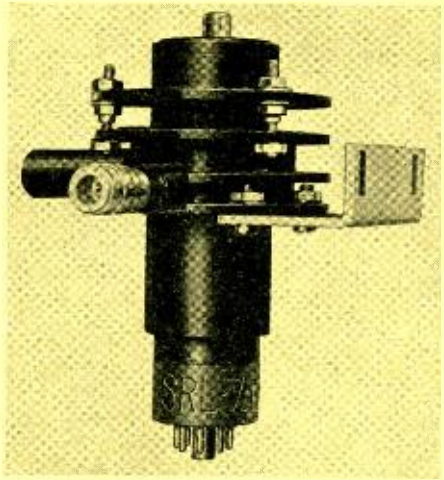


Fig. 15. Multicavity magnetron.

two force vectors. One force is due to the potential V_o on the plate and this vector is directed radially from cathode to plate. The other force, due to the magnetic field B, is perpendicular to electron and magnetic field. When the electron travels radially towards the plate, the force due to the magnetic field would be parallel to the diameter of plate and cathode. The magnitude of the vectors will be a function of the strength of electric and magnetic fields.

It can readily be seen that if the magnetic force is relatively weak the electrons leaving the cathode will travel along a curved path but reach the plate eventually. As the magnetic field increases, the angle at which electron strikes the plate becomes increasingly smaller until at some point it grazes by and returns to the cathode. This point is reached when the following relationship is true:

$$\frac{V_o}{B^2} = \frac{er_a}{8mc^2}\left[1-\left(\frac{r_c}{r_a}\right)^2\right]^2 \quad (4)$$



Reflex klystron operating in the 1875 to 2100 mc. range provides an output of approximately 10 watts.

where r_c is the radius of the cathode
r_a is the radius of the anode
m is the mass of an electron
e charge on an electron
c is the velocity of light

The curves shown in Fig. 14 show the effect of an r.f. voltage superimposed on V_o, where the value of V_o chosen is such that equation (4) is satisfied. Curve (1) represents the trajectory of an electron emitted at an instant when the r.f. field is in the same direction as the d.c. field. Thus the effective V acting on the electron is increased with the result that the electron strikes the plate.

Curve (2) represents the trajectory of an electron for the r.f. voltage equal to zero, while curve (3) indicates the path of an electron leaving when the r.f. potential opposes the d.c. field. This electron contributes energy to the r.f. oscillation and the process will continue as long as the electron is retarded by the r.f. field. A characteristic of this type of magnetron, which is important in the operation of many magnetrons, is the quick removal from the field of electrons whose phase is unfavorable to the support of oscillation and the retention of electrons aiding in the support of the r.f. oscillations.

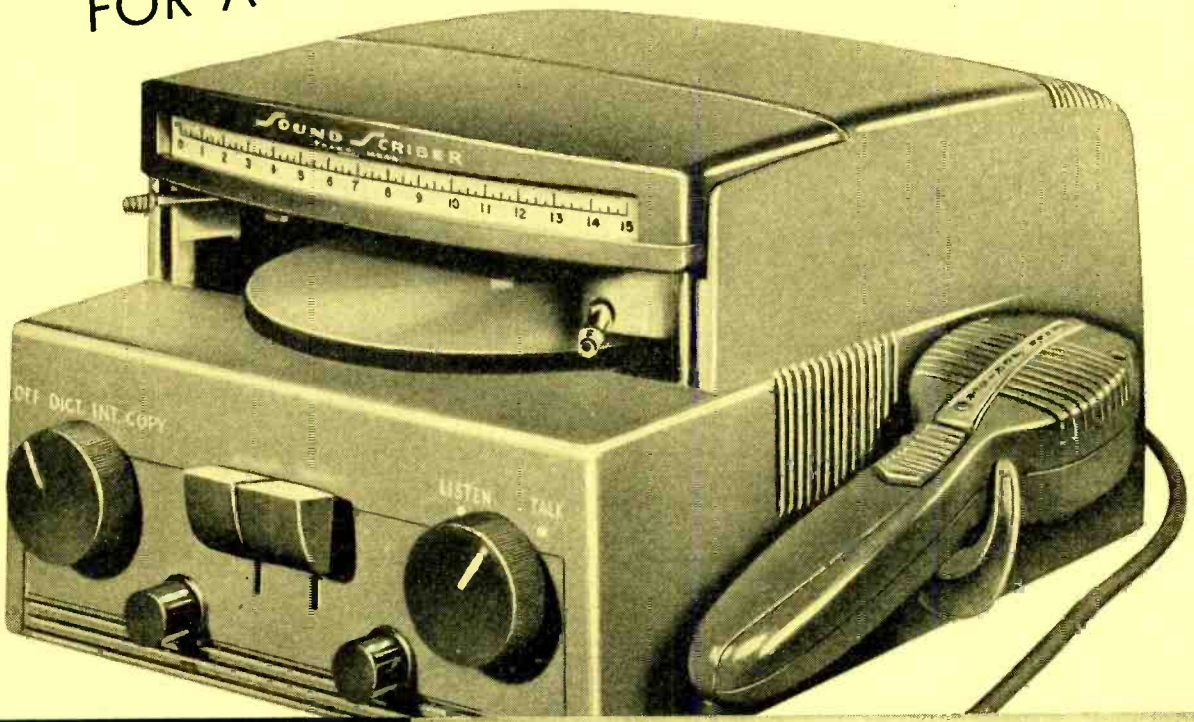
Many forms of magnetrons, all of which employ the basic principles described above, have been made in the

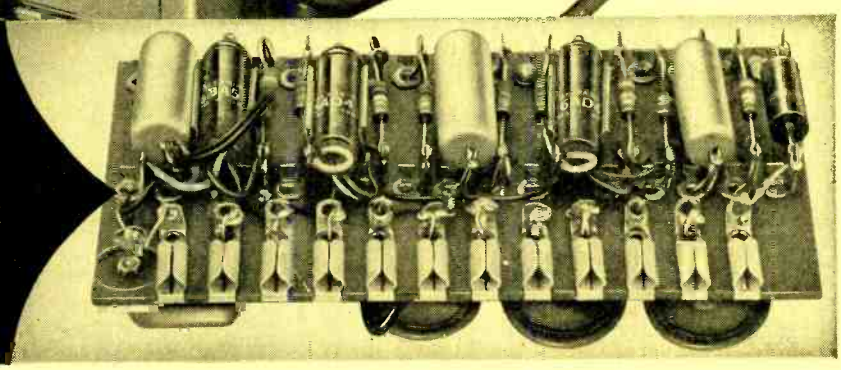
(*Continued on page* 30)

Table I. Ideal efficiency of klystron oscillator for various modes of operation.

Harmonic	Ideal Efficiency
1	58
2	48
3	43
5	37
10	30
15	27
20	24

GREAT LITTLE TUBES FOR A GREAT LITTLE INSTRUMENT





Here is the heart of the SoundScriber "Tycoon". Note how Sylvania's three subminiature tubes (1-6BA5 and 2-6AD4's) are mounted directly on the plastic card—allowing all-round compactness of design.

Sylvania's subminiature tubes are one of the secrets that enable SoundScriber to make the world's lightest, most compact dictation instrument. Only 15 lbs., the "Tycoon" covers as little desk space as an ordinary letter. Such concentration of electronic efficiency is typical of the advantages offered by Sylvania's subminiature tubes.

The "Tycoon" also owes much of its reputation for reliability to the Sylvania subminiatures that serve it . . . for they are lightweight little wonder-workers that stand up to heavyweight treatment.

In electronics, wherever compactness demands minimum size . . . wherever dependability is wedded to economy . . . you'll find Sylvania subminiatures at work, cutting space, cutting costs, cutting servicing requirements and replacement. Write Sylvania Electric Products Inc., Dept. R-2306, Emporium, Pa.

SYLVANIA ELECTRIC

RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; FLUORESCENT LAMPS, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

NEWS BRIEFS

ATOM SMASHER

Dr. C. C. Suits, vice president and director of research for the *General Electric Company*, has announced that

a machine known as a "non-ferromagnetic synchrotron" is being built under the joint sponsorship of the Office of Naval Research and the *GE* Research Laboratory.

According to Dr. Suits, this atom smasher has been operated thus far up to about a million volts and probably will be in operation at much higher energies before the end of the year. It will be used to study the effects of high-energy radiation, particularly in nuclear research. First erected in one of the old buildings of the *GE* Research Laboratory, the new synchrotron is now being installed in its own building at the laboratory's new quarters at the Knolls, in nearby Niskayuna.

In charge of its design and construction shown from left to right above are Dr. James L. Lawson, and his associates, Drs. H. R. Kratz, W. B. Jones, H. G. Voorhies and G. L. Ragan.

RADAR INTERCEPT

A miniature magnetron radio tube that might be important in radio and radar intercept work has been developed by the Signal Corps Engineering Laboratories.

Compared with the 20,000 to 30,000 volts normally required by commercial type magnetrons, the miniature tube can be operated on less than 100 volts from dry batteries. The tube is approximately the diameter of a lead pencil and is four inches in length.

The basic theory of the new tube was derived from a captured German magnetron used in radar and television, but the design and operation were improved by the Signal Corps.

INSTRUMENT TO MEASURE FARADAY

The National Bureau of Standards has developed an instrument which makes possible measurement of the numerical value of the faraday with exceedingly high precision. Developed by J. A. Hipple, H. Sommer, and H. A. Thomas, the omegatron is basically a miniature cyclotron.

For the first time the faraday is being evaluated directly by physical methods, all previous faraday measurements having been electrochemical. Also, the value of the nuclear magneton may now be determined very precisely so that the ratio of the mass of the electron

to the mass of the proton will be known with greater precision than ever before.

The omegatron with its associated electromagnet, vacuum system, and electrometer amplifier is shown here in use as a mass analyzer. Mr. H. Sommer is checking the position of the omegatron in the magnetic field.

RESEARCH ON GERMANIUM

Speaking at the M.I.T. Conference on Physical Electronics at the Massachusetts Institute of Technology recently, Dr. B. J. Rothlein of The Physics Laboratories of *Sylvania Electric Products Inc.*, described researches he has conducted on the photoresistive properties of germanium previously reported by other research workers during World War II.

Dr. Rothlein showed that a germanium photoswitch may be made to operate a relay for applications such as automatic door openers without the aid of photocells, amplifiers or direct current power supplies.

NEW RCA PLANT

Dedication ceremonies for the new television picture tube plant of the

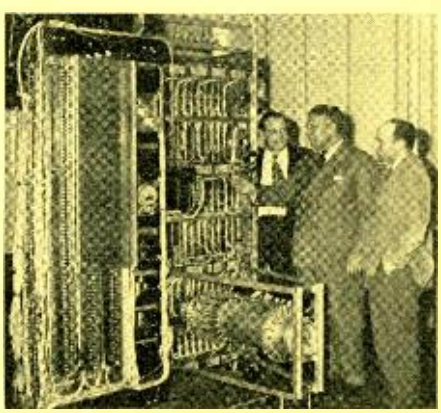
Radio Corporation of America at Marion, Indiana were held recently. Honored guest was Governor Henry F. Schricker of Indiana, who also officiated at groundbreaking for the new plant last year.

Major product of the plant is *RCA*'s recently developed short 16-inch metal picture tube. The new Marion plant is the fourth of the thirteen *RCA* plants to be located in Indiana.

REMINGTON BUYS "UNIVAC"

Announcement of the purchase of more than 95 per-cent of the stock of the *Eckert-Mauchly Computer Company* of Philadelphia, whose founders, Dr. John W. Mauchly and J. Presper Eckert originated the "electronic brain", has been made by James H. Rand, president and board chairman of *Remington Rand, Inc.*

Dr. John W. Mauchly, left, and Prof. J. Presper Eckert, right, inspect the mercury memory assembly of the Univac with Lt. Gen. Leslie R. Groves, U.S.A. (Ret), *Remington Rand's* Vice



President and Director of the company's Laboratory for Advanced Re-

(*Continued on page* 25)

NEW PRODUCTS

RECORDING AND TRANSCRIBING UNIT

The *Permoflux Corporation*, 4900 W. Grand Avenue, Chicago 39, Illinois, is

now introducing a combination recording and transcribing unit under the name of the Tape Riter.

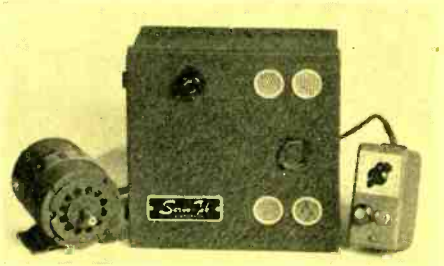
The unit is compact and on the spot recordings can be made with ease. The tape may be used over and over again simply by erasing previous recording with the new message. There is no overtone from the previous recording and correction and deletion of any portion of the message is easily accomplished.

Fast forward and reverse enables the user to find any particular spot on the tape in seconds and accurate indexing is provided.

MOTOR SPEED CONTROL

A simplified thyratron type motor speed control system which operates d.c. motors from the a.c. line has been developed by *Servo-Tek Products Co.*, 4 Godwin Ave., Paterson, N. J. Shunt wound type 115 volt motors of from one thousandth to one tenth horsepower may be controlled over a speed range of better than 50 to 1 with nearly constant speed versus torque regulation.

A physically identical model is avail-



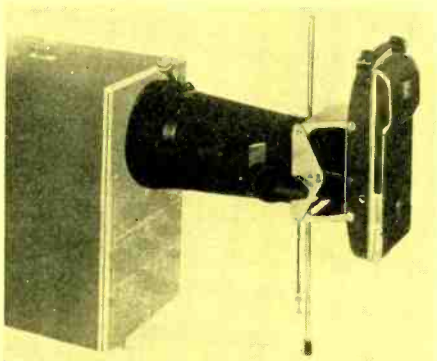
able for operation from the 220 volt line to control d.c. motors of the shunt wound type up to one-sixth horsepower. Speed range is identical for either unit.

The manufacturer believes that applications of this motor speed control system to industrial applications are many and varied, and has offered to assist in application problems.

OSCILLOSCOPE CAMERA

Fairchild Camera and Instrument Corp., 88-06 Van Wyck Blvd., Jamaica 1, N. Y., has announced a new recording camera for photographing the screen of a cathode-ray oscilloscope and producing a print for engineering study within one minute.

Designated as the F-284 *Fairchild*-Polaroid Oscilloscope Camera, this



camera is expected to prove extremely useful to engineers in that it quickly delivers an accurate photographic record of single transients or repetitive phenomena without the need for darkroom processing.

The camera is designed for use with any standard 5" cathode-ray oscilloscope. Writing speeds up to 1 inch per microsecond have been recorded with an accelerating potential of 3000 volts. Print size is 3¼ x 4¼ inches with the two recorded images reduced by a ratio of only 2 to 1 from the original trace.

Further information may be obtained from *Fairchild* by writing to Mr. W. J. Schubert.

MOBILE COMMUNICATIONS UNIT

Type ES-12-A, announced by the *General Electric Company*, Syracuse, N. Y., is a 10-watt mobile radio transmitter-receiver designed for adjacent channel operation in urban and metropolitan areas.

Features of this unit include triple-tuned transformers for extra high selectivity, peak audio putput of 2 watts, adjustable i.f. gain control, and built-in

low pass harmonic filter that reduces interference to other services, including television.

Further information on the ES-12-A mobile communications unit may be obtained from the Commercial Equipment Division.

TIME DELAY RELAYS

Westinghouse Electric Corporation, Pittsburgh, Pa., is now offering type AM pneumatic time delay relays with adjustable delay from 0.2 to 200 seconds. A large graduated dial permits delay adjustment throughout this range for general industrial timing functions.

These type AM relays are available as open or enclosed units, the latter in NEMA type I enclosures with conduit knockouts at top and bottom. Operating coils are designed for satisfactory service down to 85 per-cent of rated voltage. Coils are available in ratings up to 600 volts a.c., 25 to 60 cycles.

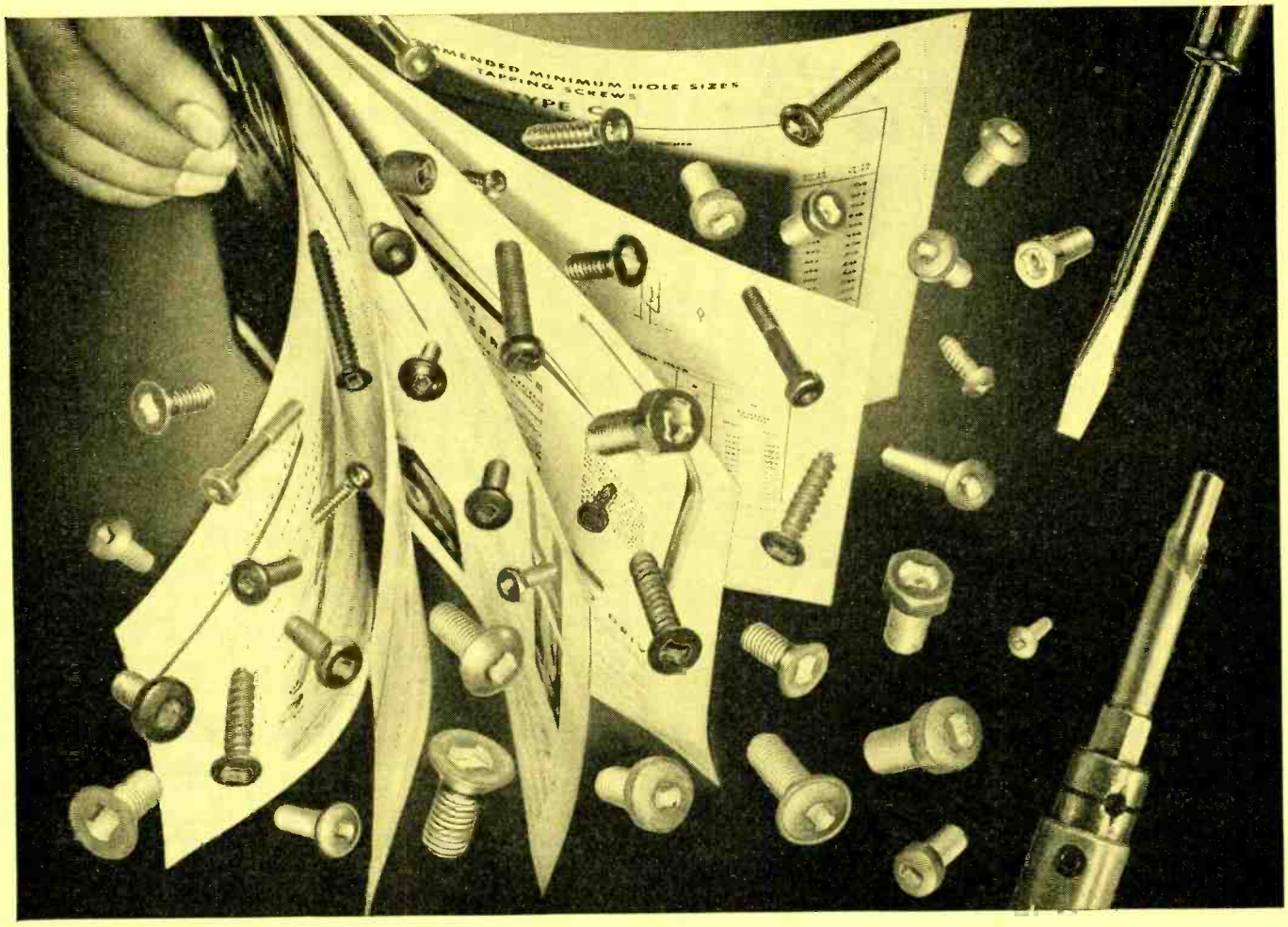
Further information may be obtained by writing the company at P. O. Box 2099, Pittsburgh 30, Pa.

MOLDED PLASTIC PARTS

General purpose and low loss dielectric molded phenolic plastic products for the electrical and electronic indus-

tries are now available from the Parts Division, *Sylvania Electric Products*,

(*Continued on page* 26)



Assembly Costs Take a Tumble with Change-over to CLUTCH HEADS

Users Certify 15% to 50% Production Increases for Lower Final Costs

In view of this testimony you may confidently expect these exclusive time and cost-saving CLUTCH HEAD features to deliver a similar ratio of production increases on your assembly line . . . to lower your final costs by producing more for less.

Higher Visibility of the clutch recess eliminates operator hesitation. Even "green" help drives with speed and confidence. No "break-in" needed.

No Damaged Heads . . . Dead-center entry with the Center Pivot Column prevents driver canting, makes straight driving automatic, and checks out delay and expense fixing burred or chewed-up heads.

Now, Non-Tapered Driving that sends skid damage to zero; safeguarding manpower and material. With CLUTCH HEAD'S all-square driving engagement there is no need for end pressure to combat "ride-out" (as set up by tapered driving) and the drive home is effortless. This safety factor and elimination of fatigue steps up production.

One-Handed Reaching at "Bottlenecks." Only CLUTCH HEAD provides a frictional Lock-On that joins screw and bit as a unit to permit one-handed reaching into inner spots and driving from any angle.

214,000 Screws Driven Non-Stop. This is the record established by the rugged Type "A" Assembly Bit . . . continuous high torque driving on a main assembly line of one of America's largest automotive plants.

New Bit Life in 60 Seconds. Consider the added tool economy of simplified reconditioning this bit REPEATEDLY . . . by a 60-second application of the end surface to a grinding wheel.

Curing Field Service "Headaches." For simplified field service, CLUTCH HEAD alone has a recess that is basically designed for operation with a common screwdriver or with any flat blade which need only be reasonably accurate in width.

These advantages are fully detailed in the New CLUTCH HEAD Brochure . . . along with technical information your engineers and plant executives will want for reference. Start your investigation of CLUTCH HEAD'S potential savings for your assembly by sending for a copy . . . and indicate sizes and types of screws which interest you.

UNITED SCREW AND BOLT CORPORATION

CLEVELAND 2 CHICAGO 8 NEW YORK 7

Personals

JAMES N. DAVIS, formerly a senior research engineer for the Physics Laboratories of *Sylvania Electric Products Inc.*, Bayside, New York, has been appointed technical representative for the company at Washington, D. C. Before joining the *Sylvania* research staff in 1946, Mr. Davis served as Radar Officer in the Naval Research Laboratory. He graduated from Purdue University with a B.S. degree in general science.

LYNN C. HOLMES has been made associate director of research for *Stromberg-Carlson Company*, Rochester, New York. Senior electrical engineer since he joined the company in 1943, Mr. Holmes is well-known in the field of magnetic sound recording. He is an active committeeman in the AIEE, RMA, the American Standards Association, and is a member of the IRE and the Acoustical Society of America.

DAVID LEO HOWARD, Assistant General Manager of Canadian Pacific Communications, has been appointed President and General Manager of the *Canadian Overseas Telecommunication Corporation*, Ottawa. As representative of Canadian wireline companies, Mr. Howard has appeared many times before Canadian Parliamentary Committees and United States Senate and Congressional hearings in the coordination of telecommunication services.

GEORGE C. JELLIFFE has been named Eastern District Manager for the *Ilg Electric Ventilating Company* of Chicago. Mr. Jelliffe's headquarters will be at 15 Park Row in New York City. A graduate of Stevens Institute of Technology with an M.E. degree, Mr. Jelliffe first became associated with *Ilg Electric* in 1946 as assistant to the vice-president. He was formerly associated with *Western Union Telegraph Company.*

G. PRYOR MOLLOY, formerly associated with *RCA*'s Tube Department, has been appointed head of the Field Engineering Department, Industrial & Electronics Division of *American Structural Products Company* with headquarters at Columbus, Ohio. A graduate of Newark College of Engineering, Mr. Molloy is a senior member of the IRE, a member of the AFCA, American Society of Naval Engineers, and an associate member of the U. S. Naval Institute.

HOWARD D. MATTHEWS, consulting engineer for the *W. M. Chace Company*, Detroit, Michigan, passed away recently. Mr. Matthews was widely known for his work in the application of thermostatic bimetal to various problems of temperature-responsive devices. He was a Fellow of the AIAS and a Fellow in the AIEE.

Loading Crystals

(*Continued from page* 9)

did not give greatest activity. Instead the optimum activity, 50 per-cent higher, was obtained by moving the electrode to a different position near the center. Shifting to the thinner edges was accompanied by increasing frequency and decreasing activity; moving from the optimum point toward the center caused both activity and frequency to decrease. The area of the crystal and the frequency range over which this anomalous behavior occurred were small. For example, in a 10 mc. plate which had an edge-to-center frequency variation of 25 kc., the frequency which gave maximum activity was about 5 kc. higher than the lowest frequency obtainable; the electrode position in this case was about one-fifth the distance from the center of the corner of the plate. Typical activity values as indicated by the rectified grid current from the oscillator tube, were 0.5 at the center of the plate, 0.8 at the optimum position and 0.2 at the corner.

Temperature runs (-60° to + 90°C) were made on several ½-inch-square 10 mc. plates which had centers about 0.00005 inch concave. All had activities which varied constantly between 0 and 0.2 milliampere over the temperature range, and frequencies which were correspondingly unstable. These oscillator blanks were etched slightly to raise their frequencies 3 to 5 kc., and then were loaded to their original frequency, thereby reestablishing the original relationship between the fundamental and other secondary modes. The loading material was woods metal, applied lightly in a ¼-inch diameter circle concentric with the center of the plate. The effect was a more than threefold increase in the activity (0.2 to 0.7 ma. or more). Subsequent temperature runs revealed that the increased activity was associated with a general improvement in operating characteristics over the entire temperature range. Also, the resistance at series resonance, R_s, decreased several fold while the Q increased correspondingly. Since the same frequency-dimension relationships were maintained, factors other than the usually ascribed coupling phenomena are responsible in some measure for the erratic behavior; perhaps the most important of these is the frequency at which the plate is being driven. In general, it appears that plates whose central active areas have a frequency that is too high for the plate as a whole tend to have poor frequency stability and activity. Elimination of this condition can very easily be effected through a lowering of the frequency by placing a small mass of material upon the central areas.

Loading certain areas of lower-frequency plates very heavily has also been found to be beneficial. It has long been known that giving a slight convexity to some types of oscillator plates results in improved performance. Recent experiments indicate that if this contouring takes the form of a plateau at the center with tapering edges, the performance is improved even more. It appears that heavily loading the central portion of the plate produces effects very similar to those produced by the plateau with tapering edges. It is believed that in both cases the thickness-shear vibration is mainly confined to the central area because the surrounding area is so far off frequency that it remains relatively inert. A difficulty commonly found in mounting low-frequency plates is their failure to oscillate when pressure is applied to the corners,—e.g., when a plate is pressure-mounted between electrodes with raised areas at the corners. Although the active portion of very thin plates in thickness-shear is mostly restricted to the central area, the flexural vibrations which may also be present become quite active at lower frequencies (thicker plates). This may be corrected either by contouring or by properly loading the plates, which may then be securely clamped at the corners with no great reduction in activity.

Several loading materials, both metallic and non-metallic, have been used effectively. Woods metal has certain advantages in hand application because it is soft, adheres well to the quartz, and can easily be removed. The amount of metal for satisfactory results varies with the percentage of the area coated as well as with the shape of the coated area. An elliptical pattern with the long axis parallel to the x-axis has good effect, and a band across the plate in the x-axis direction, covering about 1/3 the area of the plate, is also effective. A narrower band parallel to the x-axis is less effective while similar patterns rotated 90° (long dimensions perpendicular to the x-axis) are still less effective: a narrow band perpendicular to the x-axis appears to have a deleterious effect. In most of the experiments, an equal amount of woods metal was applied to both faces of a plate. (When the coated area was the size of a pinhead, an interesting effect occurs: the frequency decreases at first, as expected, but further application of metal causes the frequency to jump to a point many kilocycles higher than the original frequency).

A better understanding of the theories involved in quartz-crystal loading and how the most beneficial effects may be produced must await more comprehensive study. A considerable improvement over the hand-loading technique could no doubt be effected through evaporation processes similar to those used for coating mirrors.

News Briefs

(*Continued from page* 20)

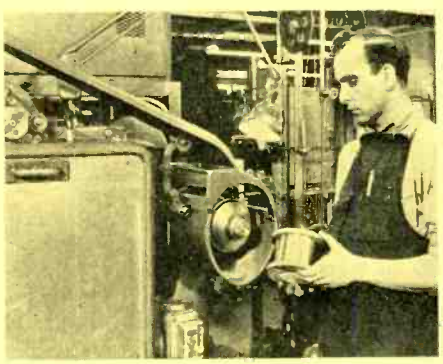
search, South Norwalk, Connecticut.

According to Mr. Rand, plans were begun immediately for developing the amazing new mathematical marvels for use by business concerns requiring large amounts of computing and recording. Manufacture and distribution of the "Univac" will be coordinated with *Remington Rand's* complete line of business equipment.

COPPER WIRES

Nickel-clad copper wires for aircraft, industrial and laboratory equipments, and many other applications where product fabrication or end use is in high temperature or corrosive atmospheres is being produced by *Sylvania Electric Products Inc.*

Mr. Howard M. Boyd, sales manager, said that Sylvania is specializing in diameters ranging from .010" to .005" which are particularly well suited for stranding and for lead wire applications where high temperature working of hard glass frequently renders solid copper wires brittle and unworkable.



Production of nickel-clad copper wire is controlled so that a practically uniform ratio of nickel to copper is maintained through a series of cold drawing operations in which the nickel-cladding ranges from 27% to 29%. This material is being marketed under the brand name "Kulgrid".

WEATHER FORECASTING TECHNIQUES

Scientists of the Geophysical Research Directorate, a branch of the Air Force Cambridge Research Laboratory, are conducting studies of new weather forecasting techniques with an analytical mass spectrometer.

The high-sensitivity range of the mass spectrometer, which was designed

and built in the *General Electric Company's* General Engineering and Consulting Laboratory at Schenectady, N. Y., is expected to be of aid in the study of reactions which meteorologists believe take place among constituents of the atmosphere as a result of absorption of radiant solar energy. Because it separates molecules of different weights, or masses, the instrument is useful in

recording presence of isotopes, particles which react chemically in the same way as the original, but differ from them in mass and atomic structure.

GE Engineer J. G. Neuland is shown seated before the control panel of the instrument as he watches the chart on which weights of molecules in gas being analyzed are automatically recorded. At the right is the electronic tube rack into which gases are introduced for analysis.

NEW LITERATURE

Measurement of Resistance

The first definitive results of a new and satisfactory method devised for independently checking the stability of the standard of electrical resistance in terms of length, time, and the permeability of free space, are described in detail in a new paper, An Absolute Measurement of Resistance by the Wenner Method.

Published by the National Bureau of Standards, this method can detect a change of a few parts in a million in the standards used to maintain the unit.

This paper may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. at a price of 30c a copy.

Mass Spectrometer Leak Detector

Vacuum-Electronic Engineering Co., 316 37th St., Brooklyn 32, N. Y. has issued a new 4-page bulletin titled Veeco Mass Spectrometer Leak Detector.

Contents of this bulletin describe typical applications, wherever a vacuum, fixed pressure or special atmosphere must be maintained for extended periods of time; principle of operation, features, and pertinent data pertaining to vacuum testing and pressure testing with explanatory illustrations.

A copy of this bulletin may be obtained by writing the company and requesting a copy of Bulletin LD-95.

New Products

(*Continued from page* 22)

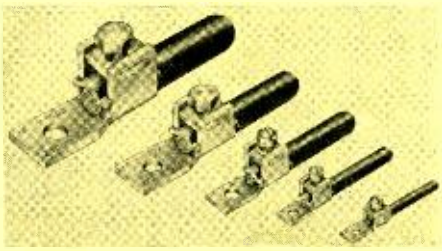
Incorporated, Warren, Pennsylvania.

Available in black, white or colors for specific product identification, parts can be fabricated to close specifications at low unit cost. Facilities include product design and the design and production of required molds for use with modern automatic high-speed rotary and multiple flat-press equipments.

Plastic parts may be supplied as molded pieces, as subassemblies with staked, eyeletted or stitched metal parts, or as complete assemblies of molded plastic and small metal parts.

PRESSURE CONNECTORS

Five lug models comprise the "Wide Range" line of medium-priced pressure connectors for use with copper, aluminum or steel wire in sizes from 14 AWG to 500 MCM, announced by *National Electric Products Corp.*, Chamber of



Commerce Building, Pittsburgh 19, Pa.

These pressure connectors are complete assemblies and each connector is said to be capable of handling a wide range of wire and cable sizes. The three smaller sizes, NE 35, 60 and 100 can be installed with a screwdriver; the larger sizes, NE 200 and 400, with a wrench. All sizes were made with minimum over-all dimensions to expedite installation in small gutters. The entire unit is cadmium plated for corrosion protection.

SAFETY DEVICE

A new kind of electrical control designed as a safety device to protect water-cooled, electrically-operated equipment, such as air compressors, vacuum pumps and the like, against damage through water failure is announced by *The Electro Chemical Supply & Engineering Co.*, 750 Broad St., Emmaus, Pa.

The Esto Water Control can be adjusted to operate at any water flow the equipment requires. If the water supply fails, a weighted lever falls which opens the circuit and the relay stops the equipment or sounds an alarm or both. Also, an Esto-controlled compressor will not start until the water has been turned on.

VOLTAGE SUPPLY

Sola Electric Company, 4633 W. 16th St., Chicago 50, Illinois, is manufacturing an adjustable, regulated, a.c. voltage supply designed for use with equipment that requires an adjustable source of constant a.c. voltage from 0 volts to 130 volts of undistorted wave shape.

The "Solavolt" type CVL provides all of the voltage stabilizing characteristics

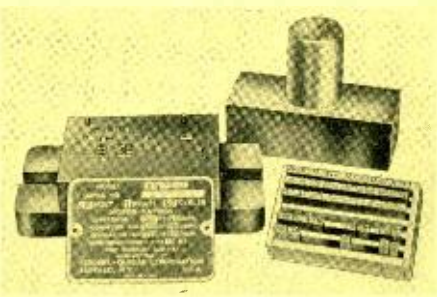
of the standard SOLA constant voltage transformer; ± 1% regulation for line input changes from 95-125 volts with less than 3% harmonic distortion of the input voltage wave. The voltage regulation is automatic and substantially instantaneous.

Each unit is provided with attached input cord and plug; line on-off switch; one standard receptacle for a fixed, regulated 115 volts; one standard receptacle for a variable, regulated output of 0-130 volts; and a pair of jacks with regulated, variable output of 0-130 volts for connecting instruments with plugs or wire type leads.

Technical Bulletin P96 CVL-140 gives full mechanical and electrical specifications and is available on request.

MARKING DEVICE

The *M. E. Cunningham Company*, 192 East Carson St., Pittsburgh 19, Pa., has developed a special stamping fixture for marking metal name plates in mass



production operations. Model PSF-10 is designed for use in a small power press,

screw press, kick press or similar device.

This marking device is composed of a chase block which contains the steel marking letters and a striking block which is held in the throat of the press by set screws. Slots for containing the letters are machined out of the solid tool steel chase block to suit the setup of the name place layout and logotypes are supplied when the same style plate is used for several different models.

Data sheets and additional information may be obtained by writing the company.

POTENTIOMETER

Technology Instrument Corporation, 1058 Main Street, Waltham 54, Mass., has announced a new type precision potentiometer now being manufactured.

Type RVC2 features a crank arm and drive pin assembly which transmits shaft rotation. At the point of contact between crank arm and drive pin the crank arm is spring loaded to eliminate back lash. Use of this method makes it possible to remove a single potentiometer from a ganged assembly by simply loosening the clamp ring and slipping potentiometer out of the assembly.

RVC2 potentiometers are available in a wide range of resistance values and can be furnished with linear or non-linear windings. Full details are available upon request from the manufacturer.

D.C. AMPLIFIER

A wide-band d.c. amplifier designed specifically to increase the sensitivity of cathode-ray oscilloscopes with extended

low frequency response is now being manufactured by *Furst Electronics*, 12 S. Jefferson St., Chicago 6, Illinois.

Model 120 is also suitable to extend the range of vacuum-tube voltmeters, frequency analyzers and other instruments. The amplifier uses push-pull amplification throughout and a special cross-coupled circuit is used to achieve stability and low drift.

Two sets of input terminals are provided, one marked "DC" and connected directly to the input attenuators, the other marked "AC" and connected through a pair of coupling condensers to the d.c. input terminals. The maximum gain of the amplifier is adjusted to approximately 100 and the input attenuators reduce this gain to approximately 10 and 1 (40 db., 20 db., and 0 db. resp.).

SCREEN ROOMS

Pre-built screen rooms for laboratory and production line use which offer maximum radio interference screening efficiency are now available from *Ace Engineering and Machine Company, Inc.*, 3644 N. Lawrence St., Philadelphia 40, Pa.

Available in "cell units", these screen rooms are built to provide a minimum of 100 db. attenuation from 0.15 to 1000 megacycles. Of sectional, double-mesh construction the units require no soldering between sections.

Background radio interference is held to an absolute minimum to facilitate accurate radio interference measurements, r.f. calibrations, inspection tests, fractional voltage measurements, and other research where background noise must be eliminated to assure real accuracy.

Literature giving complete details will be sent on request to the manufacturer.

Ripple-Tank

(*Continued from page* 6)

1/16 in. on centers. The slots were 0.040 in. wide and 3/32 in. deep; and the concave side had a radius of 1¼ in. Since there is no possibility of interference between the back radiation of the primary pattern and the secondary pattern in the case of the wave guide lens, the side lobe structure due to this cause is absent. Appreciable reflection from the first surface of the lens is evident. It should be possible to simulate some aspects of Kock's[3] path-length delay microwave lenses by using somewhat wider, "zig-zag" slots and a convex model.

Conclusion

It has been the purpose of this condensed report to bring to the attention of electronic engineers some of the virtues and some of the limitations of the ripple-tank as an aid to antenna phase-front visualization. It is believed that this device will be of value to the electronics teacher as well as to the research engineer.

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3. *Kock, W. E., "Path-Length Microwave Lenses," Proc. IRE 37: 852-855, August 1949.*

TECHNICAL BOOKS

"ELECTRONIC PRINCIPLES AND APPLICATIONS" by Ralph R. Wright, Associate Professor of Electrical Engineering, Virginia Polytechnic Institute. Published by *The Ronald Press Co.*, 15 E. 26th St., New York 10, N. Y. 387 pages. $5.50.

This textbook presents in a clear and coherent manner the basic electronic principles slanted to meet the requirements of nonelectrical students. By no means limited to the nonelectrical student, the author has also used this material in instructing electrical engineering students and physics majors.

In order to keep the text both flexible and suited to the many different curricula now offered in engineering colleges, more material is offered than will usually be covered in the average one-quarter or even one-semester course. This allows the instructor to choose those topics which he believes most valuable for the class at hand.

The first three chapters present basic electronic principles. Chapter 4, containing a brief review of d.c. and a.c. circuits, may be omitted in cases where the student does not require such a review without affecting the continuity of the text. The remaining eight chapters are devoted to electronic circuits and basic applications of electron tubes.

Only basic equations have been included and these are simply stated with the terms in each equation explained sufficiently to enable the student to use them intelligently.

"PULSES AND TRANSIENTS IN COMMUNICATION CIRCUITS" by Colin Cherry. Published by *Dover Publications, Inc.*, 1780 Broadway, New York 19, N. Y. 317 pages. $3.95.

An introduction to network transient analysis for television and radio engineers, this volume introduces circuit analysis, bridging the gap between simple alternating current theory and operational methods of analysis.

For those who have attempted to supplement their knowledge of transients and have been at a loss to know where to start, this book will be of valuable help. It provides the essential groundwork, using in most instances rigorous physical arguments and only elementary mathematics. Electric waveforms are dealt with rather than analytical functions.

References to published books and papers are given throughout the text, thus enabling the reader to continue beyond the limits of the volume itself.

Antenna Pattern

(*Continued from page* 12)

range exceeds 100 db. This includes excellent shielding of the various stages, common point to point grounds for individual stages and an excellent d.c. regulated power supply. The power drain is approximately 62 watts.

The only critical portion is in the wiring of the first stage of amplification. All grounds of the first stage of amplification including those of the input jack and calibration switch should be grounded to the chassis at only one point. Shielding of individual stages or particular components has not been found to be necessary.

Fig. 4 shows the two antenna pattern testing shacks on the roof of the *Dalmo Victor* building where this automatic antenna pattern recording system has been successfully used. Transmissions from one of these penthouse shacks is received in the other penthouse shack and fed into the automatic antenna pattern recording system.

FM in Power Ind.

(*Continued from page* 5)

United States and its possessions must be licensed. A construction permit is needed and the first step taken is to make application to the Federal Communications Commission on FCC Form 401-C made out in duplicate, and FCC Form 401-A when it is necessary. If the height of the antenna is in excess of 150 feet or within 3 miles of an airport, FCC Form 401-A is to be filled out and sent in in quadruplicate. The frequency desired is sent in with the application. The applications should be signed by an officer or official of the organization rather than by an employee.

When the construction permit is granted, call letters are assigned; equipment can then be purchased and construction completed within 8 months.

Following the construction of the station, a 30-day test period is allowed, providing the radio inspector in charge in the district is notified two days in advance.

When construction and testing are completed, an application for station license is filed on FCC Form 403. This is done well in advance of the expiration of the construction permit. A separate license is required for the land station and one for the mobile units.

The manufacturer's representative usually helps the customer with the license application procedures.

A restricted radio telephone operator's permit is required by persons operating the land or central station. No operator's license is required for mobile units operating on frequencies above 25 megacycles.

Any person making adjustments, taking frequency readings, or doing any maintenance work on either land station or mobile units must have a first or second class radio telephone operator's license.

The Federal Communications Commission also requires that an accurate log be kept of the station's operation.

Equipment Description and Installation

The manufacturer's representative usually supervises the installation work performed by technicians from the factory or from some independent company.

1. *Antennas.* If the area to be covered is from 12 to 20 miles airline, an antenna installation made on the top of the town's water tower or other high point generally gives satisfactory results. If the distance is greater than this, a special tower can be used. In the REA antenna installation illustrated, the antenna is mounted on the top of the water tower which is 125 feet in height.

The central transmitter used has an r.f. output of 30 watts. The farthest point in the system to be reached is 32 airline miles distant. Over the past year of operation, excellent coverage has been obtained. The antenna is fed by coaxial cable from the central transmitter located at the base of the tower in the housing provided for it.

The antenna should be located on a high hill if it is possible to keep it within 10-15 miles of the remote control unit.

A power gain antenna may be used at the central station to make more efficient use of the transmitted signal.

In practice, communications are being carried on over much greater distances than theory seems to indicate should be possible.

2. *Central or Land station.* The central or land station is located as near as possible to the antenna installation. When satisfactory conditions exist and the antenna installation may be made at the location where the dispatching is to be carried on, equipment is being manufactured which has all of the units self contained in a cabinet somewhat similar to the remote control console pictured. Where the r.f. power output does not have to exceed 30 or 60 watts and the antenna installation permits, this type equipment then eliminates the remote control unit, land lines, central station installation and housing facilities.

In the central station housing facilities, some means of even temperature control must be provided as these houses are heated during the winter months. A thermostatic type control is usually used.

3. *Remote control console.* The console in the illustration consists of a standard receiver and preamplifier-line amplifier

chassis to remotely monitor and control a single frequency transmitter and receiver over one pair or two pair of control lines.

The unit is supplied with a control panel which is provided with meters, switches and controls for complete control of the station such as:

a. D.b. meter for modulation and line level indications.
b. Microammeter for signal and frequency checks of transmitter.
c. Speaker selector switch.
d. Modulation control.
e. Clock.
f. Intercom. and send switch.
g. Tone-signal switch.
h. Call letter holder.
j. Pilot lights for carrier indication, transmitter-on and speaker indicators.

The remote control console may be supplied with an additional line amplifier, a frequency monitor or both. The frequency monitor works in conjunction with the monitor receiver and is useful for monitoring r.f. carrier and frequency and indicating modulation. It is also possible to get consoles which will control a two frequency transmitter and two receiver system plus the features mentioned above.

The following functions can be accomplished over one twin conductor cable:

a. Turn transmitter on and off.
b. Modulate transmitter.
c. Amplify audio from receiver from remote central station.
d. Intercommunicate with paralleled remote units on same control line.

The following functions may be added later if new system requirements arise in the future:

e. Turn transmitter on and off for a second frequency.
f. To amplify audio from a second remote receiver.
g. Turn on and off a second receiver or monitor at a remote location.

The console is operated with a dynamic microphone with push-to-talk control or foot switch control. When the output of the console is fed into a matched line, it is possible to operate this unit over very great distances. However, it does not appear economical to operate over a land line over 15 miles in length. It has been estimated that land line service can be had from telephone companies for a rental of about $4.00 per mile per month.

If the power company constructs its own line, a cost of about $300.00 per mile can be expected, depending on labor and material costs and the number of circuits used.

When land line construction is not possible, radio remote control circuits can be used when equipment is adapted for this purpose.

4. *Mobile units.* These installations are divided into two different types, one in the trucks and the other in the passenger car, usually that of the manager, official or superintendent.

Units for truck operation employ a transmitter having 30 watts r.f. output from a 6 volt d.c. battery power input. The plate supply is furnished by a dynamotor—420 volts, 250 ma. Modulation is 30-3000 cycles, 20 kc. deviation each side of carrier. Testing is accomplished by a rotary switch which meters all circuits. A one quarter wave roof top antenna is used. The driver and final tubes of the transmitter use no current until the microphone is removed from the hang-up box. This turns on the tube filaments and brings them up to operating temperature in the short space of time required to lift the microphone from the instrument panel to the operating position. Replacing the microphone on the hang-up box again turns the filaments off.

The mobile receiver has a battery drain of 6.0 amperes at 6.0 volts d.c. input using a synchronous vibrator power supply. In testing, all circuits are metered with a selector switch.

After a little practice, smooth system operation can be especially noted by the absence of useless chatter, and the direct and to the point communications being used. At the time the two-way radio of the Nishnabotna Valley Rural Cooperative was put into operation, the truck batteries and generators used were standard equipment. Trouble was experienced in keeping truck batteries charged. However, the crews soon learned the technique of operating so that oversize batteries and generators were not needed and no further trouble has ever arisen in this respect. Some power companies use code words to convey messages, thus shortening their transmissions and allowing some privacy. One of the methods used by maintenance crews to pin point the location of power line trouble is: Two maintenance crews go out, one proceeding on ahead. This crew disconnects line taps and the crew in the rear then calls in to have the line energized. This crew, in a location where they can observe to see if the oil circuit reclosers hold in, know that if the reclosers do not reopen, the trouble is on one of the disconnected taps. The first crew then reconnects these taps until the defective branch circuit is located. Communication between the two trucks makes this method speedy and sure.

In this swiftly growing field, employment should be gained by many licensed operators needed for the necessary checking and maintenance work on the equipment.

This form of communication is allowing customer service to keep in step

with customer power consumption, and is rapidly paying its way through better service, economy in operation and better public relations. Yes, this formerly undreamed of convenience now fathers the so often used, "I don't know what we would do without it".

Frequency Dividers

(*Continued from page* 8)

almost independent of tube characteristics—practically speaking at least.

A typical circuit is shown in Fig. 4B. A tube which has two grids capable of controlling the plate current is required, such as the 6SA7 and the 6AS6. The 6AS6 is especially suitable. In its stable state, a high cathode current flows, due to the low bias on the first grid. There is no plate current, the suppressor (or second control grid) being biased beyond cut-off. Consequently, the screen current is high. The plate is held at its initial level by the current through the diode. A negative trigger is fed to the plate through the diode, and the reduction in plate voltage is passed on to the control grid. The resulting drop in screen current drops the cathode voltage, reducing the suppressor bias by an amount sufficient to allow the flow of plate current. This causes a further reduction in plate voltage, and the regenerative connection between the plate and grid continues the action. This goes on until the plate voltage is essentially zero and the control grid at or near cut-off. At this point the grid starts to rise on the time constant RC and the cathode follows. Through regeneration, again the process is continued until the cathode potential is high enough to cut off the plate current and the circuit is ready for another trigger. With all voltages fixed, the delay time is proportional to the time constant RC. Since the distance (voltage-wise) the plate has to fall is determined by its initial level, the delay time can be varied by varying the diode bias, and thus the initial plate voltage. During the time the plate voltage is falling the circuit is unaffected by trigger signals, because the diode is cut off. The output is rectangular and may be taken from either the cathode or the screen. Control may be established with almost any triggering waveform, as long as it has a negative portion of sufficient amplitude.

Design is for a given output frequency and it will divide to that from any of its harmonics. Since all voltages maintain a given ratio regardless of the plate supply voltage, the latter may be varied over wide limits without causing a change in dividing ratio or failure to operate. No output is obtained without triggering signals. The total delay time may be calculated from the time constant as follows:

$$T = \frac{E_p - E_c}{E_b - E_c}\ RC$$

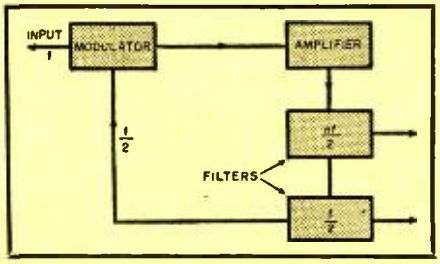
where E_p and E_c are the initial plate and control grid voltages and E_b is the plate supply voltage. The resistance R should be relatively large, to keep grid current down. The frequency of operation is limited only by the stray capacities of the circuit and by the tube capabilities. The phantastron is one of the most satisfactory and reliable of circuits for use in frequency division.

Thyratrons can be used—see Fig. 4C—for frequency division much the same as other relaxation oscillators. The major disadvantages are due to changes in triggering level resulting from temperature and emission changes, and the upper frequency is limited to some twenty or thirty kilocycles by the deionization time. The timing circuit may be either in the plate or cathode circuits, but the cathode type is favored since the timing wave has more effect there due to the amplification factor of the grid. Gas diodes can be used, but the firing and extinction potentials are relatively close together and stability is usually poor.

Any of the dividers discussed may of course be operated in chains in order to obtain stable high order ratios. By the use of feedback complex fractional ratios may be obtained. The feedback voltage is fed back from one stage to an earlier one such that the early one is triggered a little before it would ordinarily be. The duration of that stage's operation is therefore reduced slightly from normal and so of course the overall ratio of the chain is altered slightly, resulting in a complex but stable ratio of input to output frequencies.

While no attempt has been made in this article to give detailed design information, it is believed that sufficient information has been given to enable the user to determine what type he should or would prefer. In some, notably the synchronized and blocking oscillators, design is by experiment anyway to a considerable extent; and in others, design can probably be effected through a combination of the information herein presented and experiment in as short a time as would be required for detailed design preliminary to construction. A bibliography is included for those who wish further and more detailed information on the subject.

Fig. 5. Circuit for dividing input frequency by 2 and then multifying it to give various outputs as indicated.



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Microwave Trans.

(*Continued from page* 18)

past and several kinds of operation have been employed. The type of tube that is now almost universally employed is the multicavity magnetron, shown in Fig. 15, in which the anode is broken up into a number of segments, each of which contains a cavity resonator. In the simplest mode, called the π mode, alternate segments are in phase with each other, while adjacent segments have opposite polarity.

All electron trajectories are bent in the same way and they travel around the cathode as a cloud rotating at some average rotational velocity. Electrons moving across the gaps between cavities have their rotational velocity increased or decreased depending upon their phase. A bunching action occurs, similar to that in the klystron, which amplifies r.f. power across a later gap. A probe or a slot couples one of the cavities to an output circuit using either coaxial or waveguide transmission lines. In this type of magnetron, the conditions for oscillation are given by the following relationship[5]:

$$f = \frac{4\pi n\, V}{r_a^2\, B} \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

where n is the number of pairs of segments.

The starting voltage at which oscillations occur is given by[6]:

$$V = \frac{\pi f}{nc}\,(r_a^2 - r_c^2)\left(B - \frac{2\pi nf}{nc}\,r_a^2\right) \quad (6)$$

This voltage is known as the Hartee voltage after Hartee who developed the theory.

Magnetron Design Information

As in the case of the klystron oscillator, the engineer can usually select a commercially available magnetron to meet most requirements. For interpretation of magnetron performance it is necessary to make a number of observations

that are not made at lower frequencies using conventional type tubes. In addition to the fact that different modes of operation exist and multiple cavities are involved, the magnetron employs a magnetic field, instead of the usual grid voltage, as the controlling parameter.

Two types of charts are normally presented with commercial magnetrons. One type, known as the performance charts, describes the operation of the magnetron in terms of its input circuits. The other type, called the Rieke diagram, describes the operation of the magnetron in terms of its output circuits. A typical set of performance charts are shown in Figs. 11 and 13. Consider the chart shown in Fig. 11. In this chart four parameters are shown, i.e. plate voltage, plate current, magnetic field, and power output. Knowing any two of these parameters, the other two can be determined from this chart. For example, if a plate voltage of 20 kv. and a magnetic field of 2300 gauss are employed, the plate current will be 20 amperes and the power output approximately 225 kw. It should be noted that these charts assume a matched load impedance.

The second performance chart (usually 11 and 13 are combined in one chart—however the author separated them to clarify their use) plots plate voltage, plate current, efficiency and frequency deviation. Hence for the example cited above with plate voltage at 20 kv. and plate current at 20 amperes the efficiency would be approximately 58 per-cent and the frequency deviation about 2 megacycles.

A Rieke diagram, (Fig. 16 shows a typical one) expresses the performance of a magnetron in terms of the r.f. loading for a given input operation. To use this diagram, the standing wave ratio η_v and distance d from magnetron output to voltage minimum are measured. These parameters are then expressed in terms of reflection coefficient K and phase angle β_l by the following equations:

$$K = \frac{1 - \eta_v}{1 + \eta_v} \quad . \quad . \quad . \quad . \quad . \quad . \quad (7)$$

$$\beta_l = \frac{d}{\lambda} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (8)$$

The point corresponding to these values is then found on the Rieke diagram and the power output and frequency deviation determined. For example, assume that a standing-wave ratio of 2 is measured with a voltage minimum 1 cm. from a magnetron operating at a frequency of 10,000 mc. The reflection coefficient, K, is therefore equal to 0.25 and the phase angle 0.33. This corresponds to the point marked A on the Rieke diagram and indicates an output of approximately 30 kw. at a frequency deviation of about 4 mc.

There are a number of terms that have been developed to express the performance of magnetrons. One of these is the "pulling figure" which is defined as the maximum change in frequency as the load phase is changed over all values while the voltage standing-wave ratio is held at 1.5—expressed in megacycles. Another is the "pushing figure" defined as the rate of change of frequency as the current is varied with constant magnetic field and load, expressed as megacycles per ampere. "Temperature coefficient of frequency" is the change in frequency due to change in temperature. These terms are frequently used in describing the over-all performance of magnetrons.

The degree of frequency stability of a magnetron oscillator is a function of these three parameters. To increase the frequency stability an external high Q cavity is placed between magnetron and load. This decreases the pulling figure. Automatic frequency control circuits such as the ones described in the previous article[1] can be used to further improve frequency stability. In general, mechanical tuning systems are used for the same reason that they are used in lighthouse oscillators.

The magnetron is normally used in pulsed systems, though recently a number of frequency modulated microwave links have been developed which employ magnetrons. There are a number of ways in which a magnetron may be frequency modulated. An external reactance tube, which varies the r.f. loading, can be used to vary frequency. Another method involves placing a thin filamentary type wire across the axis of one cavity in the magnetrons. It has been found that amplitude modulating the current flowing through this wire frequency modulates the magnetron output.

Conclusion

The lighthouse, klystron, and magnetron oscillators are used in virtually all microwave transmitters developed thus far. Other tubes such as the resnatron and the traveling wave tube show great promise and will probably be more widely used in the future. Use of these tubes as oscillators, however, usually entails the design of the tube itself and this subject is far beyond the scope of this series of articles. The traveling wave tube will be discussed when the r.f. amplifiers are considered, since at the present time this tube seems to have its widest application as a wideband amplifier.

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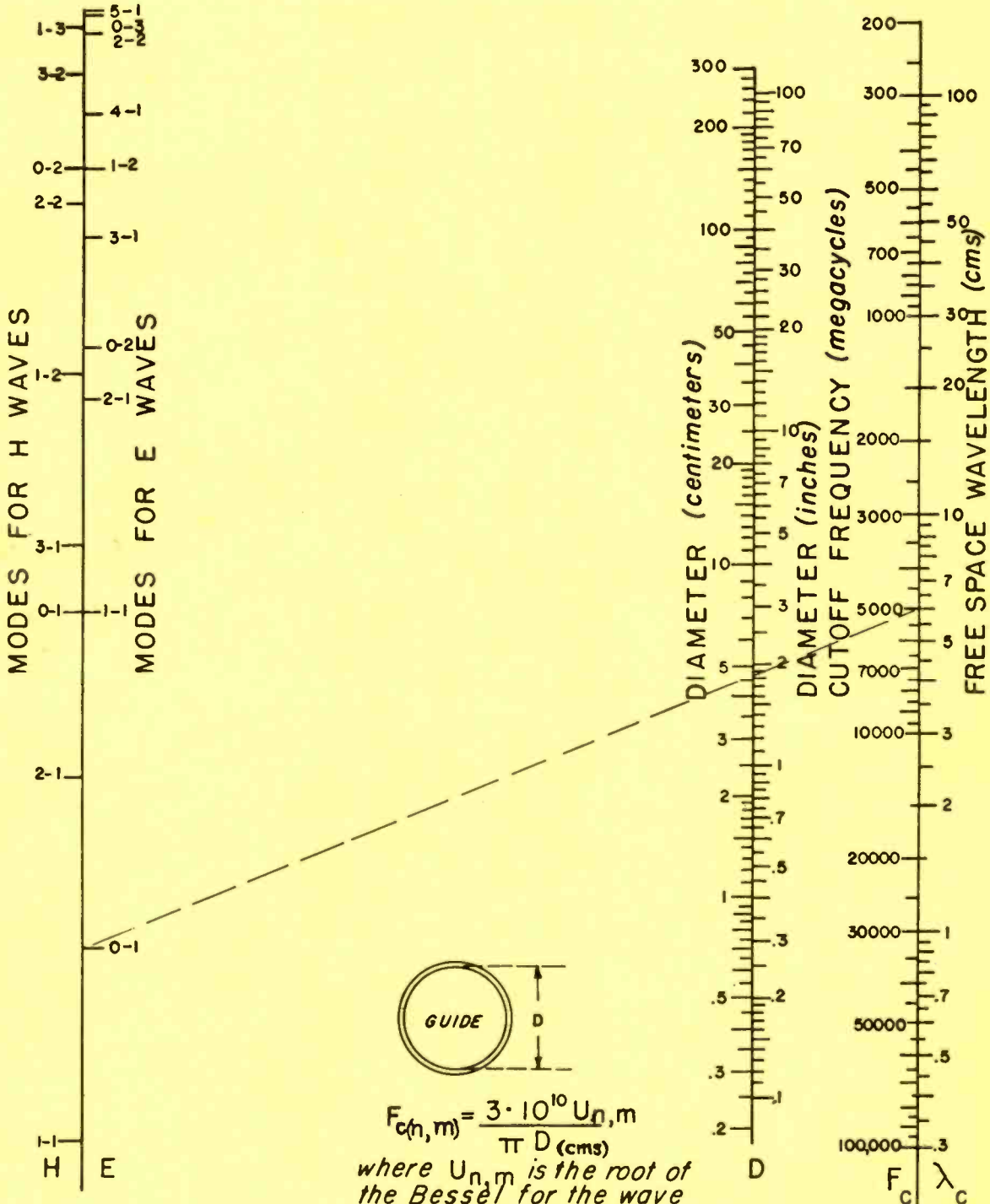
3. *Racker, J., "Microwave Components"*, RADIO-ELECTRONIC ENGINEERING, *April*, 1950, *p. 7.*
4. *Racker, J., "Microwave Techniques,"* RADIO-ELECTRONIC ENGINEERING, *February*, 1950, *p. 3.*
5. *Bronwell & Beam, "Theory and Application of Microwaves", McGraw-Hill Book Company, p. 74 to 145.*
6. *Collins, G. B., "Microwave Magnetrons", McGraw-Hill Book Company.*

PHOTO CREDITS

6.....Naval Research Lab.
12, 14.....Dalmo-Victor Co.
15.....Federal Telecommunication Labs.
20.....Sperry Gyroscope Co.

CIRCULAR WAVE GUIDE CUT-OFF FREQUENCIES

The cut-off frequency scale at right is aligned with the particular type of wave and mode selected on the scale at left, and the diameter determined from scale in center.



$$F_{c(n,m)} = \frac{3 \cdot 10^{10} U_{n,m}}{\pi D_{(cms)}}$$

where $U_{n,m}$ is the root of the Bessel for the wave and mode considered, and n is the order of the Bessel function and m is order of the root.

VEE-D-X

LOW PRICED

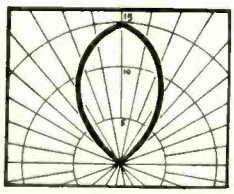
Yagi Arrays

- 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.

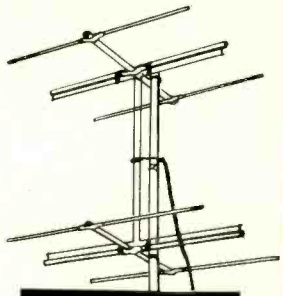
J SERIES

JA

V. S. W. R. = 1.34
Z = 335 ohms

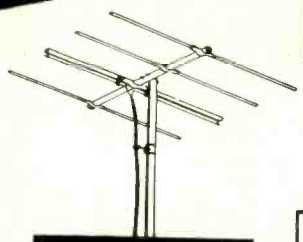


Forward gain in decibels



LOW CHANNEL **$17.35** list
HIGH CHANNEL **12.50** list
For double stack as shown

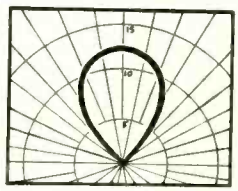
Including harness but less mast



LOW CHANNEL **$13.20** list
HIGH CHANNEL **6.95** list

JB

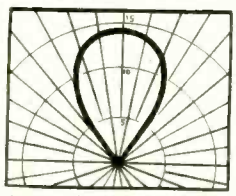
V. S. W. R. = 1.26
Z = 315 ohms



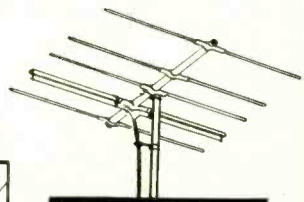
Forward gain in decibels

JC

V. S. W. R. = 1.28
Z = 317 ohms

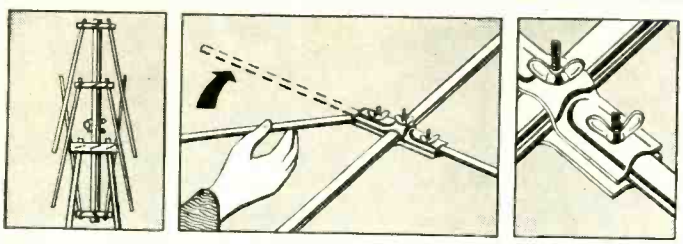


Forward gain in decibels

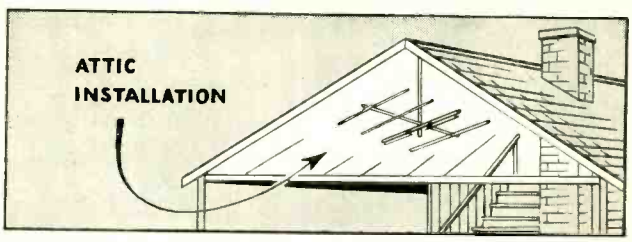


LOW CHANNEL **$14.60** list
HIGH CHANNEL **7.95** list

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 bay attic installation.

THESE ANTENNAS STAY UP

Only the highest quality duraluminum alloys are used.

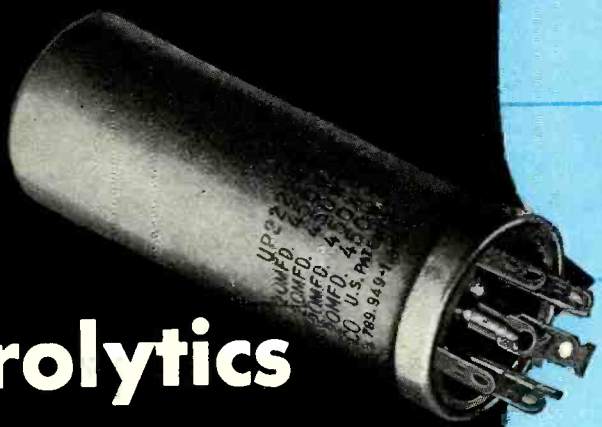
Yield Strength	36,000 lbs. per sq. inch
Ultimate Strength	41,000 lbs. per sq. inch
Shearing Strength	24,000 lbs. per sq. inch
Endurance Limit	20,500 lbs. per sq. inch

LAPOINTE-PLASCOMOLD CORP., 3
UNIONVILLE, CONNECTICUT

Send me information on the entire line of VEE-D-X antennas and accessories.

NAME .....
COMPANY .....
STREET .....
CITY ..... ZONE..... STATE.....

10 reasons why C-D type UP electrolytics are superior



For TV and auto radio applications; and wherever extremes of heat and cold are encountered

- A special formation process which results in low leakage; permits operating temperatures as high as 85° C.
- Special separator — exclusive with C-D electrolytics — prevents breakdowns under the worst field conditions.
- Special construction results in lowest intercoupling between sections.
- Special winding results in good RF impedance.
- Etched cathode construction (Type UPE) where high ripple currents require it for permanence of capacity.
- Rubber diaphragm type of construction results in a positively operated vent.
- Spot welded anode risers to lugs.
- Spot welded cathode tabs to mounting rings.
- Saddle lug permitting easy wiring of the lugs.

See your Classified Phone Book for nearest jobber.
Catalog No. 200B on request.
CORNELL-DUBILIER ELECTRIC CORPORATION, Dept. RN60, South Plainfield, New Jersey.
Other plants in New Bedford, Brookline and Worcester, Mass.; Providence, R. I.; Indianapolis, Ind., and subsidiary, The Radiart Corp., Cleveland, Ohio.

For better servicing results insist on superior C-D Electrolytics—Best by Field Test!

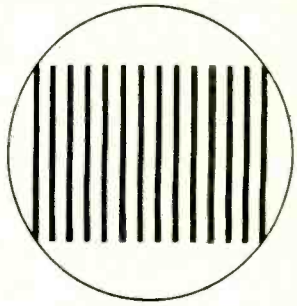
40TH ANNIVERSARY CORNELL-DUBILIER CAPACITORS 1910-1950

CONSISTENTLY DEPENDABLE

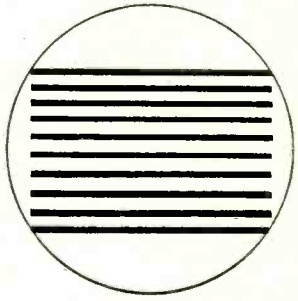
CORNELL-DUBILIER

CAPACITORS · VIBRATORS · ANTENNAS · CONVERTERS

SUBSIDIARY



Bar patterns permit rapid adjustment of linearity.



HARVEY *brings you*

the new RCA WR-39B Television Calibrator

with Crystal-Controlled Markers for all TV Frequencies

Here's what it is —

1. A crystal-calibrated TV marker generator with dual markers for All TV Frequencies.
2. A linearity-pattern generator for making linearity adjustments.
3. A 12-channel miniature TV re-broadcast transmitter.
4. A heterodyne frequency meter including amplifier and speaker.
5. A TV-FM signal generator operating on fundamentals in all bands.

Here's what it does —

1. Puts dual markers of crystal accuracy on television sweep-alignment response curves.
2. Provides signals of crystal accuracy for peak-alignment of stagger-tuned TV IF amplifiers.
3. Generates a bar-pattern IF carrier frequency for adjustment of TV set linearity controls.
4. Develops a crystal-controlled amplitude-modulated signal for alignment of intercarrier sound IF's.
5. Applies triple-markers of crystal accuracy on discriminator and ratio-detector "S" curve patterns.
6. Measures with crystal accuracy the frequency of unknown IF signals within its range.
7. Calibrates other signal generators at 2.5 Mc and .25 Mc points over range of 250 Kc to 480 Mc.
8. Allows adjustment with crystal accuracy the frequency of local oscillators in TV front ends.
9. Checks video reception on all 12 channels, using signal from normally operating TV set.

Check these features!

Crystal-controlled 4.5-megacycle output for alignment of TV receivers employing intercarrier sound

Crystal-controlled markers, 4.5 Mc removed from main marker, for television rf and if alignment

Crystal-controlled markers, 250 kc removed from main marker, for sound-discriminator alignment

Provision for injection of external marker

Internal audio and rf modulation of variable frequency oscillator

Crystal-calibrated heterodyne frequency meter

CHARACTERISTICS

Variable Oscillator
Frequency Range . . . . 19-110 Mc in 4 bands
170-240 Mc in 2 bands
Tuning Drive Ratio . . . . . 10 to 1
Output Attenuator Range from 100% to 1%

Crystal Oscillators
0.25/4.5-Mc oscillator stage
Accuracy 0.03%
Output at probe more than 50 millivolts
2.5-Mc oscillator stage Accuracy . . . 0.01%
Internal Mod. Freq. . . 0.25 or 4.5 Mc and audio
***Power Supply* . . . 105-125 volts, 50/60 cycles**

Now — in one compact, portable unit — the new RCA WR-39B provides crystal-controlled markers for all TV frequencies...included in this one instrument is a crystal-calibrated variable-frequency oscillator, two crystal-controlled oscillator stages with three crystals supplied, a wide-band modulator stage for internally modulating the output at audio and rf frequencies, and an audio amplifier with speaker.

The variable-frequency oscillator covers all commercial television bands and the FM rf bands. An internal 4.5-Mc crystal-controlled oscillator modulates the output of the vfo to provide marker "pips" spaced 4.5 Mc from the marker pip of the vfo. These markers are indispensable in the alignment of TV front ends. Similarly, a 0.25-Mc crystal-controlled oscillator may be used to provide marker "pips" spaced 0.25 Mc from the frequency of the vfo. Such markers are indispensable for determining the response characteristics of discriminator and ratio detectors. The fundamental 4.5-Mc output may be used by itself for alignment of television receivers employing intercarrier sound.

In addition to its function as a marker generator, the WR-39B can be used as a heterodyne frequency meter to identify unknown frequencies. The vfo, when tuned to any TV channel and modulated with the 0.25-Mc crystal oscillator, will put vertical bars on the raster; or when modulated with an external audio oscillator will put horizontal bars on the raster. Thus the instrument can be used for making linearity adjustments in the absence of a test pattern.

TV Station Need Not Be On Air For You To Align Receivers

The WR-39B may be modulated by the video signal from a television set, any channel, and will re-transmit the signal on any of the 12 channels to receivers under test on your bench. When using it as a transmitter in this manner, the WR-39B transmits the picture image, not just a raster!

For complete details on the WR-39B, see it at our store, or write for free literature.

$224.50 Net

IN STOCK FOR IMMEDIATE DELIVERY

NOTE: Price Net, F.O.B., N.Y.C.
and subject to change without notice.

Telephone: LUxemburg 2-1500

hrc HARVEY RADIO COMPANY INC.

103 West 43rd St., New York 18, N. Y.

"We've proved Rauland is the ideal "plus" line..."

... Says MIKE EBINGER, owner
Ebinger Radio Company
2211 Gravois Street, St. Louis, Missouri

"We've proved to ourselves that Rauland Television Tubes are ideal to round out our picture tube line, for several reasons. There's no question about the quality of their tubes and time and again the Rauland people have been first to offer important improvements for the industry.

"Another 'dollar-and-cents' reason for our selection of Rauland tubes is that the company specializes in picture tubes and offers an unusually large number of tube types for replacement purposes. In combination with our receiving tube line and the picture tubes available with it, Rauland's tubes enable us to offer a *complete* picture tube service to meet our customers' requirements.

"Illustrative of it being the ideal 'plus' line of picture tubes is the new Indicator Gun feature developed by Rauland. With this feature, the service man is enabled to make positively correct adjustment of the ion magnet quickly and without need of mirrors, thus eliminating possible compensating misadjustments of components."

With the Rauland line, you too can meet picture tube service requirements completely and with assured customer satisfaction. The Rauland line includes metal and all glass tubes, plain, aluminized and Luxide (the original "Black" tube) screens and aluminized Luxide screens.

The new Rauland Indicator Gun (patent pending) provides a visible and accurate indication for the service man making ion trap magnet adjustment, and is visible from the back of the set while adjustment is being made. No other guide is needed for correct magnet adjustment.

THE RAULAND CORPORATION

Perfection Through Research

4245 N. KNOX AVENUE • CHICAGO 41, ILLINOIS

OLSON AKRAD

Olson Radio Warehouse, Inc.
73 E. Mill St. • Akron 8, Ohio

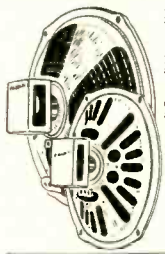
SENSATIONAL NEW INTERCOM

A real high quality Intercom ideal for home, office, nursery or sick-room. Quickly installed without tools. Remote stations may be placed as far away as 2,000 feet. Beautifully designed plastic cabinets with sloping front. Alnico 5 PM speakers deliver ample volume. Has on-off switch, push-to-talk switch and volume control. Master station uses 12SJ7; 50L6 and 35Z5 tubes. Size of cabinets 5½"x8½"x4". One or more substations may be used with the master station. Master Station with tubes and 50 ft. of 2 conductor cable. A real top quality intercom sensationally low priced.

$9.99 RA-40

RA-40 . . . . . $9.99 EACH
RA-41 SUBSTATIONS . . . . . EACH $3.99

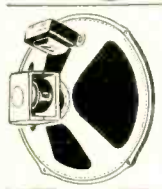
MAGNAVOX SPEAKERS



Latest model genuine Magnavox Speakers. Individually boxed. Frame is of heavy construction. Completely dustproofed. Advanced engineering and designing make these speakers highly efficient at high volume or low. Voice coils are full 1" diameter, available in 2 sizes.

12" Diameter. 8 watts. voice coil 6-8 ohms, shpg. wt. 7 lbs. S-140, each $4.95

6" x 9", 8 watts, voice coil 3.2 ohms, shpg. wt. 5 lbs. S-141, each $2.79



12"—15 Watt Speaker

Equipped with high grade output transformer. Field coil resistance 680 ohms. Voice coil 8 ohms. Ideal for PA or radio. Heavy duty Magnavox construction throughout. Shp. wt. 10 lbs.

Olson's Special Price S-144, each $3.49

12" COAXIAL SPEAKER

12"

LOTS OF 2 EACH STOCK NO. S-122 $9.50

40 to 17,000 CPS response

If you've wanted a real high-fidelity coaxial 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. Voice coil impedance is 8 ohms. Olson sells these speakers on an iron clad money back guarantee if you are not 100% satisfied. Order today. Shpg. wt. 8 lbs.

SINGLE EACH $9.95

JENSEN PM SPEAKERS

Genuine Jensen PM speakers for PA or radio use. Cone and coil assembly permanently aligned. Heavy Alnico V magnets. Order Early.

Stock No. S-121		Stock No. S-12	
Watts	9	Watts	12
Dia.	8"	Dia.	12"
Shpg. Wt.	5	Shpg. Wt.	7
Net	$3.49	Net	$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.

Special from Olson. M-66, each $5.95
Same as above but less switch. M-67, each $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

RCA Radio Electrifier Converts Portables to AC

Converts RCA Model 25BK, 25BT½, 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 lbs. RA-39 . . . . . $1.95

TAPE RECORDER

SPECIAL PRICE AT OLSON'S

Latest Model, Regular retail price is $154.50.
RA-42, Special Price at Olson's $99.50

RA-42

A real top quality recorder brought to you at a fraction of the regular list price. All latest features are contained in this tape recorder. Tape speed 7½" per second. Rewind ratio 20 to 1. Frequency response 60 to 8,000 cps. Has dual recording track. Recording time, 1 hour on 1,200 ft. reel or ½ hour on 600 ft. reel. Neon level monitor indicator. Input for crystal mike, phono pick-up or radio tuner. Has jack for external speaker. Equipped with high grade built-in PM speaker. 5 watts output. Beautiful leatherette carrying case with hinged lid. Size 10"x15"x15". Furnished with microphone and reel. Shpg. wt. 29 lbs.

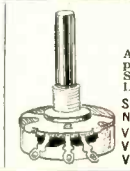
0-500 Micro-Ammeter 2" Round Milliammeter

Scale 0-600 volts DC and 0-15 volts DC. Has 1000-and-1 uses around the shop. TWICE as sensitive as a 0-1 milliammeter. Shpg. wt. 2 lbs. X-227, Special $2.79

H & H TOGGLE SWITCH

Single pole, single throw, 6 amps, 125 volts.

Regular list price 60c. X-158, each . . . . . 19¢



VOLUME CONTROLS

Available in 3 popular values. Shaft ¾" long. Less switch.

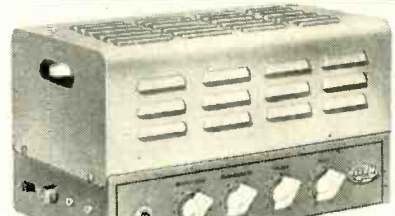
Stock No.	Resistance	Price, Each
VC-105	½ meg.	29c
VC-114	1 meg.	29c
VC-115	2 meg.	29c

Selenium Rectifiers

Individually boxed, fresh stock. Useful for AC-DC sets, amplifiers and TV sets. Rectifiers may be assorted for 10 lot price.

Stock No.	Plate MA	Size	Lots of 10, each	One Each
X-184	75	11/16"	.59	.69
X-150	100	1"	.69	.79
X-185	150	1"	.79	.89
X-186	250	1⅛"	1.19	1.29

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 $27.95 RA-38

ROSIN CORE SOLDER

Guaranteed pure tin and lead solder of highest purity. Rosin core filling is evenly distributed. 1 lb. spools.

X-4060, single each 89c
Lots of 5, each 79c

AC CORDS

Underwriters' Laboratory approved. Hundreds of uses in home and shop. Unbreakable plugs. Cord 6 feet long.

W-43, Zip Cord, single, each, 19c. Lots of 10, each 14c
W-60, Heavy duty, for motors, etc., single, each, 29c. Lots of 10, each 19c

Cornell-Dubilier Condenser

Lots of 10, each 59¢

A truly universal condenser for practically any AC-DC radio. Make any combination from its 4 sections.

40—40—40—20 MFD—150 VOLTS
C-328, single, each 69c

4-Drawer Steel Cabinet Given with Olson's Gigantic, New Akrad Kit

You get $45.20 list worth of "Akrad" Condensers plus the 4 drawer steel cabinet, size 8½"x 7½"x10½". Shpg. wt. 11 lbs.

AS-20 Only . . . $14.95

42 "AKRAD" BY-PASS CONDENSERS!

Qty.	Cap.	V.	List Total	Each
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.	V.	List Total	Each
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			$45.20

Plus the Steel 4 Drawer Chest Free

POPULAR CONDENSER KITS

Only the finest of components go into these kits. Low prices are possible because Olson buys entire over-runs from quality manufacturers.

MICA CONDENSER KIT

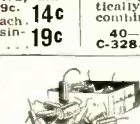
Contains an assortment of 10 Mica condensers. Popular values. Priced at less than jobbers' cost. Shpg. wt. 1 lb.

Special price, AS-18, each . . . 69¢

FP CONDENSER KIT

Assortment of 15 popular FP condensers, double and triple sections. Capacities from 10 mfd to 80 mfd; from 25 to 450 volts. Shpg. wt. 3 lbs.

Olson's Bargain. AS-24, each . . . $2.98



By-Pass Condenser Kit

Assortment of 50 popular values, 200 to 1700 volts, capacities from .0002 to .25 mfd. Quantity limited. Shpg. wt. 2 lbs.

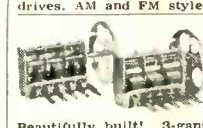
AS-35, each $1.59

KIT OF THREE VARIABLE CONDENSERS

A $3.50 value. Perfect for the experimenter. Brand new stock. Quantity limited.

Get a kit containing 3 assorted variable condensers. Popular values, 2 gang and 3 gang. Some have trimmers, vernier drives. AM and FM styles.

$1.29 X-226, Carton of 3 asst.



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"x1½"x4". Shpg. wt. 3 lbs. X-201—Only at Olson's, pair . . . . . 69¢ PAIR

FREE SEND FOR OUR LATEST RADIO AND TELEVISION BARGAIN CATALOG

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

WORLD'S FASTEST AUTOMATIC CHANGER

FOR RCA 45 RPM RECORDS

Price slashed by Olson

$9.95 each

RA-45

Developed by RCA, built by Crescent, a famous name in the changer field. Plays 8 to 10 records—50 minutes of continuous music. Ploys one hour and 40 minutes with one turnover of the discs. New design does away with posts, clamps which harm records. Discs slide easily down 1½" diameter spindle. Changes records in less than 2 seconds. Crystal cartridge has flat response from 50-10,000 cycles. Needle pressure is only 6 grams. Has built-in precious tipped 1 mil needle. Size 10⅛"x7⅛"; height overall, 6¾" requires 3½" above and 3¼" below base plate. For 105-125 volts AC. Shpg. wt. 8 lbs. Factory sealed cartons.

OLSON AKRAD

THE HOUSE OF RADIO AND TELEVISION BARGAINS

SUPERIOR ALL-PURPOSE

TUBE TESTER

Model TV-10

$39.50

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, Tyratron, 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 filament and tubes with filament 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 and 130 volts. The Model TV-10 operates on 105-130 Volt 60 cycle A.C.

Comes to you housed in a beautiful hand-rubbed oak cabinet complete with portable cover. Model TV-10 ..... $39.50

Stancor Power TRANSFORMERS

A sensational buy on Olson's part brings these high quality Stancor transformers to you at a tremendous reduction. Limited quantity on hand.

For 5 or 6 tube sets. High voltage 600 volts CT @ 55 MA; 6.3 volts @ 3 amps; 5 volts @ 2 amps; 5 volts @ 2 amps, 2"x2½" mtg. centers. Shpg. wt. 5 lbs. T-71 ..... $2.25

For 6 to 8 tube sets. High voltage 620 volts CT @ 70 MA; 6.3 volts @ 3 amps; 5 volts @ 2 amps. 2"x2½" mtg. centers. Shpg. wt. 6 lbs. T-46 ..... $2.49

For 11 to 13 tube sets and amplifiers. High voltage 700 volts CT @ 120 MA; 6.3 volts @ 5 amps; 5 volts @ 3 amps. 2½"x2⅜" mtg centers. Shpg. wt. 8 lbs. T-100 ..... $3.39

For sets over 13 tubes and amplifiers. Never before a value like this on genuine Stancor transformers. 700 volts CT @ 200 MA; 6.3 volts @ 5 amps; 5 volts @ 3 amps. Shpg. wt. 11 lbs. T-85 ..... $3.99

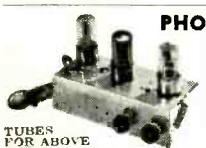
ASTATIC CRYSTAL CARTRIDGES

Model L-82. One of the most popular types. Standard replacement for millions of cartridges. 3.5 volts output, 50-5000 cps, with push-on lugs. Regular list price $5.55. Individually boxed. $1.99 XC-37, Single, each ..... Lots of 10 $1.79 Each

Model QT-3M. Exceptionally fine Astatic cartridge with smooth response over entire frequency range. 1 oz. needle pressure, 50-10,000 cps. Equipped with precious-metal needle. Regular list price $8.40. Individually boxed. $2.79 XC-32, single, each ..... Lots of 10 $2.49 Each

Note: Above cartridges may be assorted for 10 lot price.

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"x2" chassis. Shpg. wt. 2 lbs.

TUBES FOR ABOVE SET. AS-22 $1.87

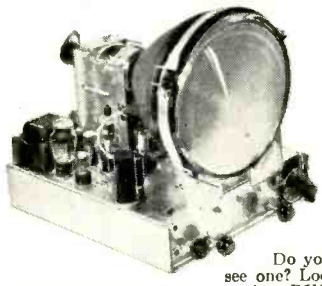
RA-19 ..... $2.98

GE LONG-PLAY RECORD PLAYER

Model 19 Only $7.95

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.

OLSON TELEVISION SCOOP!



NEVER OFFERED BEFORE—TV CHASSIS WITH 12" TUBE!

NOT A KIT—READY TO USE!

COMPLETELY ASSEMBLED!

Do you know a bargain when you see one? Look at this TV chassis. . . Check over its features . . . then RUSH your sample order for just one set. You'll wonder how Olson could bring you such a terrific TV receiver at such a ridiculously low price.

Every set is brand new and comes to you in original factory packing. Tube line-up: 3—6AG5; 2—6AU6; 2—6AL5; 1—6BG6G; 3—6SN7; 1—6AC7; 1—6J6; 1—6T8; 1—6V6; 1—6W4; 1—1B3G/8016; 1—5U4G.

Set is pre-aligned and tested. All parts are the finest and the workmanship is really precision. PM speaker is furnished. There is absolutely nothing in the country to compare with this terrific Olson bargain in TV. Pictures are the steadiest, clearest and brightest you ever saw. You get superb performance even in fringe areas. Here's a TV set that defies comparison.

Comes to you complete with all tubes including 12LP4 picture tube, speaker, knobs, cables and mounting template. Chassis size: 16" wide, 18" deep, 17" high. Operates on 115-v AC. Shpg. wt. 70 lbs.

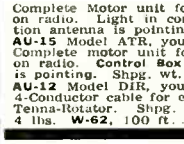
RA-33 Olson's great TV bargain, ONLY $129.95

SAFETY GLASS and MASK

For above set or any 12" TV set. Double shatter-proof glass and handsome mask. X-200. Both for only $4.95

ALLIANCE TENNA-ROTATORS

PRICE REDUCED!



Here's the answer to your antenna problems TV, FM and amateur bands. Actually aims your antenna to the broadcast station by the touch of a finger on the remote control box. Turns antenna full 360° in one minute. Starts, stops, reverses at any point. Heavy-duty, trouble-free motor built into weatherproof case.

CHOICE OF 2 MODELS

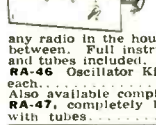
Complete Motor unit for installation on mast and control box which sets on radio. Light in control indicates end of 360° rotation but not direction antenna is pointing. Shpg. wt. 9 lbs. AU-15 Model ATR, your cost $20.53

Complete motor unit for installation on mast and control box which sets on radio. **Control Box has indicator which shows exact direction antenna** is pointing. Shpg. wt. 9 lbs. AU-12 Model DIR, your cost $26.43

4-Conductor cable for either Alliance Tenna-Rotator. Shpg. wt. 4 lbs. W-62, 100 ft. $2.49

Thrust Bearing Bracket if extra heavy antenna is used. Shpg. wt. 4 lbs. AU-13, each $2.91

2-TUBE PHONO OSCILLATOR KIT



Build in one evening. Connect to any phonograph and it will transmit to any radio in the house without wires between. Full instructions, all parts and tubes included. Shpg. wt. 3 lbs. RA-46 Oscillator Kit, each $3.29

Also available completely assembled. RA-47, completely built with tubes $4.29

ASTATIC "TURNOVER" PICK-UP ARM

Cartridge turns knob on front. One side plays 33⅓ and 45 RPM records and other side plays 78 RPM. Only 8 grams needle pressure. Employs the famous ASTATIC 1QD-1 Double-needle cartridge. Die cast curved arm. Equipped with 2 long-life needles. Frequency response 50-7000 cps output 1.2 volts. Shpg. wt. 2 lbs. Reg. list price $15.90. M-64, each $4.95

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

GENUINE ASTATIC PICKUP ARM

SPECIAL BARGAIN AT OLSON'S

With crystal cartridge . . . at less than you'd normally pay for the cartridge alone.

M-58, Lots of 10, each. Single each $1.99 2.19

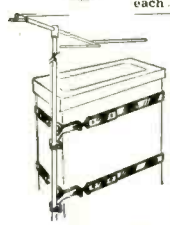
TV-FM ACCESSORIES

TV Booster Kit

Build your own TV-FM booster. Improves 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, pre-aligned coils, components, instructions. Shpg. wt. 5 lbs. RA-26, complete $9.95

TV FOCUS COIL

Same as RCA Part No. 202D1. Perfect for all RCA 630-type or similar TV sets. Regular list price is $7.50. Shpg. wt. 2 lbs. T-80, Only at Olson's, each $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 1⅛" diameter to any chimney. Comes complete with strapping and all hardware. U. S. Patent 2482575. The best. Shpg. wt. 5 lbs. Single, each, $1.59, X-207, lots of 10, each $1.39

EACH $4.49

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 ... AU-17 $3.99

TELEVISION-FM ANTENNAS

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. $11.99 AU-61

Same antenna with single bay and 5 ft. mast. Shpg. wt. 10 lbs. AU-60. $5.99

TV DEFLECTION YOKE

Same as RCA 201-D1 for 12" or 10" picture tubes. Shpg. wt. 2 lbs. $2.95 T-84

TV FLYBACK TRANSFORMER

Same as RCA 211T1. Supplies high voltage to 12" or 10" picture tube. Has filament winding and feeds horizontal scanning coil of deflection yoke. Shpg. wt. 3 lbs. $2.79 T-82

SUPERIOR ACCURATE POCKET SIZE

VOLT-OHM MILLIAMMETER

(SENSITIVITY: 1000 ohms per volt)

Compact, measures 3⅛"x 5⅞"x2¼". 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 • Comes to you complete with self-contained batteries, test leads and all operating instructions. Model 770 ..... $13.90

HOW TO ORDER: Order directly from this ad. State quantity desired, stock number, description and price. You may send remittance with order (include enough for postage on 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.

OLSON RADIO WAREHOUSE, INC.

73 E. MILL ST. • DEPT. RN650 • AKRON 8, OHIO

Within the INDUSTRY

NATIONAL ELECTRONIC DISTRIBUTORS ASSOCIATION recently held a meeting of its executive committee in Atlantic City at which several far-reaching decisions were made.

Plans were outlined and progress reports were given on the distributors' convention to be held in Cleveland during August. Present plans are that the convention proper will convene on August 27 and 28th with the exhibition being held between the 29th and 31st.

Also discussed were plans whereby NEDA would construct or buy a building to house its national headquarters.

* * *

CLAUDE NEON, INC. has recently acquired 100 per-cent of the stock of *Standard Electronics Corporation.*

The new wholly-owned *Neon* subsidiary has taken over *Western Electric Company's* inventories of AM and FM transmitting equipment, replacement parts, product designs and drawings, thus gaining a strong position in the broadcast field.

The company will also manufacture a line of television broadcast transmitting equipment in addition to the AM and FM units. The new company has already taken over the servicing and replacement business for all *Western Electric* broadcast transmitting equipment used throughout the United States.

Graybar Electric Company, formerly national distributors for *Western Electric,* will act as distributors for the new subsidiary firm.

* * *

WALTER LEFEBRE has been appointed acting field sales manager for the *Sylvania* Television division of *Sylvania Electric Products Inc.*

Since January of this year, Mr. Lefebre has been the southern district sales manager for the company. He has been active in radio and TV sales and merchandising for twenty years during which time he was associated with such firms as *Sears-Roebuck, Philco Corporation, Westinghouse,* and *Emerson Radio and Television Corporation.*

* * *

RADIO CORPORATION OF AMERICA'S *RCA Victor Division* has recently completed installation of an elaborate television display which will become a permanent exhibit at Chicago's Museum of Science and Industry.

The exhibit comprises 18 units, ranging from reproductions of the mechanical spinning discs with which early television images were first created to modern electronic facilities permitting visitors to see themselves on television. Also included in the exhibit is a panel containing four television screens on which programs from all Chicago television stations may be seen at once.

Like all exhibits at the museum the new installation is designed to be operated by the visitor.

* * *

EARL L. OLSON has been named chief engineer of *Jensen Industries, Inc.,* Chicago manufacturers of phonograph needles.

Well-known throughout the industry, Mr. Olson joins the company with a background of many years of experience as a needle and cartridge engineer with leading phonograph manufacturers. In his new position, Mr. Olson will be in complete charge of all of the engineering and new development work at *Jensen.*

* * *

ADMIRAL CORPORATION of Chicago has recently purchased the *Midwest Mfg. Company* of Galesburg, Illinois. The new firm, which brings the total of *Admiral* plants to nine, will be known as the *Midwest Mfg. Company Division.* The new division will continue to manufacture package kitchens . . . **RADIO ELECTRIC SERVICE CO.** of Philadelphia has opened a new warehouse, showroom, and sales building at 452 N. Albany Avenue in Atlantic City . . . New quarters at 66 Day Street in New York City were recently opened by **FEDERATED PURCHASER, INC.** The company also rounded out a quarter of a century in the electronic, radio, and electrical field . . . In order to provide increased production and engineering facilities, **THE WORKSHOP ASSOCIATES, INC.** has acquired a new building on Crescent Road, Needham Heights, Massachusetts. The company was formerly located in Newton Highlands . . . **TINNERMAN PRODUCTS, INC.** has announced the opening of a district office in St. Louis. The new offices, headed by Carl F. Marcussen, are located at 7614 Wydown Blvd. . . . **GLOBE-UNION, INC.** has acquired the buildings formerly occupied by *Eclipse Molded Products Co.* in Milwaukee and will use the additional 42,000 square feet in the production of wave switches and printed circuits made by the *Centralab Division* of the company . . . **AIR KING PRODUCTS COMPANY, INC.** has added 40,000 square feet to its

THESE LEADING SET MAKERS

Emerson · Admiral · hallicrafters · BENDIX RADIO · Westinghouse · Majestic · Motorola · Sparton · PHILCO · STROMBERG-CARLSON · Sentinel · TRAV-LER · GAROD · SETCHELL-CARLSON, INC. · airKing · CROSLEY

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 the original. Buy Hytron!

choose one or more of THESE HYTRON TV FIRSTS

HYTRON TV FIRST

1X2 compact, high-voltage TV rectifier.

HYTRON TV FIRST

6U4GT high-perveance damping diode.

HYTRON TV FIRST

6BQ6GT, 25BQ6GT extra-performance deflection amplifiers.

HYTRON TV FIRST

12BH7 twin-triode sweep amplifier with superior efficiency.

HYTRON TV FIRST

16RP4 original rectangular TV picture tube.

FREE

New Hytron Tool Catalogue. Describes all the famous Hytron Service Shop tools to date: Soldering Aid, Tube Lifter, 7-Pin and 9-Pin Straighteners, Tube Tapper, and Auto Tool. Find out how these Hytron Tools can ease your work. Learn how you can save money. Send for your free copy today!

OLDEST MANUFACTURER OF RECEIVING TUBES

HYTRON

RADIO AND ELECTRONICS CORP.

HYTRON RADIO TUBES

MAIN OFFICE: SALEM, MASSACHUSETTS

keeping up with radio

holdings in the Kenyon Building, Brooklyn, in order to handle the demand for its television receivers . . . The **SHAKEPROOF INC.** division of *Illinois Tool Works* has opened an Eastern sales office in the Chrysler Building, New York City.

* * *

LAWRENCE HYLAND has received the highest award that the Navy can bestow on a civilian for his pioneering work in radar.

Mr. Hyland, who is vice-president of *Bendix Aviation Corporation* in charge of engineering research, made his original discoveries in 1931 while stationed at the Anacostia Naval Air Station as an enlisted man.

During routine transmission of radio signals from the ground to a plane in flight in connection with high-frequency direction finding, he noticed the erratic behavior of the signals when the plane was airborne.

Thereafter, Mr. Hyland conclusively demonstrated that the reflection of radio waves from aircraft was sufficient to fix the plane's presence and, to some extent, its position in space, thus establishing one of the important elements of radar.

* * *

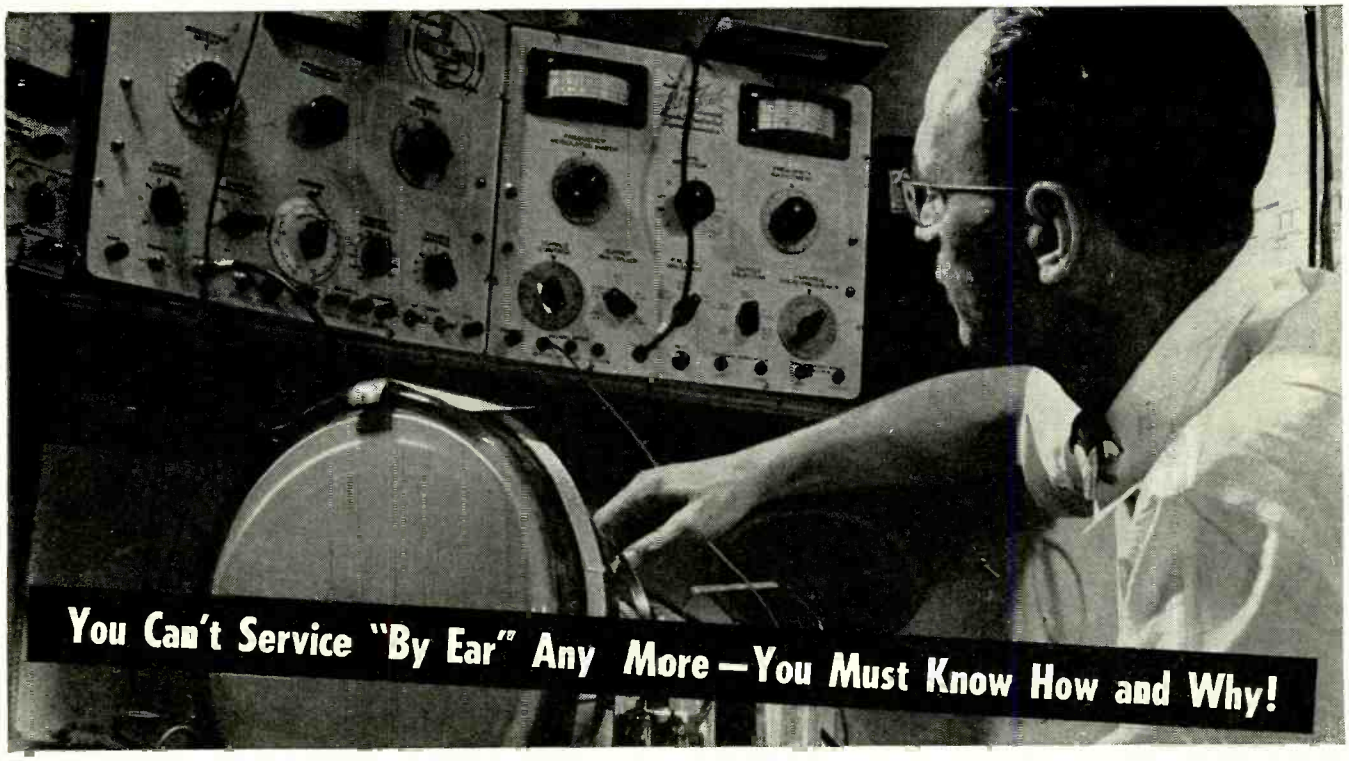
NATIONAL TELEVISION DEALERS ASSOCIATION, INC. has elected seven new members to its board of directors.

Edward A. Dempsey, Executive Director of the Association, announced the election of the following men: Edward C. Beetem, II, Baltimore; Earl Campbell, Washington; Robert T. Dowd, Washington; William H. Frederick, Wilmington; William H. King, New York; Bernard Lewis, Trenton; and Milton Rabovsky, Baltimore.

* * *

WHITE SALES COMPANY of Boston has been appointed exclusive representatives of the *Burlington Instrument Company's* line in the New England territory . . . **RAMSEY-BENNETT COMPANY** of Cleveland has been appointed northeastern Ohio distributor for the *Andrea* line of television receivers . . . The *Sightmaster Corp.* of New York is now being represented in the Philadelphia area by **TWIN-VEX MANUFACTURING CO., INC.** . . . **RADIO ELECTRIC SERVICE CO.** of Philadelphia has been named exclusive distributor for the *Peerless* line of transformers in the Philadelphia-Camden area . . . **FORREST VALENTINE** of Fort Wayne and **VERN BALLANTYNE & ASSOC.,** Portland, Oregon, will handle the *Circle "X" Antenna Corporation* line in their respective areas . . . *Allied Control Company, Inc.,* has named **G. E. HARRIS** as its sales representative in the Kansas and western Missouri territory . . . **TERMINAL RADIO CORPORATION** is the new New York area distributor for the *Victoreen Instrument Company* . . . The appointment of **HENRY D.**

(*Continued on page* 130)



CREI's Practical Course Can Mean MORE Money for You in

TELEVISION & FM SERVICING!

THE days of servicing "by ear" are gone forever. It is no longer possible for a screwdriver mechanic to do a service job on a TV or FM receiver. Anyone in the field—if he is to stay in business—needs to know how to use modern test equipment, how a TV set works, why it works, and how to make it work better. Hit-and-miss methods are not only inefficient; they are unsuccessful and unprofitable.

That's why alert technicians have been quick to use CREI's practical course in TV-FM servicing. Every lesson in the course has specific use in day-to-day repair work. Designed by top-notch teachers, taught by practical TV instructors, reviewed and checked by qualified service experts, KEPT UP-TO-DATE THROUGH DIRECT CONTACT with manufacturers, dealers, and service specialists, the CREI course equips you properly to thrive and earn more money in your career.

TV is developing at breath-taking speed. Extraordinary opportunities await *qualified* service technicians. CREI offers you—in one practical course at a popular price—the opportunity for greater earnings and a more secure future. Don't put it off! Start your training immediately and start applying your new-found knowledge in your daily work. It costs you only a few minutes' time to read the interesting facts. Mail the coupon now for complete details.

THE THREE BASIC CREI COURSES:

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Fundamental course in all phases of radio-electronics

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Gentlemen: Send me complete details of the TV and FM Servicing home study course. Also send brochure that explains the CREI self-improvement program and gives complete details and outline of course. I am attaching a brief resume of my experience, education and present position.

Check the Field of Greatest Interest

- ☐ TV, FM & ADVANCED AM SERVICING
- ☐ PRACTICAL TELEVISION ENGINEERING
- ☐ PRACTICAL RADIO ENGINEERING
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- ☐ BROADCAST RADIO ENGINEERING (AM, FM, TV)
- ☐ RADIO-ELECTRONICS IN INDUSTRY

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☐ SEND DETAILS ON RESIDENCE SCHOOL.

Billions of speeding electrons set phosphors "on fire"

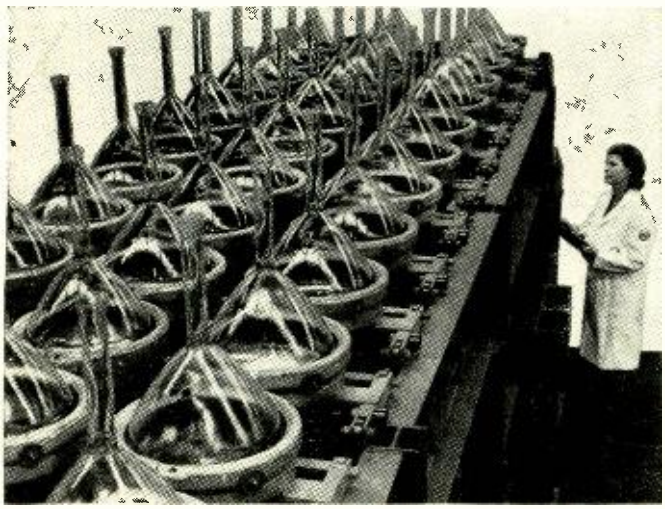
Gleaming luminescent materials, excited by an electron beam, help create television pictures

No. 5 in a series outlining high points in television history

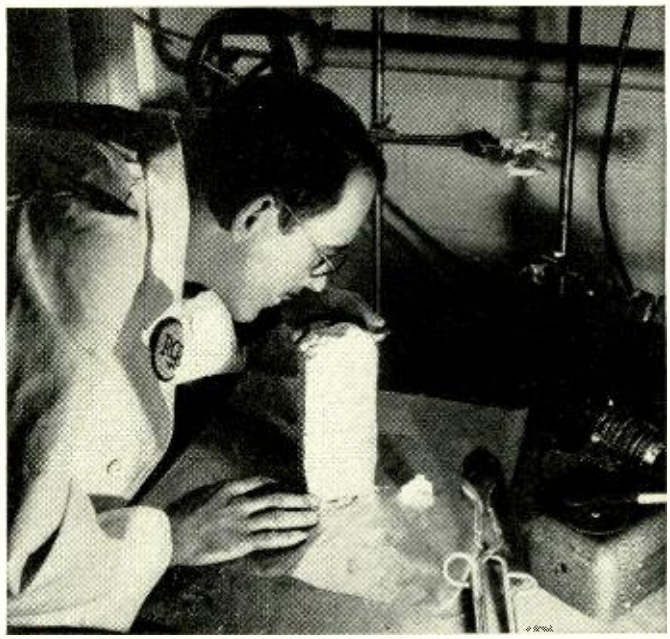
Photos from the historical collection of RCA

• *"Specpure Laboratory,"* said a sign at RCA Laboratories, *"Do Not Enter. Dust Is Our No. 1 Trouble-maker."* On the floor were moistened rugs to trap shoe-borne dust. Scientists and technicians had to change to clean white clothing before entering the room.

Purpose of this meticulous housekeeping was to provide a place where no speck of dirt would handicap the work in progress. RCA scientists were studying *luminescent materials*—seeking ways to produce them in bulk, while maintaining utmost quality and purity. Not even a speck of foreign matter could be tolerated. One part of copper *in ten million* will show up as green spots on a television screen.



In a special vibration-free room, *air-conditioned—and with temperature and humidity evenly controlled—tubes move at a snail's pace along this settling belt, while the luminescent coating settles on the face of the bulb in a delicate, film-like covering—a flawless surface, smooth and uniform.*



This block of luminescent material, *energized by ultraviolet light, provided illumination for this photograph. Luminescent materials of the highest purity are produced in bulk at RCA Tube Plant.*

Although phosphors have been known for centuries—since even sugar, salt, and diamonds have been found to have luminescent properties—little intensive research was done until scientists began seeking to perfect these glowing materials for use on the screens of television receivers. A scientist at RCA Laboratories, in the Specpure Room, was one of the first to develop the fundamentals for a way of making luminescent materials in bulk for television.

This development is one of the reasons why, at RCA Tube Plant in Lancaster, Pa., they can now be made by the tankful! Even in mass production, each "batch" has uniform characteristics. White light, of the type most suitable for creating television pictures, is produced by mixtures of luminescent materials combined in exactly the correct proportion.

Guarded at every step against any trace of contamination, these phosphors are deposited in a delicate film-like coating on the faceplates of television tubes . . . where they cling to the glass by a form of molecular attraction. Excited by an electron beam, they glow with a brilliant white light and thus produce the crisp black-and-white pictures we see on television.

To television, the phosphors developed by RCA scientists are as important as paint is to a painter. The face of the kinescope tube is the "canvas." A picture appears as a visible image when the electron gun acts as a "paint brush" to create patterns in the phosphors!

Radio Corporation of America
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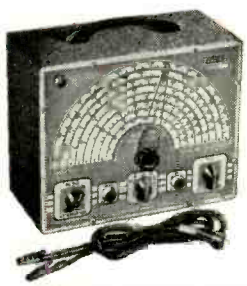

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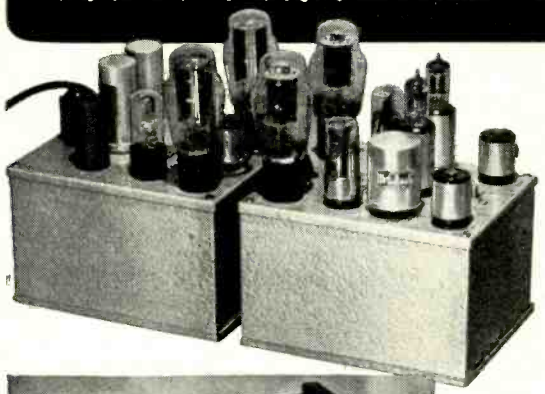

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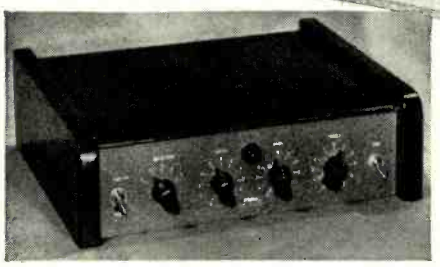

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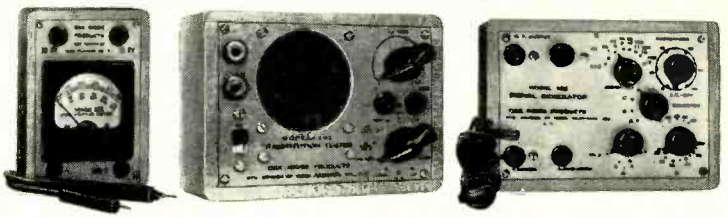

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CUSTOM-BUILT PROJECTION TV Is Still Profitable

By
DAVID T. ARMSTRONG
Vice-Pres., Electronics Research

Fig. 1. An adaptation, by Ansley Radio Co., of the Protelgram system which produces a 1728 sq. inch picture.

Is projection the TV of the future? To date it is the only way to obtain a truly large-sized picture.

AMERICA is the land of competition. In the battle of survival of the fittest, woe to the fit or only more fit. This is as true in television as it was in the case of evolution. Unfortunately, in the practice of many people the "good" becomes the enemy of the "best," for they seem to say, "Since what we have now is good enough, let's stay with it and let the better come along and make its own way in the world."

That attitude may be all right for the average customer, but it is not all right for the enterprising service technician who wants to be in business tomorrow as well as today. He *must* learn to read the handwriting on the wall without being too critical of the typography. If one interprets the handwriting correctly, it seems that the only logical answer to the problem of securing truly large-sized pictures is with projection units and that the next boom in television will be in this field. Sure, there are many who will protest that projection has made its appearance and did not "go over." This is true only to a certain extent. Prices asked for the early projection units were high—ranging as they did from $650.00 up. This economic factor naturally limited the sale of these sets to a relatively small group of consumers. Like all television receiver prices the price-tags on projection sets have been lowered to the point where the average-income family is now a potential customer.

The trend today is obviously toward larger and larger pictures. The seven inch sets, so popular a year or so ago, are now obsolete. The time is coming when today's ten and twelve inch receivers will have to make way for the newer sixteen and nineteen inch units. In fact the trend is so definitely in the direction of large pictures that one well-known manufacturer is working on a thirty-inch cathode-ray television tube.

It's a funny thing, but the company that made the very earliest cathode-ray tubes and controls the basic patents, has been content recently to license other manufacturers to make the direct view tubes under their patents. They are concentrating on projection tubes entirely. If you think they are making a mistake, stick to direct view; but if you suspect they may be right, begin to think about projection.

Most technicians specialize. The author's field is custom installations and we do about two or three a month, the year around. Actually it makes little difference whether a client or prospect wants a direct view, *RCA* projection, or the *Norelco* Protelgram. We are in business to serve our customers. But at the same time we have the responsibility of providing the very best possible television service at prices our customers can afford. Therefore it pays us to look into the new developments in the field and to offer the best of these to our discriminating clients.

We have installed *RCA* direct view and projection, *GE* direct view and projection, *Du Mont,* etc., and plans are now under way to use a number of the *Norelco* Protelgram units. There must be reasons. Figs. 2 and 3 show the fundamentals of the optical principle employed by *RCA* and the *North American Philips Company.*

Custom building is expensive and presents many specialized and difficult problems. A custom installation is not flexible, for once it is installed there

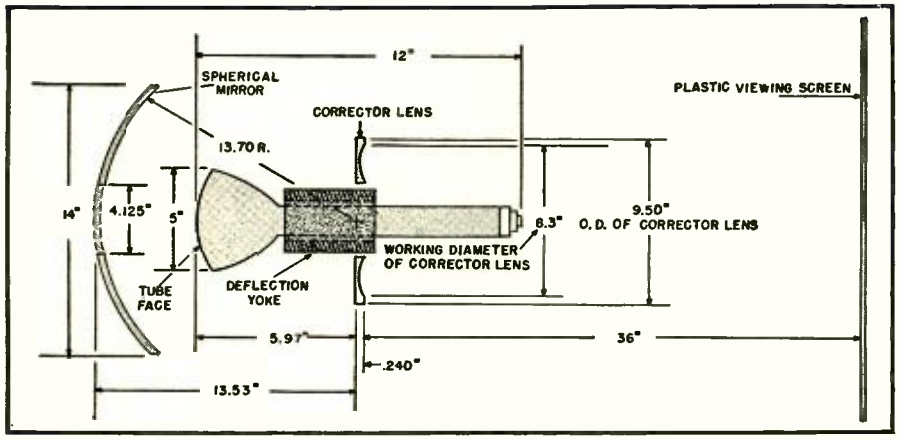


Fig. 2. A typical RCA or GE projection system which requires a space 50 inches long by about 16 inches in diameter to house the component parts. This is not the most efficient optical system because of the size of the tube face and the losses attributable to the size of the deflection coils, the leads, etc.

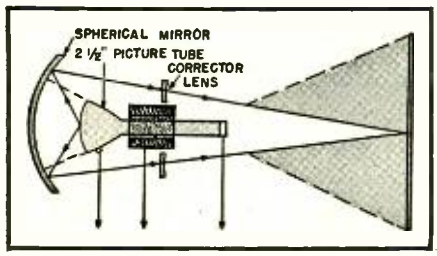


Fig. 3. Fundamenal principles of the Schmidt optical system. The tube directs its light to the concave mirror which bounces it back through the corrector lens to the plane surface mirror or a screen. This was one of the early applications of the Schmidt optical principle. It is more efficient than the one of Fig. 2 because of its smaller tube diameter.

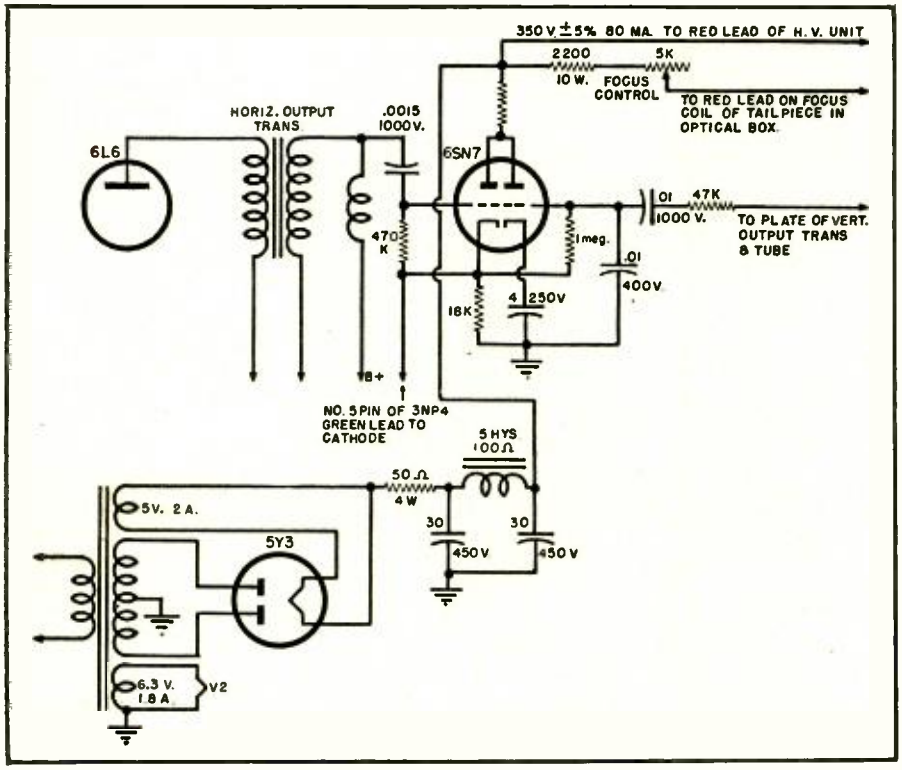
it remains. Thus, great care and much thought must be given to the placement of the viewing screen. Custom-minded customers and prospects must like an installation, because the best possible advertisement comes from satisfied customers who are proud of their installation and say so to their friends and guests.

Formerly, one of the special problems involved in installation of a projection unit was the great amount of space taken up by the projection components alone. Heretofore, this has required 50 inches of straight line space and about 16 inches of diameter. A study of the required dimensions, shown in Fig. 2, clearly indicates this. Then the supporting frame for the projection apparatus was bulky. In many instances it was difficult to find suitable depth to house such a unit.

The advent of Protelgram has been hailed by custom-installation technicians because outside of the standard chassis, which may be of the typical 630TS type, a minimum of space is necessary to install the two small additional components required for projection. Most of the basic units needed to operate the projection components are supplied by the 630TS chassis. A few minor circuit changes which may be readily performed by the average service technician will convert such a chassis to operate as an excellent projection unit.

In fact, the changes are so simple that we have rigged up a small portable assembly for demonstration purposes. This assembly contains a viewing screen, the optical box, and the high voltage unit, the basic parts necessary for this projection system. In addition, a separate power supply and a picture tube protection circuit have been incorporated. A schematic of this circuit is shown in Fig. 4. Another circuit for the production of the necessary video output voltage has also been included for use with such receivers as do not have the required 90 volts peak-to-peak to insure adequate modulation of the high cut-off tubes. This is not generally necessary as any standard 630TS chassis that can drive a 10BP4 or the 12LP4 has sufficient output and power supply to drive the projection unit. However, since the demonstration unit might be called upon to perform "miracles," all the necessary circuits to meet any demand presented by any television receiver in the field have been included. The special video output circuit is detailed in Fig. 6. This circuit is typical of that required and has adequate bandwidth for good definition. Be sure that the receiver to be adapted for projection work has an i.f. system capable of passing the full 4.5 mc. band if good results are to be obtained. A receiver with a too narrow bandwidth will not give a sufficiently detailed picture.

Fig. 4. Schematic of the power supply and protection tube circuit. Although the 630TS has sufficient low voltage d.c. for the input to the high voltage unit, the use of this circuit cuts down the drain on the chassis as a whole. The protection tube prevents screen burns in the event of either vertical or horizontal sweep failure.



The actual video circuit changes needed will depend on the particular receiver. In many cases, the only changes necessary are the increase of the video bandpass. Choice of the proper inductances and capacities will accomplish this in most cases. The values specified in Fig. 6 will serve as a guide in converting present amplifiers if a complete new video section is not contemplated.

This little gadget has been worth its cost many times over. Although it was originally designed to demonstrate the desirable features of the large pictures that are possible with only a few additions to an existing receiver, its use has grown and expanded.

There is a minimum number of leads, usually five to seven, depending on the chassis being used, that must be connected to various points on the television chassis. All that is necessary is to expose the under side of the

chassis and make connections with alligator clips, turn on the power, and the set is in operation. For safety's sake use alligator clips covered with rubber sleeves so that there is no possible danger of accidental short circuiting which could be dangerous and expensive. Use only clips that have positive grip which means high quality clips with powerful springs. You don't want one of these clips to become dislodged, nor do you want a poor contact. The teeth should bite into the solder when the clips are attached.

The frame is made of aluminum so as to be light in weight, neat in appearance, and easy to fabricate. The over-all dimensions are governed by the size of the screen. Since the screen used is 12x16 inches, the over-all dimensions are 14x18x40 inches.

A demonstration of this device excites much interest in the mind of a prospect for he can see the precise kind of picture he could have. At the same time he can see the layout of the component parts and visualize how much space is required for a unit of this type. This cuts down unnecessary questioning about the availability of placement space for the unit. He can see immediately just how much room must be provided for the installation.

One important factor. In this gadget the beam is thrown directly on the viewing screen from the corrector lens. There is no intermediary mirror for folding the beam because a mirror introduces a slight loss of light and reduces the over-all optical efficiency somewhat. Plans are under way to build another unit with a folded beam, using a plane surface mirror because this is a fairly common type of installation.

A further possibility has developed from the use of this type unit. Television can and should be built into new homes. Architects should be encouraged to think in terms of built-in projection television so that it will be possible to have 40 inches over-all straightline distance for this purpose. In some instances it is possible to take an architectural sketch and work in an ideal television setup. In many cases it is possible to conceal the optical projection box in a cabinet behind the walls. Another possibility is to build the television unit into the utility room with a straight line 40 inch throw distance or it can be built into a closet on the other side of the living room wall. In this latter instance it would be necessary to use a plane surface mirror to fold the beam.

The 40 inches required represent the total length from the bottom of the projection unit housing to the screen itself. The housing measures approximately 9 inches in height while the beam requires a throw of 31 inches.

Such built-in projection gives the average family television at its best. When it is built into the structure there is a minimum cost for the installation because all the costs are

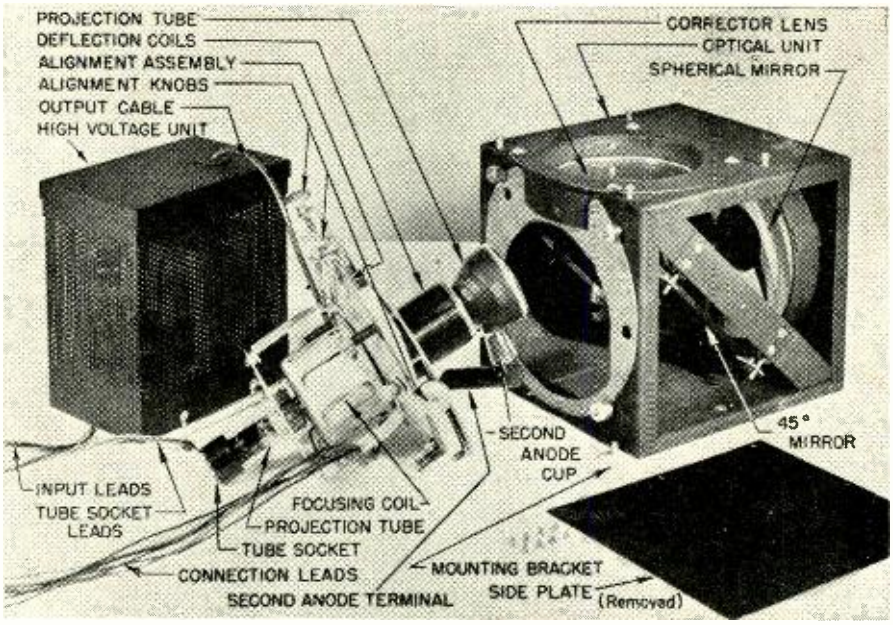


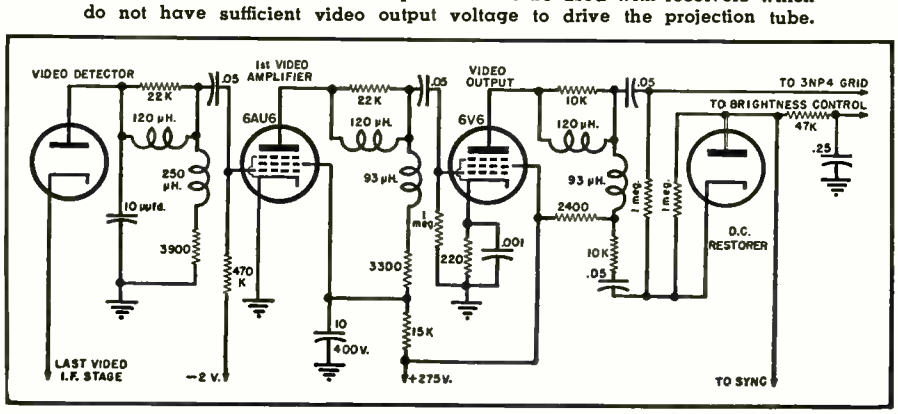
Fig. 5. The components of the Protelgram projection system required at each "slave" location. At the left is the 25 kv. power unit, in the center the projection tube assembly with its focusing coils, and at the right the "optical box," in which may be seen the concave mirror at extreme right, the flat mirror inclined at a 45 degree angle, and the round corrector lens at the top. Compactness is a feature of the Protelgram system, the power unit measures just 8½x 4½x7 inches; the optical box, with tube assembly inserted, 8½x3½x16½ inches. A brilliant, high-definition image of some 200 square inches is obtained from the system as it is currently used in leading makes of high quality television receivers. System can be adapted to project pictures of 3x4 feet.

concentrated on the installation *per se*. It is not necessary to tear down a partition, cut a hole in a wall, build up a bookcase, or provide some bric-a-brac shelves to make the television installation less conspicuous. Such extra building involves a cabinet maker, and, while it is the only type of construction possible in existing structures, it is quite expensive. In a new installation there is no extra carpentry, plastering, or painting directly chargeable to the television receiver because all of these become part of the final structure. Further, the work is done under the supervision of the architect or builder.

Now, for one of the main uses of this demonstration unit and the reason for which it was originally designed and built. Nobody wants to scrap an existing television receiver. With this *Norelco* Protelgram nobody has to. Take the case in point. A friend of the author had a fairly good direct view set using the 10BP4 tube and the standard 630TS chassis. The receiver was installed in his living room. Just beneath the living room was a large "whoopee" room in the cellar.

This direct view chassis was modified slightly and tied to the projection unit which was placed in the cellar. By utilizing the space between the beams there was plenty of room to locate the optical box and the high voltage power supply. With straight line throw and no intervening mirror required to bend the beam, he was getting the best possible 16x12 inch projection picture. He still has his 10 inch direct view receiver, but by the flick of a switch he can turn off the voltage to the direct view tube and direct it to the projection unit for large picture projection in his "whoopee" room.

Fig. 6. Schematic of a video output circuit to be used with receivers which do not have sufficient video output voltage to drive the projection tube.



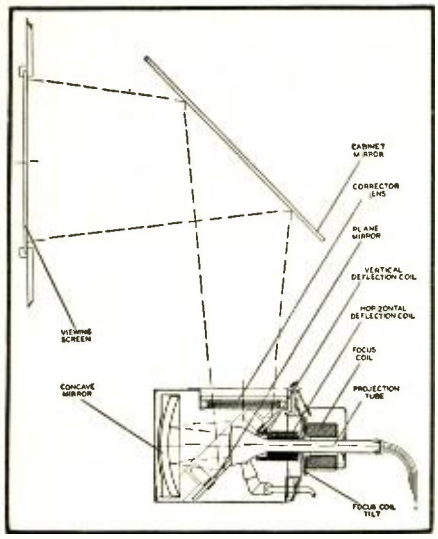


Fig. 7. The modified Schmidt optical system as used in Protelgram television. The image on the face of the 2½-inch cathode-ray tube, which may be seen in the "optical box" at the bottom of diagram, is reflected from concave mirror (left) to the plane mirror, which is inclined at a 45 degree angle. The image then passes through the corrector lens and is "folded" by the cabinet mirror, which projects the image on the viewing screen (upper left). Protelgram is a development of North American Philips Co., Inc.

This is classed as a "dual system." It is possible to have a 10 or 12 inch direct view and switch over to the large size picture should the situation warrant. There may be times when a small family group would rather use the direct view tube or there may be other times when the projection picture would be preferable. With a conversion job like this both types of reception are possible. Then, if a tube goes in the middle of a good program, simply switch to the built-in "ace in the hole."

There is another excellent reason why this dual system offers possibilities for the service technician or engineer. A television installation in a bar is an investment and the picture should be as good as possible. With a dual unit, involving both direct view and projection, it is possible for the bartender to tune the program in at its best and then switch over to projection. All the controls are accessible to him without leaving his post. In a large bar, say 50 or 60 feet long, it might be possible and desirable to have two projector units, one at each end of the room. Both could be controlled by a single master tuner with some modifications; and nobody would be outside of the optimum viewing range.

This "slave" system could be applied to a club which might find it desirable to have projection in various clubrooms; for a hotel which wants to provide multiple installations in the better class rooms, or for a school which wants high quality television in a number of key locations, all to be operated from a master tuner.

There are still other interesting features possible with the Protelgram system. It makes large scale projection possible with a quality of resolution, definition, brightness, and clarity that make a living room a telemovie center.

This latest television innovation has been incorporated in the *Ansley* unit shown in Fig. 1. This type of projection is television at its finest. The cabinet projector throws a 3x4 foot picture through a lens in the front of a "coffee table." The controls are revealed by moving the top of the cabinet forward about 6 inches.

One of the advantages of this type of unit is that the television receiver is an unobtrusive piece of furniture because the cabinet by the side of the upholstered chair closely resembles a cabinet type coffee table.

Probably the ultimate in simplicity and appeal in the use of Protelgram is in a unit made by Avery Fisher, president of the *Fisher Radio Company* of New York City. He has gone into projection in a big way and has had tuner and sweep components designed and manufactured to fit into the unused space of the projection receiver. As a result, he has been able to produce a table model with over-all dimensions of 25⅜" long, 21" deep, and 14" high.

The top lifts up to reveal a viewing screen. The simplicity of the unit is manifest in the three controls, one for tuning in the various channels, another for brightness, and a third for vertical or horizontal focusing.

Because the cost of the optical box and the high voltage unit is moderate, it is entirely possible that soon television receivers incorporating the Protelgram feature will be available at prices comparable to those now asked for 16 inch direct view receivers.

Obviously you will get the best out of projection if you design a special chassis to provide just the right output required for the optimum operation of the system. In their haste to cash in on something good, too many manufacturers have simply added Protelgram to existing cabinets and chassis. The waste of space and undesirable cable lead length which results have proven costly. By redesigning the tuner chassis, sweep chassis, and power supply to fill in all the space surrounding the optical box, it is possible to produce a compact unit.

Some manufacturers are alert to the importance of this new kind of television and have designed special circuits to feed the 3NP4 projection type kinescope. The service technician who knows his circuits will readily appreciate the fact that there are no particular changes from standard design for television circuits. This circuit represents straightforward television engineering up to the point of feeding the picture into the Protelgram system.

In the *Scott* circuit recognition was given to the fact that the electrical focus of the Protelgram system changes the signal strength with brightness or contrast more sharply than with direct view receivers, and a focus control has been provided on the front panel. This control might have been eliminated by controlling the maximum end of the brightness control by introducing a screwdriver-actuated or service control, which would limit the amount of brightness available to a point at which the focus control need not be shifted.

The *Scott* circuit also provides the proper input d.c. voltage to the *Philips* 25 kc. high voltage unit. A 6SN7 tube is used as a protection tube to cut off the high voltage to the 3NP4 in the event of failure in the sweep circuits. This is good engineering since the screen on the picture tube face will be burned if the electron beam is concentrated on it in a narrow line for even a few seconds. —30—

Fig. 8. Newest application of the Norelco projection featuring the 13½x18 inch screen, AM and FM radio, and 3-speed record changer in a Stewart-Warner console.

QUALITY CONTROL by "TYPE TESTING"

By CARL GARTNER
Quality Control Mgr., TV Rec. Mfg. Div.
Allen B. Du Mont Laboratories, Inc.

"Type Testing"—a system whereby production line sets are laboratory-tested at regular intervals as part of quality control. Reports on all sets tested are also used in planning engineering designs on new model receivers.

Sensitivity measurements on a standard Du Mont set are made with a Measurements Corp. Model 80 signal generator, a Du Mont 264B voltage calibrator, and a Du Mont oscillograph. In the foreground is safety enclosure for 19" metal and glass tube and near the operator's head is a light box which projects a test pattern which is used as comparison standard during tests.

Part of "Life Test" section of the Receiver Quality Control Dept. where a percentage of all sets manufactured are checked from a consumer's point of view before and after operational cycles of from 12 to 72 hours. Additional tests covering as long as 500 hours are frequently run on the sets.

ALTHOUGH all television receivers coming off the production lines at *Du Mont* are subjected to the usual visual and audio inspection procedures, a limited number of chassis are removed from the run each day to undergo an abbreviated form of "Type Testing."

These "Type Testing" procedures, in addition to providing quality control data, supply valuable material to the engineering and manufacturing departments of the company. In this way information of vital interest in the design and construction of future models is fed to the departments concerned in a never-ending stream.

Normally, every television set receives a detailed visual and audio examination based on the use of certain minimum and maximum test signals. These tests are in the nature of "Go"-"No-Go" gauges. Sensitivity is checked in production by having a signal of fringe sensitivity applied to the set. The set must resolve a usable picture or be rejected. At this stage in the production no measure of actual sensitivity is made. In order to provide a more detailed, objective, and accurate picture on how the set might be expected to perform, a sampling of the day's run is removed for further testing.

The selected sets are taken to special screen rooms where the receivers are put through a standardized series of tests. The results are noted on specially-prepared control forms which cover each of the attributes measured in these tests. This data is useful in determining statistically the final acceptance specifications. It may happen that a particular specification is unrealistic. During the pilot and early production runs a careful analysis of the "Type Test" data shows whether this is the case or not. For each of the measurements to be made there is a specific procedure outlined for making these tests.

Thus, in addition to its major purpose in controlling the quality of current production, "Type Test" data is useful in reviewing specifications, design, and the over-all quality index of the company's line of television receivers.

—30—

Another view inside the screen room. Test engineer is measuring oscillator drift using Cardwell TS 174/U frequency meter. ⟶

A Portable 40-Meter C. W. Station

Author with his 40-meter portable rig.

By
HAROLD C. GOULD*, W1KWU

Construction details on a combination 1-watt transmitter and receiver which was designed and built by W1KWU.

NO matter how long you have been a ham (I am a member of the Old Timers' Club myself) your appreciation of a really good low-power portable rig never wanes. The portable to be described is not intended to replace the more elaborate and higher powered rigs in the ham shack but has been designed for service on week-end trips, vacation use, or emergency operation in locations distant from power lines.

The unit was designed to meet my own particular requirements with the result that, in a cabinet less than a foot square, I have a self-powered portable transmitter and receiver which operates on the 40 meter c.w. band.

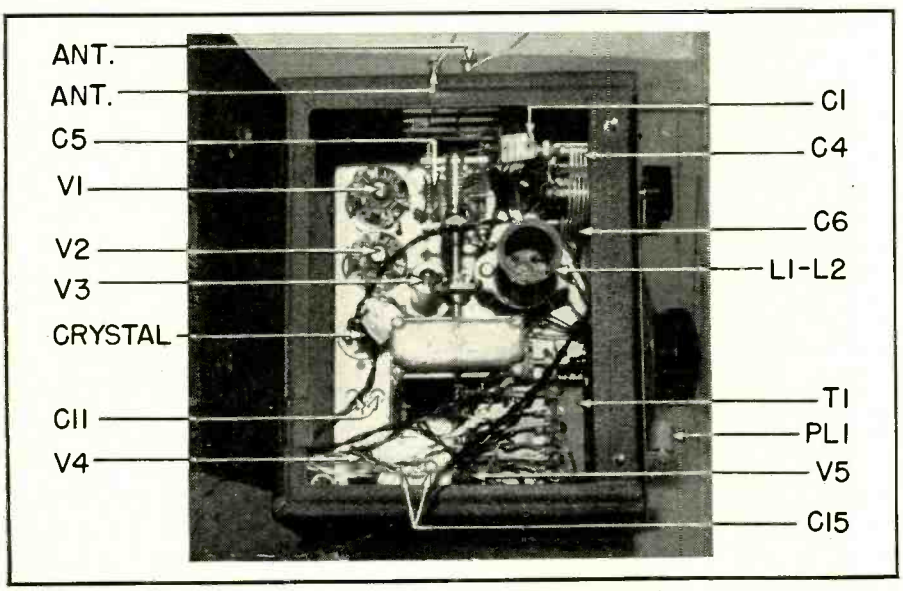
The parts layout is far from critical so other hams can make use of what they have on hand in the way of parts and cabinets. My requirements for the rig covered eight points: 1. small portable size, 2. a simple yet reliable means of communication (c.w.), 3. a small battery power supply which would be capable of delivering at least a watt, 4. simple construction, 5. low current drain and low voltage, 6. one-and-a-half volt tubes, 7. a transmitter with a crystal oscillator plus a final amplifier, and 8. a receiver with a t.r.f./detector plus a two-stage amplifier. If such a rig would provide contacts in the surrounding states and insure emergency contact in times of stress or distress, that was all I required.

In operation it is possible that I broke the record for one watt of power for DX on 40 meters. In less than a week I had contacted W7GHT (Idaho) over 2000 miles away! W9KQB reported the signal RST479 through Wisconsin. W1BVB relayed a message for me and checked RST579X in Connecticut from my portable location in Carroll, New Hampshire, a town surrounded by mountains. I have the QSL cards to prove it!

It is fun to see what can be done with one small watt of power. Once you have run contacts around the world with a big rig it is a real thrill to see what can be done with the "Little Nifty." Your operating will deserve more credit and you won't contribute your call to "Silent Keys" because of any operational dangers connected with this little job.

This rig spells absolute safety for the operator. I am not disputing the rightful existence of high power rigs, but there are advantages in small, low-power jobs such as this one.

Underchassis view of the portable station showing location of component parts.



Construction

Two antennas are used with this rig, one for transmitting and the other for receiving. The transmitting antenna is 133 feet, end-fed, and full-wave. The free end must be raised about 20 feet above the ground. Any 2 by 4, tree, flagpole, or building within reach can be used to support the antenna. It is important that the antenna be strung as high as possible since putting it six or so feet off the ground won't work.

The receiving antenna consists of 60 feet of single wire which can be strung on any tree or structure ten feet or more above the ground. A single, 66-foot, end-fed wire for half-wave can be used and switched over from trans-

* Chief of Illustration Unit (Publications), AAF Electronics Research Laboratories, Cambridge, Mass.

mit to receive but separate antennas give much better results. No external ground is used on the rig.

The chassis and cabinet can be any convenient size. The one used in this construction was a *Bud* unit, measuring 10"x8"x7", with a hinged cover and removable front panel. Two binding posts are used to secure the cover and the portable handle started life as a piece of screen door hardware.

The layout of components is not critical. The tubes, variable condensers, PWO mechanism for the bandspread condenser, crystal, plug-in coil of the receiver, antenna trimmer for the receiver, headphone jack, and connection block for the external cable to the batteries, key, and meter are all mounted on the top of the chassis.

The under chassis provides a shielded location for the transmitter tank coils, r.f. chokes, fixed condensers and resistors, the variable resistor control, tank trimmer condensers, and the hook-up wiring.

The mica trimmer condensers used in the transmitter are adjusted through twin holes drilled in the cabinet. These units are for adjusting the resonating oscillator and the final amplifier—a job which is done with a standard insulated trimmer adjustment rod. Once these are adjusted the transmitter is in action on the frequency of the crystal.

A *National* drive unit was used for bandspread on the receiver but any vernier control can be used. This unit drives a 50 μμfd. variable condenser to spread the 40 meter band over 200 divisions.

A plug-in coil is used for the receiver inductance L_1, L_2. The coil L_1 requires 16 turns of #24 d.c.c. wire closewound on a 1½ inch diameter form. A 5 turn feedback winding L_2 of the same size wire is wound directly below the first winding in the usual manner. If the receiver does not oscillate in the final test reverse the connections to this winding.

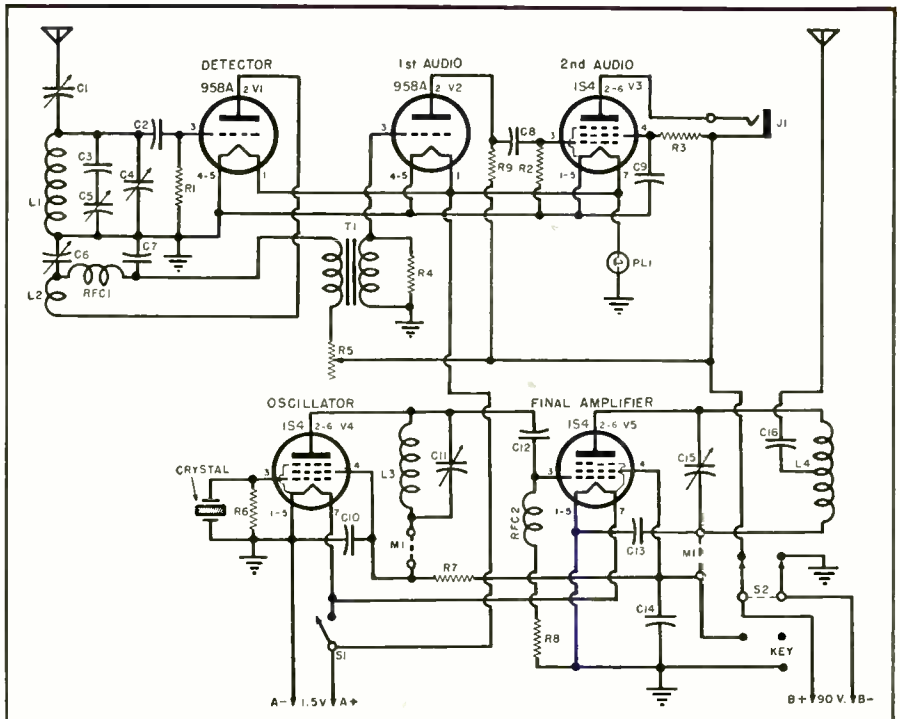
While all of the tubes could have been 1S4's, in the rig described 958A's were used for the detector and first amplifier.

Room is available in the cabinet to house small internal batteries if the constructor does not wish to use the heavy-duty batteries indicated. However, for general use, it is more economical to use the larger units.

Receiver Adjustment

First, plug in the headphones and snap the changeover switch S_2 to the "receive" position. Connect the receiving antenna to its post and adjust the antenna trimmer C_1 to about half capacity. Rotate the bandspread condenser C_8 to near maximum capacity for approximately the 7 mc. end of the band. If a superhet communications receiver is available turn it on for c.w. on the low end of the 40 meter band. The correct position of the bandset variable condenser C_4 can be quickly found when both receivers beat together on a similar frequency. As the bandspread condenser is rotated the 40 meter band will be fully covered by about half of its capacity. Later the constructor may decide to remove a plate or two, but don't overdo it! Adjust the variable resistor con-

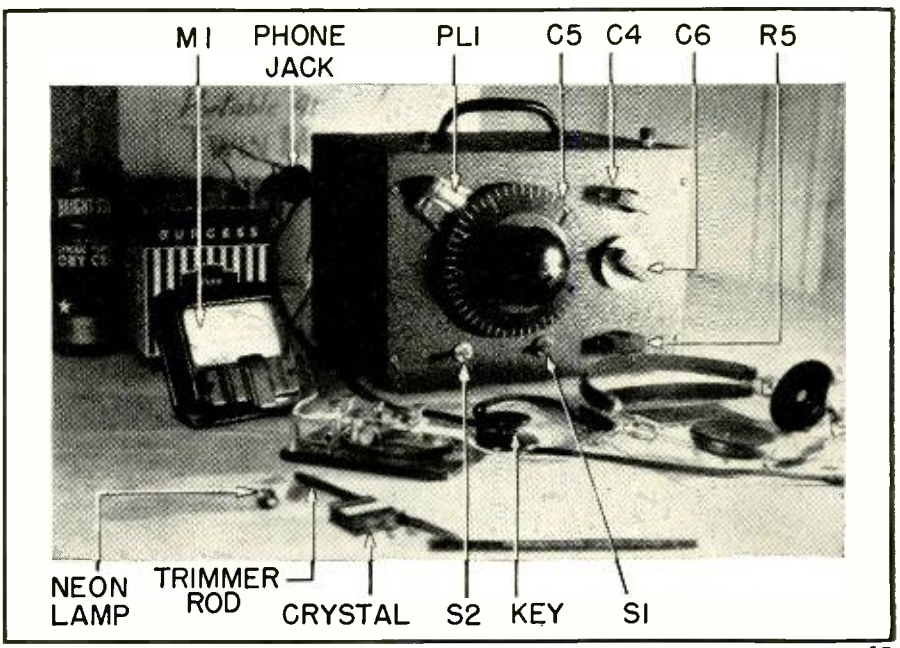
(*Continued on page 82*)

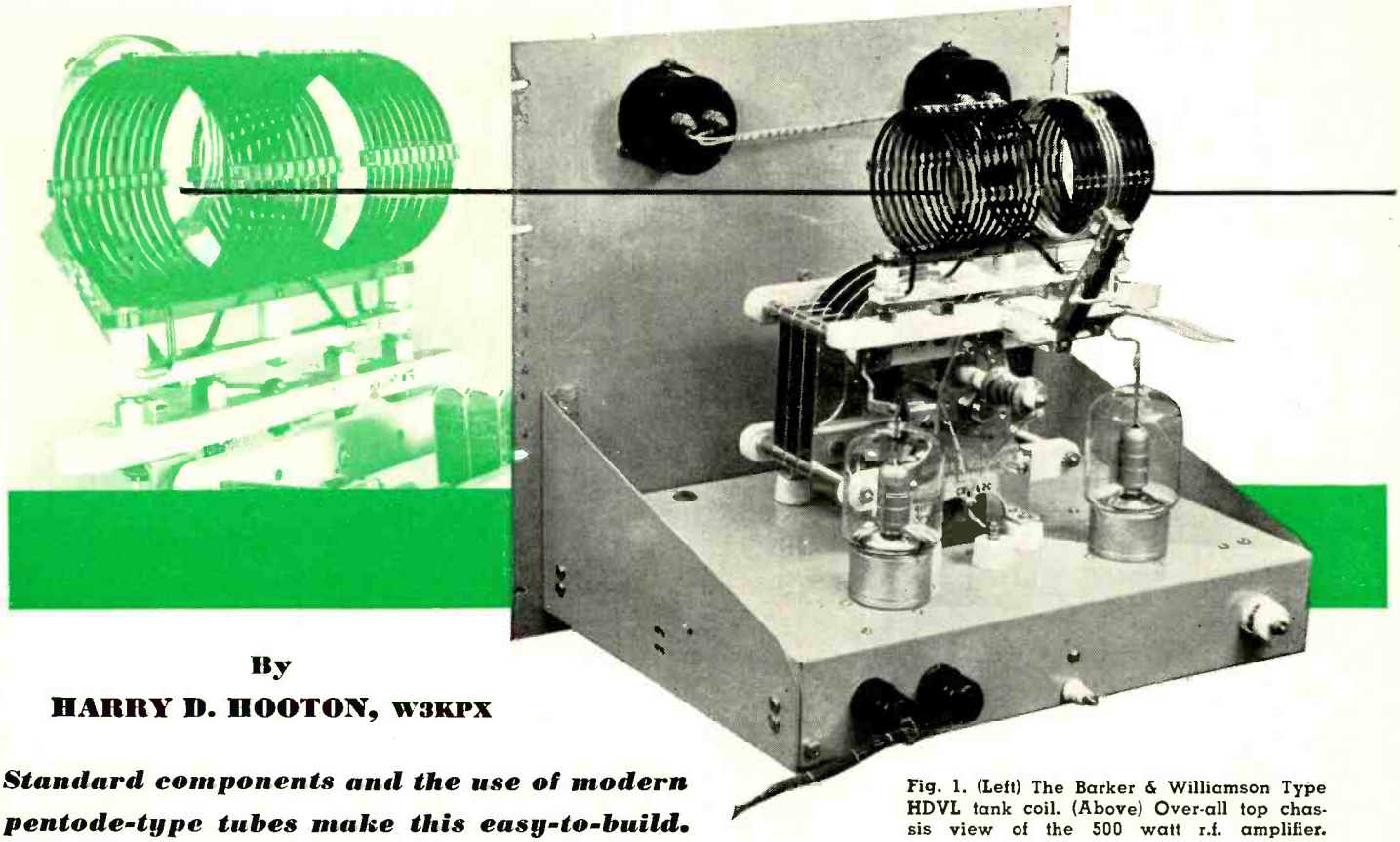


R_1—*1 megohm, ½ w. res.*
R_2, R_4—*470,000 ohm, ½ w. res.*
R_3—*5000 ohm, ½ w. res.*
R_5—*100,000 ohm pot.*
R_6—*47,000 ohm, 1 w. res.*
R_7—*1000 ohm, 1 w. res.*
R_8—*22.000 ohm, 1 w. res.*
R_9—*22,000 ohm, ½ w. res.*
C_1—*3-30 μμfd. trimmer cond.*
C_2, C_{12}—*100 μμfd. mica cond.*
C_3—*47 μμfd. mica cond.*
C_4, C_5, C_8—*50 μμfd. var. cond.*
C_7, C_9—*.01 μfd., 400 v. cond.*
C_9, C_{10}, C_{13}, C_{14}—*.003 μfd., 400 v. cond.*
C_{11}, C_{15}—*75 μμfd. trimmer cond. (Dual 150 μμfd. mica trimmer cond. in series)*
C_{16}—*.05 μfd., 400 v. cond. (See text)*
RFC_1, RFC_2—*3 mhy. r.f. choke (Standard 2.5 mhy. r.f. chokes can be used)*
T_1—*Audio trans. 3:1 ratio*
S_1—*S.p.s.t. toggle sw.*
S_2—*D.p.d.t. toggle or rotary sw.*
J_1—*Open circuit insulated phone jack*
L_1—*Approx. 16 t. #24 d.c.c. closewound on 1½" plug-in form*
L_2—*5 t. #24 d.c.c. closewound at ground end of L_1*
L_3, L_4—*20 t. #26 d.c.c. closewound on 1" dia. form*
PL_1—*1.5 v. pilot lamp*
Crystal—40 meter crystal
1—1½ volt (No. 6) dry cell
1—90 v. "B" battery (two 45 volt units in series)
M_1—*0-100 ma. d.c. meter*
V_1, V_2—*958A tube*
V_3, V_4, V_5—*1S4 tube*
Misc. Parts
¼ w. neon test lamp
Vernier drive (National Type PWO)

Circuit diagram and parts list covering 40-meter portable c.w. transmitter-receiver.

Panel view of rig with its auxiliary equipment. Unit was built of junk box parts.





By
HARRY D. HOOTON, W3KPX

Standard components and the use of modern pentode-type tubes make this easy-to-build.

Fig. 1. (Left) The Barker & Williamson Type HDVL tank coil. (Above) Over-all top chassis view of the 500 watt r.f. amplifier.

A 500 WATT R.F. AMPLIFIER FOR THE HAM

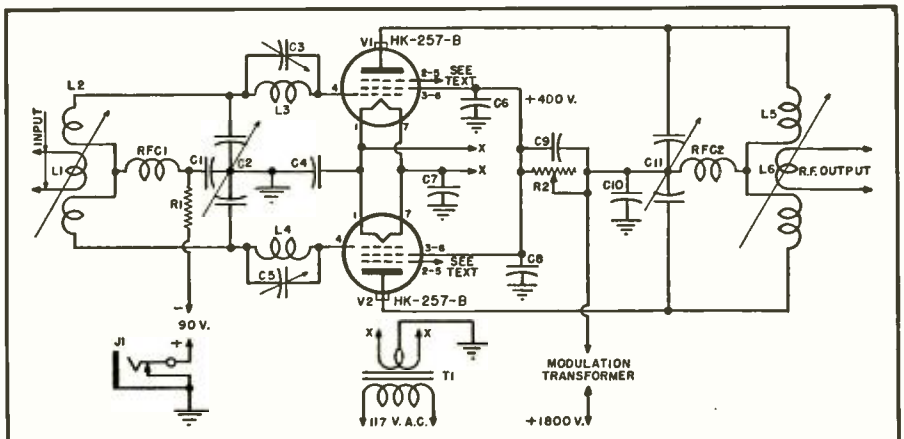
THE 500 watt radio frequency amplifier to be described in this article is a good example of modern high-power transmitter design. Using modern pentode-type tubes and standard, commercially-available components, it can be completely assembled and readied for operation in one evening. It may be used as a high-power amplifier for a code transmitter or, when used with suitable auxiliary equipment, it may be amplitude modulated in the plate and screen or suppressor circuits. If the transmitter is used mostly for code work and only occasionally for phone, suppressor modulation will afford a simple and inexpensive method of getting on the air with voice transmission. Last, but not least, the excitation requirements for this amplifier are so low that it may be driven on all bands from 80 meters down to, and including, 10 meters with nothing greater than the output from a standard 6F6 crystal oscillator or a v.f.o. unit.

As the photographs and schematic show, the amplifier consists of two HK-257-B pentodes connected in push-pull arrangement. The physical design is such that all of the components associated with the plate circuits are placed above the metal chassis and all components of the grid circuit are below. The chassis acts as a shield between the two circuits and thereby eliminates any tendency toward instability or oscillation. This type of assembly also permits very short and direct plate and grid leads, thus improving the efficiency of the amplifier and reducing the possibility of parasitic oscillation due to stray plate or grid lead inductance or capacitance. The amplifier shown in the photographs is perfectly stable even when plate and screen voltage is applied with the excitation removed. There is no perceptible change in the plate or screen current when either the grid or plate tuning condensers are rotated to any point on their scales.

The plate tank condenser is a *Barker & Williamson* CX62C "butterfly" type which has a rated capacitance of 62 $\mu\mu$fd. per section; the tank coils are *Barker & Williamson* HDVL type and are designed to handle power inputs up to 1000 watts. As shown in Fig. 1, the jack bar for the HDVL coils mounts directly on the terminals of the CX62C condenser thus practically eliminating leads between these two components. The tank condenser is so designed that the r.f. currents in the tank circuit do not flow in the frame of the unit as they do in the so-called "standard" transmitting condenser. In this manner stray inductance in the plate circuit is held to the very minimum and the inductance is kept in the tank coil where it can serve a useful purpose. Precautions such as these do not produce readily apparent effects on the lower frequencies, such as 80 meters for example, but they do make a tremendous difference in amplifier stability and efficiency on 10 meters. Most of the troubles encountered in high-power pentode r.f. amplifiers can be traced to excessively long grid and plate leads, distributed inductance and capacitance or r.f. currents circulating in the tank condensers or chassis which create fields, the phase of which is such that oscillation or parasitics are produced. The flexible leads from the plate tank coil and condenser to the HK-257-B plates are exactly *one and one-half inches* in length.

The HDVL jack bar is equipped

with a 3-turn swinging link coupling coil. Transmission lines with impedances of from 50 to 300 ohms may be connected directly to the link terminals and the amplifier loading adjusted by varying the position of the link with respect to the tank coil. The position of the link, as shown in the photographs, is approximately correct for a 70-ohm line connected to the center of a 40-meter half-wave dipole and using 2500 volts on the HK-257-B plates. On 10 meters, lines of from 400 to 600 ohms impedance may be connected directly to the link, provided that the lines are of the correct length, electrically, to terminate in a current loop at the link. In general, better efficiency will be obtained by the elimination of coupling devices between the link coil and the transmission line. However, when feeding 600-ohm or other high-impedance lines on the lower frequency bands, there is insufficient inductance in the link to properly load the amplifier plate tank circuit when the high impedance line is connected directly to the link. The details of a satisfactory impedance-matching transformer for use on 20, 40 and 80 meters is shown in Fig. 3.



R_1—2500 ohm, 10 w. wirewound res.
R_2—75,000 ohm, 75 w. wirewound var. res.
C_1, C_4, C_7—.001 μfd., 500 v. mica cond.
C_2—100 μμfd. (per section) var. cond. (receiving type)
C_3, C_5—15 μμfd. mica trimmer cond.
C_6, C_8—.001 μfd., 1500 v. mica cond.
C_9—.1 μfd., 2500 v. oil-filled cond.
C_{10}—.001 μfd., 12,500 v. mica cond.
C_{11}—62 μμfd. (per section) butterfly cond. Spacing between plates .25 inch (Barker & Williamson Type CX62C)
T_1—Fil. trans. 5 v. @ 15 amps.
L_1, L_2—Grid tank coil, plug-in type
L_3, L_4—Parasitic suppressors (see text)
L_5—Plate tank coil, plug-in type (1000 w. heavy duty)
L_6—Swinging link coupling coil, part of jack bar assembly for mounting L_5 (Barker & Williamson, 1000 w. heavy duty)
RFC_1—2.5 mh. r.f. choke (receiving type)
RFC_2—2.0 mh., 500 ma. r.f. choke (transmitting type)
1—Mod. trans. 1:1 ratio, class B driver (see text)
2—HK-257-B pentode tubes
2—"Jumbo" 7-prong ceramic sockets
Equipment Required
1—0-25 ma. d.c. meter (grid current)
1—0-500 ma. d.c. meter (plate current)

Fig. 2. The W3KPX 500 watt, plate and screen amplitude modulated r.f. amplifier.

As mentioned previously, the components associated with the grid circuit are placed under the chassis. The grid tank condenser shown is a two-section transmitting type with a rating of 100 μμfd. per section and a spacing of 0.030 inch between the plates. Any good quality receiving-type condenser of 100 μμfd. per section will be satisfactory. The condenser frame is connected directly to the metal chassis. The grid coil is a standard *Barker & Williamson* 150-watt swinging-link type. The use of a 150-watt coil in this position is not necessary as the greatest amount of power dissipated in the grid circuit, even under extreme conditions, will never be more than one or two watts. However, the coils and their jack bar were on hand and the swinging link does afford an easy means of adjusting the final amplifier grid excitation to the proper value.

The wiring between the grid coil and its tuning condenser and the grid terminals of the HK-257-B sockets must be kept as direct and short as possible. A parasitic trap, consisting of six turns of No. 14 enameled copper wire, wound on a ½ inch diameter and ¾ inch long form, is inserted in each HK-257-B grid lead between the socket terminal and the fixed plates of the grid tank condenser. It may or may not be necessary to tune these traps; usually the distributed capacitance of the small coils will resonate the trap circuits somewhere in the very-high-frequency region and no adjustments are necessary. However, small mica or air-dielectric trimmers may be shunted across the coils, if desired. Those shown in the

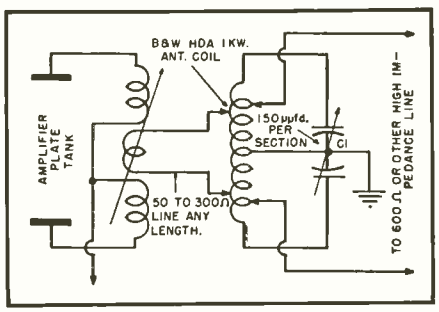
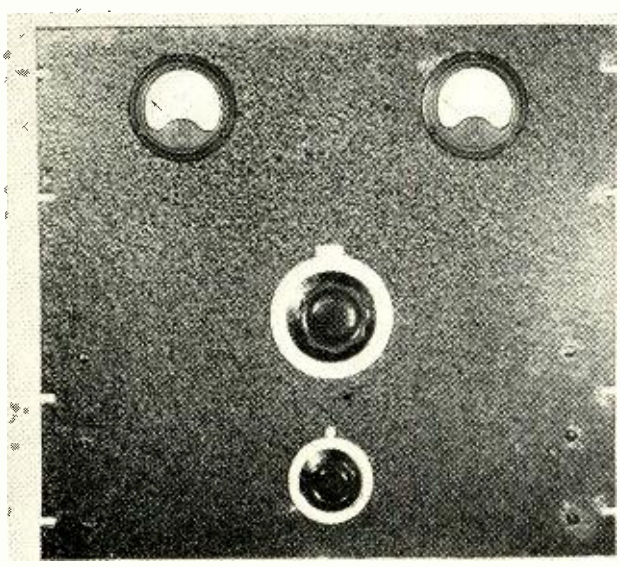
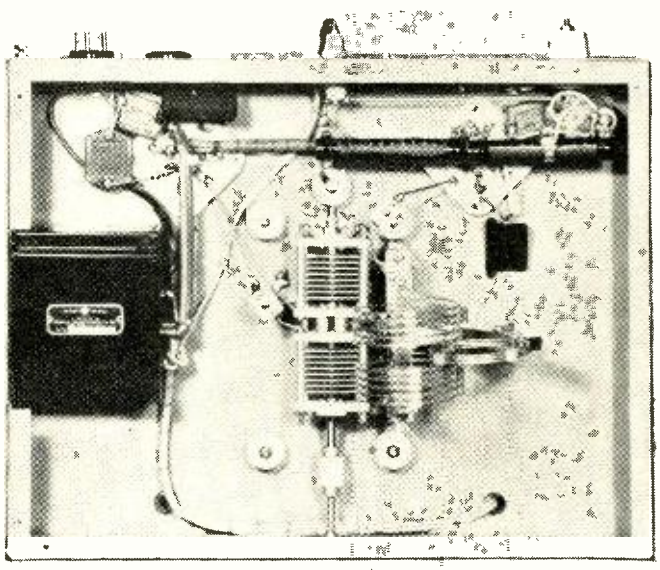
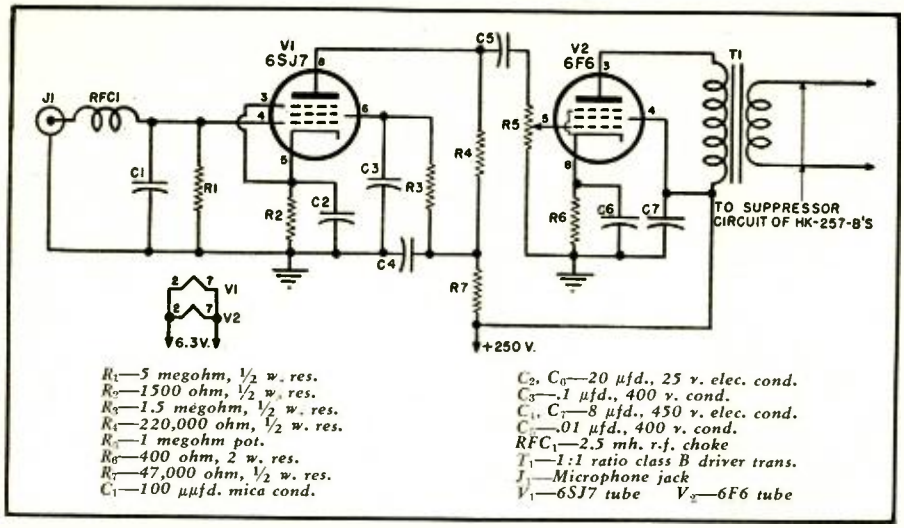


Fig. 3. Details of an impedance-matching transformer for use on 20, 40, and 80 meters.

Fig. 4. Panel and under-chassis views of the r.f. amplifier unit. The components comprising the grid circuit are placed under the chassis while those in the plate circuit are above chassis, the chassis acting as an effective shield.







R_1—5 megohm, ½ w. res.
R_2—1500 ohm, ½ w. res.
R_3—1.5 megohm, ½ w. res.
R_4—220,000 ohm, ½ w. res.
R_5—1 megohm pot.
R_6—400 ohm, 2 w. res.
R_7—47,000 ohm, ½ w. res.
C_1—100 μμfd. mica cond.
C_2, C_6—20 μfd., 25 v. elec. cond.
C_3—.1 μfd., 400 v. cond.
C_4, C_7—8 μfd., 450 v. elec. cond.
C_5—.01 μfd., 400 v. cond.
RFC_1—2.5 mh. r.f. choke
T_1—1:1 ratio class B driver trans.
J_1—Microphone jack
V_1—6SJ7 tube V_2—6F6 tube

Fig. 5. Modulator unit for the suppressor modulation of the HK-257-B tubes.

bottom chassis view are 15 μμfd. receiver-type mica trimmers. This particular amplifier had no parasitics and, therefore, did not actually require the traps. In working with pentode and tetrode amplifiers, however, particularly those using relatively expensive type tubes, it is good insurance to incorporate the traps until it is definitely known that the amplifier is stable. Sometimes the presence of parasitics will cause excessive plate current to be drawn with a possibility of damage to the tubes. These parasitic traps are *not* harmonic suppressor circuits for elimination of interference to nearby television receivers. The use of harmonic suppressors will be covered later in the article.

The filament transformer for the two HK-257-B's is mounted under the chassis, as shown in the photograph. The wiring from the secondary of the transformer to the filament terminals of the sockets must be heavy—at least No. 8 copper—and dressed very close together. As shown in the photograph, the filament leads between the two sockets are insulated by means of flame-proof extruded tubing and then *laced* very closely in parallel. This type of construction effectively places both sides of the filaments at the same r.f. potential due to the high capacitance between the leads. The filament terminals of the two sockets are also placed at ground r.f. potential through *mica* bypass condensers, as shown on the schematic, Fig. 2.

The male plug mounted at the rear left corner of the chassis is the 117 volt a.c. connection for the filament transformer; the 5-prong socket, to the right of the male plug, is the control-grid bias connection. The small porcelain feedthrough insulator at the center is the screen voltage terminal (used only when the amplifier is operated as a suppressor-modulated phone or a telegraph transmitter); its purpose is to permit voltage from a supply other than that used for the plates to be applied to the screens. This arrangement makes adjustment of the various circuit conditions easier when suppressor modulation is used and improves the screen voltage regulation during telegraph operation. The large porcelain insulator at the right rear of the chassis is the HK-257-B plate high voltage terminal.

The amplifier should be checked for parasitics and spurious or self-oscillation before placing it on the air. The outlined procedure is generally followed by the author before any new amplifier is connected to an antenna and excited. Light the tube filaments and apply approximately 90 volts of negative *fixed* bias to the HK-257-B grids (two 45-volt "B" battery blocks will serve). Now place about 1000 volts on the plates and about 350 volts on the screens of the two tubes. The plate voltage may be reduced by connecting a 300 watt, 110-volt lamp in series with the primary of the high voltage transformer. The plate current milliammeter should indicate a small plate current flow—possibly 30 to 40 milliamperes; *no grid current should be indicated.* Rotate the plate tank tuning condenser to approximately half maximum capacitance and rotate the grid tank condenser to minimum and then to maximum capacitance. Watch the grid and plate milliammeters during the rotation of the grid condenser; *if grid current is indicated at any point or if there is a change in the plate current indication, the amplifier is oscillating and steps to correct this condition should be taken before proceeding further.* The metal base shells of the HK-257-B's may require grounding (they did not in this amplifier) or larger filament bypass condensers may be necessary. All preliminary checking should be carried out with the highest frequency (10 meter) coils in place. It is also a good practice to have the receiver in operation, with the b.f.o. turned on, during this period. Oscillations usually will manifest themselves by causing whistles or loud rushing noises in the receiver; the presence of parasitics may sometimes be detected by tuning the receiver over its highest frequency range, listening for whistles, or by adjusting the small trap trimmer condensers, leaving the receiver tuned to its highest frequency band.

If the amplifier appears to be stable, leave the 90 volts of negative bias connected to the grids but remove the plate and screen voltages. Connect the r.f. output from a crystal oscillator or other r.f. excitation source, through a 70-ohm low-impedance line to the grid tank link coil terminals. The coupling between the link and the grid tank coils should be very loose. Rotate the grid tank condenser and watch the grid circuit milliammeter for an indication of grid current. The coupling between the link and tank coils should be increased slightly and the grid tank condenser retuned for maximum indication on the grid milliammeter. Continue this procedure until the grid current is approximately 12 milliamperes when the grid condenser is "peaked." Leave the grid circuit in this condition.

Now, apply approximately 60 volts of positive potential to the suppressors of the HK-257-B's. Connect the transmission line from the antenna to the plate tank link coil terminals and adjust the link position to approximately that shown in the photographs. Apply the plate and screen voltages (2000 and 500 volts respectively) and quickly tune the plate tank circuit for minimum plate current. *With the*

Table 1. Operating characteristics of the HK-257-B pentode-type tubes

GENERAL CHARACTERISTICS	
Max. plate dissipation	75 watts
Filament	5 v., 7.5 amp.
Max. plate volts	4000
Max. screen volts	750
Max. screen dissipation	25 watts
Grid-to-fil. capacitance	13.8 μμfd.
Grid-to-plate capacitance	0.04 μμfd.
Plate-to-fil. capacitance	6.7 μμfd.
Max. freq. rating	120 mc.
Base	Jumbo 7-prong

CLASS C TELEGRAPH R.F. AMPLIFIER (Two Tubes)	
Plate volts	2000
Screen volts	500
Suppressor volts	60 (pos.)
Control grid bias	—200
Plate current	300 ma.
Screen current	22 ma.
Control grid current	12 ma.
Driving power	2.8 watts
R.f. power output	460 watts

CLASS C TELEPHONE R.F. AMPLIFIER (Two Tubes)	
Plate volts	1800
Screen volts	400
Suppressor volts	60 (pos.)
Control grid bias	—130
Plate current	270 ma.
Screen current	22 ma.
Control grid current	16 ma.
Driving power	3.4 watts
R.f. power output	356 watts

SUPPRESSOR-MODULATED R.F. AMPLIFIER (Two Tubes)	
Plate volts	2000
Screen volts	500
Suppressor volts	—300
Control grid bias	—130
Plate current	110 ma.
Screen current	54 ma.
Control grid current	6 ma.
Driving power	0.8 watt
R.f. power output	70 watts

tank condenser and coils shown, the "dip" in plate current should occur between 60 and 80 on the dial scale on the 10 and 20 meter bands. If no plate current dip is indicated, or if the minimum is too high, loosen the coupling between the link and tank coils and retune the circuit. The link should be adjusted so that the plate current drawn by the two tubes is from 250 to 300 milliamperes (500 to 600 watts input). It is advisable to keep the power input down to about 500 watts until it is certain that the amplifier is operating at good efficiency. The operator should practice varying the loading on the plate tank circuit while watching the change in color of the HK-257-B plate. *It may be found that the greatest plate circuit efficiency does not occur when the plate tank is tuned for minimum plate current.* This is a characteristic of pentode r.f. amplifiers and may be somewhat confusing at first. If the amplifier is loaded by varying the antenna coupling and retuning for minimum plate current and *then* carefully readjusting the plate tank condenser for *minimum color brilliance in the HK-257-B plates,* it will be found that a greater r.f. output for a given d.c. input will be obtained. If an r.f. ammeter is available, tune the plate tank circuit for maximum r.f. current indication on the meter and adjust the link for the proper plate current value.

The above description assumes that the amplifier is to be used for c.w. (code) or narrow-band FM transmission. For AM phone operation, the HK-257-B's are operated under slightly different conditions. The plate and screen voltages are reduced to 1800 and 400 volts respectively and the control grid bias is reduced to minus 130 volts. The required driving power is 3.4 watts and the control grid current is 16 milliamperes. The plate current should not exceed 270 milliamperes (486 watts input). In areas where interference with television reception is likely to occur, it may be necessary to reduce the grid driving power and the amplifier efficiency. These adjustments will be covered in detail later in this article.

For AM operation the screens should be modulated as well as the plates. The easiest method of modulating the screens is to return them to the plate high-voltage supply through a voltage-dropping resistor, as shown in Fig. 2. The screen voltage-dropping resistor should be returned to the *plate side* of the modulation transformer as shown. The condenser C_9 across resistor R_2 is not absolutely necessary. However, when modulating the HK-257-B's above 85% this condenser will prevent peak distortion due to a phase difference between the audio voltage applied to the plates and screens. The correct value of C_9 will depend upon the values of C_8 and C_{10}, the three condensers forming a capacitance-voltage divider network. In this amplifier, C_9 is a 0.1

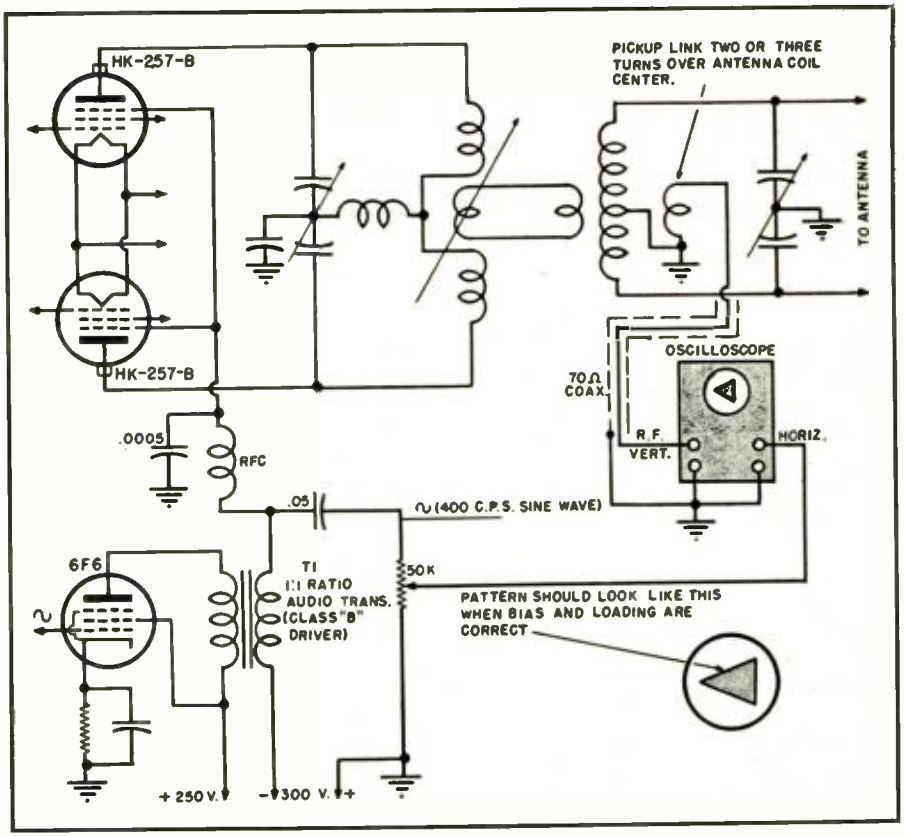


Fig. 6. Setup for adjusting the HK-257-B amplifier for suppressor modulation.

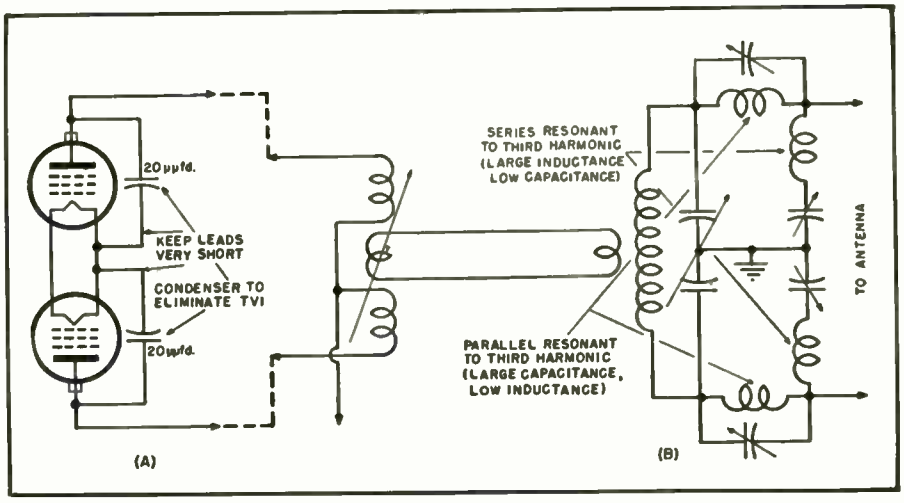
μfd., 2500 volt, oil-filled condenser. The voltage dropping resistor is a 75,000 ohm, 75 watt, wirewound adjustable type. It should be adjusted so that the screen voltage is 400 when the amplifier is loaded to 250 milliamperes with 1800 volts on the plates. A modulator unit capable of supplying 175 to 225 watts of audio frequency power will be required for 100% modulation of the HK-257-B plates and screens. A pair of TZ-40's in push-pull, Class B operation with 1250 volts on the plates will be suitable. The modulation transformer should be rated at 225 watts and preferably should be of the adjustable impedance-matching type. The r.f. amplifier should be tuned up and thoroughly checked for stability before applying any type of modulation.

A speech amplifier suitable for suppressor modulation of the HK-257-B's is shown in Fig. 5. The modulation transformer, T_1, is an ordinary 1:1 ratio, Class B audio driver type.

The suppressor modulated r.f. amplifier is not difficult to adjust but for best results the use of an oscilloscope is recommended. The suppressors of the HK-257-B's are returned through the modulation transformer secondary to approximately minus 300 volts with respect to the filament center tap, as shown. No r.f. excitation or screen and plate voltage should be applied to the HK-257-B's at this point. The

(*Continued on page* 134)

Fig. 7. Two circuits for eliminating interference. (A) A harmonic bypass circuit, and (B) a trap for eliminating the third harmonic signal which causes interference.



RCA's New Direct-view Tri-color Kinescopes

H. B. Law, E. W. Herold, and R. Law, RCA engineers, discuss the tri-color TV tube.

Color television problems simplified by introduction of single- and three-gun tubes.

RCA's long-awaited and eagerly-discussed color television tube was recently demonstrated to the public in Washington, D. C., as part of the color video hearings.

The new picture tube was shown in two direct-view types. The color picture is viewed directly on the face of the tube the same as black-and-white pictures are seen on the majority of the television receivers now in use. The new tube is all-electronic, high-definition, and completely compatible with existing receiving standards. According to the company, so close is the relationship between the new tube and the present system that both color and monochrome are capable of existing or operating on the same channels, with the same transmitters, and on the same receivers, except that present sets reproduce the color programs in monochrome. To receive the programs in color, the present television receiver in the home can be adapted to use the new color tube, or a new receiver designed to operate with the color tube can be used.

The color receivers used in the demonstration were similar in size and outward appearance to the standard *RCA* table model television receivers. The face of the tube appears to the observer exactly the same as in a black-and-white receiver except that the picture is in natural color.

During the demonstration, receivers employing both types of the new color tubes were used. In one set the tube with three electron guns was incorporated while in another receiver the tube with a single electron gun was demonstrated.

In the first type the electron beams which pass through the same tube neck and the same deflection yoke strike the color screen. In the single electron gun type the single deflection yoke is also employed. Both of the assemblies are housed in 16 inch metal cones and produce pictures approximately 9 by 12 inches.

The direct-view color screen is composed of an orderly array of small, closely-spaced, aluminized phosphor dots arranged in triangular groups, each group comprising a green-emitting dot, a red-emitting dot, and a blue-emitting dot. The laboratory sample tubes used in the demonstrations had 351,000 such dots, 117,000 of each color.

Three-gun Kinescope

The manner in which the color screen produces a color picture may be best understood by first considering the operation of the three-gun tri-color kinescope. An apertured mask is interposed between the three guns and the dot-phosphor screen in such a manner that the electrons from any one gun can only strike a single color phosphor no matter which part of the raster is being scanned. The mask is comprised of a sheet of metal spaced from the phosphor screen and containing 117,000 holes, or one hole for each of the tri-color-dot groups. This hole is so registered with its associated dot group that the difference in the angle of approach of the three oncoming beams determines the color. Thus, three color signals applied to the three guns produce independent pictures in the three primary colors, the pictures appearing to the eye to be superimposed because of the close spacing of the very small phosphor dots.

Insofar as the color aspects are concerned, this three-gun tri-color kinescope may be utilized in a receiver in much the same manner as three single-color kinescopes, except, of course, that no optical superimposing or registration means need be provided and deflection power is necessary for only one deflection yoke.

One of the research-type receivers demonstrated employed the three-gun tri-color kinescope and high-level sampling. This single-kinescope receiver utilized 46 tubes and consisted essentially of a 27 tube black-and-white television receiver to which had been added 19 tubes for color synchronization, sampling, additional power supplies, etc.

Single-Gun Kinescope

The operation of the single-gun tri-color kinescope is analogous to the operation of the three-gun tri-color kinescope in that the beam from the single gun is magnetically rotated so that, in effect, it occupies, in time sequence, the three positions of the three guns in the three-gun kinescope. Thus, when the beam is in a position corresponding to the green gun of the three-gun kinescope it excites only the green phosphor dots and is at this particular time modulated only by the green component of the video signal. A short time later the beam has been rotated to a position corresponding to the red gun of the three-gun kinescope and is modulated by the red component of the video signal to excite red phosphor dots. A third position similarly produces the blue picture. Sampling is automatically provided by rotating

the beam synchronously at sampling frequency.

The research-type receiver employing the single-gun tri-color kinescope utilized 37 tubes and consists essentially of a 27 tube black-and-white television receiver to which had been added 10 tubes for color synchronization, beam rotation, additional power supplies, etc.

Three-Gun Tube Sets

A block diagram of the principles of the circuit arrangement employed in the receiver utilizing the three-gun tri-color kinescope is shown in Fig. 1. Video signal from a conventional black-and-white television receiver is applied simultaneously to the three, internally-connected control grids of the three-gun kinescope. Another signal, derived from the video amplifier, is used to actuate an automatic color phasing and sampling synchronization circuit which produces a local 3.58 mc. sampling wave. The latter is applied through an amplifier tube and appropriate delay lines to three gating tubes which supply three sampling pulses, differing in phase by 120 degrees at 3.58 mc., to the three cathodes of the kinescope. Thus, each gun is turned on in time sequence corresponding to the original sampling process at the transmitter and the beam current from each gun excites only one of the three phosphor colors.

The tuning adjustment in the plate circuit of the 3.58 mc. sampling-signal amplifier permits fine adjustment of the over-all color phasing. However, proper color phasing is essentially determined by the permanently installed delay lines which are initially cut to proper length.

The front-panel operating controls are the same for color as for black-and-white operation. Individual service adjustment controls are provided in the cathode circuits of the three guns in order to permit initial equalization of the control characteristics of the three guns.

The deflection circuitry is of the conventional type. Minor changes in deflection-tube types have been made to supply additional deflection power occasioned by the increased kinescope second-anode potential (18 kv.). The deflection yoke is of the anastigmatic type and has an internal diameter of two inches to accommodate the converged beams from the three guns.

The registration in this three-gun tube is built in by the proper registration of the masking apertures with their corresponding groups of phosphor dots. Means are also provided to converge the three beams to the same point on the phosphor screen during scanning. This is done for the undeflected beams by a convergence electrode, operated at 9000 volts, and, when necessary, by small correcting magnets set up initially as a permanent service adjustment when the tube is installed. Because of the essentially flat face of the phosphor screen, simple geometrical considerations show

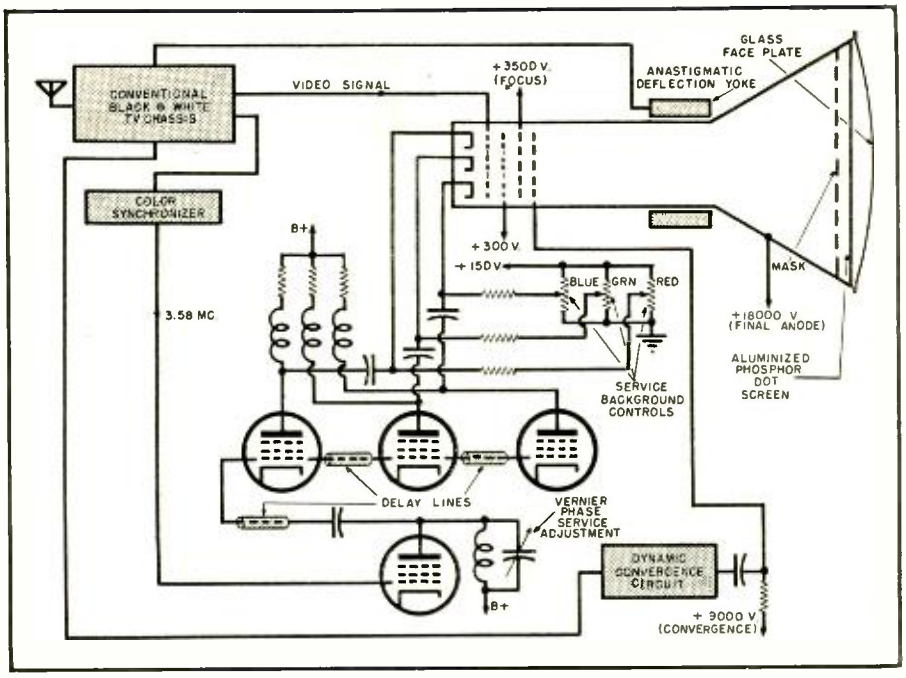


Fig. 1. Block diagram of receiver circuit principles for three-gun, tri-color kinescope.

that slightly less convergence is desirable as the beam is deflected from center. This dynamic convergence is accomplished by deriving a voltage from vertical and horizontal deflection circuits of the receiver and applying it to the convergence electrode through a condenser.

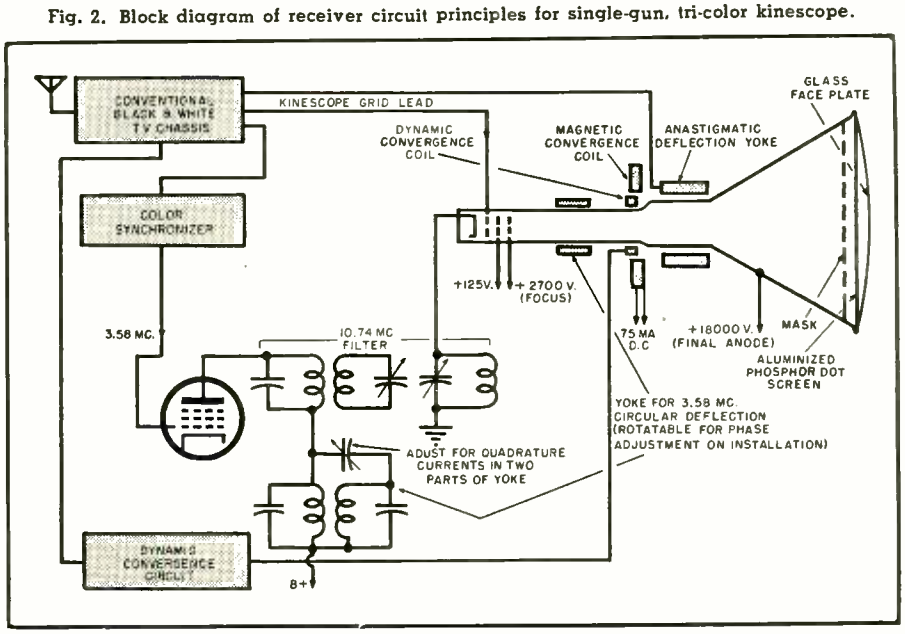
An r.f. anode voltage supply provides a potential of 18 kv. for the kinescope final anode, 9 kv. for the electrostatic converging electrode and approximately 3.5 kv. for the parallel-connected first anodes which produce initial electron-beam focus. A small auxiliary power unit provides heater and "B+" power for the other added circuits.

Single-Gun Tube Set

A block diagram of the principles of the circuit arrangement employed in the receiver utilizing the single-gun tri-color kinescope is shown in Fig. 2. Video signal from the output of the video amplifier of a conventional black-and-white television receiver is applied to the control grid of the single-gun kinescope in the conventional manner. Here again, as in the previous receiver, another signal from the video amplifier actuates an automatic color phasing and sampling synchronization circuit which produces a local 3.58 mc. signal which is locked in step with the transmitter sampler. Circular deflection of the beam, which produces sampling automatically, is provided by a small deflection yoke having two sets of coils which are fed with quadrature currents at sampling frequency to produce a rotating field. Service adjustment of color phasing is provided by

(*Continued on page* 118)

Fig. 2. Block diagram of receiver circuit principles for single-gun, tri-color kinescope.



Mac's RADIO SERVICE SHOP

By JOHN T. FRYE

HASTY CONCLUSIONS

MISS PERKINS, the office force of Mac's Radio Service Shop, was a little surprised to find that Barney, the apprentice radio man, had not arrived yet when she came to work; but she thought to herself that no one could be blamed for staying outside in that glorious sun-drenched June morning as long as possible. Mac, of course, already had a couple of sets blatting away back in the service department.

Scarcely had she seated herself at the desk, though, when the laggard arrived—and how! He burst through the door and went skipping and leaping around her desk with all the awkward gamboling grace of a ham-strung faun. Cradled in his left arm was his disreputable old felt hat, and from this he kept plucking handfuls of rose petals and tossing them wildly into the air as he frolicked about the room. The rapt look on his freckled face, the easily-recognized parody of ballet dancing, the half-graceful half-clumsy movements of his lanky frame—all three combined to render the performance screamingly ludicrous.

"Sit perfectly still, Matilda; don't move," Mac admonished from where he stood grinning broadly in the open door of the service department. "Just as soon as I find my butterfly net I'll get him!"

Amid a final burst of rose petals, Barney plumped himself down on Miss Perkins' desk. "Whew!" he panted; "that's hard work, but I feel better now. We sensitive souls simply must express our feelings when spring really hits us, you know. Where's the broom, Tilly? I'll clean up this mess."

"No you won't," Miss Perkins said as she wiped tears of laughter from beneath her glasses. "If I live to be a hundred, I never expect to see anything funnier than that 'Dance of Spring' of yours. I'll take care of the rose petals."

"Yes, Sensitive Soul, suppose you come on back and brighten the service department with your gleaming presence," Mac invited.

A few minutes later Barney was busily installing a new volume control when Mac stopped him by asking, "Look, Nature Boy, where are you putting that lockwasher?"

"Why, underneath the nut, where I always put them," Barney answered in the patient tone of a parent answering one of those childish Why-is-grass-green? sort of questions.

"In short, you conclude that since lockwashers *usually* go beneath nuts they *always* go there," Mac said. "It is true that lockwashers go beneath volume control nuts when the control has a projecting finger that fits into a hole in the chassis and keeps the control from turning, but in this case there is no such projection or hole. All that keeps the control from turning is the friction between the small mounting surface and the chassis. In such a case, the proper place for the lockwasher is between the control and the chassis. In this position, its sharp edges will bite into both surfaces and keep the control from turning even under extreme twisting pressure applied to the shaft."

"See what you mean! see what you mean!" Barney interrupted as he started to remove the control. "If I hadn't been a dummy, I'd have thought of that myself."

"Don't be too hard on yourself," Mac consoled him. "We all jump to conclusions. Take the case of the little speakers that have no provision for recentering the cones. Some of the fellows jump to the conclusion that since these little jobs do not have moveable spiders and since re-coning them is not considered practical, the only thing to do when one develops a voice-coil-rubbing-on-the-pole-piece condition is to replace the whole speaker."

"What do you do, Professor?"

"Sometimes I replace them, too," Mac admitted, "especially when the cone itself is warped, worn-out, or torn. But we get in many almost-new sets with this complaint. Most of the trouble lies in the fact that there is very little clearance between the coil and the pole piece in these PM jobs. If the voice coil becomes the least bit out of position or alignment, it rubs. In these little sets, the speaker is subjected to a good bit of heat. Unless the voice coil is perfectly centered to begin with, the expansion and contraction of the frame of the speaker will cause trouble either when the set is cold or when it is warmed up.

"To correct this, the first thing to do is find out *where* the voice coil is actually rubbing. You can do this by removing the felt dust cap with acetone and examining the center opening of the cone in a good light and by doing a little delicate probing around the pole piece with the thinnest of speaker shims.

"Sometimes you find that the voice coil is oval rather than circular in shape. Ordinarily you can correct this by simply stretching the coil back into a circle. Work two fairly-thick shims into position at the diametrically opposite points where the coil comes nearest the center pole. The 'pushing-out' of the coil at these points and the accompanying 'pulling-in' along the sides will usually produce the desired circular shape."

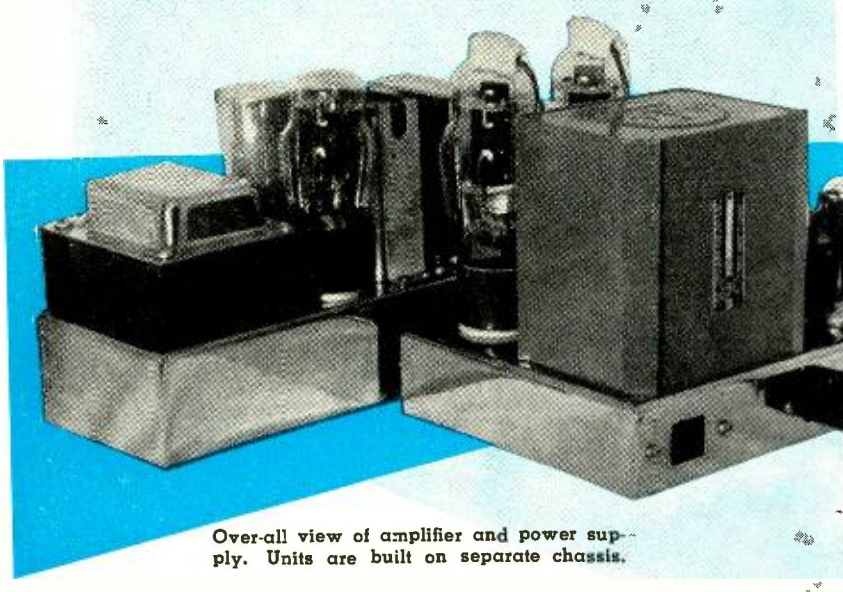
"But how about those cases where the voice coil is round enough but where it has moved over so that one side is touching the pole?"

"The trouble there is that the spider is not holding the coil properly centered. The spider must be softened and allowed to 'set' again while the coil is held in its proper place. First, work a speaker shim in between the coil and the pole piece at the narrowest gap. Then work three other slightly thinner shims into position at points every ninety degrees around the pole. This 'over compensation' for the original incorrect positioning of the coil will allow a bit of spring-back to put it right where it should be after the shims are removed.

"With the shims in place, the next thing to do is to soften the fabric-type spider. This is done by applying acetone *very carefully* to the outside edges of the spider where it is cemented to the speaker frame. It is of the most importance that the acetone be used sparingly and that it be kept entirely away from the voice coil proper. Just the outside rings of the spider should

(*Continued on page* 149)

Cathode Follower DRIVEN AMPLIFIER



Over-all view of amplifier and power supply. Units are built on separate chassis.

By
J. CARLISLE HOADLEY*

At 15 watts output, amplifier's range is 38-20,000 c.p.s. (± 1 db.) with 2 per-cent distortion.

THE proper reproduction of recordings or FM program material demands a carefully integrated high fidelity system. A variable reluctance pickup cartridge, properly equalized, or a live FM broadcast will produce a signal of such excellent quality that much thought and care must be given to the power amplifier in order not to impair the fidelity of the program.

It is not enough that the signal is delivered at the output terminals with good fidelity and adequate power, but this signal must be capable of driving the loudspeaker in a positive manner. The loudspeaker must be a slave to the output stage and not inject its own personality in the form of resonances, harmonic generation, and hangover into the reproduction.

To control unruly speakers, the output stage must deliver its power from such a low impedance as to offer a veritable short circuit to any wayward excursion of the speaker cone.

There are three basic choices for the power amplifier. Pentode output tubes with heavy negative feedback, triode output tubes with or without negative feedback, or cathode follower connected output tubes may be selected. Each has its advantages and drawbacks.

The pentode or beam power tubes have high power sensitivity and will deliver considerable power output with low drive requirements and modest power supply demands. They are, however, inherently a high impedance device and require the application of generous amounts of negative feedback to properly drive a loudspeaker.

The triode tubes are harder to drive and are relatively inefficient, but by virtue of their low output impedance are eminently suited for driving a loudspeaker.

The cathode follower requires a very large driving voltage and is extremely inefficient without special driver design and high voltage power and bias supplies. It does have a very low output impedance and constitutes an almost ideal speaker driving circuit.

An excellent compromise would be a combination of the desirable characteristics of each of these output systems. Favorable characteristics would include ease of drive, good efficiency, and low output impedance with adequate power output to provide the desired sound level with negligible distortion. The author set up each type of output stage and made comparative measurements.

Certain limitations were imposed. Among these were the power supply requirements of 350 volts at not over 200 ma., a *UTC* Linear Standard LS-55 output transformer, and a negative bias supply of not over 105 volts if fixed bias were required. It was further decided that the minimum power output was to be 8 watts and preferably 10 watts over a frequency range of 30 to 20,000 cycles per second at very low distortion.

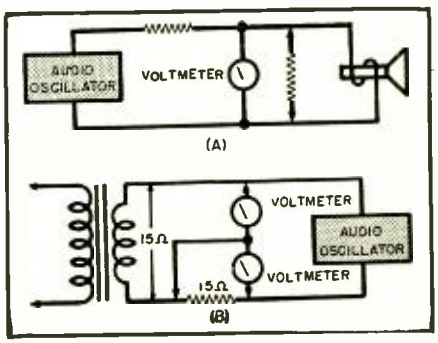
The cathode follower amplifier could not meet the power requirements without using a large number of output tubes in parallel, which would exceed the current rating of the output transformer. Sufficient feedback could not be applied conveniently around the pentodes to give the desired low output impedance and low distortion, so the triode output stage was decided upon.

6B4G tubes were tried and met all the requirements, but it was found to be next to impossible to eliminate the residual hum level in these directly heated tubes when using a sensitive loudspeaker. These tubes require considerable driving voltage and worked best with a driver transformer (*UTC* LS-19), which would have entailed the expenditure of an additional $14.00.

Since *RCA* had recently released triode characteristics on the 807 tube, they were tried. As a triode, the 807 (screen hooked to plate) requires a peak grid-to-grid driving voltage of 90 volts, which is considerably lower than the 124 volts required by the 6B4G's. This driving voltage was low enough to consider driving the output tubes with cathode followers.

A cathode follower as a driver tube has the desirable characteristics of a perfect driver transformer, *i.e.,* low impedance, and no audio frequency dis-

Fig. 1. (A) Setup for determining the effect of damping. (B) Circuit for measuring the effective output impedance of transformer.



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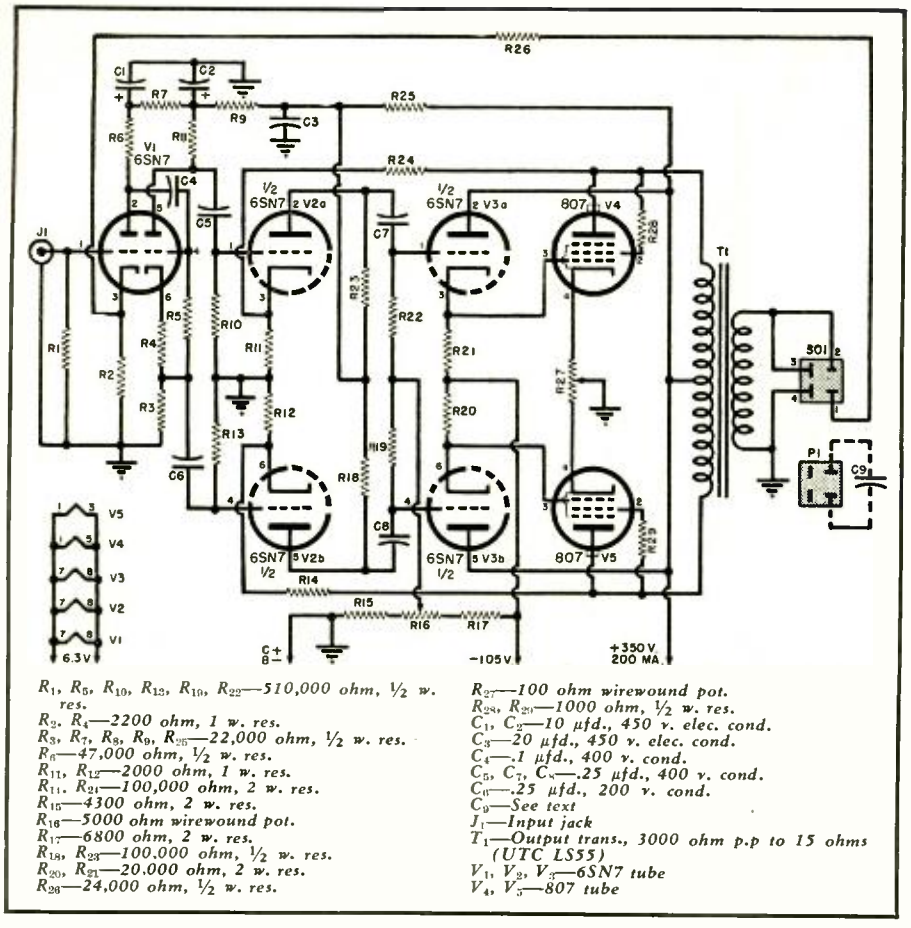


R_1, R_5, R_{10}, R_{12}, R_{19}, R_{22}—*510,000 ohm, ½ w. res.*
R_2, R_4—*2200 ohm, 1 w. res.*
R_3, R_7, R_8, R_9, R_{25}—*22,000 ohm, ½ w. res.*
R_6—*47,000 ohm, ½ w. res.*
R_{11}, R_{12}—*2000 ohm, 1 w. res.*
R_{11}, R_{24}—*100,000 ohm, 2 w. res.*
R_{15}—*4300 ohm, 2 w. res.*
R_{16}—*5000 ohm wirewound pot.*
R_{17}—*6800 ohm, 2 w. res.*
R_{18}, R_{23}—*100,000 ohm, ½ w. res.*
R_{20}, R_{21}—*20,000 ohm, 2 w. res.*
R_{26}—*24,000 ohm, ½ w. res.*
R_{27}—*100 ohm wirewound pot.*
R_{28}, R_{29}—*1000 ohm, ½ w. res.*
C_1, C_2—*10 μfd., 450 v. elec. cond.*
C_3—*20 μfd., 450 v. elec. cond.*
C_4—*.1 μfd., 400 v. cond.*
C_5, C_7, C_8—*.25 μfd., 400 v. cond.*
C_6—*.25 μfd., 200 v. cond.*
C_9—*See text*
J_1—*Input jack*
T_1—*Output trans., 3000 ohm p.p to 15 ohms (UTC LS55)*
V_1, V_2, V_3—*6SN7 tube*
V_4, V_5—*807 tube*

Fig. 2. Schematic diagram of amplifier. The power supply is diagrammed on page 140.

crimination. The cathode follower drivers could supply appreciable power to the output tube grids, if necessary. This would allow the output tubes to be driven into class AB conditions with the low distortion associated with class A operation.

The cathode follower had the further advantage that it could be direct-coupled to the output tube grid, eliminating low frequency losses. It also has the desirable characteristic of having very high input impedance, so that it does not appreciably load the previous stage.

The output circuit was designed with a 6SN7 push-pull cathode follower driving a pair of 807 tubes triode connected with fixed bias. Triode output stages are much improved by the use of fixed bias. The output impedance is lowered by the elimination of the current feedback caused by the conventional self bias resistor. Greater output with less distortion is realized. There is no shift of operating characteristics with increase in signal level with fixed bias when triodes are operated class AB as there is with self bias. Heavy bypassing of the self bias resistor will not completely correct this bias shift condition, and will cause other troubles.

Fixed bias was obtained from a 105 volt negative supply. The 807 grid voltage is dropped to the proper value by adjusting the negative voltage on the grids of the cathode followers. This changed the cathode followers' plate current which causes the drop across the cathode resistors to change. The circuit was designed so that the proper voltage would appear at the 807 grids without exceeding the dissipation of the 6SN7 (2.5 watts).

The cathode follower operates differently from a conventional amplifier stage. When the grid is driven positive, the cathode follows it in a positive direction. The cathode swing in the plus direction is limited by the plate supply voltage and the maximum current the tube will stand.

When the grid swings negative, the cathode follows the grid negative. The cathode, however, can swing negative only the number of volts that it takes to cut the tube off.

The application of negative voltage to the bottom of the cathode resistor has the effect of increasing the plate voltage by that much. In this case, the total plate voltage amounted to 455 volts, yet none of the power supply electrolytic condensers are required to withstand over 350 volts, a factor which contributes greatly to their life.

With this high plate voltage, the cathode followers require a greater negative bias to limit the quiescent plate current to a value within the tube's rating. With this higher negative bias, the tube may swing farther in a negative direction.

Because these cathode followers are operated in push-pull driving output tubes in push-pull, the clipping which occurs from driving the cathode followers so far negative as to cut them off does not show up at the output of the output stage. The cathode followers are operating almost class B but, because of their good inherent regulation and the push-pull connection of the output tubes, the output wave is not distorted.

This phenomenon was observed on an oscilloscope. The cathode followers were driven to the region beyond cut-off with an audio oscillator. The negative peaks were heavily clipped, yet the output waveform was an excellent sine wave with low measured distortion. Although the driver tubes started clipping at a power output of 11 watts, the output tubes could be driven to 15 watts with less than two per-cent harmonic distortion! Intermodulation distortion was negligible below a power output level of 10 watts.

The tube manufacturers always recommend the use of low resistances in the grid circuits of power triodes when they are operated with fixed bias. This is because even when operating in pure class A, the grids draw a small current which increases with an increase in signal level.

This current causes a voltage drop across the grid resistor which is of such polarity as to subtract from the fixed bias voltage. So, under large signal conditions where the full bias is essential, it is inadequate, causing serious distortion and limited power output.

The cathode followers' cathode load resistors form the grid resistors of the output stage. They are far lower in value than could be used with a conventional *RC* coupled driver stage. Even fair low frequency response at 30 cycles per second would require the use of 3 μfd. coupling condensers with 20,000 ohm grid resistors.

The cathode followers were preceded by a push-pull 6SN7 voltage amplifier stage. Negative feedback was introduced from the cathodes of these voltage amplifier tubes to the plates of the 807's. No reactances were included in this feedback loop, so that equal feedback would be applied at all frequencies. This feedback loop reduced the already low output impedance of the triode-connected 807 tubes to a value more nearly that of cathode followers.

The output transformer, looking back into the 807's, sees a nearly ideal low impedance generator, which is particularly desirable at low frequencies where the transformer impedance is low. These three stages, together, then have approximately the same gain as beam tetrodes (6L6's) but all the desirable features of output triodes plus the noise and hum reduction of negative feedback. The addition of a triode voltage amplifier stage and a split load phase inverter completed the tube lineup.

Several phase inverter circuits were tried but the split load type was found to be superior where its two disadvantages are not objectionable. This inverter cannot be used in low level stages because of the hum which results when operating the cathode so far

above ground. The gain is low, in the order of 1.5 times.

In contrast to these disadvantages, the split load inverter produces output voltages which are exactly 180 degrees out-of-phase, and if the load resistors are low enough the output impedances are similar. Its low gain and excellent stability are the result of the large amount of inherent degeneration caused by the large resistance in the cathode circuit, plus the unbypassed cathode resistor.

Because of the various feedback loops within this amplifier circuit, it was possible to apply an appreciable amount of feedback around the entire five stages from the voice coil winding of the output transformer to the cathode of the input stage, without instability. This outside feedback loop served to improve the output transformer characteristics and provided a greater damping factor.

This damping factor turned out to be seven, at 40 cycles per second. It might be noted here that cathode follower output tubes could provide a higher damping factor, but in trying to provide the increased damping factor, the law of diminishing returns is encountered. The effect of increasing the damping factor beyond a certain value is small.

The effect of this factor was determined experimentally (see Fig. 1A). A 15-ohm loudspeaker with pronounced low frequency peaks was connected to an audio oscillator through a high resistance (500 ohms). A voltmeter was connected across the voice coil of the speaker and was used to read the voltage across the speaker as the frequency was varied. This amounted to operating the speaker from a very high impedance.

The low frequency peaks in the speaker were very pronounced, demonstrating the inadvisability of driving a speaker from a high impedance source. Then the speaker was shunted with successively lower resistors until the value of 2 ohms was tried. The peaks were much smaller and considerably broadened. Lowering the resistance below this value of 2 ohms did not appreciably affect the amplitude of the peaks. We should, therefore, insure that the effective output impedance of our amplifier be 2 ohms or less, at the 15-ohm tap.

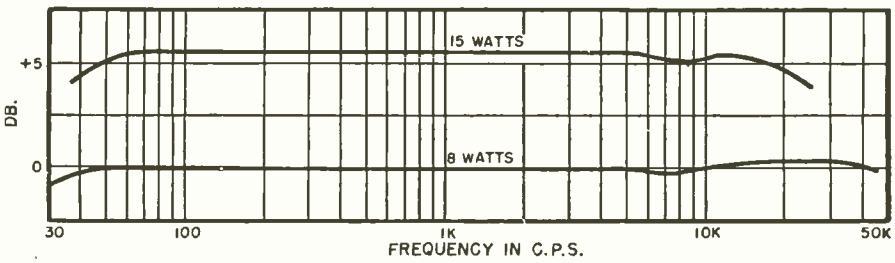


Fig. 3. Frequency vs. output of the 807 amplifier with a 15 ohm resistive load.

The effective output impedance was easily measured. The setup is shown in Fig. 1B. It consists of an audio oscillator connected to the output transformer through a resistance R_1. It was merely necessary to measure the voltage drop across R_1 and compare it with the voltage across the output transformer winding with the amplifier turned on and its input short circuited.

The nominal impedance of the output transformer secondary was 15 ohms. The ratio of the voltage across R_1 (also 15 ohms) to the voltage across the transformer is equal to the damping factor. The nominal output impedance divided by the damping factor gives the effective output impedance, *i.e.*, if the voltage across the transformer secondary were 2 volts and the voltage across the resistor R_1 were 4 volts, then the damping factor would be 4/2 or 2, and the effective output impedance would be 15/2 or 7 ohms. The effective output impedance as measured by the above method was 2 ohms across the 15-ohm tap of the output transformer.

Although a high damping factor is desirable throughout the audible frequency range, the most important point for the amplifier to exhibit a high damping factor is at the resonant frequency of the low frequency loudspeaker. This will reduce the single note bass effect and diminish the generation of higher harmonics which the speaker cone would generate when its amplitude of swing became so great as to be actually outside of the linear portion of its voice coil's magnetic gap.

The amplifier exhibited a frequency characteristic (see Fig. 3) which was flat within plus or minus 0.5 db. from 30 c.p.s. to over 40,000 c.p.s. at an output level of 8 watts. At 8 watts output the total measured harmonic distortion was less than one per-cent. The amplifier was flat plus or minus 1.0 db. from 38 c.p.s. to 20,000 c.p.s. at a power level of 15 watts and a total distortion of two per-cent.

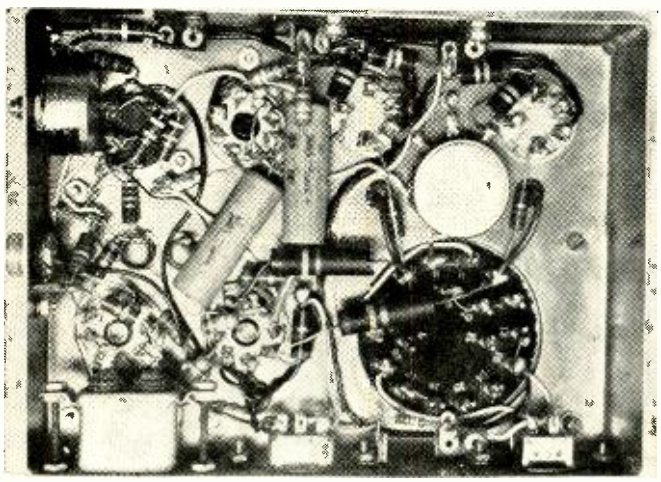
This variation at the two power levels is partly a function of the output transformer frequency vs. power output characteristic. For all practical purposes, the amplifier will deliver 15 watts to a loudspeaker load from any recording or frequency modulation broadcast.

After the development of the amplifier (Fig. 2), a layout was decided upon. The multi-chassis layout is desirable from several standpoints. First and foremost, isolation of the power supply results in lower hum level. Secondly, any one of the units may be changed or replaced without spoiling the others, and the amplifier system may be tucked into odd shaped spaces in a desired cabinet more readily.

The amplifier was built on a 6¼" by 8¼" by 1½" chassis made of 1/16" brass. The layout was chosen to eliminate as much wiring as possible and point-to-point wiring was used. All the grounds were returned to one point located on the multiple section electrolytic condenser, and the input connector was insulated from the chassis. When completed, although the chassis is almost obscured by the various small parts, the wiring is neat and the unit is eas-

(*Continued on page* 139)

Bottom view of amplifier. Chassis is 6¼ x 8¼ x 1½ inch brass.



Top view of amplifier. Power supply is on a separate chassis.

Improving Response of Home-Assembled COAXIAL SPEAKERS

By
NORMAN V. BECKER

Description of a method by which the frequency range of "low-cost" coaxial speaker assemblies can be substantially extended at little expense.

MOST low-budget, serious-minded audio enthusiasts, like myself, are forced to make drastic compromises in the selection of wide range speaker systems. It's fun to look through the elegant slick paper bulletins describing elaborate professional type speakers, but when the chips are down, very few of us can afford to peel off two or three hundred dollars for such a unit.

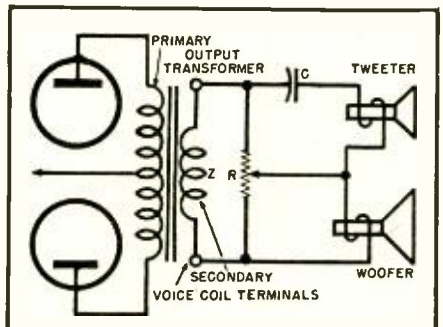
Occasionally, such speakers are overrated, and in actual operating conditions they do not deliver the extraordinary performance their laboratory data implies. Then too, we sometimes overlook the fact that in order for professional speakers to function at their peak they must be used with equally costly auxiliary equipment, and must be fed program material of highest quality, for example, live, well-engineered FM studio productions.

Even though FM is becoming more generally popular and is now available to most communities, its wide range potentialities are seldom realized. Smaller FM stations, particularly, seem to overlook the importance of good audio. I know of one such outfit that maintains the latest, most beautifully designed FM transmission equipment at a distance of ten miles from its AM station. All program material is fed to it over very poor class telephone lines direct from the AM console, and in the process no special attention is given to line equalization. As a result, the same material—broadcast simultaneously over both AM and FM—shows no improvement in being frequency modulated.

So, with the exception of a few *good* FM studio broadcasts, the audio man has no source of really pure sound. (A sine wave generator might be mentioned, but it doesn't make very enjoyable listening!)

In light of this, it behooves us shoestring experimenters to forget about that "dream speaker" and come face to face with practicalities. In the first place, residential radio-phono systems should never be operated at public address sound levels—unless you have tolerant neighbors and a fool-proof lease. There is no need to invest in a speaker that can, for example, take a continuous input of 40 watts. Low bass notes and transients can be handled beautifully by speakers of half this rating at moderate listening levels. Further, there is no practical need for a speaker that can respond in the supersonic region, because of the aforementioned limitations of audio sources. These very limiting factors, however, reduce the home builder's speaker problems considerably.

Fig. 1. Hookup of coaxial speaker system.



R = Z (voice coil output impedance) 10 w. wirewound var. res.
C = High pass filter (paper or oil-filled cond. of 2 to 6 μfd.)

The speaker system to be described was constructed of "bargain" units and enclosed in a solid, non-resonant cabinet at a total cost of less than $40. Its performance, determined on the basis of comparative listening tests, is equal in many respects to its higher priced counterparts. Its electrical efficiency, however, is much lower and thereby hangs a tale.

It is a known fact that loudspeakers are deplorably low in efficiency, the best of them averaging not more than 30 per-cent. So in order for a speaker to produce a sound of given intensity it must be connected to a power amplifying source capable of putting out far more wattage than can actually be converted into sound energy.

In comparison with the cost of "efficient" speakers, audio power is a cheap commodity. Let's assume we have an amplifier capable of producing 20 watts with negligible distortion. Connected to a speaker of average efficiency and run at full output it would produce a painfully loud sound for mere "listening" purpose. Since my concern is primarily for the best possible *quality* at *moderate* levels, and since I have 20 watts of clean audio available from my amplifier, the circuit to be described was designed to provide this at the expense of reserve audio power *only* and with *no* additional equipment costs.

Referring to Fig. 1, *R* is a variable wirewound 10 watt resistor which equals the voice coil output impedance of the amplifier. The "woofer" is a 15", 20-watt job purchased from a wholesale supply house for $17. The "tweeter" is a common garden variety 5" PM costing $1.50. The high pass filter section *C* consists of two 1 μfd., 400 volt paper condensers connected in parallel. As can be seen from the illustration the "woofer" operates across one portion of *R*, while the "tweeter" operates across the remainder. By moving the contact up and down the resistor element the "woofer" receives more or less of the total output—resulting in an effective volume control of this unit. The "tweeter" is connected in such a manner as to *increase* its volume as the "woofer's" is *decreased*. Therefore, by properly adjusting the contact the *relative* efficiency of the "tweeter" can be made to approximate expensive horn type units which require *LC* networks for their operation.

At first glance this might appear to be a crude method by which to achieve the results desired, but a little analysis reveals two very distinct advantages. First, loading of the output transformer is more resistive than with the speakers connected directly to it. Consequently, there is less inductive reactance reflected to its primary, and the output transformer takes on smoother response charac-

(*Continued on page* 88)

Flying spot CRT 7BP7 generator with transparency in front of tube. Inexpensive mounting is constructed of plywood and twin-lead straps.

Simplified HAM TV STATION

Part 2. Construction details on flying spot scanner, pickup amplifier, and blanking and sound circuits. The receiver and r.f. transmitter will be covered in next month's issue.

Fig. 1. Sweep circuits, high voltage, sync and blanking generators used in lieu of TV set.

By
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THE station units to be described in this, the second, article are those which were shown in the block diagram (Fig. 2) which appeared in the first article of the series (May 1950 issue). These particular units are shown in the block diagram as items 1, 2, 3, 4, 5, 6, and 8.

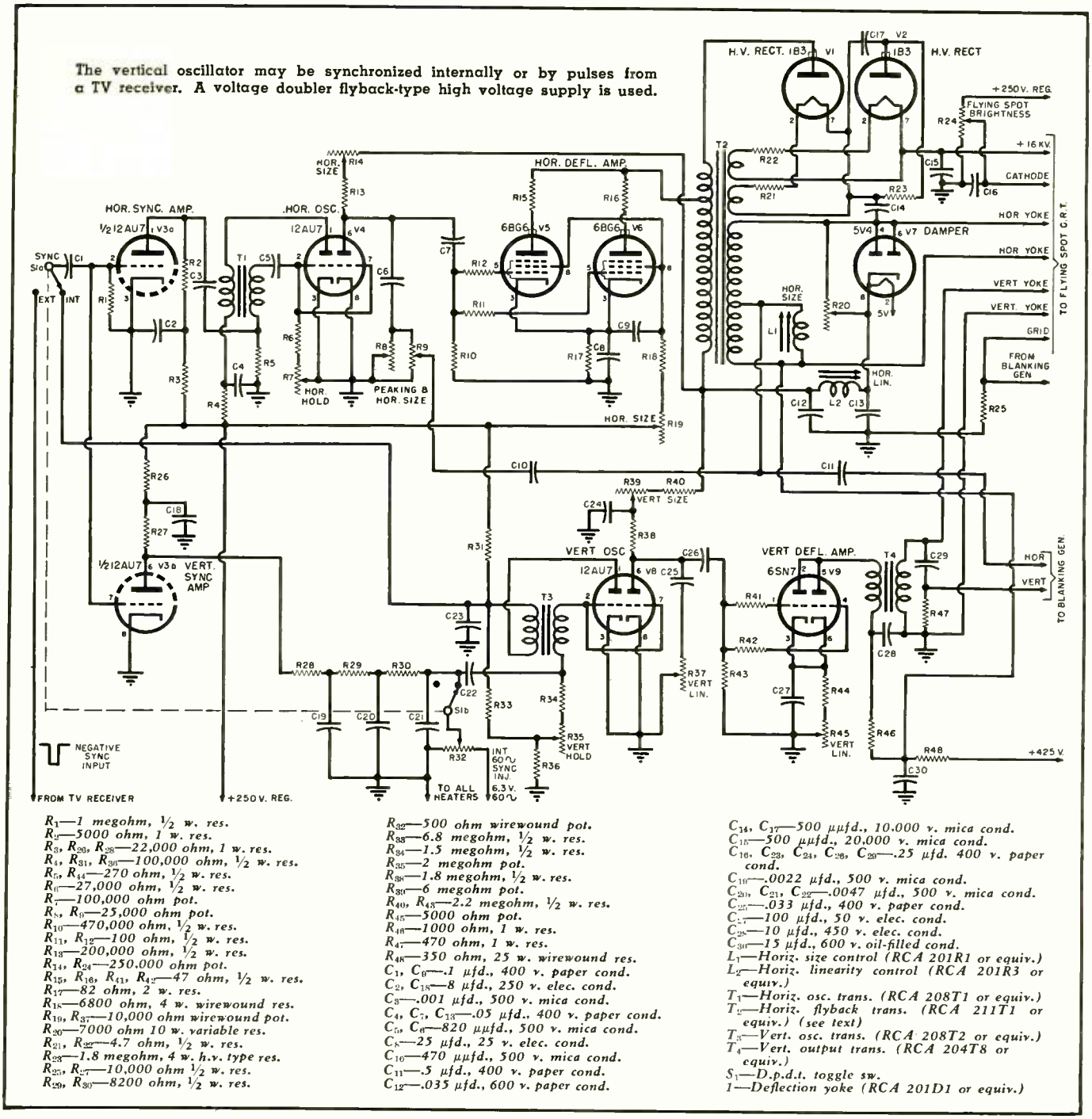
A standard television receiver may be used as a source of standard RMA synchronizing pulses (which are taken from the complete received picture signal) and may also be used for obtaining the necessary high voltages, sweeps, focusing, and accelerating voltages for the picture tube which is to be used as the flying spot scanner.

Even a television receiver is not necessary, as a small separate receiver can be used for the sole purpose of obtaining the sync information from the television station. Its bandwidth would have to be no more than 400 to 600 kc., as the synchronizing information can be obtained within this bandwidth. The sync pulses thus derived would not have the same fidelity as those obtained from a standard television receiver but would be adequate for synchronizing purposes. Similarly, a separate chassis which gives the necessary accelerating high voltage, sweeps, blanking source and focusing voltages might be built for the flying spot scanner alone. Because of the large differences in various television receivers and the obvious impossibility of giving definite modification data except in a general manner for all television sets, it was decided to build a separate deflection chassis corresponding in most details to the design found in the back end of magnetic deflection television receivers. This is shown in Figs. 1 and 2.

The usual television set, having a 10-inch tube, rarely has a second anode voltage exceeding 9000 volts. The sharpest and brightest possible raster that can be obtained will be the best for flying spot use, in order to provide a good signal-to-noise ratio in the derived video picture. Such a raster is obtained by higher voltages on the second anode of the cathode-ray tube. It was decided, therefore, to add a voltage doubler to the standard *RCA* type 211T1 transformer, as shown in Fig. 2.

A piece of polyethelene insulated wire, about the same length (approximately two feet) as the present high voltage filament winding and having sufficient insulation to withstand 18,000 volts, is carefully wrapped over the present high voltage filament winding. The inside conductor and insulation from RG/59-U coaxial cable is suitable. The winding gives the heater power for the second 1B3GT voltage doubler. When this high voltage is applied to the CRT, it will be found that the raster will be reduced to about two-thirds of its former dimensions. Additional current will now be required through the focus coil to bring the raster into focus. The current for the focusing coil may be taken from the power supply described last month or one of the new permanent magnet type focus coils may be used. The raster will be considerably brighter and sharper, and no loss in the resolving ability of the flying spot will occur. The additional high voltage doubler is, of course, not necessary to make pictures, but if the phototube used is not particularly sensitive there may be considerable noise in the picture as the video gain is increased if no added high voltage is used. The more light available, the less noise.

A switch is used for changing over the receiver's kinescope grid circuit from receiver video output to a blanking connection. The switch should be of the low-capacity type, such as a wafer switch, in order not to lose definition due to the high frequencies in the video signal being attenuated by the added shunt capacity of the switch. An internal-external sync switch S_1 should be added if it is desired to run the flying spot scanner without the benefit of the RMA sync transmitted by the station. This switch allows the vertical oscillator to be synced from the 60-cycle line, at the same time allowing the horizontal oscillator to run



R_1—1 megohm, ½ w. res.
R_2—5000 ohm, 1 w. res.
R_3, R_{26}, R_{28}—22,000 ohm, 1 w. res.
R_4, R_{31}, R_{39}—100,000 ohm, ½ w. res.
R_5, R_{14}—270 ohm, ½ w. res.
R_6—27,000 ohm, ½ w. res.
R_7—100,000 ohm pot.
R_8, R_9—25,000 ohm pot.
R_{10}—470,000 ohm, ½ w. res.
R_{11}, R_{12}—100 ohm, ½ w. res.
R_{13}—200,000 ohm, ½ w. res.
R_{24}—250,000 ohm pot.
R_{15}, R_{16}, R_{41}, R_{42}—47 ohm, ½ w. res.
R_{17}—82 ohm, 2 w. res.
R_{18}—6800 ohm, 4 w. wirewound res.
R_{19}, R_{37}—10,000 ohm wirewound pot.
R_{20}—7000 ohm 10 w. variable res.
R_{21}, R_{22}—4.7 ohm, ½ w. res.
R_{23}—1.8 megohm, 4 w. h.v. type res.
R_{25}, R_{27}—10,000 ohm ½ w. res.
R_{29}, R_{30}—8200 ohm, ½ w. res.
R_{32}—500 ohm wirewound pot.
R_{38}—6.8 megohm, ½ w. res.
R_{34}—1.5 megohm, ½ w. res.
R_{35}—2 megohm pot.
R_{36}—1.8 megohm, ½ w. res.
R_{40}—6 megohm pot.
R_{43}, R_{48}—2.2 megohm, ½ w. res.
R_{45}—5000 ohm pot.
R_{46}—1000 ohm, 1 w. res.
R_{47}—470 ohm, 1 w. res.
R_{48}—350 ohm, 25 w. wirewound res.
C_1, C_6—.1 µfd., 400 v. paper cond.
C_2, C_{18}—8 µfd., 250 v. elec. cond.
C_3—.001 µfd., 500 v. mica cond.
C_4, C_7, C_{13}—.05 µfd., 400 v. paper cond.
C_5, C_8—820 µµfd., 500 v. mica cond.
C_9—25 µfd., 25 v. elec. cond.
C_{10}—470 µµfd., 500 v. mica cond.
C_{11}—.5 µfd., 400 v. paper cond.
C_{12}—.035 µfd., 600 v. paper cond.
C_{14}, C_{17}—500 µµfd., 10,000 v. mica cond.
C_{15}—500 µµfd., 20,000 v. mica cond.
C_{16}, C_{23}, C_{24}, C_{26}, C_{29}—.25 µfd. 400 v. paper cond.
C_{19}—.0022 µfd., 500 v. mica cond.
C_{20}, C_{21}, C_{22}—.0047 µfd., 500 v. mica cond.
C_{25}—.033 µfd., 400 v. paper cond.
C_{27}—100 µfd., 50 v. elec. cond.
C_{28}—10 µfd., 450 v. elec. cond.
C_{30}—15 µfd., 600 v. oil-filled cond.
L_1—Horiz. size control (RCA 201R1 or equiv.)
L_2—Horiz. linearity control (RCA 201R3 or equiv.)
T_1—Horiz. osc. trans. (RCA 208T1 or equiv.)
T_2—Horiz. flyback trans. (RCA 211T1 or equiv.) (see text)
T_3—Vert. osc. trans. (RCA 208T2 or equiv.)
T_4—Vert. output trans. (RCA 204T8 or equiv.)
S_1—D.p.d.t. toggle sw.
1—Deflection yoke (RCA 201D1 or equiv.)

Fig. 2. Schematic diagram of flying spot scanner unit and high voltage supply. Photograph of the unit assembly is shown in Fig. 1.

free at approximately 15,750 cycles per second. A sync output lead for supplying the RMA transmitted sync should be taken off the output of the sync separator in the TV receiver. In the case of the type 630 *RCA* receiver the sync output is taken from the grid of the last sync limiter (following the 6SH7 tube). Should the television station sync source not be used, means will be discussed later for obtaining the sync from blanking pulses which are themselves derived from the return traces of the horizontal and vertical sweeps.

The use of coaxial cables or shielded leads for the blanking and sync outputs is desirable, but not necessary, in order to minimize cross coupling and pick-up on unshielded leads. If the television receiver is used for receiving the amateur television signals then a double-pole, double-throw switch or relay should be arranged to switch the input of the receiver from its television antenna to the output of the 420-megacycle converter.

Adjustments

The adjustments referred to in the following discussion are those pertaining to the sweep chassis which has been built especially for the flying spot scanner source in order to leave the television set unchanged. The adjustments apply equally well to any television receiver which is to be modified as a source for the flying spot scanner.

Standard RMA negative sync from the TV receiver is fed into the external sync connection of the sweep chassis. The blanking input lead to the grid of the flying spot picture tube is disconnected and in its place the video output of a television receiver, tuned to a commercial station, is fed into the CRT grid as in the normal receiver. The horizontal and vertical controls should be adjusted (preferably while looking at a test pattern) to obtain the proper pattern from the television station. With the exception of the hold (or speed) controls, it will be found that each of these controls affects the adjustment of the others. The horizontal size control R_{14} in the plate of the 12AU7 and the screen of

the 6BG6G's affects the right-hand side of the pattern, while the peaking and horizontal size controls R_8, R_9 affect the left side of the pattern. The horizontal-linearity resistor R_{20} across the 5V4G damper tube affects the left side of the pattern as does the horizontal linearity control L_2 in the cathode of the damper tube. The vertical size control R_{30} in the plate of the 12AU7 blocking oscillator affects the bottom portion of the pattern and the vertical linearity control R_{45} in the cathode of the 6SN7 vertical deflection amplifier affects the top of the pattern. The vertical linearity control R_{37}, in series with the .033 μfd. condenser, C_{25}, affects both parts of the vertical pattern. The focus and brightness adjustments for the CRT are the same as for a standard television set.

In general, after all these adjustments are made, a sharper, brighter, and clearer picture should be obtained on the face of the CRT than the one normally present on the screen of a television set. No particular attention need be paid to the contrast range of the picture as the flying spot tube is operated at the brightest light output which will still give a sharp raster.

Raster Linearity

The sync switch S_1 is thrown to internal sync. A 60-cycle sine wave of 6 volts or so is fed into the CRT grid and the vertical hold control R_{35} on the sync is adjusted until one black and one white horizontal bar appear on the CRT screen. This assures that the vertical blocking oscillator is locked to the local 60-cycle line. The size of the raster should be adjusted so that it has the proportions of three units high to four units wide.

The 60-cycle source is then disconnected from the CRT grid and an audio signal between 600 and 900 cycles is fed into the grid of the CRT. A series of horizontal black and white bars will appear on the CRT face and the vertical size and linearity controls should be adjusted until the bars are evenly spaced. Should the bars not stand still, the input signal frequency should be adjusted to give a multiple of 60 cycles.

For adjusting the horizontal linearity the audio tone is disconnected and a radio-frequency signal of 150 kc. or higher is fed into the grid. This time a series of black and white vertical lines will appear and the horizontal linearity and size controls should be adjusted for equal spacing. Should the bars not stand still the radio frequency source should be varied until it is approximately in synchronism as a multiple of the horizontal sweep frequency. It is also possible to feed some of these signals simultaneously into the external sync input to lock the sweep oscillators in step with the signal. In the event that r.f. sources, such as a signal generator, do not have enough output, several stages of video amplification can be used to raise the level sufficiently to modulate the CRT grid.

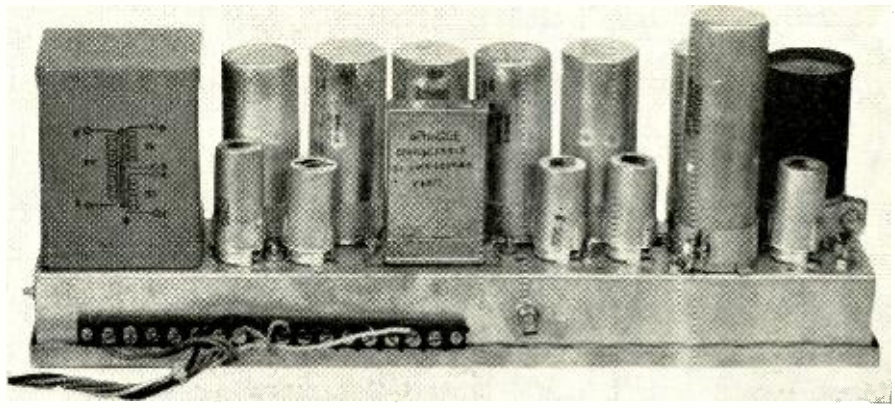


Fig. 3. Top view of pickup strip, video amplifier, and phase splitter unit. The 931A pickup phototube is shown at right of chassis, mounted within the black shielded case.

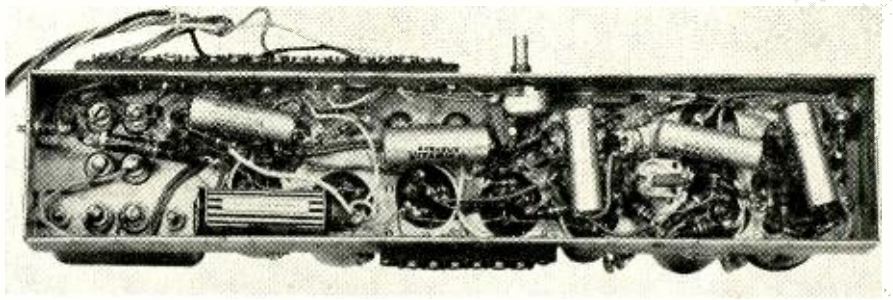
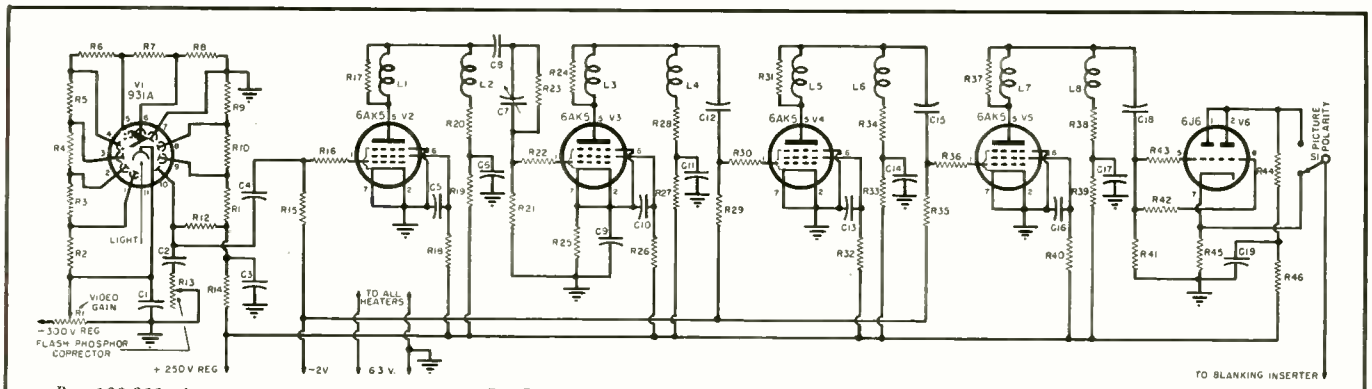


Fig. 4. Bottom view of the pickup strip, video amplifier, and phase splitter assembly.

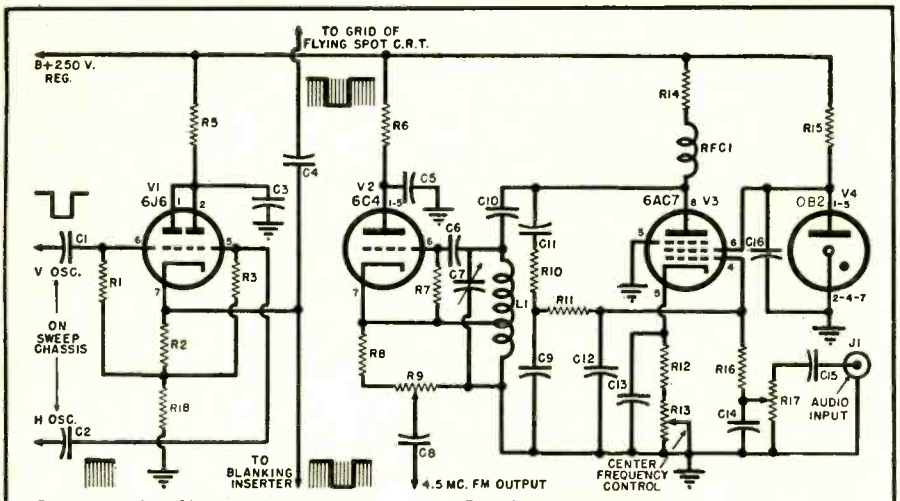
Flying Spot Tubes

It has been found that practically any surplus CRT can be used as the flying spot source with the exception of the P1 tubes which are very hard to compensate for their phosphor decay characteristics.

Fig. 5. Complete schematic diagram of the pickup strip, video amplifier, and phase splitter. Switch (S_1) permits choice of picture polarities.



R_1—100,000 ohm pot.
R_2, R_3, R_4, R_5, R_6, R_7, R_8—22,000 ohm, ½ w. res.
R_9, R_{10}, R_{11}—10,000 ohm, ½ w. res.
R_{12}—3900 ohm, ½ w. res.
R_{13}—5000 ohm pot.
R_{14}—10,000 ohm, 1 w. res.
R_{15}, R_{29}, R_{35}, R_{41}—2.2 megohm, ½ w. res.
R_{19}, R_{22}, R_{30}, R_{36}, R_{42}, R_{43}—33 ohm. ½ w. res.
R_{17}, R_{21}, R_{31}, R_{37}—15,000 ohm. ½ w.res.
R_{18}, R_{26}, R_{32}, R_{40}—82,000 ohm, 1 w. res.
R_{19}, R_{27}, R_{33}, R_{39}—68,000 ohm, 1 w. res.
R_{20}, R_{28}, R_{34}, R_{38}—3300 ohm, ½ w. res.
R_{21}—1000 ohm, ½ w. res.
R_{25}—120,000 ohm, ½ w. res.
R_{26}—180 ohm, ½ w. res.
R_{44}, R_{45}—510 ohm, ½ w. res.
R_{46}—6800 ohm, 4 w. wirewound res.
C_1, C_4, C_6, C_{12}, C_{15}, C_{18}—.5 μfd., 400 v. cond.
C_2—300 μμfd., 500 v. mica cond.
C_3, C_{14}—120 μfd., 250 v. elec. cond.
C_5, C_{10}, C_{13}, C_{16}—10 μfd., 250 v. elec. cond.
C_8, C_{11}, C_{14}, C_{17}—30 μfd., 250 v. elec. cond.
C_7—10-60 μμfd. ceramic trimmer high peaker
C_9—470 μμfd., 500 v. mica cond.
L_1, L_3, L_5, L_7—100 μhy. peaking coil
L_2, L_4, L_6, L_8—85 μhy. peaking coil



R_1—1 megohm, ½ w. res.
R_2—51 ohm, ½ w. res.
R_3—100,000 ohm, ½ w. res.
R_5, R_{14}—3000 ohm, 2 w. res.
R_6—8200 ohm, 1 w. res.
R_7—50,000 ohm, ½ w. res.
R_8—4700 ohm, ½ w. res.
R_9, R_{18}—500 ohm pot.
R_{10}, R_{11}—3000 ohm, ½ w. res.
R_{12}—500 ohm, ½ w. res.
R_{15}—10,000 ohm, 10 w. res.
R_{16}—200,000 ohm, ½ w. res.
R_{17}—500,000 ohm pot.
R_{18}—2000 ohm, 2 w. res.
C_1—.1 μfd., 600 v. paper cond.
C_2—.006 μfd., 500 v. mica cond.
C_3—120 μfd., 250 v. elec. cond.
C_4, C_{13}, C_{15}—.1 μfd. 400 v. paper cond.
C_5, C_8, C_{16}—.01 μfd., 400 v. paper cond.
C_6—50 μμfd., 500 v. mica cond.
C_7—12-125 μμfd. ceramic trimmer
C_9, C_{12}—5 μμfd. ceramic cond.
C_{10}—500 μμfd., 500 v. mica cond.
C_{11}—100 μμfd., 500 v. mica cond.
C_{14}—100 μμfd., 500 v. mica cond.
L_1—40 t. #28 s.s.e. closewound on 7/16" diam. form. Tapped 8½ t. from bottom
RFC_1—2.5 mhy. r.f. choke
J_1—Input jack

Fig. 6. Schematic diagram of blanking generator for negative input pulses and FM sound subcarrier unit. Top and bottom views of the assembly are shown in photographs below.

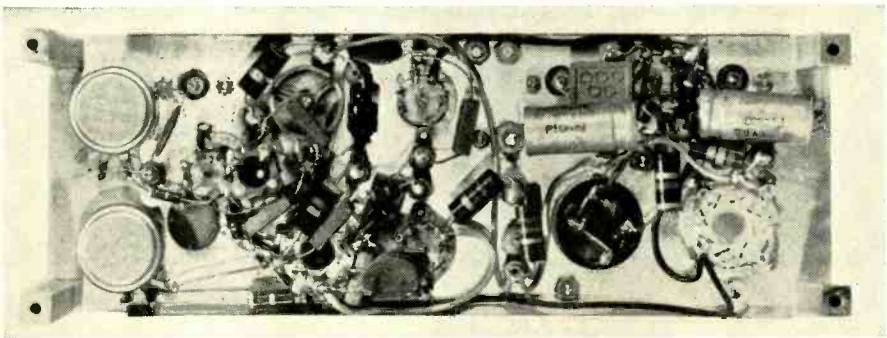
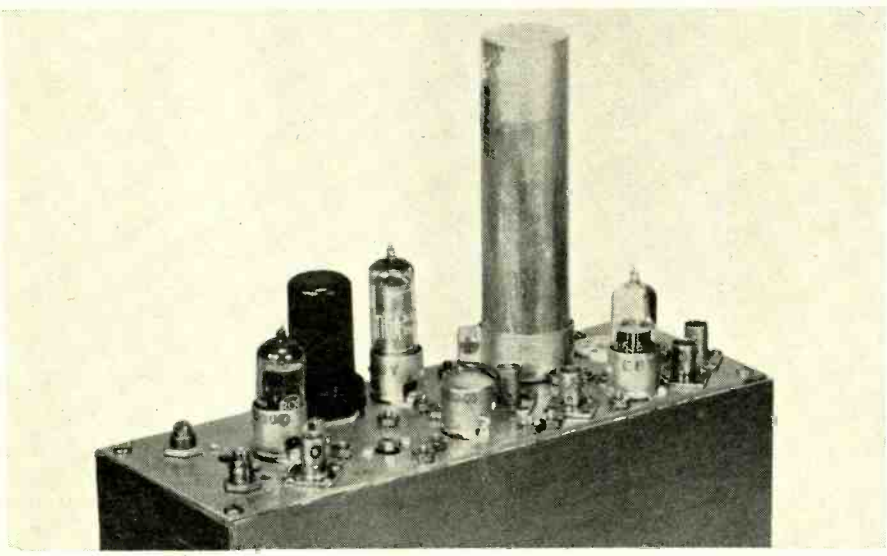


Fig. 7. Bottom view showing details of wiring. The 4.5 mc. FM sound subcarrier generator is shown on the left. The blanking generator may be seen at right of photograph.

Fig. 8. Top view of the 4.5 mc. FM sound subcarrier and blanking generator. Sound output, output level control, and center frequency controls are on the left. Blanking generator inputs and outputs are at right. The empty tube socket (center) can be used as a high gain (6AU6) audio amplifier for feeding a crystal mike into the audio amplifier. The other empty socket (right) is used to connect unit to the power supply.



Surplus radar tubes with P7 phosphors make fine inexpensive flying spot sources. They have the disadvantage, however, that the P7 phosphor has two screens on its face, the blue, or fast, phosphor which is the useful one for our purpose and the yellow, or slow, one. The long-persistence phosphor decays so slowly that it does not interfere with the flying spot pickup, acting only as extraneous light, decreasing the signal-to-noise ratio. The yellow phosphor, being deposited between the useful blue raster and the face of the tube, causes the picture to have a graininess or spottiness which is the result of the crystalline structure of the long-persistence phosphor interfering with the passage of light.

It is recommended that only magnetic-deflection tubes be used for flying spot service, as, in general, the second-anode construction will enable the tube to stand a higher accelerating voltage than the electrostatic types. Any size tube can be used. Preferred types are the 7DP4, 7BP4, 10BP4 or 10FP4. Of course the most satisfactory of all tubes is the P15 series, such as the 10BP15, the 5WP15 and the 4BP15, which are designed expressly for flying spot scanner service. However, these tubes are considerably more expensive than the standard television types or surplus radar tubes.

Phototube and Video Amplifier

The phototube and video amplifier unit is shown in Figs. 3, 4, and 5. The resistor network for the phototube and multiplier is soldered from pin to pin at the socket of the phototube. No special precautions need be taken in the wiring of the section except to see that the pin 10 and 11 connections are well separated because a possible 550 volts appears between these two points. The socket should be well shielded against stray pickup from audio or radio frequencies, as the video signal level at these points is very low. Similarly, the glass envelope of the phototube and multiplier should be shielded from extraneous light, as well as from audio and radio-frequency pickup.

A metal can, of thin metal or foil sheet, is placed around the glass envelope of the phototube and grounded. A window slot is cut in the shield approximately 1½" long and ⅝" wide and so located that the wire saw-tooth mesh inside the tube faces the window.

The socket of the tube is oriented so that the wire mesh and slot opening of the shield face the direction of light pickup.

It will be noticed in the diagram that the power supply to the phototube is −300 volts and +250 volts. This use of both polarities is done to minimize the power supply requirements, although a power supply of 550 volts of one polarity can be used.

The voltage is divided at pin 7 in order to improve the regulation of the supply feed to pins 7, 8, 9 and 10, where the dynode-multiplier currents become relatively high.

A flash phosphor corrector composed

of a 3000 ohm potentiometer R_{13} and a 300 $\mu\mu$fd. condenser C_2 is used to correct the initial fast decay time of the CRT phosphors. This adjustment can be made most easily while looking at a test pattern or picture transparency where it will be seen that a short "ghost" or blur directly follows a black or white line or the edge of a face or object. The proper adjustment of this control will remove the "ghost."

Should the phototube be mounted separately from the video amplifier strip, as in the case of 35 mm. transparencies (see Part 1, published in May issue), then the same shielding precautions are required. The d.c. supply leads to the phototube should also be filtered for r.f. and audio. In addition, a preamplifier and cathode follower are desirable to prevent the loss of high frequencies and picture detail if the phototube is connected by cable to the video amplifier. The video gain control need not be located near the phototube as long as the .5 μfd. bypass condenser C_1 is located near socket pins 1 and 11.

The same precautions that apply to the phototube and multiplier apply equally well to the video amplifier. Failure to shield the bottom wiring of the video amplifier with a cover will probably result in picking up all the local broadcasting stations, completely spoiling the picture.

It should be remembered that the same layout and wiring precautions that would be observed in designing a multi-stage, high-gain 6 mc. r.f. amplifier apply to the video amplifier since it is carrying frequencies in this range.

Peaking coils, load resistors, and coupling condensers for each stage should be separated from the corresponding components in the next stage. In addition, they should be as small sized as possible. For example, the coupling condensers, although large in value, should be of the "Solite" type, manufactured by *Solar,* or the "Vitamin Q" type, manufactured by *Sprague.* The coupling components should be mounted away from the chassis in order to minimize high-frequency losses due to distributed shunt capacitances.

The peaking coils can be the same as those used in ordinary video amplifiers of television sets with some loss in the picture detail, if they are used unmodified. Peaking coils having a tuning slug for varying the available inductance give the best results.

The 2 volt bias supply can be derived from a battery, which will have a very long life, since no current is drawn. This battery can be mounted inside the video amplifier chassis. An alternative bias supply from a higher negative voltage can be obtained by using high-resistance dividers to obtain the proper bias. The electrolytic condensers are mounted as close as possible to the stage that they bypass. The filament transformer, shown in the photographs, does not have to be mounted on the video amplifier, nor is a separate one necessary, but in this case it was found convenient because it was possible to buck out any hum induced in the video amplifier through the heater circuits.

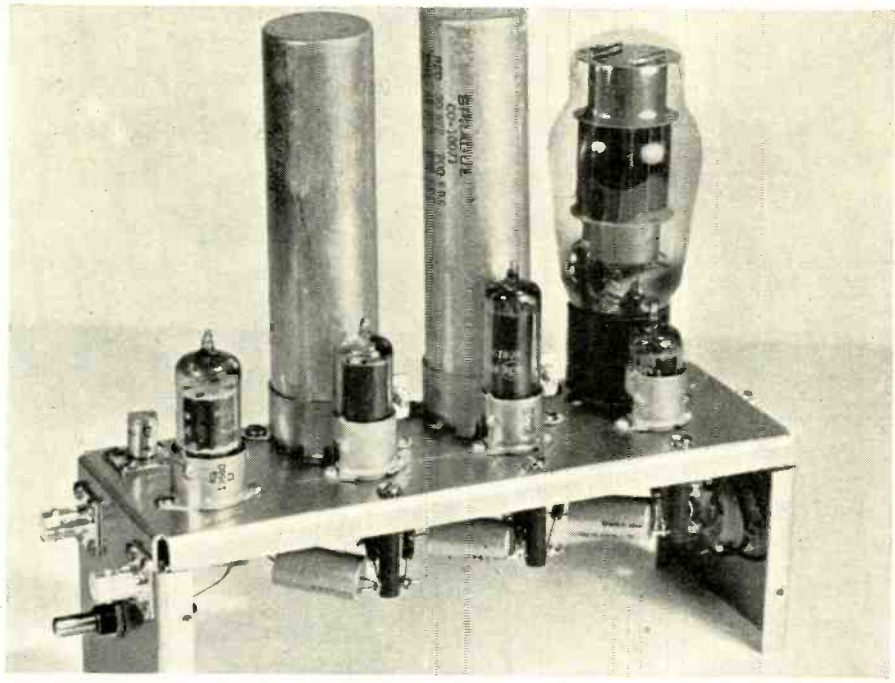


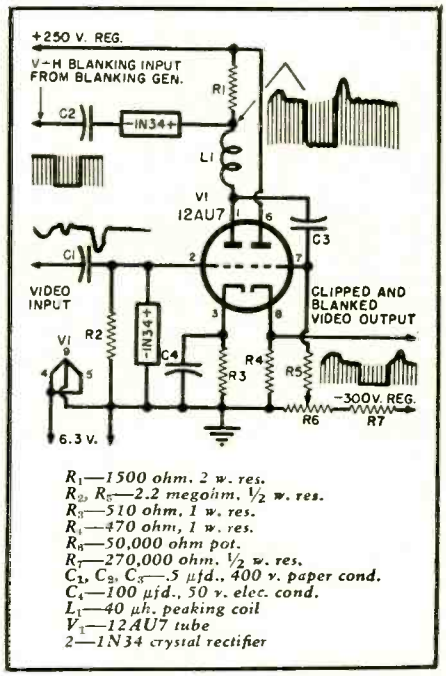
Fig. 9. The top view of the video modulator, the sound mixer, and the sync generator.

The high peaker stage V_3 is essentially the same as an ordinary video amplifier stage with the exception of the capacity coupling and the high-frequency bypass C_9 on the cathode resistor.

The capacity coupling network consists of a resistance divider R_{21}, R_{23} having all frequencies attenuated 120 to 1, with a condenser C_7 emphasizing the higher frequencies. It will be seen that if the 120,000 ohm resistor R_{23} is removed, the same condition holds as for bass suppression in an audio amplifier. The use of a 470 $\mu\mu$fd. condenser C_9 across the cathode resistor is further assurance that the low frequencies will have degenerative feedback, while high frequencies will not. Therefore, this stage will amplify the high frequencies much more than the low frequencies.

It has been found that if the high peaker stage is subjected to mechanical vibration there will be a series of

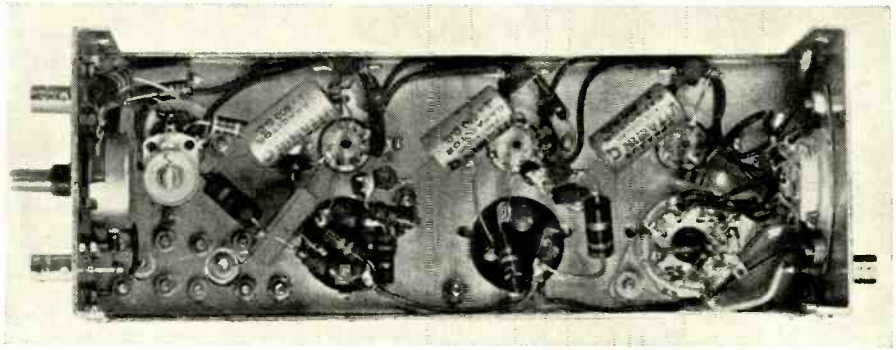
(*Continued on page* 109)



R_1—1500 ohm, 2 w. res.
R_2, R_5—2.2 megohm, ½ w. res.
R_3—510 ohm, 1 w. res.
R_4—470 ohm, 1 w. res.
R_6—50,000 ohm pot.
R_7—270,000 ohm, ½ w. res.
C_1, C_2, C_3—.5 μfd., 400 v. paper cond.
C_4—100 μfd., 50 v. elec. cond.
L_1—40 μh. peaking coil
V_1—12AU7 tube
2—1N34 crystal rectifier

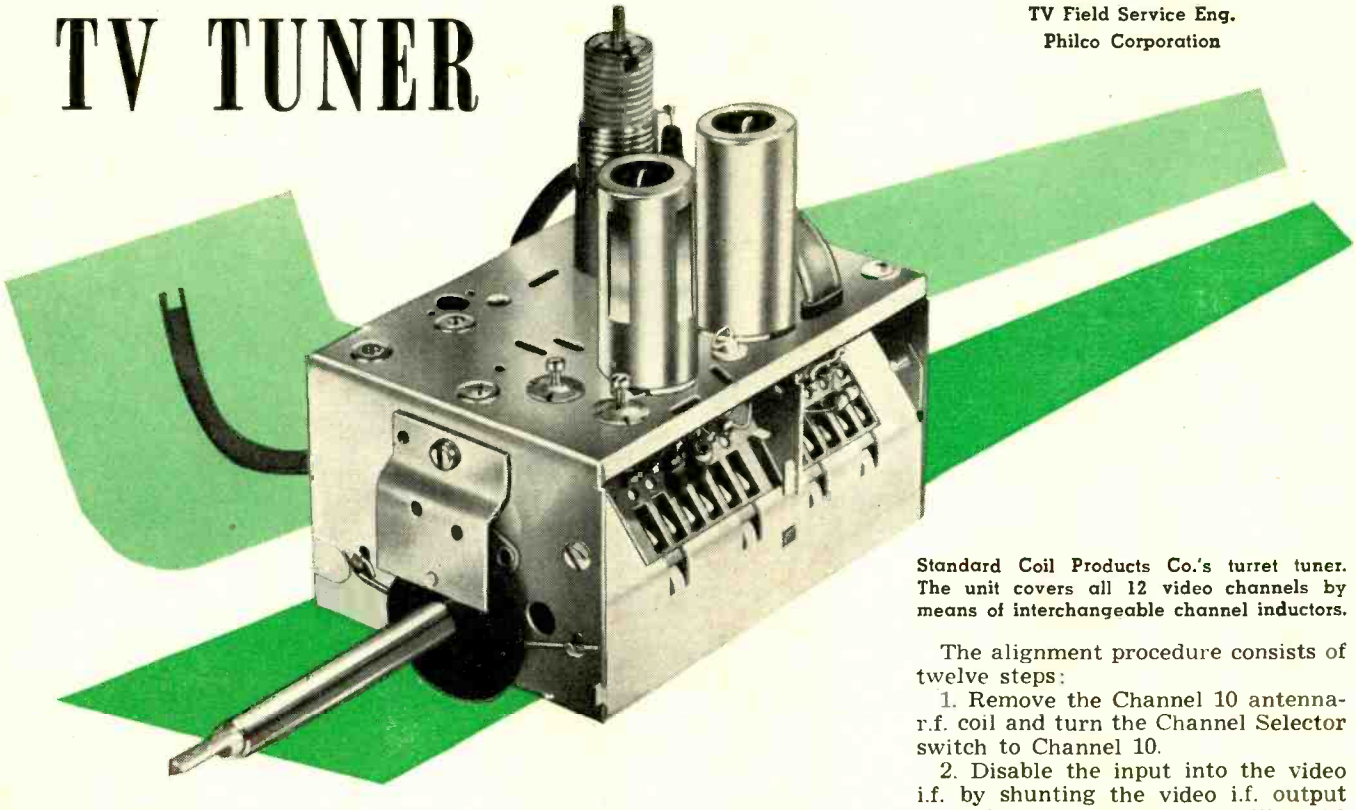
Fig. 10. Blanking inserter and clipper circuits. This is a part of the assembly shown in the photographs of Figs. 9 and 11.

Fig. 11. Bottom view of the video modulator, sound mixer, and sync generator. The sync delay condenser and sync level adjust are shown at left, video output, right.



The TURRET TYPE TV TUNER

By
DANIEL LERNER
TV Field Service Eng.
Philco Corporation



Standard Coil Products Co.'s turret tuner. The unit covers all 12 video channels by means of interchangeable channel inductors.

Alignment data on a popular TV tuner. With minor changes fringe area reception can be improved.

THE *Standard Coil Products Company's* turret type tuner is being used in television sets made by such large television receiver manufacturers as *Philco, Admiral,* and *Emerson.* It has proven to be one of the most versatile and efficient tuners on the market. It is also a unit that can be serviced without using any special or complicated test equipment.

The turret tuner consists of a rotating turret which has twelve antenna-r.f. snap-in coils and twelve mixer-oscillator snap-in coils. As the turret is rotated, the terminals of the appropriate coils are brought into contact with the two contact panels, which provide connections to the antenna, r.f. amplifier, mixer, and oscillator circuits. This type of channel switch insures the low contact resistance and inductance which is so essential to high frequency operation. The antenna input circuit is flexible as it is designed for 300 ohm line, balanced to ground, or unbalanced 72 ohm line.

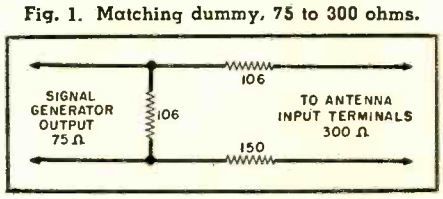
Whenever a parts replacement is made in the tuner, or when the tuner is to be checked for proper response for optimum operating conditions especially in fringe area work, the tuner should be realigned according to the following procedure.

Three pieces of test equipment are required: a sweep generator covering all TV channels, a marker generator covering all of the television channels, and an antenna-matching dummy (see Fig. 1). This matching network is comprised of carbon type resistors and their values should be as near those specified on the diagram as possible.

Television v.h.f. band carrier frequencies.

Channel	Channel Limits (mc.)	Video Carrier Freq. (mc.)	Sound Carrier Freq. (mc.)
2	54-60	55.25	59.75
3	60-66	61.25	65.75
4	66-72	67.25	71.75
5	76-82	77.25	81.75
6	82-88	83.25	87.75
7	174-180	175.25	179.75
8	180-186	181.25	185.75
9	186-192	187.25	191.75
10	192-198	193.25	197.75
11	198-204	199.25	203.75
12	204-210	205.25	209.75
13	210-216	211.25	215.75

Fig. 1. Matching dummy, 75 to 300 ohms.



The alignment procedure consists of twelve steps:

1. Remove the Channel 10 antenna-r.f. coil and turn the Channel Selector switch to Channel 10.
2. Disable the input into the video i.f. by shunting the video i.f. output lead of the tuner to ground with a 470 ohm resistor. This will reduce the *"Q"* of the first i.f. transformer and remove any "notch" which appears in the r.f. response pattern as a result of mixer grid-plate coupling.
3. Connect the vertical input of the oscilloscope to the test tuner jack, J_1, as shown in Fig. 3.
4. Remove the component cover plate and connect the alignment generators to the grid of the r.f. tube, pin 1 (terminal 7 of the contact-panel assembly).
5. Set the sweep generator to the approximate center frequency of Channel 10 (195 mc.) and the sweep width to approximately 12 megacycles.
6. Set the marker generator to 192 mc. and 198 mc., respectively, and observe the marker pips on the response curve.
7. Tune C_8 and C_3 for maximum and symmetrical response as far as the two peaks are concerned.
8. Replace the Channel 10 antenna-r.f. coil and the component cover plate. Disconnect the generators.
9. Connect the generators to the antenna input terminals through the antenna matching dummy.
10. Tune C_2 for maximum and symmetrical response, as shown in Fig. 4.
11. Remove the short from the tuner video i.f. output lead.
12. Remove the input of the oscilloscope from the tuner test jack, J_1, and connect it to the ratio detector or discriminator output. Set the marker generator to 197.75 mc. which is the sound carrier for Channel 10. Now us-

ing low signal generator output and high oscilloscope gain, adjust C_{11} for minimum indication on the oscilloscope. C_{11} is in parallel with the fine tuning control and thus its correct setting assures proper range for fine oscillator tuning.

As shown in Fig. 4 it is apparent that this tuner has a relatively wide bandpass, approximately 11 megacycles. It also should be noted that the sound and picture carrier are placed on the curve so that they never appear less than 70% up on the response. Naturally the 4.5 mc. separation is maintained between the carriers at all times.

In fringe areas where the signal available at the antenna input terminals is in the order of 50 microvolts with the total equivalent noise about 20 microvolts, the front-end performance is of prime importance. A large percentage of the inherent receiver noise occurs in the front-end with most of it in the mixing process.

What can be done to a turret type tuner to increase its signal-to-noise ratio? Primarily this becomes a problem of increasing the front-end sensitivity at the channel frequencies involved.

As was shown in Fig. 4., the normal bandwidth of the tuner, when measured at the 70% point of the response curve, is about 7 megacycles. By changing the coupling of the coils in the r.f. section, the bandwidth of this response can be narrowed and the gain increased so that the selectivity and the sensitivity are increased. In striving to secure the greatest tuner gain, it is important to keep the video carrier at the 100% response level of the curve.

Fig. 2 shows the effects of coupling on the sensitivity and selectivity of transformer system. Notice that overcoupling causes a "saddle" in the response and hence a decrease in selectivity. Also notice that loose coupling causes a high sensitivity and an increase in selectivity.

The procedure for realigning the tuner to improve its performance for fringe areas is as follows:

1. Connect the equipment as outlined in the alignment procedure discussion.

2. Referring to Fig. 5, remove the r.f.-antenna form (Z_1 in Fig. 5).

3. Move the primary of the antenna coil (L_{1a}) away from the secondary (L_{1b}) turn-by-turn. This has to be done experimentally to check whether the sensitivity is increasing without affecting the shape of the response curve.

4. Decrease the coupling of Z_2 by increasing the physical spacing of L_{3a}, and L_{3b}. This will decrease the frequency distance between peaks as mentioned previously. Adjustment of the inductances L_{3a} and L_{3b} by spreading turns may be necessary in order to secure symmetrical response after the windings have been separated.

5. The local oscillator injection, which affects tuner gain directly, can be checked at the tuner test point with a v.t.v.m. If it is low (below 1.5 volts), the 6J6 should be replaced.

6. In some cases an improvement in noise figure, with a consequent decrease in "snow," can be effected by raising the values of the damping resistors, R_1—3900 ohms and R_2—10,000 ohms. Making R_1 larger increases the gain of the antenna transformer, Z_1. However, too great a change in the value of R_1 will also increase the standing wave ratio, which in turn, makes the length of the antenna lead-in critical with respect to phase shift (ghosts, etc.).

7. The 6BC5 tube, which is directly interchangeable with the 6AG5, may be used to advantage since it will provide greater r.f. gain.

8. In extreme fringe areas excellent results can be obtained by removing the a.v.c. bus line (white wire) and grounding it. This retains a.v.c. on the i.f. strip and removes it from the r.f. tube. —30—

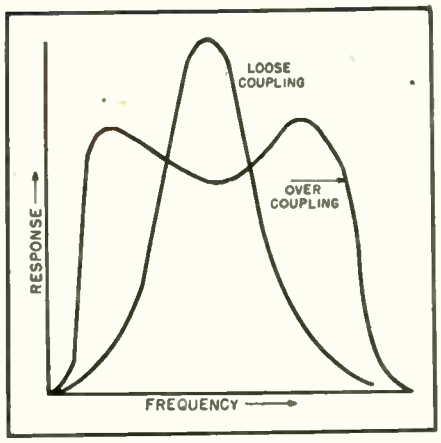


Fig. 2. Effects of coupling on response.

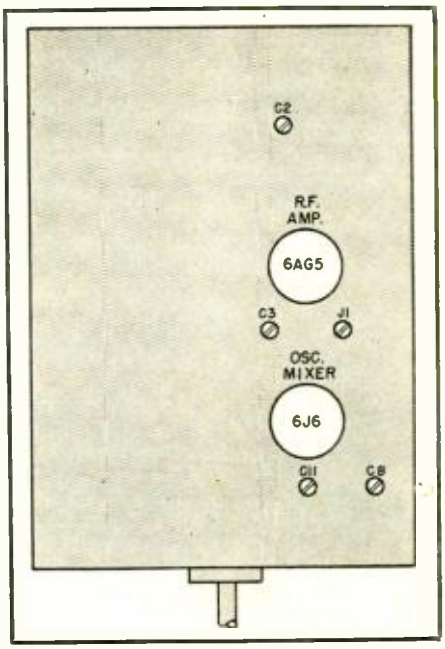


Fig. 3. Location of the various turret tuner trimmers involved in alignment.

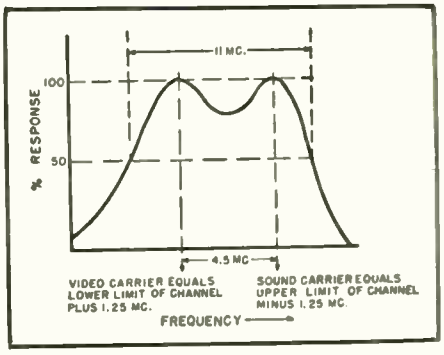
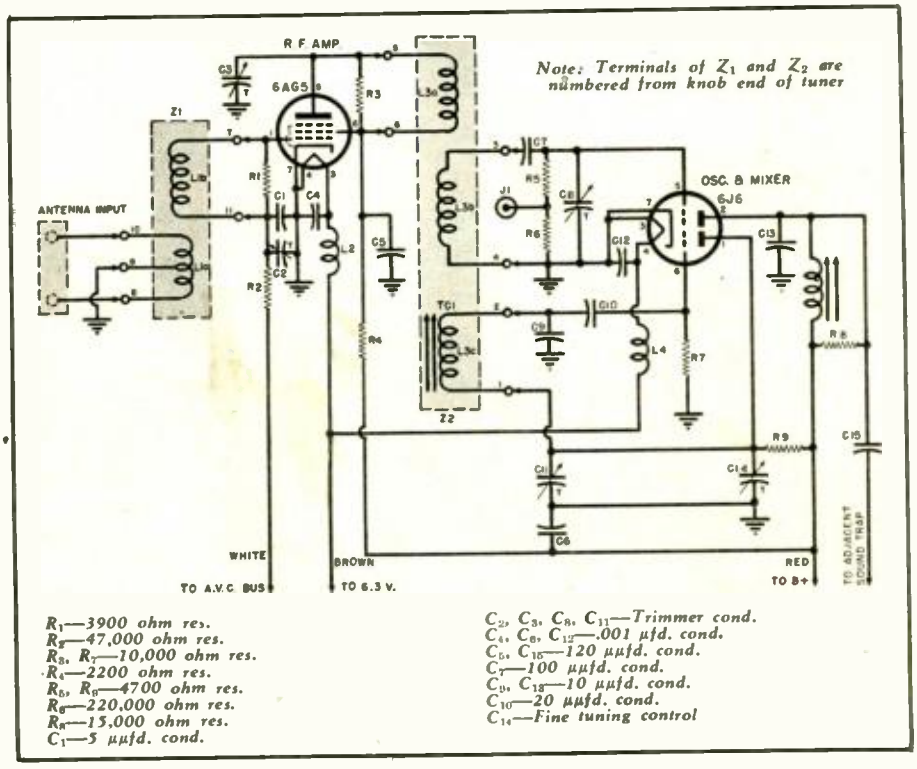


Fig. 4. Response curve of the turret tuner.

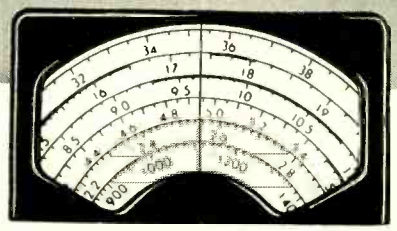
Fig. 5. Schematic diagram of the Standard Coil Products Company's turret type turner.



R_1—3900 ohm res.
R_2—47,000 ohm res.
R_3, R_7—10,000 ohm res.
R_4—2200 ohm res.
R_5, R_6—4700 ohm res.
R_8—220,000 ohm res.
R_9—15,000 ohm res.
C_1—5 μμfd. cond.

C_2, C_3, C_8, C_{11}—Trimmer cond.
C_4, C_6, C_{12}—.001 μfd. cond.
C_5, C_{15}—120 μμfd. cond.
C_7—100 μμfd. cond.
C_9, C_{13}—10 μμfd. cond.
C_{10}—20 μμfd. cond.
C_{14}—Fine tuning control

International SHORT-WAVE



***Compiled by* KENNETH R. BOORD**

HIRAM PERCY MAXIM, famous American inventor, once said: "Amateurs can be found somewhere in the world on some band every minute of the day." Mr. Maxim, the first president of the American Radio Relay League and of the International Amateur Radio Union, was referring to the radio amateurs or "hams"—as they are self-nicknamed.

Radio amateurs, active in almost every country of the world, have won fame as pioneers in the development of short-wave communications. Time and again they have provided invaluable assistance during emergencies. Their national networks and international communications are important foundations of good will and mutual understanding.

Hence, the 15-minute broadcasts of, by, and for the radio amateurs of the world inaugurated in June 1949 by the English Section of the *Voice of America* are of interest to SWL's as well as amateurs.

The programs are prepared in cooperation with the American Radio Relay League, pioneer amateur organization which has an active membership of some 68,000 enthusiasts. George Bailey, president of both the ARRL and the IARU, appeared on the first broadcast.

The *Voice of America's* "ham" show features Bill Leonard, a popular radio personality in the United States, whose medium-wave program, "This is New York," is well-known in the metropolitan area over station WCBS. Mr. Leonard holds amateur station call letters W2SKE. Everyone directly connected with the *Voice of America's* "ham" show is an active licensed radio amateur. Henry T. Miller (W2AIS) provides the script; Larry Weintraub (W2ECL) is the studio engineer, and Gene Kern (W2BAK)—Assistant Chief of the English Section—is in charge of the series.

Each program is composed of news of amateur activities, technical advice, "DX" news, interviews with leading radio amateurs in the United States and abroad, and a regular feature on radio propagation predictions in the amateur bands (these predictions oftimes are also helpful to SWL's).

If you're a member of the amateur radio fraternity, or if you're just interested in "ham" activities, the *Voice of America* and the American Radio Relay League invite you to tune in every Sunday. At the time this was compiled, the Amateur Program was scheduled (originating in New York City) from the West Coast beamed to the Orient over KWID, 9.570, KCBR, 15.130, KNBA, 9.515, KNBI, 9.650, KGEX, 11.730, KNBX, 17.830, with relays from Honolulu over KRHO, 11.79, and from the Philippines over Manila I, 11.89, Manila II, 15.330, and Manila III, 17.780, and beamed to Latin America over WLWR-1, 15.350, and WLWS-1, 17.800; time is 0845-0900 (1345-1400 GMT); with repeat beamed to Central and Southeastern Europe at 1415-1430 (1915-1930 GMT) over WOOW, 21.500, WCBN, 15.270, WNBI, 17.780, and relayed from London over BBC frequencies of 7.200, 15.230, 9.700.

While the *Voice of America* had no definite plans formulated for a DX broadcast for short-wave listeners when this was compiled, the idea was being given consideration by VOA officials.

(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.

Bill Leonard, who holds amateur station call letters W2SKE, conducts the "Radio Amateur Program," broadcast in English every Sunday over the "Voice of America."

* * *

Propagation Notices

WWV, Bureau of Standards, Washington, D. C., USA, notifies listeners of expected interference to radio signals. The letter "U" covers unstable conditions during which many circuits have difficulty in getting messages through natural interference; "W" indicates an ionospheric storm within 12 hours; "N" indicates conditions normal. On all frequencies, this propagation notice is given at 19 and 41 minutes past the hour; the single letter follows the c.w. station call and is given (in c.w.) 6 times; voice announcement of station and time follow. (W1AW via NNRC)

* * *

Short-Wave Census

Arthur E. Bear, London, secretary of the *International Short Wave Club*, informs me that ISWC is conducting a worldwide census of opinion to discover the most popular short-wave broadcasting stations or services. The club asks listeners—whether members of ISWC or not—to send ISWC the names of their five (5) favorite stations in order of popularity. A postcard will do. It is believed that interesting information will be derived and it will be published and communicated to the stations in question. QRA is ISWC, 100, Adams Gardens Estate, London, S.E. 16, England.

* * *

Club Notes

Canada—A newcomer to the radio club ranks is the *Canadian DX Club*

(*Continued on page* 98)

WHEATSTONE BRIDGE APPLICATIONS

By
MICHAEL WOLFE

A compact, a.c. operated Wheatstone bridge used as an electronic lock and if desired, for remote control applications.

Several relay-operated control circuits designed around the well-known Wheatstone bridge principle.

TO MANY readers the Wheatstone bridge will be associated chiefly with precision test equipment and other applications in which the value of an unknown quantity is to be determined. Less well known are the uses to which this versatile circuit may be employed in other fields. One of these is in controlling a number of circuits, remotely located, over a single transmission line. One solution, commonly used, is the triggering of resonant circuits and relay combinations by means of appropriate audio or supersonic frequencies. A simpler method is to adjust the spring tension or series resistance in a number of paralleled d.c. relays in such a manner that the separate relays will close at various values of voltage impressed across them (Fig. 1A). This system has an obvious disadvantage in that all of the remote circuits must be energized in order to operate the last relay of the sequence, although the arrangement may be made somewhat more flexible by impressing both an a.c. and a d.c. component on the control line and using a simple resistance-capacitance network at the receiving end to separate the two components which may then be used to operate two separate relay sequences.

An interesting and flexible arrangement may be set up by using a number of relays in a modified bridge circuit such as shown in Fig. 1B. In this instance, each relay will have current flowing through its coil at all times except when its particular portion of the bridge element is balanced. As a result it is possible to open or close any relay in the series by manipulation of a variable resistance or voltage source at the control point. A system of this nature is analogous to the tuned circuit method in that the total current change available in the bridge system has a counterpart in the total bandwidth or frequency range available in the resonant circuit technique. Similarly, the sensitivity of the relay used is analogous to the "*Q*" of the resonant circuit. This places a limitation on the number of circuits that may be controlled by a given set of conditions. For example, if the relay sensitivity is one milliampere and the maximum permissible current is twenty milliamperes, then the total number of circuits would probably not exceed ten, as each relay would operate over a range of plus or minus one milliampere or a total of two milliamperes.

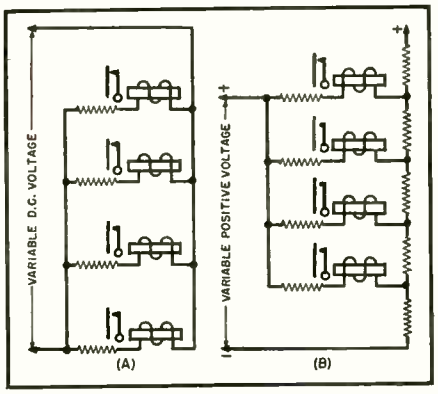
More flexible operation may be secured by using a tube operated relay system. In Fig. 2, the two sections of a 6SN7 dual triode are used as two legs of the bridge circuit. The reference voltage is applied to the grid of one section and the signal voltage to the grid of the other. Advantages are that no energy need be contributed by the signal source and any reasonable amount of time delay may be obtained by inserting the proper resistance-capacitance network in the signal grid circuit. Likewise, the tube tends to perform a current limiting function and isolates the relay so that the other relay circuits are not affected by an accidental relay burnout or short circuit. In addition, extra relay sensitivity may be secured by tube amplification, thus increasing the number of usable circuits.

The particular value of the bridge circuits described is that they will function at one point only. This characteristic may be used in cases where indication or warning of any phenomenon may be converted into a change of voltage or resistance. Many pieces of industrial equipment make use of this fact in indicating variations of temperature, pressure, or other physical changes, and in production line work, similar circuits are used to automatically reject components which exceed the tolerance limits.

Probably the application that will appeal most to the home constructor is the construction of an electronic lock (Fig. 3). Conventional locks suffer from a physical restriction. If a key of reasonable dimensions is to be used, then the elements of the lock must be

(*Continued on page* 102)

Fig. 1. (A) Diagram of simple relay group. Control sequence may be varied by adjusting resistance in series with relay or changing relay spring tension. (B) A modified bridge setup. Any relay in the series may be opened by applying a voltage equal to that developed across relay.



MOBILE ANTENNA FOR 75 METERS

By
R. W. JONES,
W6EDG

Details on a center-loaded whip. A test unit for adjusting it to exact resonance is included.

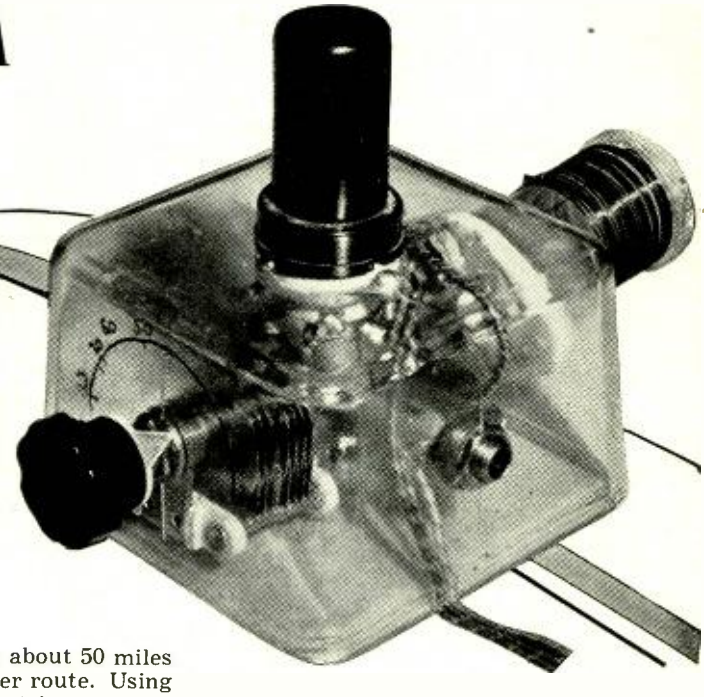


Fig. 1. Close-up view of the test oscillator used to adjust antenna to resonance.

OPERATION of mobile rigs on 75 meters is becoming increasingly popular; it is a lot of fun and opens a new field for ham operation and experimentation. Most mobile operation in the past has been confined to 10 meters and the higher frequency bands. Some good DX records have been made on 10 meters with mobile rigs but these contacts lack the personal touch of the relatively local QSO's on 75 meters. On a recent trip from Sonoma, California to Bremerton, Washington the writer's 75 meter mobile rig was used for contacts with hams along the route and these QSO's were followed up by visits in person. In one case a QSO with W7HHH, Bea and Carl Austin in Bend, Oregon, saved about 50 miles and took us over a better route. Using the 75 meter rig on this trip made the otherwise dull trip one to remember.

Generally the first question asked of a mobile station when he makes a contact is, "What type antenna are you using?" This article will describe an antenna that has worked very well on the mobile installation for W6EDG and will also give some ideas on pruning a mobile antenna to the operating frequency for those that already have mobile antennas in use.

The general practice on mobile rigs is to use an electrical quarter-wave antenna. A normal quarter-wave for 75 meters is about 60 feet long so it is obviously impossible to have that much antenna on the automobile. The next best thing is to have the antenna an electrical quarter-wave by lumping some of the inductance of the antenna in a loading coil.

The portion of any antenna that does the most radiating is that part of the antenna carrying the highest current. The high current section of a quarter-wave antenna is the section near the base or ground end. The best place for the loading inductance would, therefore, be at the top of the antenna. If the loading coil is put at the top of the antenna there must be a top loading capacity of a disc or can. The top loading job would probably be the best system but there are mechanical limitations with the antenna installed on the rear of the car. The antenna to be described in this article is a center-loaded job which gets the high current portion of the antenna out in the open and not in a base-loading inductance. This antenna has the top section adjustable for tuning the antenna to the operating frequency. Another advantage of a center-loaded antenna is that rain and ice will have less detuning effect since the bottom of the antenna is at ground potential. With base-loaded jobs or with transmitters using loading inductances in the output circuits the base of the antenna will have some r.f. potential and be affected by weather changes.

Fig. 2. Detail of form for loading inductance (left), antenna dimensions (right).

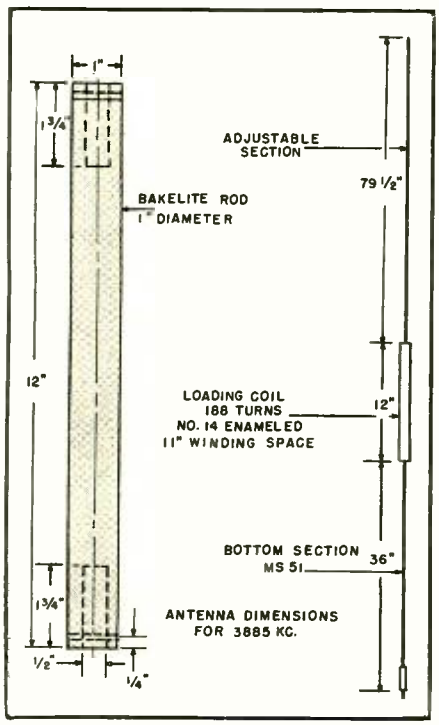
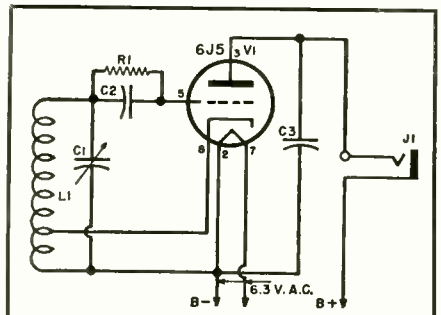


Fig. 3. Wiring diagram of test oscillator.



R_1—1 megohm 1/2 w. res.
C_1—100 μμfd. midget var. cond.
C_2—250 μμfd. mica cond.
C_3—600 μμfd. mica cond.
L_1—27 t. #26 en. tapped 7 t. from gnd. end. 1 1/4" form, 1" winding length
J_1—Phone jack
V_1—6J5 tube

The antenna is made in three sections: bottom section, center loading inductance, and top adjustable section. The bottom section is a mast section from a whip antenna, available as surplus for 50 cents. The bottom section is part of a 5-section whip and is marked part number MS51. The center section, the loading inductance, is made up of a 1" diameter, 12" long bakelite rod with the ends drilled to fit the MS51 mast section and the adjustable top portion of the antenna. The top section of the antenna is an adjustable automobile antenna made for cowl mounting. The extended length of the top section is 96". The top adjustable section is adjusted, as explained later, to tune the antenna to the correct frequency. The

antenna is mounted on the car bumper on a base that was purchased as surplus and strengthened with two braces to hold the extra weight. The two braces are bolted to two pieces of bakelite that are clamped on the top of the base section.

The holes in the ends of the bakelite rod were drilled out on a lathe to make sure they were properly centered. Both holes are ½" diameter and 1¾" deep. The knurled end of the MS51 section is ½" diameter and will be a snug fit into the bottom of the bakelite rod. In the top, a brass collar was fitted into the ½" hole and the top adjustable section fitted into the brass collar. This supplies extra mechanical support. After the MS51 section and the top automobile whip has been fitted into the bakelite rod two small holes are drilled ¼" from either end of the bakelite rod, completely through the bakelite rod and the antenna sections. These holes should be a tight fit for a machine screw that can be screwed through the bakelite rod and antenna sections. These two screws, one at each end of the bakelite rod, serve as connections for the loading inductance winding. The winding is started ½" in from the end of the rod and 188 turns of #14 enameled wire are closewound on the bakelite rod. The ends of the winding are connected to the two machine screws that go through the rod and antenna sections.

In using a mobile antenna with a transmitter of moderate power it is important that the best efficiency be obtained from the antenna and transmitter installation. Experience has shown that the two most important things for good results with a low power mobile transmitter are 100% modulation and a good radiating system. A good radiating system means not only an antenna that is well built but one that is tuned to the operating frequency. An antenna that is self-resonant at the operating frequency will require no loading section in the transmitter or additional inductance at the base of the antenna. The best way to check for the resonant frequency of an antenna is with a grid dip meter. The antenna will act like a tuned circuit, giving a reading on the grid dip indicating device when the grid dip meter is tuned through the resonant frequency of the antenna. To couple the antenna, a two-turn loop is connected from the bottom of the antenna to the car body and the grid dip meter coupled to the two-turn link. Fig. 4 shows a reading being taken with a grid dip meter. If the resonant frequency indication of the antenna is too low the antenna is shortened by adjusting the top section. If the resonant frequency is too high the top adjustable section is made longer. The antenna should be checked and adjusted until it is resonant at the frequency of the transmitter. Fig. 6 shows the relative effect of change of length on resonant frequency. This graph will not be correct for all antenna installations but will give some idea of the amount of adjustment required for a specified frequency shift. It may be necessary to remove or add turns to the loading inductance. After the antenna has been checked at the correct resonant frequency, with the antenna installed on the car at its normal position and the trunk lid closed, it is ready for operation. The antenna should be fed at the base with some type of low impedance line.

I have stressed the importance of checking the resonant frequency of the antenna with a grid dip meter. I realize that many amateurs do not have grid dip meters and therefore a junk box substitute was built up to see if a circuit could be used that would do the same job as a grid dip meter.

Fig. 1 shows a close-up of the "Blooper," as I call it. This little rig

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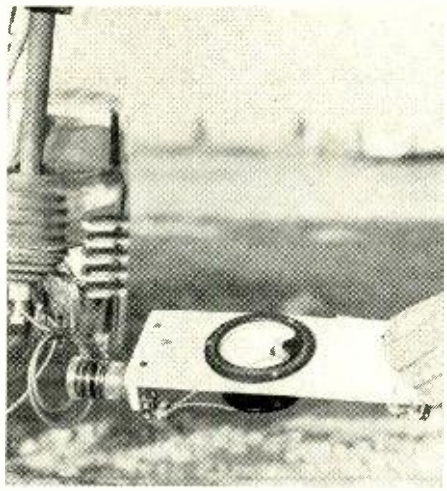


Fig. 4. Checking the resonant frequency of the mobile antenna with a grid dip meter.

Fig. 5. A close-up view of the loading inductance as used in the mobile antenna.

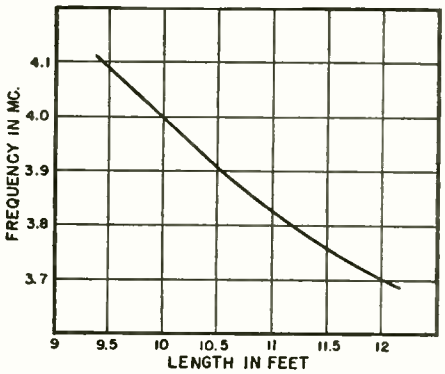


Fig. 6. Effect of length of antenna on resonant frequency. This is an example only and is designed to show the change of resonant frequency with length variations. The actual resonant frequency will vary with different installations due to different capacity effects of car body. Final adjustments should be made only after antenna is in its normal position and trunk is closed.

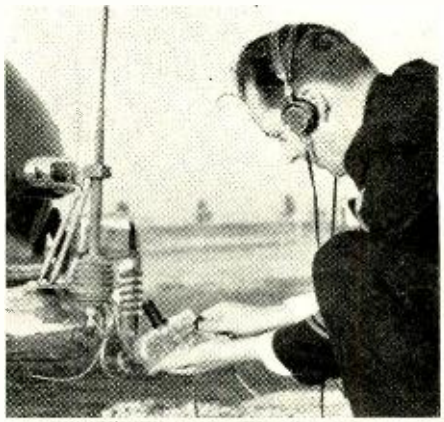


Fig. 7. (Left) Taking a reading of the resonant frequency of the mobile antenna with the "Blooper." When the audio tone stops in the headphones the resonant frequency is indicated on the dial. The rods used to strengthen the base mounting are also visible. (Below) The antenna is attached to the rear bumper of the car and coupled to the transmitter through a low impedance line.

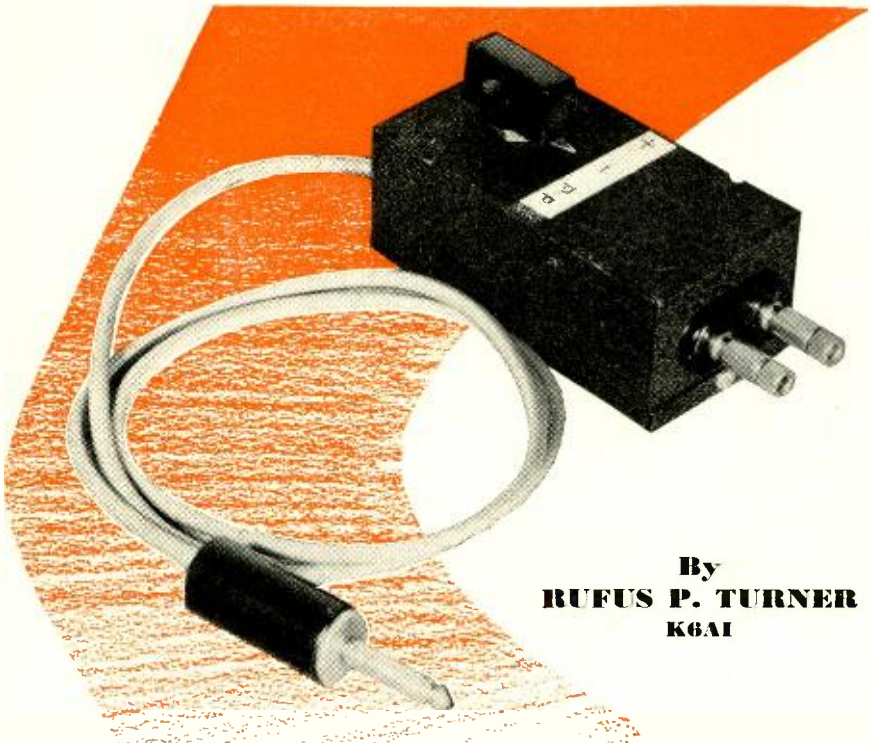


Fig. 1. Combination probe using the circuit shown in Fig. 2. Setting the 3-position switch enables the d.c. vacuum tube voltmeter, to which the probe is attached, to read either negative peaks, positive peaks, or peak-to-peak voltages.

By
RUFUS P. TURNER
K6AI

NEW APPLICATIONS for CRYSTAL DIODES

A description of several interesting and handy gadgets which use the popular germanium diodes.

THE versatility of the germanium crystal diode is unsurpassed by any other simple circuit component. Intended primarily as a signal-powered 2-terminal rectifier, this war-spawned refinement of the ancient crystal detector has been adapted to a variety of interesting and useful devices. Presented herewith are several of the most recent gadgets from the author's workbench. These devices will be of particular interest to experimenters and amateurs.

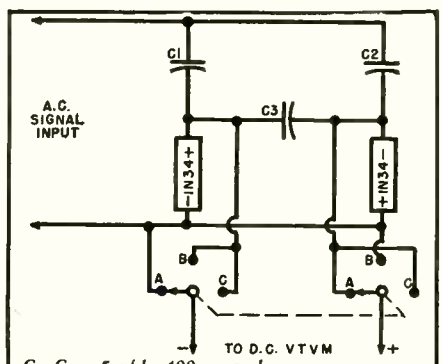
Combination Meter Probe

In audio and r.f. testing, it very often is desirable to know peak-to-peak voltage values. Conventional cable-end probes of both crystal and tube types employed with d.c. vacuum tube voltmeters commonly indicate either positive or negative peaks only, depending upon polarity of the diode.

The probe circuit shown in Fig. 2 permits measurement of peak-to-peak voltages with a d.c. vacuum tube voltmeter. The peak-to-peak voltage is read directly on the scale of the d.c. instrument, except at low voltages (less than 2 volts r.m.s.) in which instance the meter reading deviates slightly from true peak values.

The circuit consists of two shunt-connected diodes in parallel. The left-hand 1N34 is the negative peak rectifier; the right-hand 1N34, the positive peak rectifier. Condensers C_1 and C_2 are charged approximately to peak voltage levels by alternate half-cycles of input voltage, and serve also to isolate the crystal diodes from any damaging d.c. component which may be present in the signal voltage.

Fig. 2. Circuit diagram of the peak-to-peak probe with details of switch wiring for three-way voltage measurements. Position A is for measuring positive peaks, B for negative peaks, C for peak-to-peak.



C_1, C_2—.5 μfd., 400 v. cond.
C_3—.25 μfd., 200 v. cond.
2—1N34 crystal diodes
For radio frequencies up to 10 mc. C_1 and C_2 should be .02 μfd. and C_3 should be .01 μfd.
Above 10 mc. C_1 and C_2 should be .001 μfd. and C_3 should be .002 μfd.

For use throughout the audio-frequency spectrum; condensers C_1 and C_2 each must be 0.5 μfd., and C_3 must be 0.25 μfd. These can be the new miniature metallized units. At radio frequencies, up to 10 megacycles, C_1 and C_2 each must be 0.02 μfd. and can consist each of two 0.01-μfd. mica condensers connected in parallel. C_3 must be 0.01 μfd. Above 10 mc., C_1 and C_2 must be reduced to 0.001 μfd. and C_3 must be 0.002 μfd.

By connecting a small 2-pole, 3-position, single-wafer selector switch in the circuit, as shown in Fig. 2, the probe may be used at will for checking positive peak, negative peak, or peak-to-peak voltages. A completed probe of this latter type is shown in the photograph, Fig. 1.

Use of both probe circuits (Fig. 2) is limited to a.c. input voltages not in excess of 20 volts r.m.s. (56.6 volts peak-to-peak).

Germanium Diode Modulator

The non-linear characteristic of the germanium diode may be used to advantage in obtaining amplitude modulation in a very simple manner. Fig. 3A gives the circuit of a modulator of this type. Ring modulators have been used formerly for comparable modulation, but the ring circuit has two important disadvantages for some applications—it requires four closely-matched crystals and it suppresses the r.f. carrier, delivering upper and lower sideband output. The circuit of Fig. 3A requires only one 1N34, which need not be specially selected, and delivers amplitude-modulated carrier.

An unmodulated (pure c.w.) signal is fed into one pair of input terminals, and a modulating voltage into the other pair of input terminals. The output terminals deliver a modulated r.f. signal at the original carrier frequency. The modulating signal may be a single audio tone of any desired frequency, speech, or r.f., and may be sine-wave or complex-wave. The modulating voltage level may be adjusted (for example, by means of the output control of a modulating audio oscillator) to obtain complete modulation, or any percentage of modulation, with low distortion.

The diode modulator can be used to modulate the c.w. output of a signal generator which has no provision for external modulation. It may be used similarly to modulate the output of a frequency standard. An application which undoubtedly will interest c.w. operators is use of the modulator to tone-modulate incoming straight c.w.

signals. Fig. 3B shows one way of connecting the modulator into a receiver for this purpose. Here the unit is inserted between two successive i.f. amplifier stages or between the last i.f. amplifier and 2nd detector. It can be connected similarly between two tuned r.f. amplifier stages. A simple 1-tube audio oscillator can be employed as the audio signal source.

The circuit of Fig. 3A has the advantage that a common ground is provided between r.f. carrier source, modulating source, and output.

Fig. 6 shows a complete modulator unit mounted on a small phenolic subpanel ready to be wired into a receiver circuit or installed in a metal can.

Harmonic Accentuator

The non-linear characteristic of the germanium diode also may be employed to intensify radio-frequency harmonics in the output of a frequency standard or of a *low-powered* oscillator or buffer in a transmitter. Fig. 4 is the circuit of a tubeless harmonic accentuator built especially for intensification of harmonics from a 100 kc. standard frequency oscillator.

Two Type 1N56 high-conduction diodes are used. These are connected back-to-back so as to operate on each half-cycle of signal voltage. The distortion introduced by these diodes serves to intensify harmonic output.

Tuning condenser C_1 will be 50 or 100 $\mu\mu$fd. maximum for the amateur bands. For general coverage, use a 350- or 365-$\mu\mu$fd. broadcast-type tuning condenser. The coils may be wound according to instructions which may be found in the coil tables in the amateur handbooks.

In order to operate properly, the crystals must have a complete d.c. return path. This generally is provided by the output coupling coil or attenuator in the r.f. signal source. When the latter has condenser output, however, the return path is blocked, and a resistor (R_1) must be connected into the accentuator circuit, as shown by the dotted lines in Fig. 4. The resistance of R_1 is not critical, but it is a good rule to make it equal to the output impedance (in ohms) of the r.f. signal source. If this output impedance is of an undetermined high value, 10,000 ohms will be a good compromise value for R_1.

Condenser C_1 is tuned to resonate coil L_1 at the desired harmonic frequency. Both L_1 and L_2 may be wound on a single 4-prong, plug-in coil form.

The r.f. input voltage must be held to a maximum of 10 volts r.m.s., in order to keep within crystal ratings.

Voltage Regulator

The germanium diode can be used to regulate low d.c. voltages in a fashion somewhat comparable to the use of VR-type gaseous regulator tubes for regulation of higher voltages. Fig. 5 shows the simple circuit of a germanium regulator.

While the crystal does not maintain a *constant* voltage drop across itself as the VR tube does, its change in voltage is small as the output current drain varies over rather wide limits. A regulator of this type was set up to supply 1¼ volts for a particular application. The input voltage was 1½ v. and the current limiting resistor, R, was 10 ohms. The no-load and 1-ma. output voltage was 1¼ v., and the output voltage at 50 ma. drain was 1.10 v. Between 1 ma. and 50 ma. drain, this performance represented a voltage drop of only 12 per-cent for a current increase of 50 times.

The current limiting resistor, R, must be adjusted with each particular d.c. supply voltage to pass maximum rated current through the crystal when the load circuit is disconnected from the output terminals. This maximum current value is 40 milliamperes for the 1N34, 38, 39, 54, 55, and 58 and is 50 ma. for the 1N56. The exact value of resistance required will vary with individual crystals and different supply voltages. It must be determined by experiment.

When R must be reduced in order to obtain more output current, connect two or more crystals, as required, in parallel to handle the increased current. When higher output voltage than about 2 volts d.c. is required, connect several crystals in series, allowing about 2 volts per crystal.

"R" Oscillator

The reverse conduction curve of the germanium diode (when the crystal anode is connected to the *negative* terminal of a d.c. supply) is interesting in that it shows a sharp increased-current slope at a relatively high back voltage. The point at which this rapid increase in reverse current starts is designated as "X" in the curve in Fig. 7. The actual voltage at this point varies with individual crystals, but lies

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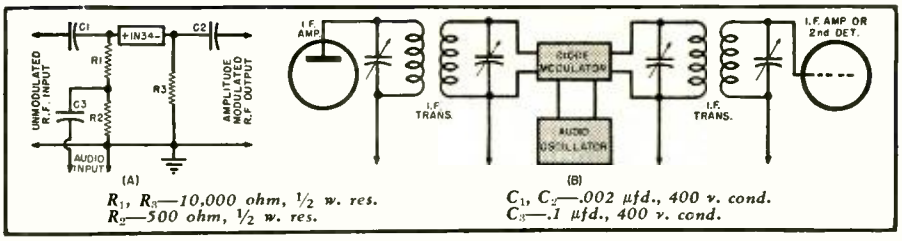
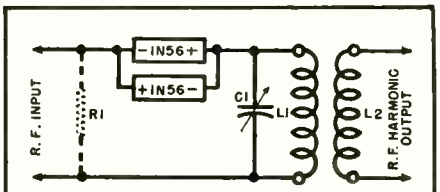


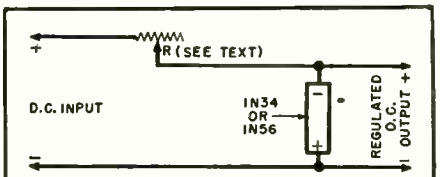
R_1, R_3—10,000 ohm, ½ w. res.
R_2—500 ohm, ½ w. res.
C_1, C_2—.002 µfd., 400 v. cond.
C_3—.1 µfd., 400 v. cond.

Fig. 3. (A) Circuit of diode modulator. (B) Arrangement for tone-modulating receiver signals.



R_1—Required only when r.f. generator has condenser-coupled output. Resistance must equal output impedance of generator.
C_1—See text
L_1—Plug-in coil wound to resonate with C_1 to desired harmonic frequency
L_2—Coil containing same number of turns as L_1 and wound on top of L_1 and insulated from latter

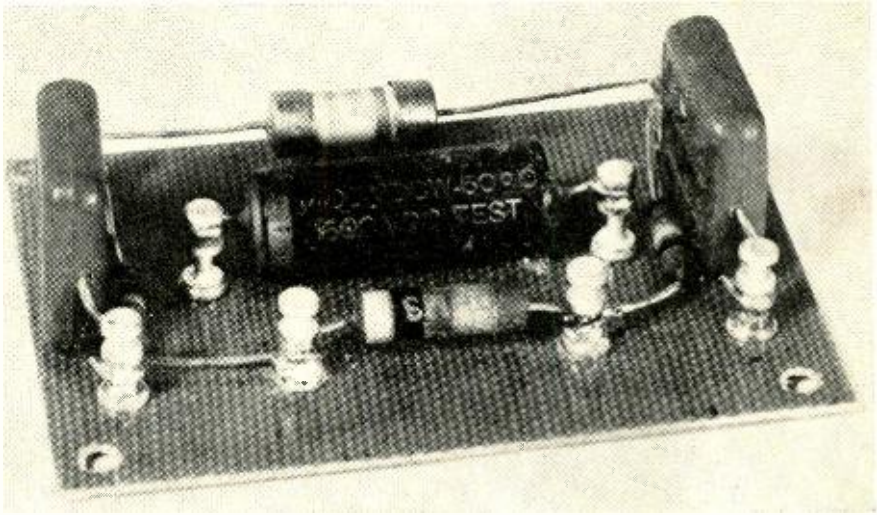
Fig. 4. Diagram of a harmonic accentuator.



Adjust R to pass 40 ma. through 1N34 or 50 ma. through 1N56 when no load is connected to output terminals
Use 1N34 for maximum current of 40 ma.
Use 1N56 for maximum current of 50 ma.

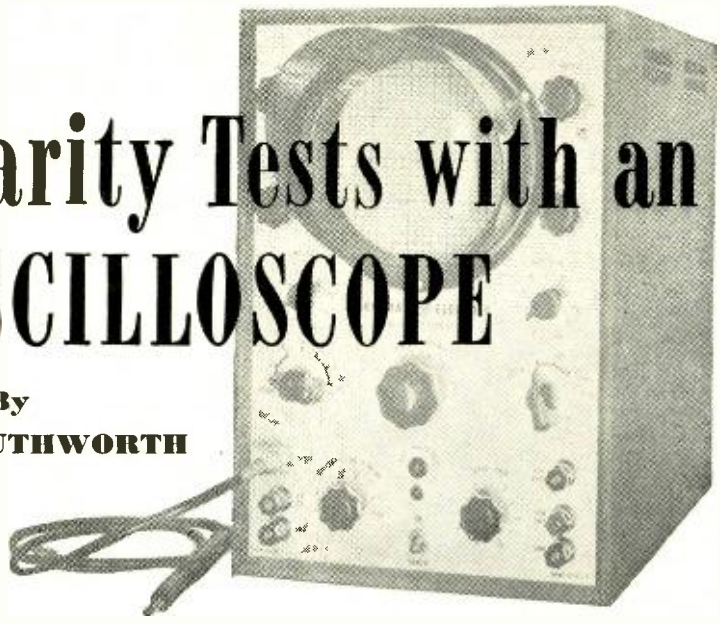
Fig. 5. Circuit for a low-voltage regulator.

Fig. 6. Crystal diode amplitude modulator using the circuit shown in Fig. 3A. This simple device permits modulation of a low-level r.f. signal with either an audio frequency source or speech. It may be used for external modulation of a signal generator and also to tone-modulate received continuous wave signals.



Linearity Tests with an OSCILLOSCOPE

By
GLEN SOUTHWORTH



An easily-assembled amplifier test setup which uses an audio oscillator and an oscilloscope.

AN AUDIO oscillator in conjunction with an oscilloscope makes an excellent and flexible means of providing an almost literal representation of linearity. If the same signal is applied to the horizontal and vertical amplifiers of a scope a diagonal line will result, the direction of which will depend upon the relative magnitudes of the signals applied to the two deflection plates. A system of this nature is very easy to set up and is versatile in that it may be used to quickly identify nonlinearity, harmonic distortion, phase shift, or frequency response variations in an audio system. A block diagram of a test setup that may be used to identify all of these characteristics is shown in Fig. 1. The output of a variable frequency audio oscillator is fed into an attenuator, the output of which feeds both the equipment under test and the horizontal scope amplifier. The output of the equipment under test is connected to the vertical scope amplifier.

Probably the best known test is for phase shift. In this case a straight diagonal line will be formed if the output of the equipment under test has a zero or 180 degree phase relationship with the input. Other phase shifts will produce an oval pattern, while a 90 degree relationship will tend to produce a nearly circular pattern. The phase characteristic is important because in order to achieve maximum accuracy in the other tests, the phase distortion should be as low as possible.

If harmonic distortion is present in a system, the input-output relationships will not be such as to produce a straight diagonal line on the oscilloscope screen, but will result in curvature or a sudden discontinuity. Harmonic percentages as low as approximately three per-cent may be detected in this manner, and due to the fact that no careful tuning or adjustment of controls is necessary, such as in the case of wave analyzers or other types of distortion meters, rapid checks over a wide frequency range may be made.

The oscilloscope patterns shown in Fig. 2 illustrate some of the traces likely to be encountered. *A* is the straight diagonal line resulting from undistorted input-output relationships. *B* is the same case but with less than 180 degree phase shift causing the pattern to assume an oval shape which makes small discontinuities less easy to detect. The third pattern illustrates second harmonic distortion such as is likely to be encountered in single-ended amplifiers. The bend is caused by gradual flattening of the positive peaks, such as shown by the accompanying sine wave pattern. This form of second harmonic distortion appears to be most common and is caused by out-of-phase harmonic components. Less often found is the in-phase form shown in *E* and in which one of the peaks develops an extra projection. This type of distortion may occasionally be observed in push-pull output stages where a split load or "kangaroo" type of phase inverter is used. The cause for this seems to be that if the output tubes are driven hard enough to draw grid current, a partial short circuit of the driver cathode resistor may result due to the change in grid impedance; this, in turn, may cause the gain in the plate circuit of the driver to considerably exceed unity during peaks.

G shows the pattern of out-of-phase third harmonic distortion, often found in push-pull amplifiers. Both positive and negative peaks are suppressed with the result that not only are harmonics produced but high frequency components of a complex wave will tend to be modulated in a negative sense. *I* illustrates in-phase third harmonic distortion characterized by extension of the sine wave peaks. In this instance, positive modulation of the high frequency components of a complex wave will occur due to the relatively greater gain during the peaks of a low frequency cycle.

Although presumably everyone knows what distortion sounds like, an experiment was performed in order to see if there were any readily identifiable characteristics of systems producing almost exclusively third harmonic distortion of considerable amplitude. The comparison between systems generating in-phase and out-of-phase third harmonics were very interesting and it might be noted that simple harmonic distortion is not necessarily of an unpleasing character although it may produce wide variations in apparent dynamics and tone color.

In the first experiments in-phase third harmonics were obtained by means of a circuit similar to a modified class B amplifier. The resultant reproduction tended to resemble that which might be produced by an inertialess volume expander in that high intensity sounds received added emphasis. This, in turn, gave rise to an effect of an apparent change in acoustics due to the rapid decay of damped wave trains following high level transients. The resulting reproduction had a somewhat hard, mechanical effect with apparent added emphasis to the mid-frequencies producing a somewhat monotone effect, much of which was assumed to result from the greater stimulation of speaker, cabinet, and room resonances due to the higher amplitude peaks involved, although harmonic products tend to be most audible in the mid-frequency region.

Out-of-phase operation appeared to secure almost the reverse effects. Amplitude peaks tended to be suppressed with the result that the apparent decay period was longer. Suppression of high frequency components due to negative modulation gave the effect of added bassiness, while dynamic effects tended to resemble those produced by volume compression.

The previous observations were made with equipment which, by virtue of their linearity characteristics, produced relatively large amounts of third harmonics without producing appreciable higher order distortions. This is of importance in achieving acceptable reproduction due to the fact that the ear, itself, has a nonlinear characteristic—that is, it is capable of perceiving sounds varying over an intensity range of more than 100 decibels. From this it might be inferred that it would be almost impossible to achieve perfect reproduction of even simple tones because the distortion in the reproduction should then not exceed one thousandth of one per-cent. As a matter of practice it has been

shown that due to the nonlinear characteristic of the ear three per-cent simple harmonic distortion is usually undetectable even if the original signal is available for direct comparison. However, high order harmonics, especially in the lower frequencies, are readily detectable at much lower percentages due to the lowered masking of the harmonic by the fundamental and the nonlinear frequency characteristic of the ear.

In connection with the foregoing paragraph, a factor seldom considered is the waveform of an amplifier output at saturation. It is often the practice to use feedback or other means to hold the distortion percentages to a low value until maximum output is very nearly reached. Above this point a very abrupt flattening of the sine wave peaks may occur with resultant high order harmonic distortion. This effect is not particularly important in cases where adequate power reserve for any situation is available, but becomes a factor in public address work or other applications in which maximum efficiency must be achieved. The abrupt flattopping of the output may cause the load line to change greatly and in the case of an inductive load, such as a loudspeaker, cause a high intensity transient, such as illustrated in *K*, to be produced. If the output is too lightly loaded, the primary inductance of the output transformer may react to the square topped wave by producing a transient pulse of up to several thousand volts, often resulting in punctured insulation and subsequent failure of some component. In practice, a condenser is often placed across the primary of the output transformer in order to create a relatively low reactance at high frequencies where the loudspeaker may not represent sufficient impedance, but this may have the disadvantage of resonating with the transformer inductance somewhere in the audio range and causing distortion of impulse noise as well as other effects. Triodes, due to the fact that they have lower plate resistances, may have a somewhat superior damping effect on the output transformer, and usually require lower values of primary inductance, thereby decreasing the likelihood of excessive leakage reactance.

In many instances flattopping appears to result from the use of driver stages with insufficient capacity. In the case of a conventional class AB amplifier, driven by an *RC*-coupled phase inverter, the grids of the output stage will represent a relatively high impedance up to the point at which grid current is drawn. At this point a sharp decrease in grid impedance will occur, resulting in driver mismatch and peak clipping. One solution to this problem found in some high quality amplifiers is the use of a relatively low impedance driver stage, such as a cathode follower, capable of delivering power to the output grids during momentary periods of overload. The peak output available is somewhat increased by this method and the peaks of the waveform at overload are somewhat rounded rather than presenting sharp discontinuities. The effect is somewhat analogous to the peak clipping used in communications in which limiting is accomplished without accompanying splatter.

Although by Fourier analysis, a flat topped or essentially square wave can be resolved into a fundamental and series of harmonics, in many cases neither a loudspeaker nor the ear will act as a perfect wave analyzer and waveforms with sharp discontinuities may act as transients which excite any resonances in the system. In woofer-tweeter systems using a high frequency crossover network, the clipping of a sudden peak may result in the application of a sharply differentiated pulse to the tweeter with disagreeable reproduction ensuing.

Although nonlinearity is usually associated with harmonic distortion, under certain circumstances there is no exact relationship and there are several methods of achieving a high degree of nonlinearity without appreciable harmonic production. Probably the most familiar example of this is the conventional volume expander or compressor, although a certain amount of electrical inertia is usually associated with this effect. A more recent device makes use of nonlinearity to achieve inertialess noise reduction by splitting the audio spectrum up into octave bandwidths and clipping or otherwise altering the audio frequency components in the desired manner. Any harmonics produced by this process are suppressed due to the limited individual bandwidths involved and

(*Continued on page* 157)

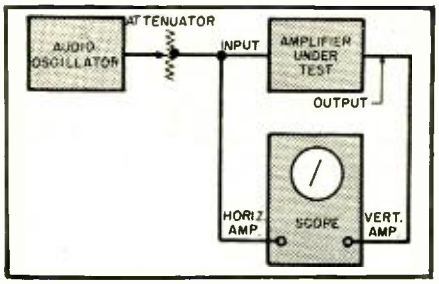
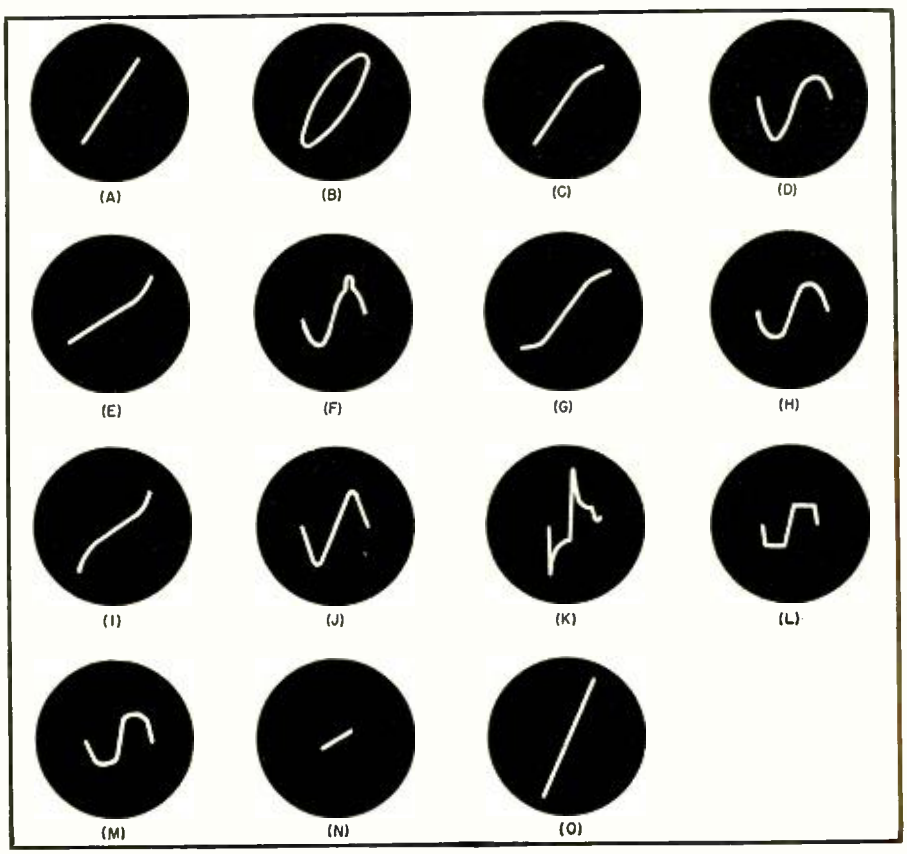
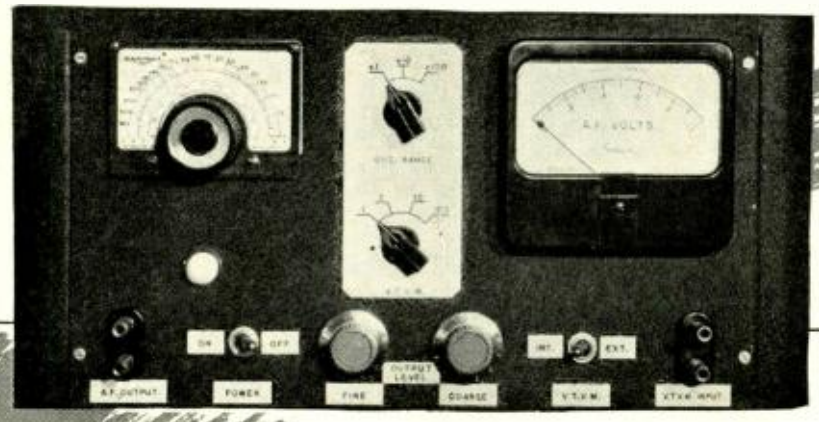


Fig. 1. Block diagram of simple test setup for checking phase shift, frequency response, harmonic distortion, and nonlinearity.

Fig. 2. (A) Trace obtained by method described in text when no phase shift or harmonic distortion is present. (B) Shows same trace but with some phase shift present. (C) Illustrating trace obtained when out-of-phase second harmonics are present. (D) Corresponding sine wave trace of (C). (E) In-phase second harmonic distortion. (F) Corresponding sine wave trace. (G) Trace of out-of-phase third harmonic distortion. (H) Resulting sine wave pattern. (I) and (J) Representative in-phase third harmonic patterns. (K) Illustrating the high intensity transient pulses that may be caused by an overdriven amplifier feeding an inductive load. (L) Showing the trace of the same amplifier feeding a resistive load while (M) illustrates pattern of an amplifier feeding a resistive load in which the output tubes are driven into the grid current region thus producing a waveform with more rounded peaks. (N) The reference pattern of a nonlinear device, such as a volume expander at low level. (O) Pattern of same device at high output levels showing change of direction of trace caused by nonlinearity.



An AUDIO OSCILLATOR and V.T.V.M.



By
LOREN C. WATKINS, JR.
W5JXO

Fig. 1. Front view of completed unit. Frequency range covered is from 21-35,000 c.p.s.

Construction details on a versatile test instrument. Frequency range of oscillator is 21 to 35,000 c.p.s. The v.t.v.m. features linear meter scale, one-tenth volt maximum full-scale sensitivity, and flat response from 20 to 200,000 c.p.s.

THE many uses for a good, continuously variable frequency audio oscillator and dependable vacuum tube voltmeter for audio frequency use are well known to the amateur fraternity, "hi-fi" enthusiasts, and for service work in general. Several excellent articles on the subject have appeared in RADIO & TELEVISION NEWS and other radio magazines in recent years. A rather thorough review of this information is highly recommended to anyone contemplating the construction of such a unit as we are about to describe.

In our unit the oscillator and v.t.v.m. are actually independent devices, utilizing the same power supply and cabinet. The oscillator covers a frequency range, continuously variable, from 21 c.p.s. to 35,000 c.p.s. This is accomplished in three "decaded" ranges with only one dial calibration necessary. The output voltage remains constant within 1 decibel and the total distortion present in the output is less than 1%. Coarse and fine output level controls are provided so that the output voltage may be smoothly varied from a few millivolts to the maximum of approximately 20 volts.

The v.t.v.m. may be switched to read either the output voltage of the oscillator or an external audio voltage. Maximum full scale sensitivity is 0.1 volt, with additional full scale ranges of 1, 10, and 100 volts. The frequency response is flat from 20 to 200,000 c.p.s., these figures being the limits of our standard frequency source. No special scale is required for the 0-1 ma. meter used in this instrument, as the tracking error is well within the inherent percentage accuracy of the meter itself, or 2%. The v.t.v.m. input impedance remains nearly constant at 10 megohms so negligible loading occurs of a circuit under test.

The Audio Oscillator

In the schematic diagram, Fig. 2, V_1 is the oscillator tube. V_2 acts as a feedback amplifier. The 3-watt lamp in the cathode circuit of V_1 serves to stabilize the amplitude of oscillation. The Wien Bridge oscillator may conveniently be made to produce a wide range of frequencies, with excellent frequency stability. The frequency at which the circuit oscillates is $f_0 = 1/2\pi RC$. For example, if R is 20 megohms and C is 380 $\mu\mu$fd. the frequency of oscillation is 21 cycles per second.

Two methods are commonly used to vary the frequency of oscillation of the Wien Bridge circuit. We may use a dual potentiometer and switch in different values of fixed condensers to cover the desired range, or we may use a ganged variable air condenser and switch in fixed values of resistance. The first method may immediately be eliminated from consideration for use in a quality oscillator. The tracking error cannot be tolerated where we wish to use a decaded range switch and a one-calibration dial for all ranges. A small percentage of tracking error will introduce considerable distortion, among other ill effects. It is also easier to obtain precision resistors than fixed condensers within the necessary tolerance. A variable air condenser tracks almost perfectly, and used with the economical *IRC* "Precistors" of 1% accuracy a satisfactory solution to the problem is obtained. The variable condenser used in this unit actually costs less than a standard dual potentiometer at regular net prices.

There remains one other problem to be solved in connection with the variable condenser method of changing frequency. Commercial practice has been to employ a total frequency variation of 20 to 20,000 c.p.s. obtained in three decaded ranges, that is from 20 to 200 c.p.s., etc. This allows the dial to be engraved with only one set of numbers, from 20 to 200 c.p.s., the two higher ranges being read by adding either one or two zeros to the indicated dial setting, depending upon the position of the range switch. The above mentioned frequencies adequately cover the audible frequency range and so were used as the design basis of our unit. We also desired to use the decade system of range switching in order to avoid the inconvenience of a separate dial calibration for each frequency range. Reference to the frequency of oscillation formula indicates that a capacitance variation of ten to one must be obtained to vary the frequency over a range of ten to one. If we mount the variable condenser on the chassis without a shield cover the oscillator will usually have a stubborn tendency to lock in with the a.c. line frequency and multiples thereof due to stray a.c. fields. If we place a shield around the condenser we eliminate that trouble but immediately increase the minimum capacitance to the point where difficulty may be had in maintaining the desired ten to one variation in capacity.

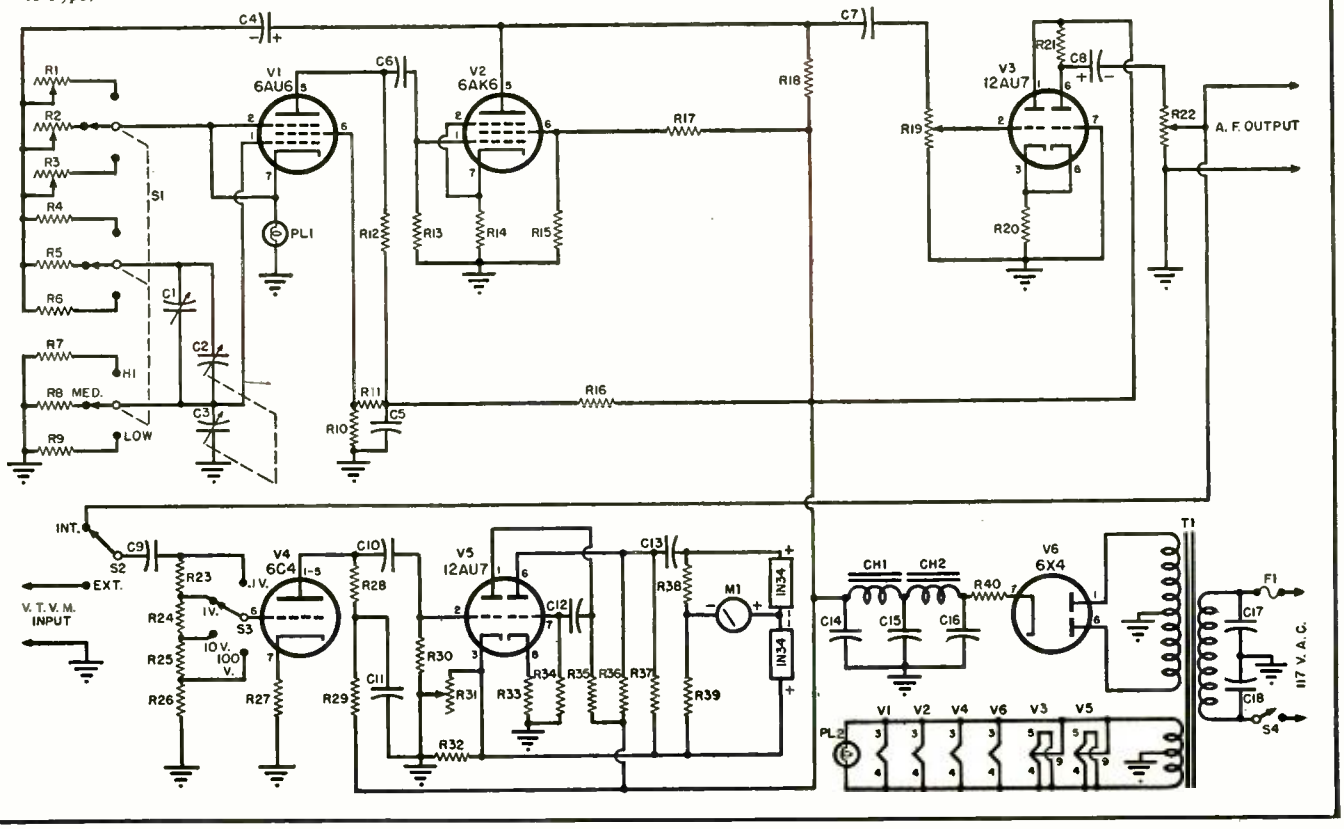
It has been common practice to employ a high capacitance per section, 4-gang variable condenser with two sections tied in parallel for each half of the bridge circuit. A total capacitance of around 900 to 1050 $\mu\mu$fd. is thus obtained for each parallel group permitting the use of relatively low values of fixed decade resistors and a resultant decrease in circuit impedance to hum pickup, among other factors.

The large physical size of the condenser, and shield cover if used, results in a quite high minimum capacitance. Nevertheless, the desired ten to one variation in capacity is obtained with a good overlap. The main disadvantages of the use of a 4-gang variable is that the physical size of the completed oscillator is increased considerably, it is not a common stock item at most supply houses, and the cost is rather high even if a suitable high capacitance unit can be located.

We felt that the home constructor would gain a considerable advantage if a common two-gang variable could be used satisfactorily. Both sections of the condenser must have the same capacity and we need a condenser of small physical size to avoid increasing the frame capacity to chassis more than necessary. Condensers of this type are commonly used in broadcast receivers. One can easily be obtained from a junked chassis at the local radio service shop, or most junk boxes will yield a suitable unit. The condenser we used is a "junk box special" and saw former service in a small t.r.f. broadcast receiver. After a bath in carbon-tet and a drop or two of oil on the bearings it appeared good as new. Its capacity, as measured on a *General Radio* capacity bridge, went from 13 $\mu\mu$fd. minimum to 375 $\mu\mu$fd. maximum. We felt that, by taking a few precautions, the minimum capacitance could be held to about 30 $\mu\mu$fd. after the condenser was mounted on the chassis. On this basis the maximum capacitance could be expected to increase by not more than about 10 $\mu\mu$fd. Taking these allowances into consideration we still obtain a capacity variation of over 10 to 1. A few rough calculations indicated that a resistance of 20 megohms would be needed with 385 $\mu\mu$fd. to obtain an oscillator frequency of 20 c.p.s. This same 20 megohm value should then yield a frequency of about 300 c.p.s. at the minimum capacitance setting of the condenser. Following through with our range "decade" scheme we note that a resistance of 2 megohms will give a frequency range from 200 to 3000 c.p.s., and a resistance of 200,000 ohms will provide the remaining coverage from 2000 to 30,000 c.p.s. These resistors must be the precision type of 1% accuracy, unless facilities are at hand to bridge a number of stock resistors and select suitable ones. The resistances specified are standard stock values in the *IRC* "Precistor" line and are economical in price. Reference to the photograph of Fig. 3 will show that we used various types of precision resistors from the junk box. Suitable *Ohmite* units were on hand for the 2 megohm and 200,000 ohm values. A quantity of standard *IRC* Type BTA composition resistors were bridged and a matched pair selected for the 20 megohm values. As it is quite difficult to obtain accurate

Fig. 2. Complete circuit diagram and parts list for the sine wave audio oscillator and audio frequency vacuum tube voltmeter.

R_1, R_2, R_3, R_{31}—5000 ohm pot. (log taper)
R_4, R_7—200,000 ohm, ½ w. res. (IRC 1% "Precistor")
R_5, R_8—2 megohm, ½ w. res. (IRC 1% "Precistor")
R_6, R_9—20 megohm, ½ w. res. (IRC 1% "Precistor")
R_{10}, R_{21}—47,000 ohm, 1 w. res.
R_{11}—100,000 ohm, 2 w. res.
R_{12}—56,000 ohm, 1 w. res.
R_{13}, R_{30}—470,000 ohm, ½ w. res.
R_{14}—100 ohm, 1 w. res.
R_{15}—33,000 ohm, 2 w. res.
R_{16}, R_{38}, R_{39}—10,000 ohm, 1 w. res.
R_{17}—10,000 ohm, 2 w. res.
R_{18}—10,000 ohm, 10 w. wirewound res.
R_{19}—500,000 ohm pot. (log taper)
R_{20}—390 ohm, 1 w. res.
R_{22}—50,000 ohm pot. (log taper)
R_{23}—9 megohm, ½ w. res. (Continental 1% X-Type)
R_{24}—900,000 ohm, ½ w. res. (Continental 1% X-Type)
R_{25}—90,000 ohm, ½ w. res. (Continental 1% X-Type)
R_{26}—10,000 ohm, ½ w. res. (Continental 1% X-Type)
R_{27}—1800 ohm, 1 w. res.
R_{28}—100,000 ohm, 1 w. res.
R_{29}—20,000 ohm, 1 w. res.
R_{32}—1500 ohm, 1 w. res.
R_{33}—1000 ohm, 1 w. res.
R_{34}—1 megohm, ½ w. res.
R_{35}—270,000 ohm, 1 w. res.
R_{36}—33,000 ohm, 1 w. res.
R_{37}—150,000 ohm, 1 w. res.
R_{40}—400 ohm, 10 w. wirewound res.
C_1—50 $\mu\mu$fd. midget var. cond. (Hammarlund Type HF-50 or equiv.)
C_2, C_3—Two-gang var. cond., 375 $\mu\mu$fd. per sec. (See text)
C_4—40 μfd., 350 v. can-type elec. cond. with bakelite mounting plate
C_5-C_{11}—Dual 20 μfd., 350 v. can-type elec. cond.
C_6, C_7—.5 μfd., 400 v. cond.
C_8—20 μfd., 350 v. can-type elec. cond. with bakelite mounting plate
C_9—.01 μfd., 400 v. cond.
C_{10}, C_{12}—.05 μfd., 400 v. cond.
C_{13}—2 μfd., 400 v. bathtub cond.
C_{14}-C_{15}—Dual 40 μfd., 350 v. can-type elect. cond.
C_{16}—20 μfd., 350 v. tubular elec. cond.
C_{17}, C_{18}—.01 μfd., 400 v. cond.
S_1—3-pole, 3-pos. ceramic rotary sw.
S_2—S.p.d.t. toggle sw.
S_3—S.p. 4-pos. ceramic rotary sw.
S_4—S.p.s.t. toggle sw.
PL_1—120 v., 3 w. pilot lamp (used as cathode res. for V_1)
PL_2—6.3 v. pilot lamp
F_1—1 amp. fuse
T_1—Power trans., 300-0-300 v. @ 50 ma., 6.3 v. c.t. @ 2 amps.
CH_1, CH_2—10 hy., 50 ma. filter choke
2—1N34 crystal rectifiers
M_1—0-1 ma. meter
V_1—6AU6 tube
V_2—6AK6 tube
V_3, V_5—12AU7 tube
V_4—6C4 tube
V_6—6X4 tube



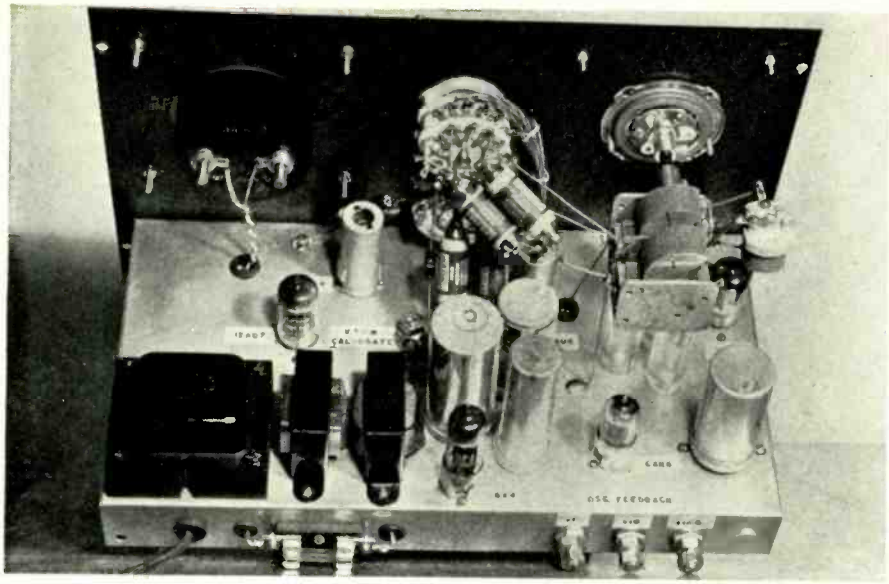


Fig. 3. Rear view of the completed instrument showing general layout of parts.

bridge measurements at 20 megohms of resistance, except by use of laboratory type equipment, it would be advisable to purchase precision resistors. The *IRC* Type DCH deposited carbon "Precistors" are readily available and, to the best knowledge of the writer, are the only 20 megohm, 1% precision resistors available at low cost at the present time. The resistors specified in the parts list were chosen for their ready availability and low cost, although any resistors of suitable accuracy may be used. In case a variable condenser has to be purchased new, a suitable unit may be obtained from *Allied Radio,* Stock No. 61-061. This unit has a minimum capacitance of 13 $\mu\mu$fd. and a maximum of 498 $\mu\mu$fd. With the same values of range resistors the lowest obtainable oscillator frequency would then be about 16 c.p.s.

To avoid using a shield cover on the variable condenser, and thereby raising the minimum capacitance, certain component parts were placed on the chassis so that a natural shield was formed between the power supply components and the variable condenser. See Fig. 3 to get an idea of the arrangement. The condenser was mounted above the chassis on three polystyrene rods, ½ inch in diameter and 2 inches long. The rods were drilled and tapped on each end for 6/32 screws, the bottom of the condenser already being provided with three tapped 6/32 holes. As the condenser shaft must be insulated from the chassis, a length of ¼ inch polystyrene rod and a solid shaft coupling is used from the variable shaft to the dial. This method was favored over an insulated flexible coupling which gave too much "slop" to the tuning action. The condenser should be spaced on the chassis so that about 2 inches of clearance is obtained in every direction from chassis or cabinet. The small compensating condenser, C_1, is supported at one side of the front section of the main condenser by short, heavy bus leads soldered directly to the terminals. This mounting method results in a very low minimum capacitance, and once the chassis is in the cabinet no tendency of the oscillator to lock in at the a.c. line frequency is observed. It will do so, however, if the unit is operated out of the metal cabinet.

That we were successful in keeping the minimum capacitance to a low value is indicated by measurements of the frequency range by use of a *General Radio* audio frequency bridge after the unit was completed. The lowest frequency obtained was 20.8 c.p.s. and the highest frequency for the "x1" range was just over 350 c.p.s. Substitution in the formula then reveals that the actual values of capacitance in use in the circuit are approximately 384 and 22.8 $\mu\mu$fd. respectively, which is even better than the original approximations. It is also seen that the capacity ratio is 16.84 to 1 which serves as a check on our calculations, as the actual measured frequency variation bears the same ratio.

We have now obtained, in three ranges, a total frequency variation from 21 to 35,000 cycles per second and with the use of standard, easy to get, components. Reference to the front view of the unit, Fig. 1, will show that only one scale calibration has been made on the *National* Type MCN dial, from 21 to 350 cycles. This is, of course, a greater coverage than one decade, but we felt that it would be convenient to utilize the extra coverage that the unit provides, namely from 210 cycles to 350 cycles. Thus the upper frequency limit of 35,000 cycles can be made available on the calibrated dial. As a matter of convenience, and with the above idea in mind, we shall continue to refer to the three oscillator frequency ranges as being "decaded."

One other interesting feature of the circuit should be examined at this point. In a typical oscillator of this type, only one feedback adjustment is usually provided. The problem then is to secure a setting of the feedback potentiometer such that oscillation is maintained over the total frequency range. If the feedback voltage is adjusted to the point where the unit will oscillate at the highest frequency then the feedback will usually be too great at the lowest frequency with a resultant large increase in output distortion. In addition, the frequency tracking problem of the decaded ranges is also the further problem of trying to hold the output voltage constant over the entire range of frequencies. These problems were solved nicely by using three identical feedback potentiometers, one for each range, and switching them by an extra deck on the range switch. The added cost of the two extra pots is insignificant and the final operational results many times repay the extra expense and trouble. The three potentiometers are mounted along the rear chassis drop, as may be seen from the photograph of Fig. 3. Shaft locks are used to prevent accidental turning of the shafts once calibration of the oscillator has been effected.

The electrolytic coupling condensers, C_4 and C_8, must have their cans isolated from ground or chassis, so must be mounted on insulating plates. In Fig. 3, C_4 is located just to the left of the tuning condenser and C_8 is mounted in the right rear corner of the chassis. Tube V_3 is simply a voltage amplifier and isolating stage to prevent undesirable loading effects on the oscillator proper. Potentiometer R_{19} acts as the "coarse" output level control and determines the amount of signal voltage fed to the grid of the first triode in V_3. This first section of V_3 acts as a cathode follower, its output being coupled through the common cathode resistor, R_{20}, to the second triode section which acts as a grounded grid amplifier. This particular type of amplifier is capable of nearly distortionless amplification up to about 20 volts of output level, and requires but few parts. Potentiometer R_{22} is the "fine" output level control.

Coupling condenser C_7 is shielded by a strip of copper or tin wrapped around the condenser and spot soldered. A ground lead is soldered to the shield and run to chassis ground. This shielding was found necessary to prevent undesired coupling into the nearby v.t. v.m. input circuit components at the higher audio frequencies. This condenser may be seen located near the output level potentiometers in the bottom view of Fig. 4.

Calibration of the oscillator is probably best accomplished by use of another oscillator of known accuracy and an oscilloscope, utilizing a "one to one" indication on the scope. The Lissajous figure method[1] may also be used but is rather tedious and requires considerable care in interpretation of the scope patterns. Before the actual frequency

[1] Smith, Richard M.; "An RC-Type Audio Signal Generator," QST, January, 1950.

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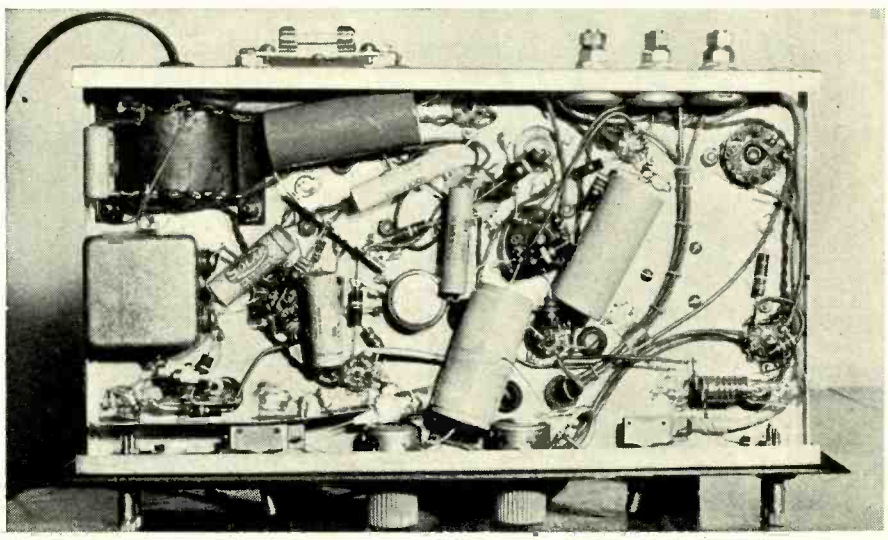
calibration is attempted the feedback potentiometers and balancing condenser must be adjusted. Install the completed unit in the cabinet, tighten the panel mounting screws, and be sure the cabinet lid is closed. Advance both output level controls full on, set the oscillator range switch to the "x1" position and the v.t.v.m. range switch to the "100" position. (Operation and calibration of the v.t.v.m. will be covered in later paragraphs.) An oscilloscope is then connected to the "A.F. Output" terminals so that the output waveform may be observed. Set the main tuning condenser and the small compensating condenser to the minimum capacity position. Adjust feedback potentiometer R_3 so that oscillation is just obtained in a stable manner. The output voltage should then approach 20 volts. Swing the tuning condenser back and forth between maximum and minimum capacity and adjust the compensating condenser, C_1, so that the output voltage is maintained constant over the entire tuning range at about 20 volts. A small readjustment of the feedback control may be necessary. Keep one eye on the scope during the adjustments to see that a good waveform is being obtained at all times. When the proper adjustments have been obtained the oscillations will be stable over the tuning condenser range, the output voltage will hold constant at about 20 volts, and the output waveform will be excellent. If the oscillator, installed in the metal cabinet, shows any tendency toward locking in with the 60 cycle a.c. line frequency or multiples thereof, look the wiring over for a possible coupling path that can be eliminated. It was not found necessary to shield the a.c. filament leads in our unit, however the a.c. line from the power transformer to the power "On-Off" switch on the front panel was shielded. Tube V_1 should also be shielded. After completion of the "x1" range adjustments, proceed to the two higher ranges in order and adjust the feedback potentiometers as above. As the oscillator frequency is increased the compensating condenser adjustment may be made to a finer degree and will reach its final setting at the high frequency end of the "x100" range. If these adjustments are made carefully the oscillator frequency should "decade" quite accurately on all three ranges, at least within a few per-cent. The actual frequency calibration of the oscillator may now be accomplished and the scale inked in on the dial.

The V.T.V.M.

The vacuum tube voltmeter circuit consists essentially of a three stage amplifier with a suitable rectifying system for the 0-1 ma. meter, M_1. The original scale on the meter need not be altered as it will be read directly, keeping in mind the position of the range multiplier switch. The calibration is linear from zero to full scale indication. Although a large 4½ inch meter was used in our unit for ease in reading, any size or style meter may be used, providing only that it has basically an 0-1 ma. movement and that it is in good condition. The advantage of the 0-1 milliammeter over a microammeter sometimes used in this type of circuit will be apparent when the instrument prices are compared.

Due to the inverse feedback employed the voltmeter circuit has excellent stability against aging or changes in tube characteristics as well as supply voltage variations. Assuming the input decade resistors have been accurately chosen, only one calibration adjustment need be performed for the meter to indicate accurately on all ranges. Merely apply an audio frequency voltage of known amplitude to the input terminals, with the v.t.v.m. range switch in the proper position, and adjust potentiometer R_{31} until the meter indicates that same value of voltage. It should be noted that, regardless of the position of the range switch, one-tenth volt is always present at the grid of V_4 for full scale deflection of M_1.

Fig. 4. Under chassis view. A.c. wiring should be twisted and dressed close to chassis.



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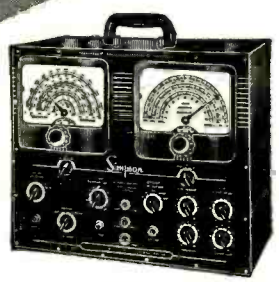

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Condenser C_9 must be shielded to avoid stray pickup since the input impedance of the circuit is quite high. For the same reason a shield strip is soldered in place along the chassis behind the v.t.v.m. input jack and "Int.-Ext." switch, as shown in Fig. 4. The only other shielding needed is on top of the chassis where a 1½ inch wide strip was soldered to the chassis and looped up and over the voltmeter range switch to prevent stray coupling from the adjacent oscillator range switch. Tube V_4 should also be shielded.

The power supply employs a two-section, condenser input filter system with the output voltage dropped to 250 volts by R_{40}. The sensitivity of the various circuits to hum voltages is large and the filter system shown is superior to several other ones tried. Note the paralleled filament connection for 6.3 volt operation of the 12AU7 tubes.

The entire unit is housed in a *Bud* streamlined cabinet, 8 x 16½ x 8¼ inches, panel size 8 x 14 inches, enclosing the 7 x 13 x 1½ inch chassis. The front panel name plates were cut from white card-file stock. All lettering was done with a *Le Roy* lettering set, including the oscillator dial calibration and the "A.F. Volts" on the meter scale.

The writer wishes to express his appreciation for the assistance of Louis J. Frenkel, Jr., W5PQJ, in taking the photographs of the completed unit.

—30—

TV IN LATIN AMERICA

By KENNETH R. BOORD

FLAVIO SERRANO, Rio de Janeiro, a monitor for the International Short-Wave Department of RADIO & TELEVISION NEWS informs me that the first Latin American television station will be located in Rio de Janeiro and will be on the air this year. Studio and mobile equipment, as well as the 5 kw. transmitter manufactured by General Electric at a cost of $1,000,000, are already in Rio de Janeiro.

The transmitter and the antenna (probably a super-turnstile) will be installed atop world-famous Sugar Loaf Mountain, 1400 feet above sea level. Every effort is being made to get the station on the air in July. The first programs will include telecastings of education programs and the International Soccer Tournaments.

The station is owned by "Radio Tupi," which recently purchased television equipment from the Radio Corporation of America for its projected TV outlet in Sao Paulo. A third television transmitter, manufactured by General Electric, may be installed in the near future in Rio de Janeiro by "Radio Televisao do Brasil," a new organization.

According to a recent broadcast from the Voice of America, the first television station in Mexico will be on the air next September. Call letters will be XEW-TV, and the station is owned by "Cadena Radiodifusora Mexicana," which also operates XEW on m.w. and XEWW on s.w. For the first three months, transmissions will be purely experimental.

A Cuban television station is slated to go on the air in 1951.

—30—

Easily-Built 10 kc. to 1mc. Multivibrator

By GUY DEXTER

Construction details on a dual-range multivibrator which can be incorporated into existing equipment.

IT IS common knowledge that multivibrators are used for frequency division. Thus, a 10 kc. multivibrator driven by a 100 kc. oscillator effectively divides the 100 kc. by 10. But few experimenters are aware of the fact that the scheme also works the other way, that is, a standard frequency oscillator can be used to control a multivibrator at a higher, rather than lower frequency. This latter method of operation may be employed to obtain strong 1000 kc. points from a 100 kc. oscillator.

Fig. 1 shows the circuit of a multivibrator which, at the flip of a switch, will deliver either 10 kc. or 1000 kc. spot-signal output. It may be driven by any 100 kc. oscillator already on hand, such as the miniature *Hammarlund* Type FS-135-C frequency standard recently bought by hundreds of experimenters at closeout prices. A space of only 2" x 2" is required by the complete multivibrator, so it can be installed comfortably on the chassis of most receivers or 100 kc. oscillators. No special tricks are necessary to get the circuit into operation.

The 100 kc. control oscillator output is available at the multivibrator output terminals via coupling through the 12AX7 miniature tube and associated circuit components. The 100 kc. points are strong enough to be useful up to about 10 or 15 megacycles with receivers of good sensitivity. The 10 kc. points are useful up to about 4 mc. The 1 mc. points may be heard up to 50 or 100 megacycles, depending upon sensitivity of the receiver or monitor used.

It is a simple matter to place the multivibrator in operation. The only adjustable control is the 10,000 ohm wirewound potentiometer, R_1, adjustment of which locks the multivibrator into step with the controlling oscillator. When R_1 is set for synchronization at 1000 kc. (with switch S_1 in its 1 mc. position), the multivibrator will be synchronized for 10 kc. operation (with switch S_1 in its 10 kc. position), and vice versa. Hence, only one adjustment of R_1 is required, and only one sync control is needed. To adjust the multivibrator: (1) Connect the filament and plate voltage terminals to proper sources of voltage (these conveniently can be the "B+" and "B—" terminals and 6.3 volt filament terminals of the receiver or 100 kc. oscillator with which the multivibrator is operated). (2) Throw S_1 to its 10 kc. position. (3) Throw S_2 to its "Off" position. (4) Connect the output terminals of a 100 kc. oscillator (in operation) to the multivibrator input terminals. (5) Connect the multivibrator output terminals to the antenna and ground terminals of a broadcast receiver which can be made to regenerate or oscillate slightly. (6) Tune the broadcast receiver, noting that a signal is heard at each 100 kc. point on the dial. (7) Throw switch S_2 to its "On" position and retune the broadcast dial, noting that somewhat weaker extra signals now are tuned-in between the louder 100 kc. points. Count these weaker signals. (8) If the multivibrator is operating at 10 kc. as it should be, nine such signals will be heard between any two adjacent 100 kc. points. If the number is greater or less than 9, adjustment of potentiometer R_1 will bring the number exactly to 9. (9) To check 1000 kc. operation, it is best to use an oscillating (or regenerating) all-wave receiver tuning continuously above 10 mc. Throw switch S_1 to its 1 mc. position, and tune the receiver, noting that a strong signal is heard at each 1000 kc. point on the dial. If the 100 kc. points are also heard, note that each adjacent 1 mc. point is much stronger than the nine 100 kc. points heard in between.

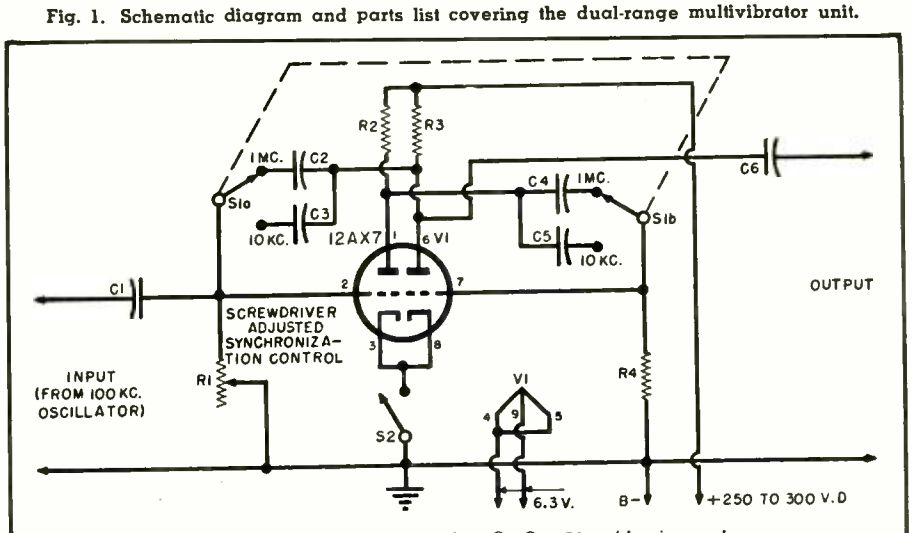
The Bureau of Standards station, WWV, broadcasts standard frequencies on 2.5, 5.0, 10.0, 15.0 and higher frequencies. These may be used to check the accuracy of the basic 100 kc. oscillator, enabling the user to make accurate measurements at intermediate points.

The 1000 kc. output of the multivibrator may be amplified readily for use in applications requiring an accurate signal at this frequency. Such applications include operation of a radio-frequency bridge, 1-mc. "Q"-meter, etc.

This multivibrator unit is economical in two ways. It does away with the separate tubes and circuits which ordinarily would be used to produce the two frequencies. And it is cheaper and more accurate than the dual-mode crystals usually employed for 100-1000 kc. operation. Power supply requirements are 250 to 300 volts d.c. at 9.8 milliamperes, and 6.3 volts a.c. or d.c. at 0.3 ampere.

The writer is indebted to Mr. C. T. Corey, at whose suggestion this dual-range multivibrator was produced.—30—

Fig. 1. Schematic diagram and parts list covering the dual-range multivibrator unit.



R_1—10,000 ohm wirewound pot with slotted shaft for screwdriver adjustment
R_2, R_3—10,000 ohm, 1 w. res.
R_4—5600 ohm, ½ w. res.
C_1, C_6—20 μμfd. mica cond.
C_2, C_4—50 μμfd. mica cond.
C_3, C_5—.005 μfd. mica cond.
S_1—D.p.d.t. toggle sw.
S_2—S.p.s.t. toggle sw.
V_1—12AX7 tube

NEW 1950 Heathkits have all the Features

New 1950 Heathkit

PUSH-PULL EXTENDED RANGE 5" OSCILLOSCOPE KIT

Features

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- Tremendous sensitivity .06 Volt RMS per inch deflection.
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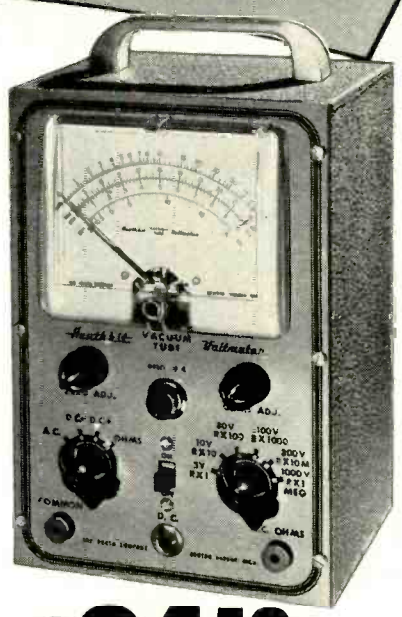

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- Modern streamline 200 ua meter.
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- 24 Complete ranges.
- Isolated probe for dynamic testing.
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The Heathkit VTVM is the only kit giving all the ranges. Check them — DC and AC-full scale linear ranges of 0-3V, 0-10V, 0-30V, 0-100V, 0-300V, 0-1000V and can be extended to 0-3000V and 0-10,000V DC with accessory probe at slight extra cost. Electronic ohmmeter has six ranges measuring resistance accurately from .1 ohm to one billion ohms. Meter pointer can be offset to zero center for FM alignment.

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The new instruction manual features pictorial diagrams and step-by-step instructions for easy assembly. The Heathkit VTVM is complete with every part — 110V transformer operated with test leads, tubes, light aluminum cabinet for portability, giant 4½" 200 microamp meter and complete instruction manual.

Order now and enjoy it this entire season. Shipping weight 8 lbs., Model V-4

Accessory: 10,000V high voltage probe, No. 310, $4.50.
Accessory: RF crystal diode probe kit extends RF range to 100 Mc., No. 309, $6.50.

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Checks all types of condensers, paper-mica-electrolytic-ceramic over a range of .00001 MFD. to 1000 MFD. All on readable scales that are read direct from the panel. NO CHARTS OR MULTIPLIERS NECESSARY. A condenser checker anyone can read without a college education. A leakage test and polarizing voltage for 20 to 500 volts provided. Measures power factor of electrolytics between 0% and 50%. 110V. 60 cycle transformer operated complete with rectifier and magic eye tubes, cabinet, calibrated panel, test leads and all other parts. Clear detailed instruction for assembly and use. Why guess at the quality and capacity of a condenser when you can know for less than a twenty dollar bill. Shipping weight, 7 lbs. Model C-2.

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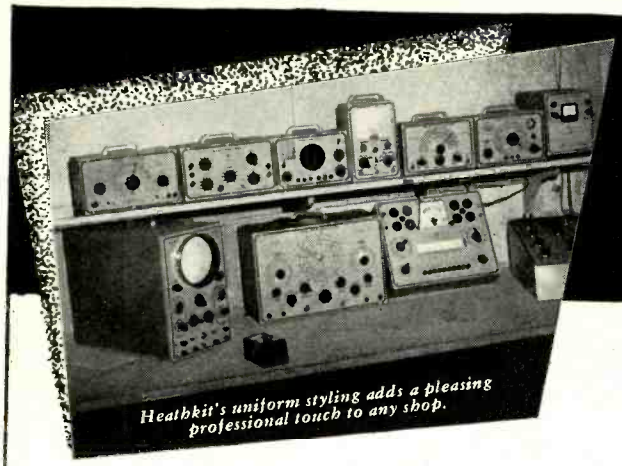

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550 to 1600 Kc.

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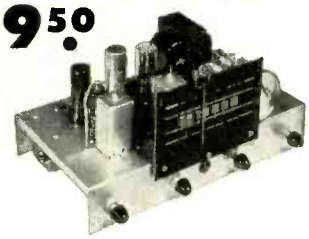

Ideal AC operated superheterodyne receiver for home use or replacement in console cabinet. Comes complete with attractive metal panel for cabinet mounting. Modern circuit uses 12K8 converter, 12SH7 input IF stage, 12C8 output IF stage and first audio 12A6 beam power outpur stage, 5Y3 rectifier. Excellent sensitivity for distant reception with selectivity which effectively separates adjacent stations.

The husky 110 V. cased power transformer is conservatively rared for long life.

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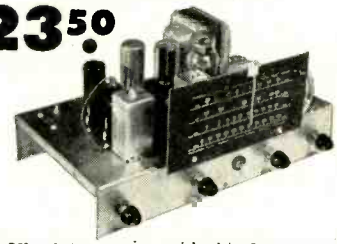
3 BAND MODEL AR-1
550 Kc. to 20 Mc.

$23.50



Enjoy the thrill of world wide short wave reception with this fine new AC operated Heathkit 3 band superheterodyne — amazing sensitivity 15 microvolt or better on all bands. Continuous coverage 550 Kc. to over 20 Mc. Easy to build with complete step-by-step instructions and pictorial diagram. Attractive accurately calibrated six inch slide rule dial for easy tuning. Six tubes with one dual purpose tube gives seven tube performance. Beam power output tube gives over 3 watts output.

Separately assembled coil turret with band switch eliminates difficult construction. Conservatively rated 110 V. power transformer supplies full operating voltages to all tubes for maximum reception. Has band switch, tuning, volume, tone and phono-radio controls. Chassis size 2¼" x 7" x 12½" — supplied complete — punched chassis — tubes — controls — transformers (quality output to 3.4 ohm voice coil) — all small parts — hardware and insrructions (less speaker). Shipping Wt., 10 lbs. No. AR-1 Receiver $23.50.

No. 335 Communications Type Table Model Metal Cabinet..... **$4.50**
No. 320 High Quality 5" PM Speaker for above..... **2.75**

Heathkit
PUSH-PULL HIGH FIDELITY AMPLIFIER KIT

$12.50

Build this high fidelity push-pull amplifier and save two-thirds the cost—has two pre-amplifier stages, phase inverter stage and push-pull beam power output stage. Comes complete with six tubes—quality output transformer (to 3-4 ohm voice coil) tone and volume controls—varnish impregnated cased 110V. power transformer and detailed instruction manual and all small parts. Six watt output with output flat within 1½ db between 50 and 15000 cycles.

Build this amplifier now and enjoy it for years.

Shipping Wt. 7 lbs. Model A-4
12" PM Speaker for above..... **$6.95**

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MARS Station of the Month

MARS BEAMS WEEKLY BROADCASTS

MARS—Army Headquarters station, WAR, located at the Pentagon Building, Washington, D. C., broadcasts a weekly message each Tuesday at 0100Z and at 0400Z. (This is Monday at 8 p.m. and 11 p.m., Eastern Standard Time; Monday at 7 p.m. and 10 p.m., Central Standard Time; Monday at 6 p.m. and 9 p.m., Mountain Standard Time; and Monday at 5 p.m. and 8 p.m., Pacific Standard Time.)

Simultaneous broadcasts are made on frequencies 3497.5 kc., 6997.5 kc., 14,405 kc., and 20,994 kc. Each message is sent three times, once at 10 words per minute, once at 15 words per minute, and once at a higher rate of speed—usually 20 words per minute.

Designed especially to transmit quasi-official traffic and training information to MARS members, the broadcast offers an excellent opportunity to all amateurs in building up their code proficiency.

AN OLD timer, well known to traffic men and rag chewers alike, is A3ANK/W3ANK, handle "Bill" (William H. Hurst) named station of the month by Captain E. L. Nielsen, Chief of MARS—Army. The nomination came as a recognition of the outstanding service performed by A3ANK as net control station for the Military Amateur Radio System Pennsylvania State Net.

A look at the paper on 3ANK's shack wall should convince even the unbeliever that Hurst spends a good deal of time on the air. For, in addition to the QSL cards from near and far, are framed parchments attesting that A3ANK is WAS, WAC, RCC, 35 w.p.m., and a member of ARRL, Philadelphia Amateur Society, and the Old Timers Club.

Hurst can claim twenty-eight years as an amateur. And he is proud of the fact that after almost three decades of hamming his interests are still varied enough to permit his enjoying activity on eight bands—that's right—eight of them: 2, 6, 10, 11, 20, 40, 80, and 160 meters.

Keeping his rig to a minimum amount of equipment, A3ANK uses a "Signal Shifter" or Xtal, with an 807 driving an 813 and a final input of 150 watts, bandswitching, A-1, A-3, or FM emission. He uses an *HRO* with *Selecto-Jet* for reception on the low frequencies and an S36 (not shown in picture) for a v.h.f. receiver.

Antennas used are folded dipoles for the low frequencies and a four-element *Collinear* for 144 mc.

When not relaxing in his home shack, William H. Hurst is better known to his fellow townsmen as Director of Admissions and Placements at Spring Garden Institute, Philadelphia, Pennsylvania. Not strictly a one-hobby man, Hurst fills off duty hours with golf, bowling, etc.

His military affiliation is with Detachment Number 1, Organized Reserve Corps Control Group of Philadelphia, in which unit he holds the rank of Major. —30—

William H. Hurst A3ANK/W3ANK, net control station for the MARS Pennsylvania State Net.

Portable 40-Meter Rig
(*Continued from page 41*)

trol R_8 to near maximum rotation and increase the regeneration condenser C_6 slowly toward maximum capacity (just where it breaks into regeneration) and c.w. signals should come through.

We will now assume that the receiver is operating correctly and proceed to the adjustment of the transmitter.

Transmitter Adjustments

A connection block is used for the external cable. This block was made by soldering the lugs of the nut-and-bolt units to the contacts of a resistor block section but any piece of insulated base could be constructed to serve the purpose. The unit must be capable of supporting at least six pairs of connecting posts for the cable, etc.

One pair of posts is used to connect the phone jack. A second pair is for checking the oscillator by attaching leads to a 0-100 ma. meter. This is bridged with a short piece of insulated wire when the meter is not in use. Another pair is required for checking the final amplifier. Normally these posts are bridged with a short piece of insulated wire but during tune-up they are left open. A fourth pair is needed to connect the cable wires to the external hand key while the fifth and sixth sets of posts are used to connect the "A" and "B" battery cables.

To adjust the transmitter snap the changeover switch S_2 to its "transmit" position. Do not connect the transmitting antenna at this time. Make sure the filament switch S_1 of the transmitter is on. Short the key and the meter will indicate the current reading of the oscillator stage. With the insulated trimmer adjustment rod adjust the oscillator trimmer condenser C_{11} for minimum current as indicated on the meter. If a superhet receiver is available and tuned to the frequency of the transmitter, you should be able to hear the oscillator in action.

Next open the key and replace the meter with a short piece of insulated wire. The oscillator should now be working properly. Connect the meter cable to the connector posts for the final amplifier and short the key again. With the insulated trimmer rod adjust the final trimmer C_{15} to the minimum current reading on the meter. If a ¼ watt neon lamp is touched to the antenna post (minus antenna) it will show an r.f. glow. This will indicate resonance.

Now, release the key and connect the transmitting antenna to its post. Short the key again and retune the final trimmer for minimum current reading on the meter.

There will now be no indication of r.f. with the neon lamp but the signal will be present. The milliammeter will read around 12 mils. The tap-off

point, on the final tank, of the lead to the antenna post is a couple of turns from the plate end of the coil, and must be determined by experiment. It is important that the tap-off point, which will dip the meter to a minimum, is chosen when the final trimmer is being adjusted. For this tap-off lead I used about a foot of polyethylene insulated wire in order to avoid any r.f. loss.

The meter cable may now be removed from the final tank position and the connectors shorted with a short wire bridge. The meter should now be inserted in the positive lead of the "B" battery for a general reading. When the key is depressed the meter will read somewhere betwen 36 and 40 mils —the total transmitter current. Snap the changeover switch to the "receive" position and the meter will read between 28 and 30 mils of receiver current drain.

The first contact I made from the home location was with W8DEV in Ohio. This convinced me that it was a good little rig with a hot signal. Let's go portable, OM, but don't forget to drop the District Inspector a card as to the location of your portable operations!

—30—

"ELECTRIC EYE"

BELL Telephone Laboratories has announced the development of a new "electric eye" which is said to be much smaller and sturdier than present photoelectric cells.

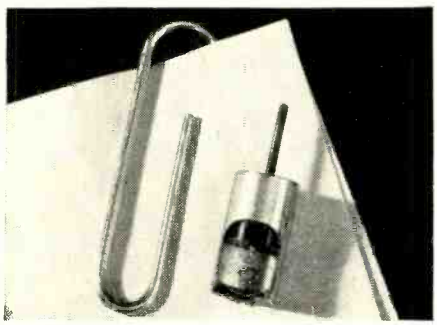
The new device which has been named the "Phototransistor" is capable of delivering very high power for a photoelectric device so that in some instances enough power is generated to operate a switch directly without the preliminary amplification usually required.

The whole apparatus is housed in a tiny cylinder about as big as a .22 caliber rifle cartridge. Like the Lab's recently-developed "Transistor", the new unit has no vacuum, no glass envelope, no grid, plate or hot cathode.

The Phototransistor is similar in operation to the amplifying Transistor, but it is controlled by light rather than by the electric current of the emitter. It also uses a piece of germanium but only a single collector wire. The tip of this wire rests in a small dimple ground into one side of the germanium disc. At this point the germanium disc is only three-thousandths of an inch thick.

—30—

Bell Labs' new "Phototransistor" unit compared in size to an ordinary paper clip.



Technical BOOKS

"TELEVISION TUBE LOCATION GUIDE" by the Sams Staff. Published by *Howard W. Sams & Co., Inc.,* Indianapolis. Price $1.50.

As another step toward providing the television technician with new and faster ways of servicing video receivers, this tube location guide covers hundreds of the popular model sets.

Designed to permit the preliminary diagnosis without chassis removal this book presents layout charts showing the tube lineup and the function of each tube. The index lists manufacturer, chassis number, and the chart number that applies for that particular make and model.

A little practice with this guide will undoubtedly give the service technician many good ideas for the fullest possible utilization of this servicing tool.

* * *

"AMATEUR RADIO MAP OF THE WORLD" by the ARRL Staff. Published by *The American Radio Relay League,* West Hartford, Conn. Price $2.00.

The new and revised postwar edition of this map is prepared in four colors especially for use by amateur radio operators.

A special projection by *Rand McNally,* the new map measures 30 by 40 inches and shows the various countries of the world together with the callsign prefixes used by the hams of those countries. In addition to the regularly assigned prefixes, the map lists those used by the various military occupation forces throughout the world.

This map is a modified equidistant azimuthal projection, centered on Wichita, Kansas, allowing distance measurements of reasonable accuracy to be made between points in North America and the rest of the world. The map may also be used for determining great circle bearings from most points in the U. S. Besides the country boundaries, the map also gives the time zones, principal cities and the International Amateur Radio Union continental subdivisions.

Most amateurs will welcome this new map as a valuable and important addition to their ham shacks.

* * *

"MOST - OFTEN - NEEDED 1950 TELEVISION SERVICING INFORMATION" by M. N. Beitman. Published by *Supreme Publications,* Chicago. 144 pages. Price $3.00.

This new and considerably enlarged edition of a popular servicing manual contains all of the well-known models produced by the leading television manufacturers in their 1950 lines.

Blueprint type circuit diagrams of the receivers are inserted in the manual where they can be used in conjunction with the service notes or removed and then used separately on the service bench. Complete i.f. amplifier and trap alignment charts are presented for the various models along with step-by-step procedures for testing the various sections of the receiver.

The material is clearly and concisely written to provide the maximum amount of information in the least space. Service technicians will find this a handy volume to have on hand when they are faced with a tricky servicing problem.

* * *

"RADIO OPERATOR'S LICENSE Q & A MANUAL" by Milton Kaufman. Published by *John F. Rider Publisher, Inc.,* New York. 575 pages. Price $6.00.

This new volume for the neophyte amateur or commercial license applicant contains a wealth of carefully prepared and arranged material covering the FCC examination questions.

As is customary with such a text the material is divided into the six elements in accordance with subject matter covered on the actual tests. The elements include the basic radio laws, rules, and regulations; basic theory and practice; radiotelephone; advanced radiotelephone; radiotelegraph; and advanced radiotelegraph. The balance of the text is devoted to amateur radio questions and answers, rules governing amateur radio service, and Classes A, B, and C amateur radio license examination questions and answers. Five valuable appendices have been included treating the rules concerning commercial radio operators, extracts from radio laws, conventional abbreviations and the international Morse Code, small vessel direction finders, and automatic alarm.

Written by an instructor at the *RCA Institutes,* the book is thoroughly practical and may be used either as a basic study guide or as a text for quick review or reference.

* * *

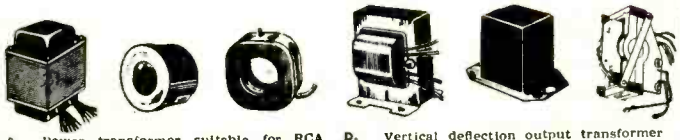
"DIAL CORD STRINGING GUIDE" by the Sams Staff. Published by *Howard W. Sams & Co., Inc.,* Indianapolis. Price $1.00.

This is Volume 2 of a handy little reference book for the service technician. Like its predecessor this volume presents a maximum of information in the minimum amount of space.

The guide covers receivers manufactured in the two years since the appearance of Volume 1, and includes all of the receivers covered in the Photofact Folders through Set No. 70. The index in the front of the new book covers both the first and second volumes with the same numbering system retained to provide proper continuity.

Service technicians who own and use the first volume will need no introduction to this co-volume while newcomers would do well to investigate its time-saving advantages.

—30—



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

MOLDED PLASTIC CAPACITORS

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.

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.

6-TUBE—3 BAND RADIO

ANOTHER McGEE SCOOP

ONLY $15.95

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.

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 cushioned 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 a $25.00 value, but McGee offers them to you for only $7.95. Shipped by express only. Ship. wt. 22 lbs.

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.

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, 6½x3¾x4½". Weight 3¼ 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 450 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.

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-003 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.

15" PM SPEAKER sale price $12.95

BRING OUT THOSE LOW NOTES!

MODEL 15-WO

McGee's new 1950 Model, 25 watt 15" speaker with 14.7 oz. Alnico V magnet. A $30 to $40 class speaker, but mass production enables our price of $12.95. It will respond to notes down to 20 cycles and up to 9,000 cycles. Especially desirable for those who like to have good bass response, or ideal for use with any high frequency tweeter speaker. Finished in splatter grey with a metal pot cover. The cone is of one piece molded construction with a 1¼" voice coil. Ideal for use with all high fidelity amplifiers and radios. Why pay more? McGee's 15" PM Model 15-WO. Shipping weight 11 lbs. Our special price, $12.95 each; 2 for $25.00.

BOES MODEL 103 REG. $7.77 SIGNAL TRACER PROBE WHILE OUR STOCK LASTS $2.95

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 pee-wee clip. You can connect this probe to any AC amplifier and have a signal tracer or you may buy this just for the parts to build a HV multiplier or RF probe for VTVM use. Usable inside space for building purposes is 1¼ x 4". Overall length is 5". Price includes 6F5GT tube. A red hot special. Stock No. 103. Shipping weight 1 lb. Net, $2.95; 2 for $4.95.

MC GEE'S NEW 1950 TELEVISION DUPLICATOR KIT

"HOOK AS MANY AS YOU LIKE TO ANY T.V. SET"

10-TUBE KIT LESS TUBES ONLY $29.95

Get Started in T.V. Buy Building A.T.V.

Duplicator for 16", 12" or 10" Picture Tubes

A sensational new 1950 Model kit. Every part including a ready punched chassis, to build a television duplicator. (Sometimes called a slave or remote unit). This kit has two definite uses. Build as a TV duplicator or build with the idea of later adding the video-tuner stages: to use as an independent TV receiver. A real educational and useful item. After this kit is wired, you simply connect a standard 72 ohm coaxial cable to your present television set. May be used on any size set: 7, 10, 12 or 16". Connect at the video detector and operate the remote unit up to 100 feet or more away from your TV set. Have a TV duplicator for your recreation room, etc. No special test equipment is needed to align this duplicator. It is in reality about ¾ of a complete TV set. You could build your own video and tuner later on and have a complete TV set if you want to. This duplicator has its own controls and power supply circuit. Just hook to any PM speaker. Adjusting the brightness and contrast controls on master TV set does not effect the duplicator unit. We think that this duplicator unit offers you a chance to experiment with TV and end up with a piece of equipment that you will benefit from. The complete kit of parts, less tubes and picture tube; Stock No. FG-19. Shipping weight 40 lbs. Net price $29.95.

Tube kit (except picture tube); 5U4G, 6K6, 3-7N7, (or 6SN7), 6X5, 6AC7. 6BQ6, 1B3 and 6H6. Net price $7.95 extra.

Picture tubes, with the FG-19. Use any size tube, 10, 12 or 16" round or square. See our special prices on picture tubes, elsewhere in this ad. (Bracket for 12" picture tube comes with the FG-19 kit.) It's a simple mechanical adjustment to use other size picture tubes.

Diagram and Photo furnished with kit. Only those who have Radio and Basic Electronic understanding should buy this kit.

TERRIFIC T.V. PICTURE TUBE SALE

16JP4 BLACK FACE $24.95

16JP4 NEUTRAL FACE $22.95

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.

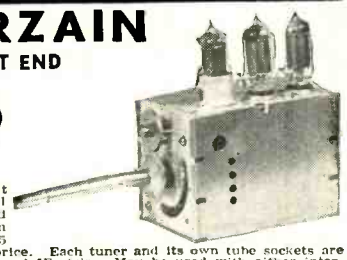
All above tubes are not seconds and pass RMA standards. Guaranteed for 90 days by us. Name of famous maker has been withheld and does not appear on the tubes for obvious reasons.

TELEVISION VIDEO COIL KIT AND TUNER SALE

SARKES-TARZAIN

13-CHANNEL T.V. FRONT END

WITH TUBES AND DIAGRAM $7.95

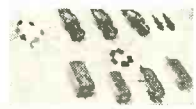


This popular Sarkes-Tarzain television front end is widely used to-day. The 13 channel rotary switch type with individually tuned coils. Price includes a schematic diagram and 3 tubes, 6C4 osc, 6BH6 RF and 6AG5 mixer. Regular factory cost is twice our price. Each tuner and its own tube sockets are wired, 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



TELEVISION VIDEO COIL KIT—20 MATCHED COILS FOR PICTURE AND SEPARATE SOUND I. F. $7.95

20 matched TV coils: video and sound I.F. 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 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.

BUY YOUR RADIO KITS AT McGEE FOR LESS

MODEL 6-ACX6

2 BAND CHASSIS KIT

6 TUBE AC SUPERHET KIT BROADCAST AND SHORTWAVE MATCHED PARTS $11.95

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. 8" Heavy duty PM speaker, $2.95 extra.

10" Heavy duty PM speaker, $3.95 extra. 12" Heavy duty PM speaker, 4.95 extra.

McGEE RADIO COMPANY

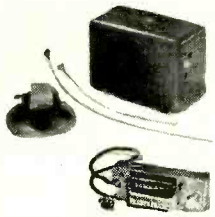
Prices F.O.B. K.C. Send 25% Deposit with Order, Balance Sent C.O.D. With Parcel Post Orders, Include Postage

TELEPHONE VICTOR 9045. WRITE FOR FLYER

1422 GRAND AVE., KANSAS CITY, MISSOURI

BRAND NEW—OVER $80.00 LIST
MOTOROLA 8-TUBE
AUTO RADIO $39.95
With Speaker and Cables

Universal Under Dash Control $1.95 Extra
FITS MOST CARS AND TRUCKS
Push Pull 6K6 Audio 8-Watts Output



Priced less remote control. For all trucks and cars, order our 2A1 universal underdash control, or pick custom controls from our limited selection listed below. Of course you may buy a custom control from your Motorola jobber.

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 $39.95.** 2A1 underdash remote control **$1.95** extra. (Will supply 7", 6x9", or 8" PM speaker in place of the 6" for **$1.95** extra.)

Note: Pick a custom control from our limited list below for **$1.95** extra.

REG. $7.95 DCF-3 FENDER or COWL ANT. $2.95

Regular $6.95, 3 section top cowl or fender mounting antenna. 3 section 56"—only 3½ inches exposed when collapsed. A universal mounting design. May be ordered with your Motorola set or purchased extra for **$2.95.** Stock No. DCF-3. Weight 2 lbs.

10 Assorted Motorola Remote Control Heads $14.95

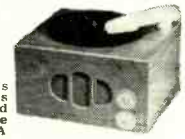
10 assorted genuine Motorola remote control heads with knobs, pilot light, etc. 5 of each type, manual and automatic. Automatic heads: 42 Hudson, 46-47 Packard, 40 Hudson, 46-47 Hudson, 42-46 Cadillac, 42 Oldsmobile, 41 Nash, 41 Packard, 40 Pontiac, 40 Lincoln Zephyr, 40 Nash, 42-46 Lincoln Zephyr. Manual 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.**

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.

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.**

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.**

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). Ballantine 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.

VM-800 78 RPM changers **$12.95.** VM-400 78 RPM changers **$12.95.** Farnsworth 3 post 78 RPM changer with variable reluctance cartridge and needle **$14.95.** Aero-Stewart Werner 78 RPM changer **$12.95.** Crescent Model 350 78 RPM changer **$12.95.**

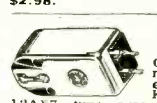
WEBSTER 356-1 $24.95

Brand new in original factory cartons. Only 50 to sell. Webster 3 speed automatic record changers with crystal cartridge and tandem tip permanent needle. Webster-Chicago Model 356-1. Shipping weight 16 lbs. Sale price **$24.95** each while 50 last.

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-408, 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.**



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.**

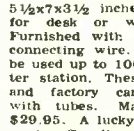
Kit of parts to build 12AX7 type preamplifier, **$2.49** extra.

A lucky purchase by us enables this terrific General Electric cartridge value.

McGEE HAS INTERCOMS AT TERRIFIC PRICES

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.**



Master and Sub $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.**

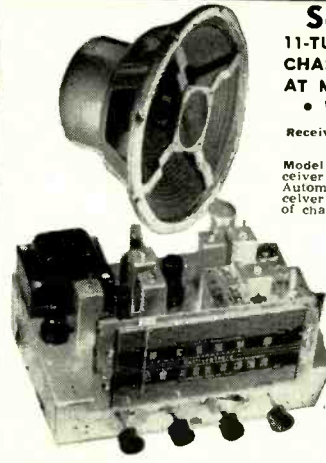
BUY YOUR 556 HALLICRAFTERS WITH A 15 INCH COAXIAL $77.95

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 KC.

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 S-56. Only 4 wires to connect (insirucctions 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.**

BUY YOUR S-56 WITH A CHANGER AND CABINET

Ⓐ **Arm Chair Cab. $29.95** Ⓑ **VM-406 3-Speed $33.21** Ⓒ **Furniture Baffle $29.95** Ⓓ **Radio Changer Compartment $29.95**

Ⓐ Armchair radio-phono combination cabinet. Specify when ordering whether you want the radio panel cut for the S-56 or blank. Size, 24" high, 27" long and 16½" wide. Will hold a changer up to 14" square. Changer panel is uncut. For any speaker up to 12". Radio chassis area is 14" long, 9" high and 10" deep. Top quality furniture construction and finish. Will also accommodate 7B-22 chassis, but not offered cut for same. Walnut armchair cabinet, cut for S-56 or blank, net price **$29.95.** Mahogany armchair cabinet, cut for S-56 or blank, net price **$29.95.** Blond armchair cabinet, cut for S-56 or blank, net price **$34.95.** Shipping weight 40 lbs.

Ⓑ 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 13/16x12¼", 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-408 with All-in-one General Electric Variable Reluctance Cartridge and Twin Needles. Model 406GE. Specify VM406-GE. Add **$2.85** to above cost.

Ⓒ A fine furniture quality speaker baffle, made of ¾" brown mahogany. Will hold either a 12 or 15" speaker. (Specify size speaker you intend using when ordering.) You may buy this baffle by itself or for use with our radio and changer compartment. The two pieces are a matched pair. Set the radio cabinet by your chairside and the speaker baffle elsewhere. You may extend the speaker leads up to 50 feet on your S-56 or any other radio. This baffle is of high quality, non-rattle construction. Stock No. LS-4. Shipping weight 40 lbs. Net price **$29.95.**

Ⓓ Radio chassis and changer compartment (no space for speaker). Intended for use with the speaker baffle on the left, or may be purchased separately if you have some place to put your speaker. Cabinet is made of ¾" brown mahogany and is of furniture quality. It is 25" high, 18¼x17¼". Consists of two drawers, first for the record changer 14¼x14½x6¼ above the motor board; the other drawer has space for radio chassis up to 15" long, 9½" front to back and 8½" tall. We can supply with the radio panel cut for the S-56, the 7B-22 utility chassis, or blank. Specify which when ordering. Stock No. UR-2. Shipping weight 38 lbs. Net price **$29.95.**

McGEE OFFERS YOU A NEW IMPROVED 4-PRONG VIB IN SERRATED ALUMINUM CANS— 1950 ENGINEERING AND PRODUCTION

McGee's new 1950 XX quality vibrators. Extremely long life construction. New assembly technique and design changes makes a more perfect product. Research found that resin vapor attacks the latex rubber boot inside vibrators. This new model eliminates that trouble. A full floating select unit with latex rubber boot and mounting, housed in a new aluminum serrated can. All McGee XX vibrators are unconditionally guaranteed for one year. Priced right, 3 types fill most of your vibrator needs. V-53, standard 4 prong vibrator. Replacement for Motorola, Chrysler original equipment, Mallory, etc. Net price **$1.19** each. VO-13, 4 prong offset, non-sync vibrator. Replacement for Delco 1301 and Mallory 852, General Motors, etc. Net price **$1.29** each. FF-4, small can 4 prong vibrator used in Ford, Zenith original equipment radios. Net price **$1.29** each.

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 bass 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.**

McGEE RADIO COMPANY

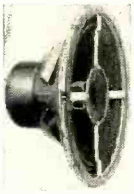
Prices F.O.B. K.C. Send 25% Deposit with Order, Balance Sent C.O.D. With Parcel Post Orders, Include Postage

TELEPHONE VICTOR 9045. WRITE FOR FLYER
1422 GRAND AVE., KANSAS CITY, MISSOURI

AMERICAS BEST VALUES IN

WIDE RANGE PM SPEAKERS

"THEY WOOF AS THEY TWEET"



MODEL P15-8
15 INCH "COAXIAL" P.M. SPEAKER

- NEW 1950 MODEL
- REGULAR $62.50 LIST

$19.95

"IT WOOFS AS IT TWEETS"

REPRODUCES ALL MUSIC AND SPEECH WITH NATURAL CLARITY

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

REPRODUCES ALL MUSIC AND SPEECH WITH NATURAL CLARITY

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 impedance 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 $45.00 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-Kit, 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

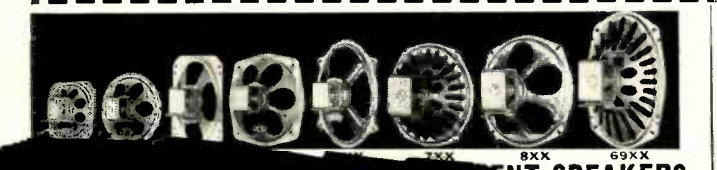
Model A-50, 12" 40 watt super heavy duty permanent magnet speaker. Has 1½", 8 ohm treated voice coil and one piece molded cone. Heavy half inch machined pot, with bolt secured 21 oz. Alnico V magnet. Frame is of heavy construction with metal pot cover. Finished in silver-grey enamel. This speaker is 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**
TWO FOR **$26.00**

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 curvelinear 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. 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**



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3.2 ohm V.C.

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1.69	ea., 10 for	14.95
1.95	ea., 10 for	17.95
1.49	ea., 10 for	13.95
1.95	ea., 10 for	17.95
2.79	ea., 10 for	24.95
2.95	ea., 10 for	27.95
2.95	ea., 10 for	27.95

r single plate
ard size strap

10 for $ 7.50
10 for 9.50
10 for 11.00
10 for 13.95
coil. 4 watt.
..... $4.50

BROADCAST QUALITY TRANSFORMER KIT

Response 18 to 22000 C.P.S. The Same Quality as Used in the Finest Quality Audio Amplifiers

Why Pay More **Sale Price $12.95**

You Get→1. Broadcast Quality Push Pull 6V6 Output. 2. Power Trans., Rectifiers. 3. Filter Choke. 4. Hook Up Data and Suggested Diagram.

If You Build a Music Lover Amp Build the Best

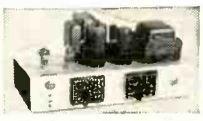
Here is the hottest transformer kit we have ever offered. Originally intended for use in the high priced Lear recorder amplifier. Made of the best possible material to give broadcast station frequency response: 18 to 22,000 CPS. A suggested diagram is furnished to build your own amplifier; with inputs for G.E. variable reluctance phono pickup, crystal phono pickup or radio tuner. Here are the transformer specifications: The output is a compound filled case, 3 x 2½ x 3½" high, weight 2¼ lbs., response 18 to 22,000 CPS, matches 2—6V6 in push-pull (15-watts), output taps match 4 or 8 ohm speaker. The power transformer is a fully shielded upright model, 3½ x 4½ x 4½" tall, weight 8¼ lbs. This transformer is utilized in a full wave selenium rectifier bridge, (easy to hook up, full details included), which delivers 300 volts at 200 mils, with the best possible voltage regulation. Also has a 6.3 volt 5 amp. filament winding. The selenium rectifiers come with this kit. The choke weighs 2¼ lbs. and is the same size as the output. You get full description of the kit, including a suggested schematic. You supply the other parts. We furnish the power transformer, choke, output and rectifiers. Shipping weight 15 lbs.
Stock. No. TD-1822. Net price **$12.95**

WIDE RANGE AMP KITS COST LESS AT McGEE

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**
Wide range output transformer to 8 ohm voice coil **$3.95** extra.

MODEL ZZ-30—30-WATT
Commercial Quality Amp Kit
"Build an Amp Like You Would Buy"

$19.95

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.
Wide range Capehart (regular $7.95) Output transformer **$5.00** extra.

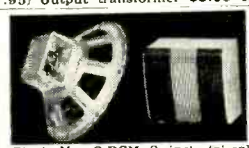
MODEL CN-1232 12 INCH
25 WATT P.M. $5.95

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**.

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**.

SCOOP!



8" Speaker $2.95
8" Baffle $1.95

Stock SE-8X 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.**
8 inch 6.8 oz. Alnico J PM speaker made by Jensen for Bell and Howell. A terrific bargain. Stock No. JEN-8. Net **$2.95, 10 for $27.50.**

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 3⅞x 4½x3". Suggested diagram furnished. Shipping weight 8 lbs. Net Price A-403 **$6.95.**

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 50 watts peak. An Alnico V job that is completely weather and water proof. 1 year guarantee. Impedance 15 ohms. Standard thread 1⅜x18. Sh. wt. 8 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.**

NY 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

Improving Response

(*Continued from page 52*)

teristics. Second, since the impedance source of the "woofer" is pure resistance it has a tendency to smooth out resonant peaks, and to improve transient response noticeably.

Not having access to speaker testing apparatus, I was forced to rely on my ear in determining the final results of this arrangement. Using a steady state frequency test record in conjunction with a *General Electric* variable reluctance pickup I found that tones up to 12,000 c.p.s. were very clearly audible (with reference to a 1000 cycle tone). Beyond this range there was a gradual roll-off until, at 16,000 cycles there was no audible output. Considering the fact that the *General Electric* pickup has an inherent roll-off commencing at the 10,000 cycle region, and remembering that the human ear, itself, loses sensitivity at this point, it is safe to assume that the speaker's response extends with negligible attenuation to at least 15,000 cycles. With proper amplifier equalization, speaker response could be made to extend all the way to 20,000 cycles.

Using the same test set-up it was found that the low range held up wonderfully to 50 cycles, at which point it began to roll-off. Twenty cycles was the lowest audible sound detected.

If you have intentions of trying this circuit on your own speaker, it would be a good idea to first use a variable resistor as the diagram shows. Later, if you desire to make a permanent installation, a potentiometer could be substituted for the resistor and installed in the speaker cabinet. This would allow instant, convenient adjustment of speaker response to suit different program material. A switching arrangement could also be employed whereby this circuit could be cut out entirely and the speakers reconnected directly to the amplifier output terminals in the normal manner. This would permit full output of the amplifier to be utilized in cases where maximum power is required.

Your amplifier should be capable of furnishing at least 10 watts of low-distortion power in order that this circuit can function to the best advantage.

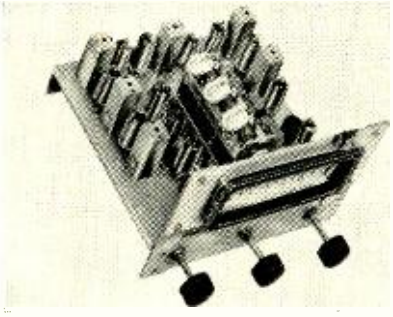
What's New in Radio

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.

FM-AM TUNER

A moderately priced FM-AM tuner is currently being marketed by *Approved Electronic Instrument Corp.* of 142 Liberty Street, New York 6, New York as the Model A-710.

The unit, measuring only 8¼" x 5⅜"



x 8", is particularly suitable for custom installations in confined spaces. The tuner can be mounted either horizontally or vertically and is available with the appropriate scales for either mounting. The tuner covers from 88 to 108 mc. and from 540 to 1800 kc.

Power requirements are 170 volts d.c. at 20 ma. or 140 volts d.c. at 37 ma. and 6.3 volts at 4 amps.

COILS AND CHOKES

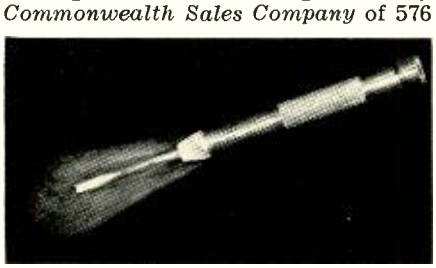
A new line of coils and chokes adaptable to "tailor-made" specifications has been introduced by the *Shallcross Manufacturing Company,* Collingdale, Pa.

Available types include high *"Q"* radio-frequency chokes, progressively-wound slug-tuned broadcast coils, and oscillator coils, all of them having special characteristics which cannot be matched by standard coil types. The r.f. chokes may be made up as two separate coils having a specified coupling coefficient. High permeability iron cores are sometimes used to provide greater inductance in a small unit.

For full details on these new units, write direct to the company.

HANDY TOOL

Service technicians will find the new flashlight screwdriver being offered by *Commonwealth Sales Company* of 576



Broadway, New York 12, New York a handy addition to the tool kit.

Moderately priced, this sturdy hand tool is built for rough usage. Of polished aluminum with a knurled handle and hardened steel blade set in plastic, the screwdriver measures 8¼" overall and has a 3/16" blade.

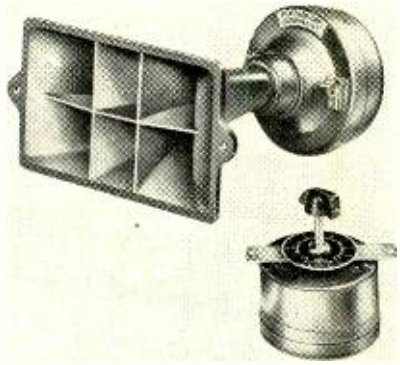
The flashlight, which takes standard batteries and bulbs, permits the illumination of hard-to-see areas in radio and television chassis.

SOUND SYSTEM

Atlas Sound Corp. of 1449 39th Street, Brooklyn 18, is currently introducing a new multi-cellular tweeter reproducer and high pass filter for use in connection with any suitable type of cone speaker woofer.

The horn, because of its six cell construction, offers a wide angle distribution pattern and the response is clean and efficient to 15,000 cycles, according to the company.

The unit will handle 25 watts of program material above 1000 cycles. The die cast sectoral horn with flush



mounting measures 6¾" wide, 3½" high, and 8" deep. The new unit has been designated the Model HR-2.

PORTABLE INSTRUMENTS

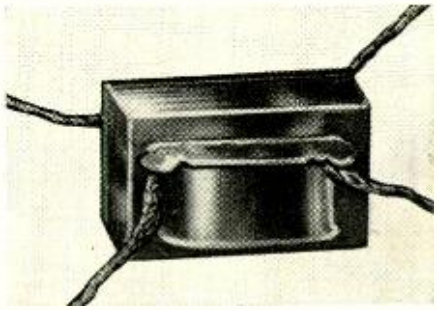
A new line of portable instruments has been introduced recently by *Westinghouse Electric Corporation* of 306 Fourth Avenue, Pittsburgh 30, Pa.

Both single and multiple range models are available in the new line. Ammeters are available in full-scale ranges from 20 microamperes to 50 amperes d.c. and from 5 ma. to 50 amperes a.c. For d.c. voltages, the full-scale ranges run from 10 millivolts to 800 volts, with a.c. ranges from 1.5 volts to 300 volts. Rectifier milliammeters are available in full-scale ranges from .5 to 10 milliamperes, and rectifier voltmeters from 2 to 800 volts.

The meters, which are rated in the 2% accuracy class, measure 3 5/16" wide, 4¼" long, and 1 25/32" deep for the d.c. type while the a.c. meter is the same size except that the depth is 2 5/16". The line, Type P-12, utilizes both moving iron and permanent magnet moving coil mechanisms housed in compact molded cases.

UTC SUBMINIATURES

The development of a subminiature audio transformer, so small that 30 of



the units will fit into a cigarette pack, has been announced by *United Transformer Company* of 150 Varick Street, New York 13.

The *UTC* Type SSO transformer's dimensions are only .4 x .75 x .56 inches and it weighs only .28 ounce. Five stock types cover input, interstage, output, and reactor applications. All of these units are vacuum impregnated to assure dependable operation under high humidity conditions.

INTERFERENCE LOCATOR

A new radio interference locator for the 550 kc. to 30 mc. frequency range has just been introduced by *Sprague Products Co.* of North Adams, Mass.

Designed specifically for use by public utility troubleshooters and others interested in tracking down and eliminating man-made radio noise, the new Model 302 locator is compact and easy to operate.

The instrument uses a sensitive 8-tube superheterodyne circuit and operates either from self-contained batteries or 115 volt power lines. An auxiliary inverter power supply is available for automobile battery operation.

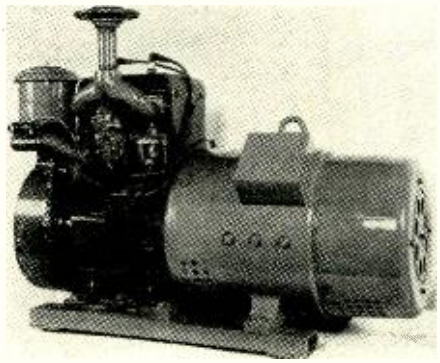
Each locator is supplied with both a loop and a collapsible rod antenna for normal use. An r.f. search probe, insulated for 35,000 volts a.c., is also available for field use as is an audio probe for circulating current faults and cable fault locations.

The unit features a built-in loudspeaker, built-in dual range output meter and battery test meter, calibrated r.f. and audio gain controls, a b.f.o. for detecting unmodulated signal sources, etc.

Bulletin M-446 covering the new Model 302 locator is available upon letterhead request.

POWER PLANTS

Kato Engineering Company of Mankato, Minnesota, has recently added a



new model plant to its line of standby power units.

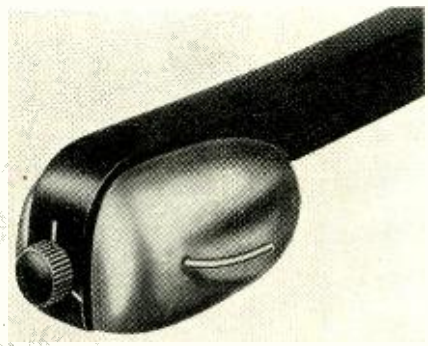
The Model 45HFW4 is a 5 kw., self-excited, a.c. generator which provides 110/220 volts, three wire service, 60 cycles at 1800 r.p.m. The unit is powered with a Wisconsin Model TF, two cylinder, air-cooled engine. The plant measures 37" long, 28" high, and 22" wide.

Because the engine is air-cooled there is no radiator and consequently no necessity for anti-freeze solutions. The engine is equipped with a high-tension magneto which permits hand cranking and there is no requirement for batteries of any kind unless electric cranking is desired in which case that feature is available.

TURRET-HEAD ARM

An answer to the problem of playing back an assortment of 33⅓, 45, and 78 r.p.m. recordings both vertical and lateral without the use of a number of pickups is being offered by *Fairchild Recording Equipment Corporation* of 154th Street & 7th Avenue, Whitestone, Long Island, N.Y., in their Turret-Head Arm.

The new design provides for three separate cartridges all in one pickup. Vertical, standard, lateral, and microgroove cartridges, in any combination of three, can be mounted on a turret contained within the head of the *Fairchild* pickup. Mounting has been made



possible by the miniaturization of the company's moving coil cartridge. A knob on the front of the head is rotated to select the desired cartridge.

Stylus pressure changes automatically to conform with the requirements of the individual cartridges. Another feature of the new arm is the viscous damping used at the pivot point to isolate the pickup from mechanical coupling with the transcription turntable and eliminate tone arm resonance within the audio spectrum.

CRYSTAL CALIBRATOR

Measurements Corporation of Boonton, New Jersey, is now in production on its new Model 111 crystal calibrator.

This new instrument has been designed for the frequency calibration of signal generators, transmitters, receivers, grid dip meters, and other equipment in the range of 250 kc. to 1000 mc. The frequency accuracy is ± .001%.

The Model 111, a dual-purpose unit, not only provides a test signal of crystal-controlled frequency, but also has a self-contained receiver with a sensitivity of 2 microwatts.

The circuit arrangement utilizes the cross modulation products of three

separate oscillators operating at the fundamental frequencies of .25, 1 and 10 megacycles.

MAST CLAMP

A one-piece, self-gripping mast standoff insulator is being produced by *Radio Merchandise Sales Co., Inc.* of 1165 Southern Blvd., New York 59.

The rib-reinforced, integral unit construction is claimed to provide greater strength than that afforded by welded or riveted section types. The clamp is also provided with a plating which is resistant to corrosive attack.

Both twin-lead and coaxial cable can be accommodated in the high-efficiency universal polyethylene insert.

Full details on the new mast clamp are available on request. Send your letters direct to the company.

MICRO-MINIATURES

Smaller than any miniaturized tubulars previously available, the new Type P83Z "Aerolite" capacitors have just been introduced by *Aerovox Corporation* of New Bedford, Mass.

These new micro-miniature units measure only 3/16" in diameter and 7/16" long. They are all made in one size and are particularly applicable to ra-

LOWEST PRICES TUBES and PARTS

29c ea. 1S5, 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! NEW OFFER

10 high list price tubes over $25.00 list value FREE with each 100 tubes LIMITED QUANTITY.

79c each

1B3GT, 1X2, 2A3, 2A4, 3Q5, 6A7, 6AK5, 6BQ6GT, 6E5, 6G5, 6L6G, 6SD7GT, 6U5, 32L7GT, 50A5, 70L7GT, 350B, 807

89c each

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$1.19 ea. 6BG6G, 19BG6G

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, 1U4, 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

59c ea. 0Z4, 1A5GT, 1A7GT, 1C5GT, 1C7G, 1LA4, 1LE3, 1Q5GT, 1T5GT, 1V, 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, 50C6, 81, 83, 117Z6GT, 2050, 2051, 9001, XXB

Less than 50 tubes, 5c per tube extra.

Tube prices are for 50 tubes or more—may be assorted. Individually boxed—Standard factory guarantee.

50L6, 35Z5, 12SK7, 12SQ7, 12SA7 . . . 5 tubes for $2.19

1R5, 1S5, 1T4, 3V4 Battery Tube Special . . . 4 tubes for $1.49

7JP4	$9.95	12LP4	$19.95
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3-Way Portable Tube Kit, 117Z3, 1U5, 3V4, 1R5, 1T4 . . . all for $1.99

3S4, 1T4, 1S5, 1R5 . . . 4 tubes for $1.49

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
6"	$1.49	$1.59
8"	2.95	3.25
10"	4.25	4.50
12"	4.95	5.95

2½", 3", 4"—95c-$1.05

JENSEN 8" SPEAKERS

Jensen 8" Speakers 9 watts output, heavy duty 10 oz. Alnico V magnet . . . $3.25 ea.

Sound Men and JOBBERS, buy them packed 12 to each carton . . . $2.95 ea.

Utah Speaker Baffles—completely enclosed for 8" speakers and smaller . . . ea. $2.00

Jobbers: write for quantity prices.

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Standard Replacement

Regular size 455 Kc . . . ea. 29c

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VIBRATORS

Red Hot Vibrator Special. 4-prong, small size Universal, fits 80% of all jobs . . . ea. 89c

Jobbers: Write for quantity price.

4 PRONG VIBRATORS—VERY BEST BRANDS

Standard Replacement Universal. Sensational Value . . . $1.29 ea.

4 Prong PHILCO VIBRATOR . . . $1.29 ea.

RED HOT VIBRATOR SPECIAL!

Standard small size, 2⅞" in height (the popular small size), bright and shiny . . . $1.29 ea.

Stock up while they last, all 4 prong Universal Vibrators.

OCTAL SOCKETS MOLDED . . . 10 for 49c

7 PIN MINIATURE SOCKETS . . . 10 for 49c

9 Pin Miniature Sockets . . . 10 for 49c

Loctal sockets . . . 10 for 49c

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
2 meg. for battery sets—switch, long shaft	29c	35c
½ meg., 1 meg., 1/10 meg. or 2 meg., long shaft, less switch	16c	19c
1000 ohm	16c	19c
4 meg.	16c	19c
5000 ohm	16c	19c
½ meg. with 6" shaft	49c	59c

VOLUME CONTROL KITS

½ meg., 1 meg., 2 meg., with switches and good shafts. 10 controls for . . . $2.89

½ meg., 1 meg., 2 meg.—long shaft, no switch. 10 controls for . . . $1.59

Special on No. 47 Pilot Lights Only—100 Bulbs...$3.95 Box of 10...54c

PILOT LIGHTS—100 BULBS $4.90

Box of 10 bulbs . . . 54c

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No. 51 6-8 V .20 Amp . . . $3.79 per 100

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Appliance Cord, up to 1,000 watts, 1 rubber plug. 5 for . . . 99c

Appliance Cord as above, with UL label 5 for . . . $1.29

Good Rubber with plug. 10 for . . . $1.25

Underwriters' Approved. 10 for . . . $1.69

SPECIAL—CONDENSER KITS

Kit of 25 BY-PASS CONDENSERS best assorted brands and sizes . . . $1.19

Kit of 50 BY-PASS CONDENSERS very best, assorted sizes . . . 1.98

Kit of 50 MICA CONDENSERS, complete . . . 1.98

100 resistors—packed in a box, IRC, etc. Best values only—½ watt, 1 watt, 2 watt . . . 1.98

SELENIUM RECTIFIERS

Standard 100 mil. Each . . . 79c

PUSH-BACK WIRE 100-ft. rolls . . . 39c ea.

OUTPUT TRANSFORMERS

STANDARD REPLACEMENT

For 50L6, 35L6, 50A5, 35A5, 117L7 . . . 39c ea.

For 6V6, 6F6, 3Q5, 3Q4, 3S4, 3V4, 41, 42, 6K6, 2A3, 45, 6L6 . . . 45c ea.

Additional Standard Replacement Outputs

2000 ohm	39c ea.	8000 ohm	45c ea.
3500 ohm	45c ea.	12000 ohm	45c ea.
5000 ohm	45c ea.		

KIT of 10 Outputs of above numbers . . . $3.90

All outputs match standard voice coils.

UNIVERSAL OUTPUT TRANSFORMER SPECIAL

Up to 12 watts to any speaker (while they last) . . . ea. 98c

KIT OF IF TRANSFORMERS

455 KC universal contains regular and miniature sizes. 10 for . . . $2.69

BY-PASS CONDENSERS

100 Condensers assorted in package . . . $5.95

.001	5c	.0005			
.002	5c	.00025			
.005	5c	.0005			
.01	7c	500 mmf	6c		
.02	7c	250 mmf			
.05	8c	100 mmf			
.1	9c	50 mmf			

600 V. / 600 V. MICA

BYPASS SPECIAL—SOLAR

In lots of 25 or more . . . each 9c

.25 mfd. 600 V. . . . Less than 25 each 12c

400-VOLT BY-PASS CONDENSERS

.05 mfd. . . . ea. 6c

.2 mfd. . . . ea. 6c

.25 mfd. . . . ea. 10c

.5 mfd. . . . ea. 15c

BUFFER CONDENSERS

.005 mfd. 1600 WV

.008 mfd. 1600 WV

.01 mfd. 1600 WV

. . . ea. 15c

VARIABLE CONDENSERS

Two gang for superhet or TRF . . . ea. 69c

Oscillator Coils for any 5 tube AC-DC . . . 19c

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"Your Tube Source Since 1926"

dio-electronic usages calling for extra-tiny, low-capacitance paper capacitors.

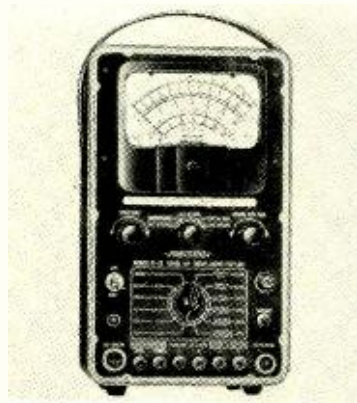
Metalized dielectric is used in place of the conventional foil-paper, providing both dielectric and electrodes. Capacitance is predetermined mechanically in the initial processing. The Hyvol K impregnated section is molded in humidity-resistant thermoplastic. Operating temperatures range from −15 to +85 degrees C.

The units are available in .0005 to .003 μfd., 400 v. and .005 and .01 μfd., 200 v. They may be substituted for usual mica and ceramic types.

TEST UNIT

Precision Apparatus Company, Inc. of Elmhurst, Long Island, New York, has just introduced a new portable v.t.v.m. and multi-range test set, the "Series EV-20."

This portable circuit-testing laboratory has been designed for general electronic, AM, FM, and television applications. It is a complete v.t.v.m.-megohmmeter with true zero-center on all v.t.v.m. ranges, plus direct-reading high frequency scales. In addition it provides full standard 100 ohms-per-



volt functions. The unit provides 48 ranges to 1200 volts, 2000 megohms, 12 amperes, + 63 db. and d.c. v.t.v.m. ranges to 12,000 and 30,000 volts when used with the company's TV super-high voltage test probe.

Full details on this new test instrument are available on request.

GEIGER COUNTER KIT

Science Kits, Limited of 5514 Hollywood Blvd., Hollywood 28, California, has just released a Geiger Counter unit in kit form.

No special knowledge is needed to assemble the kit. Complete and illustrated instructions come with each kit for easy assembling.

The "Searchmaster" kit contains all components needed to assemble the Geiger Counter which is sensitive enough to detect both gamma and beta radiation.

Each set includes tubes, batteries, resistors, condensers, sockets, a type SK-1 Geiger tube, headset, and a metal case which measures 9¼ by 4 by 3½ inches. All parts are laboratory-tested and fully guaranteed by the manufacturer.

A radioactive specimen and a copy of the Atomic Energy Commission's book "Prospecting for Uranium" are also included with the kit.

COMPLETE TEST UNIT

General Electric Company in currently offering a complete test instru-

ment for the service technician which eliminates the need for separate multimeters, r.f. generators, and field strength meters for in-the-field tests on radio communication equipment.

The new Type EX-1-C is designed for use with equipment operating in the 25-50, 72-76, and 148-174 mc. bands. It is housed in a compact steel carrying case and weighs 11 pounds.

One of the primary purposes of this new unit is to align sensitive land-mobile communication receivers which require a very weak signal. The attenuator on this self-contained crystal-controlled oscillator is adjustable down to substantially zero r.f. output.

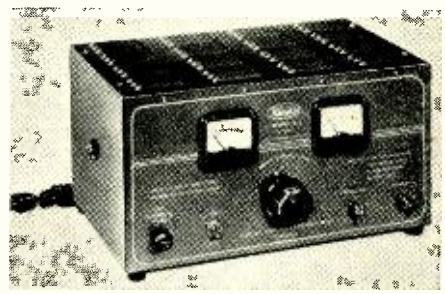
A crystal diode pickup head, supplied with the instrument, permits comparative measurement of antenna power output. The new instrument also contains a full range of current and voltage scales as well as a resistance scale which provides for continuity checks.

The Commercial Equipment Division of the company at Syracuse, New York, has further details on the EX-1-C available on request.

D.C. POWER SUPPLY

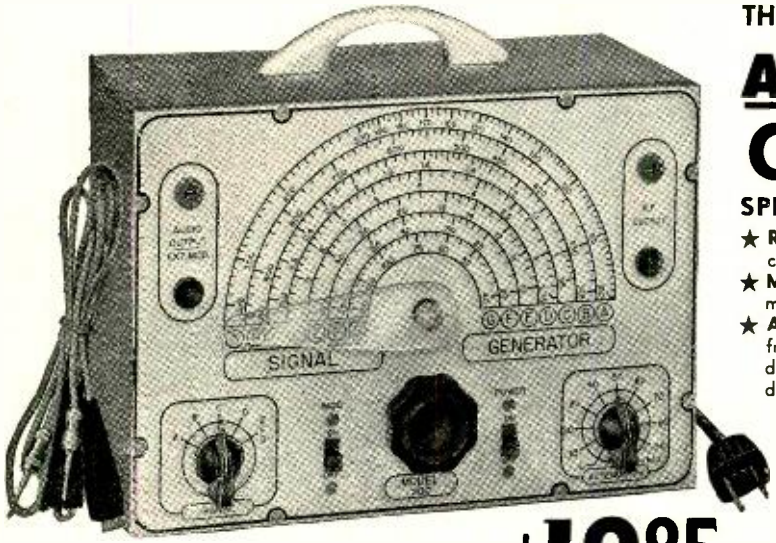
A low-cost d.c. source of filtered power which utilizes the same exclusive application of selenium rectifiers as found in the company's Model "B" has just been announced by *Electro Products Laboratories, Inc.,* 4501 N. Ravenswood Avenue, Chicago 40, Illinois.

Known as the Model "BJ" Junior, the new unit supplies 1 to 12.5 amps., 6



volts continuous duty, with an intermittent rating up to 25 amps. The supply is capable of providing 3 to 9 volts at other ratings, operating from 115 volts, 50/60 cycle power source.

OUR POLICY Every unit we advertise is offered on a strict "money-back-if-not-satisfied-basis." No if's—no but's—no maybe's. If you are not completely satisfied after a 10 day trial—return for complete refund. No explanation—you are the sole judge. Plain enough?



THE NEW MODEL 200

AM and FM SIGNAL GENERATOR

SPECIFICATIONS

★ **R.F. FREQUENCY RANGES:** 100 Kilocycles to 150 Megacycles.

★ **MODULATING FREQUENCY:** 400 Cycles. May be used for modulating the R.F. signal. 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 1/10th 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

Superior's 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—7.5/15/75/150/750/1500 VOLTS. **4 D.C. CURRENT RANGES:** 0—1.5/15/150 MA. 0—1.5 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

SUPERIOR'S NEW MODEL TV-10 TUBE TESTER

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 housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

$39.50 NET

GENERAL ELECTRONIC DISTRIBUTING CO. DEPT. RN-6, 98 PARK PLACE, NEW YORK 7, N. Y. RN-6

GENTLEMEN: PLEASE RUSH THE MATERIAL LISTED BELOW:

Quantity	MODEL	PRICE	
	TOTAL		

Name_____

Address_____

City_____ Zone____ State_____

$..... (Payment in Full Enclosed)

$... (Deposit Enclosed—Ship Balance C.O.D.)

Special features of the power supply include new type heavy duty selenium rectifiers; 8 position tap switch; 0-10 volt voltmeter, 5% accuracy; 0-20 amp. ammeter, 5% accuracy; heavy duty transformer and choke; 2000 μfd. filter condenser, and a readily-accessible fuse.

AUDIO OSCILLATOR

A lightweight, portable audio oscillator has just been introduced to the trade by *Radex Corporation* of 2076 Elston Avenue, Chicago 14, as the Model 500.

This test instrument is *RC* tuned, has an output of 10 volts into 2000 ohms, and an input impedance of 100

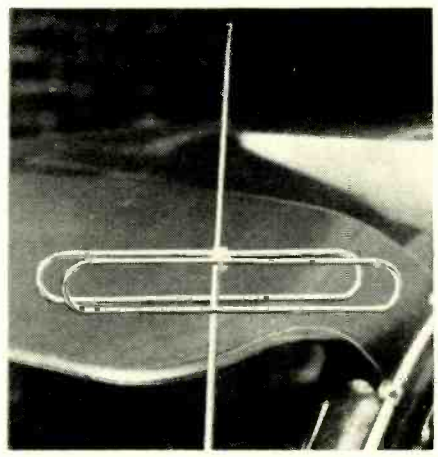
ohms at full output. The oscillator covers the frequency range from 145 to 145,000 c.p.s. in four ranges. Stability is 2% and distortion is ¼ of 1% with high impedance load and 1% with 2000 ohm load. Output variation is ± 1 db. The hum level is 50 db. below signal at any output level.

Housed in a 9x5x6 inch cabinet, the new unit weighs only 8 pounds and operates from any 110 volt, 50 or 60 cycle a.c. source. It uses three tubes, a 6SN7, a 6V6, and a 5Y3.

AUTO AERIAL

Trio Products, Franklin, Michigan, has developed and is marketing a unique radio aerial for an automobile or boat patterned after a television antenna.

The unit is manufactured from five feet of brightly chromed material. This



added length is said to provide clearer and longer distance reception with increased volume.

The new accessory may be attached to any aerial in less than a minute. It retails in the low price class. —30—

BC-603 Receiver

10 tube, superhet FM receiver; Foster Seely discriminator, 10 channel; pretuned, push-button selector; optional manual tuning; adjustable squelch control; speaker mounted in receiver; freq. range 20 to 27.0 mc. Small change in RF trimmers will cover 10 & 11 meter bands. POWER REQUIREMENTS—Receiver 260-280 v. at .08 amps DC, 14 v. at 3.5 amps. AC. **Price $18.95.**

BC-684 Transmitter

30 Watt 10 Channel Push Button Controlled 27-38 MC. Complete with Tubes Price $23.95

Budd 500 W. COILS
40 Meter
80 Meter
$1.78 ea.

OIL CONDENSERS FAMOUS MAKES BRAND NEW

Mfd.	Volt	Price
.15	220AC	$ 2.20
.5.5	400	.50
1	600	.45
6	600	.98
7	600	1.05
.5	750AC	1.69
7	800	1.20
.5	1K	.69
1.5	1K	.75
2	1K	.99
4	1K	.98
10	1K	1.95
15	1K	2.20
.25	1.5K	1.05
1	1.5K	.89
1.5	1.5K	.95
2	1.5K	1.05
6	1.5K	2.25
1	2K	.98
.1	2.5K	1.20
.15	4K	2.95
.1.1	4.8K	2.95
.4	5K	2.95
.1	6K	2.79
.15.15	6K	3.95
1.5	6K	9.75
.1.1	7K	3.39
.1	7.5K	2.95
1	7.5K	12.95
.15.15	8K	4.95
.1	10K	14.95
.0016	15K	7.95
1	15K	30.95
.015	16K	6.95
.25	20K	16.95
.5	25K	36.95
1	25K	83.95
4	50	.29
1	100	.15
2.5	100	.23
	200VDC	
2x.1	2ST	.15
2x.1	3TT	.15
2x1	4ST	.16
2	2ST	.20
.5	2TT	.15
.5	2ST	.15
	400VDC	
2x.25	3ST	.21
2x.1	3ST	.21
2x.1	2TT	.20
3x.1	3ST	.25
.1	2TT	.19
.5	1TT	.19
1	2ST	.23
2	2ST	.26
	600VDC	
.1	2ET	.20
.1	2ST	.21
2x.1	3ST	.27
2x.1	3BT	.25
2x.1	2ST	.26
3x.1	ST	.25
2x.25	3ST	.23
.25	2TT	.20
1	2ST	.30
2x1	3ST	.35
2	2ST	.40
2	2BT	.39
	1000VDC	
1	2ST	.45
MANY OTHERS		

MICROWAVE

WRITE FOR FLYERS OF SURPLUS PLUMBING AND ACCESSORIES

★ SPECIALS ★

ELECTROLYTIC CONDENSERS

D. Y. Type Prong Mount 18c ea. 10 for $1.75

MFD.	VOLT	MFD.	VOLT
40	150	40	250
80	150	30	300
10	200	80	350
8	450	10	450
16	450	15	450
20-20	25	30-30	25
10-10	150	20-10	150
20-20	150	40-20	150
40-40	150	50-30	150
20-30	250	20- }	350
3X20	150	10- }	300

Write for Many Others

Silver

Feed	
Thru	
50	
500	
470	
Button	
40	100
180	200
115	500
185	
100 for	
$8.50	

29c ea. 10 for $2.75

MFD.	VOLT	MFD.	VOLT
6	400	60	300
50	400	30	450
40	450	32	450
30-20	150	30-30	150
50-50	150	70-30	150
20-20	350/25	30-20	350/25
20-20	400/25	10-10	450
40-20-10	150	40-20-20	150
40-30/20	150/25	40-30-20	150
50-50/20	150/25	3X50	150
60-40/10	150/25	40-20/100	150/10

WRITE FOR MANY OTHERS

AC CONDENSERS

75-84	125	1.30
20-24	110	1.00
26-30	110	1.00
31-37	110	1.00
38-42	110	1.00
43-48	110	1.00
43-65	110	1.25
50-75	110	1.25
72-87	110	1.25
86-96	110	1.45
88-106	110	1.50
107-129	110	1.75
124-138	110	1.75
130-150	110	1.75
130-180	110	1.90
161-180	110	1.75
158-191	110	2.00

Write for many others.

TELEVISION CONDENSER

Mfd	Volt	Price
5000	1.5	$1.20
1000	3	.85
500	6	.45
2000	6	1.35
225	15	.30
100	50	.95
1000	15	.85
500	50	.95
6000	12	1.35
9000	12	2.00

Write for Flyer of 100,000 New Electrolytics in Stock.

MINICAPS PIGTAIL

Mfd.	Volt	Price
30	450	$0.49
30	300	.45
30	350	.48
40	450	.50
40	525	.70
16	350	.35
16	525	.45
16	450	.40
16	100	.24
20	25	.20
20	80	.25
20	450	.40
24	350	.30
8	400	.30
8	150	.15
10	150	.20
10	50	.15
4	50	.10
4	150	.14

932 PHOTO TUBE

Gas Photofotube having S1 response, particularly sensitive to Red and Near Infrared Radiation. Can be used with incandescent light source. Send for Data. **75c**

Price .....

SENSATIONAL BUY BUYS

Silver & Mica Cndsrs	.30/$1.50
Controls,500hmTo2Megs.	.10/ 2.00
Resistors,½&1W, to 2 Megs.	.100/ 2.50
Vitreous WW Resistors	.20/ 1.00
Rotary Switches,Asstd	.6/ 1.75
Coil Forms,Thd'd SM,HF	.50/ 1.00
Iron Core Slug&Screw	.50/ 1.00
Elastic Stop Nuts, Asstd	.50/ 1.00
Ceramicon Cndsrs,Asstd	.15/ 1.00
Fuses,Asstd LF&Buss	.300/ 1.95
Grommets,Rubber Asstd	.100/ 1.00
Solder Lugs, Large	.100/ .55
Solder Lugs, Small	.100/ .35
Asst Hdware	1 lb/ .75
Terminal Strips	.25/ 1.00
Metal Washers	.200/ .30
Mounting Brackets	.50/ .70
Cable Clamps	.50/ .45
TogglePushSlideSwitches	.10/ .95
Ferrule Resistors	.10/ .95
Trimmer Cond	.100/ 2.95
Asst. Popular Bath Tubs	.10/ .95

MOUNTINGS

FT 234A For 274N Trans
FT 232A For 274N Trans
FT 229A For 274N, BC442
FT 225A For 274N, BC456
MT 62 For ARC/5, ARR2
MT 78/ARC5 Control Unit
MT 85/ARC5 Junction Box
MT 141 8¾x4¾
MT 80/ARC5 Junction Box
MT 65/ARC5
MT 76/ARC5
MT 63/ARC5
MT 69/ARC5
MT 68/ARC5
FT 282A P/o SCR 518A
FT 308A P/o PE119A
MT 187/U SAR
FT 340 P/o SCR 540
FT 265A P/o BC-701
MT 171A/U SAR
MT 7/ARR2 R4/ARR2
MT 5/ARR2 6¾x10¾

Write for Many Others

Ceramicons Mmf.

1
3
3.1
4
5
6
7
8.5
11
15
20
24
79
115
125
150
180
200
25
27
35
30
47
50
57
58
60
62
67
70
220
240
250
350
1000
100 for $6.50

6V Input Dynamotor

Output 150V/75MA or 12V Input, 500V/50MA Out **$3.49**

VEEDER COUNTER

Counts to 9999 and repeats. Many uses. ¼" shaft front meas. 1" x 1¼". **Price 98c.**

RE - 2/ARC5 Ant. Sw. Relay w/current meter 19.5 milli-volt movement. current XFRMR & Thermocouple used w/ any Rig. **$3.49**

Hi-Gain Dyn Mike Xfmr UTC / Super Elec 3Wdg 600 CT & 4000 ohms tapped 250&150 ohms. Fully Shielded Herm. Sld **49c**

2 for 95c
10 for ..$4.50

Electric Motor

115V 60Cy 3500 RPM ¾" Shaft 3¼x2x1⅝

$1.95 Each

AUDIO XFRMRS

UTC 80707 ouncer Pl. to Mult. Gds. $1.29
5119—Ouncer Pl. to line .49
901—Pl. to V. coil ..... .75
6262—Pl. to Hdst or line .69
5640—Mike or Line to Grid 1.29
T202—6V6 Pl to 811 Gds. 1.45
765—Line to Grd ..... .98
25—Pl. to Line ..... .98
837—1:1-1:2 Ratio ..... .75
622—1:2.28 Ratio ..... .75
Many Others—Write

GIBSON GIRL

The Emergency Radio Transmitter. Sends S O S signals automatically on 500KC. 150-mile range. No batteries required. Has hand-driven generator, tubes, wire. New. It's only **$3.25**

ARC 3 complete Audio Modulation XFMR pkg. T103 Carbon Mike to Grid ..... $ .95
T102 6J5 to PP 6L6 Grids (Modulation) 1.15
T104 Mod. XFMR PP 6L6 to 832 or 8298 Plates 1.49
COMPLETE KIT OF THREE **$2.98**

SCR-522 100-156 MC. RECEIVER AND TRANSMITTER

One of the most interesting and useful pieces of surplus equipment. Designed for plane and ground station use, this unit offers remote control of pre-selected crystal controlled frequencies in the spectrum of 100-156 Mc. This spectrum covers facsimile. air navigation aids, airport control, railroad, police. urban telephone, as well as the amateur band 144-148 Mc. October 1948 Radio News gives details for converting the SCR-522 receiver section. BC-624.

Transmitter section, BC-625, is voice amplitude modulated and has an output of 8-9 watts. Tubes used and included: 2—832, 3—12A6, 1—6G6, 2—6SJ7, 1—12J5GT, 3—12SG7, 1—12C8, 1—9002, 3—9003, 1—12AH7GT. **$33.95**

XFMR POWER SUPPLY KITS

Trans. 1080V/55Ma, 6.3V/1.2A, 6.3/1.2 A. 2-.1 Mfd 2500V 2X2 Tube, Socket, 1-100000 ohm Resis. Price **$6.95**

Trans. 2300V/4Ma, 2.5/2A. 2-.1 Mfd 7500V Pyr. 2X2 Tube, Socket, 1-100000 ohm Resis **$8.49**

BASIC 15 WATT POWER KIT

Pwr. Supply contains Trans. 600VCT/.155 MA, 6.3V/5A. 5V/3A, 2—7 MFD 600V. Dual Choke, 10HY 200MA, 5T4 Tube, Socket. Price **$6.95**

BASIC 50 WATT POWER KIT

Pwr. Supply contains Trans. 820VCT / 200 MA. Dual 10HY 200 MA Choke, 2 — 7MFD 600V. 5T4 Tube, Socket. Price. **$8.95**

250 MA 1100VCT KIT

Contains Xfrmr 550-550V 250MA 6.3V/1.5A, 200 Bias, 2—10HY Chokes 2—4MFD 1000V Cond. All for **$10.95**

1619—1619—1619

Octal Base Pentog Aversatile High Perveance Tube. **21c**
5 for....New $1.00

Meter Cabinet

For BC221 Freq. Meter. Brand New Wood. 14½ll x 10½W x 10D. Value $20.00. Only $2.95

Birtcher Tube Clamps

926C-24
926—C15
926—C13
926B

11c ea. 100 for $10.50 1000 for 10c ea.

926C
926—16
926—B1
926—82
926—B8
926B—16
926A—14
926C—19
926A
926—C1
926—A11

ARC/5 PARTS

80 Mtr. Xmitr. Conv. Kit. $1.50
Fuses, 10A, 3AG ..... .04
Condenser Kit. 4—3X-.05, 1-15 Mfd. ..... .75
Cond., .05-.01-.05 ..... .19
Cond., 3X .05 ..... .19
Mod. Xfrmr. 807 to Parlel 807 ..... 1.00
Xmttr. Rack 1.79
Shock Mts. for Rec. ..... .29
Control Cable 1.19
Modulator, w/Dyn. & Tubes. New 7.95
Parasitic Suppressors ..... .10
Dial Plates, Rec. & Trans. 190-550 Kc. ..... .10
Plates for Control Box, 190-550, 6-9.1 ..... .10
Kit of 2—5 Mfd. Cond., 1—Choke 5634, 1—Trans. 692327-1. 1—Choke 5546 ..... .98
Control Box Switch ..... .15
Neon Ind. Bulb ..... .15
15 Mmf. Trimmer ..... .49
Relay, 24V Dpdt ..... .59
12SK7 Tube ..... .59
12SR7 Tube ..... .29
12A6 Tube ..... .59
12SF7 Tube ..... .59

PLUGS FOR ARC-5

9821—8 Png, Female ..... .55
6418—8 Png, Male ..... .30
6577—8 Png, Female ..... .55
5577—6 Png, Male ..... .30
PL154A—12 Png, Female ..... .55
PL154—12 Png, Male ..... .45
W/15U—16 Png, Female ..... .55
PL148A—3 Png, Female ..... .35
7027—18 Png, Male ..... .30
PL147—2 Png, Female ..... .50
6967—5 Png, Female ..... .50
Small—3 Png Chassis, Female ..... .10
Large—3 Png Chassis, Female ..... .15
Chassis—6 Png, Male ..... .15
7025—12 Png, Male ..... .30
FB103442—5 Mfd. ..... .19
.85 Mfd., 600V ..... .23
5413—3X .22 Mfd. ..... .49
10247—.35 Mfd. ..... .19
7582—3 Mfd. ..... .19
3X .05 Mfd. ..... .19
2933—4X .8 Mfd. ..... .29
7324—Variable Cond. ..... .95
7321—Variable Cond. 1.95
5032—Variable Cond. 1.25
6558—Variable Cond. 1.95
5546—Rec. Choke Assy., RF ..... .49
5634—Rec. Choke Assy., AF ..... .49
6385—Relay Spst. ..... .69
MC211A—Right Angle Drive ..... .50

VFO FOR BC 221 FREQ. MTR.

Unit contains two temperature and moisture compensating coils, wafer switch, 3 variable condensers, carbon resistors, and silver mica condensers. FULLY WIRED and mounted on sturdy aluminum sub-chassis, ready for installation. Brand new—in original packing **$6.95**

BC605 INTERPHONE AMPLIFIER

Easily converted to an ideal intercommunications set for office—home—or factory. Complete w/conversion diagram for 110V operation. Brand New **$4.75**

Aircraft Rec. or Xmittr (RU/GF) for Mobile or Aircraft Covers 187—13,950 Kcs by interchange plug in tuning units Less Tuning Unit ..**$3.95 ea.**

RU/GF (SCR 183) REC. TUNING UNITS

D—Range 850-1330 Kc
E—Range 1330-2040 Kc
F—Range 2.04-3 Mc
G—Range 3-4.5 Mc
H—Range 4-6 Mc
K—Range 9.05-13.5 Mc
Dual Range 400-600 Kc 6-9 Mc
$1.95 EACH
3 For $5.00

RU/GF (SCR 183) TRANS TUNING UNITS

1-1.2 Mc $1.49
1.2-1.5 Mc 1.49
3.2-4 Mc 1.49
5-6.2 Mc 1.49
3 For $4.00
4-5 Mc w/4495 Ks XTAL 2.95
Many Others

TUNING UNIT FOR BC 223

TU 18A 3-4.5 MC. $2.50
TU 25 3.5-5.2 MC. 2.50

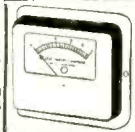
SPECIAL XFMRS

Trans 115V/60 cy Sec. 24V/1.5A. For ARC 5, etc. ..$1.95
Trans 115V/60 cy Sec. 36V/3.5A. For Rect. etc. $2.75
Trans 115V/60 cy Sec. 720 VCT / 220Ma. 6.4/8.7A, 6.4/.6, 5V / 3A. 1.25/3 ..$2.95

RF CHOKES

1MHY/125MA ..$0.23
1.9-2MHY ... .10
2.5MHY/500MA ... .89
3.2MHY ... .10
3.3MICHY ... .10
3.65MHY ... .10
5.2MHY/200MA ... .39
5.5MHY/500MA ... .98
6.4MHY ... .10
10MHY/350MA ... .39
20MHY ... .18
94MHY ... .10
115MHY/150MA ... .39
MANY OTHERS

T.V. Transformer 7" or 9" scope 3000V / 5 MA, 720 VCT / 200 MA, 6.4 / 8.7A, 6.4 / 5/3A, 1.25 / .6A, .3A. New. Pr **$3.95**



0-5MA SQ 2" Metal Case or 0-5 volt readrite meter **98c**

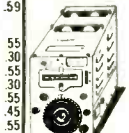
BC-733-D

Localizer receiver of the blind landing system. Companion to the glide path receiver. Also contains 90 and 150 cycle band-pass filters. 108.3 to 110.3 mc. by easy selection of crystals in the local oscillator. Wide pass-band on 6.9 mc IF's ideal for FM. Has a wonderful AVC system using rectified output of an RF oscillator as power supply for 100 volt DC bias. With relays, and 10 tubes: 3—717A, 2—12SG7, 1—12SQ7, 1—12A6, 1—12AH7, 2—12SR7 Condition: Used, excellent, w/ DYN $6.95. only **$4.95**

SCR610 Mobile FM TRANSCEIVER—Includes 10 meter band. Excellent condition with tubes **$15.95**

PE-120 Power Supply — Less Vibrator and Con. Tubes **$5.50**

Combination BC-620 and PE-120. Both for..... **$20.95**



ARC/5 Transmitters 40 Watt Output These Famous V.F.O. Drivers Available

2.1—3 MC **$7.95**
3—4 MC 7.95
Used. Good condition w/tubes.

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Sensitivity is 2-6 microvolt 6 tube Superhets w/12SK7 RF Amp. 12K8 Mixer 12SK7. 1st IF Amp. 12SF7. 2nd IF Amp. 12SR7 Detec. FO. 12A6 Audio Amp. Used. Good condition, w/ Tubes.
190—550KC **$7.95**
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3—6 MC **4.95**
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UHF Rec as is condition (Fair) **11.95**
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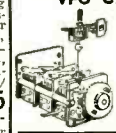
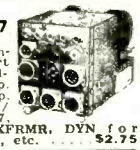
ARR2 Homing Receiver
W/Dyn 334-358MC **$5.95**
Less Dyn **3.95**

VFO CAPACITOR



High Grade Unit. Consists of 3 Gang Capacitor 240 mmf per sect. Ceramic ins. Low drift w/Worm Gear (reduction) 120:1 w/ext Shaft and Vernier 4 digit Counter. **$3.95**

RL 9 or RL 7



Interphone Amplifier Convert to High Fidelity Phone Amp. or Spch. Amp. Compl. w/ 12A6, 12SL7 2 Chokes, 1XFRMR, DYN for 24v operation, etc. **$2.75**

EE65E Telephone Test Set

To locate any kind of trouble on Tel. lines, can be used as telephone. Includes ringing circuit meter, etc. A valuable unit. **$19.95**

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Used to extend range of field telephones. Simplex Teleg. and 20 cycle ringing possible over lines equipped with unit. Supplied w/3Q5 tube. Phone supplied (Featherweight) **$9.75**

Navy ARB 4-Band Rec. 195KC to 9 M.C.

For Ships, Planes, Mobile, etc.

Most Ideal of All Surplus Receivers

You can convert this over easily to a good ham receiver. It's one of the hottest values in surplus receivers. 28 volts DC input. Covers 4 bands. 195 kc to 9 mc. This is a deluxe type superhet receiver, note that the frequency coverage includes the standard broadcast band. Has 4 gang tuning condenser; can be converted to a 110 volt AC receiver. Priced complete with tubes: 12SF7, 12SA7, 3-12SF7 and 12A6. Has dial built on front of chassis. Electric driven or manual band change switch. Weight 28 lbs. Size 6x7x15 inches. ARB with tubes and dynamotor. Used. Fair condition. As is **$16.95**

CUSTOMERS Can Be Friends, TOO!

By PHIL HINER

Your customers can be a real and valuable "capital" asset. Treat them right and you'll stay in business.

IF YOU are one of the fellows who makes a living selling radio and television service, you're well acquainted with the customer who screams to high heaven that he's being robbed and anybody else would have done the job for half the price, and he has half a mind to report you to the Better Business Bureau, et cetera . . . You'll doubtless agree that he has half a mind, you may even tell him so, should he happen to be the fifth or sixth weeper you've encountered during the day.

Now looking at this oft-repeated drama with cold, business logic we know that while telling an irate customer to go jump may give us a measure of personal satisfaction, it isn't exactly a wholesome business practice. We need our customers, even the screaming ones. Although his disposition isn't as good as the next fellow's, his money is!

How, then, to collect the cash—and a smile at the same time? We have here a problem that has been pretty generally ignored by both the profession and those who write for the profession. Outside of knowing our craft it's the most important daily problem we face. It's not only the one customer we lose that hurts; he may, in an attempt at self-justification, blackball us with a half dozen cronies.

It's a serious problem, too, from the standpoint of what it can do to you. I've talked to hundreds of technicians during my years in the profession and the conversation invariably turns to the unreasonableness of customers and their inability to understand that a technician must collect more than fifteen cents for installing a fifteen cent coupling condenser. I talked to a shop owner the other day who told me that he just lost his best technician via the nervous breakdown route. And it wasn't troubleshooting that cracked up his boy.

So, you ask, what can I do about an irate customer? It's his disposition that needs a retread, not mine.

Actually, there's a lot you can do. Try the suggestions outlined here and I guarantee you'll be amazed at your control over situations that too often turn an otherwise pleasant profession into something distinctly unpleasant.

In the first place why does the customer holler? Let's analyze the basic cause of his unhappiness. To this question most technicians would immediately answer he thinks he's been overcharged. Could be, but I'm going to be different and say that that's not the reason but merely the line he follows once the argument gets underway. In nine out of ten cases it's the element of uncertainty, nothing else, that brings on the tempest. Call it a feeling of insecurity in business relations, if you like, because you the technician set the price, on your own terms, and he the customer is at your mercy with no clear-cut recourse.

Mr. Average Customer knows he has a radio in for repair but he doesn't know what it will cost him. Human nature being what it is, he expects the worst. He returns for his property in fear and trembling, hand hovering protectively close to his pocketbook. In short, friend, he's already in the mood for an outburst and the stage is set for same even before he gets the bad news.

Psychologically, this set-up is all wrong. If the customer could be given in advance some assurance of a fair charge within certain definitely prescribed limits he would resign himself as he does to the cost of his daily bread or cigarettes. He would enter your shop in the same gentle mood as his wife enters the grocery.

Setting up this idyllic situation is not at all difficult. And you don't have to worry about expensive and time consuming estimates, either. Let's begin with the small a.c.-d.c. set which makes up a goodly percentage of your business. The great majority of these sets are fixed for $5 or less. As you know, one new tube usually brings this set back to life and you will probably, in addition, touch up the alignment, treat the volume control with contactene, clean the tuning condenser, tighten the dial cord, and clean the dial face and cabinet. Some of your customers ask for an exact estimate, others do not. Eliminate this confusion by explaining to each one as they bring in their sets that it is your policy to call the customer if repairs amount to more than $5 but to go ahead with-

out a call if it can be done for that amount or less.

It's a rare customer, indeed, who won't agree to this. And with agreement all basis of argument is dissolved. Your man knows it may cost him a fiver, maybe less; he's prepared mentally. If it's under $5, he's agreeably surprised. You're a fine fellow.

There's an interesting variation of this idea I would like to pass along. One shop owner of my acquaintance advertises with flamboyantly colored signs—*ANY A.C.-D.C. SET FIXED FOR $3.50.* He does a big business and claims it's a paying proposition for although he loses money on some sets he more than compensates for it by increased business, time saved by eliminating estimates and calls, and the large number of jobs which require but little servicing.

On larger sets carried into the store, I set a limit of $10 before making a special call. If the customer will not agree to this limit I find out how much he is willing to spend. If I can do it for that and make money —well and good. If not, I at least retain his friendship.

House calls on floor model combinations require a different customer technique. You have a definite charge for house calls, don't you? Tell your customer what it is when he calls for service. Once in the house and you discover that the set must go to your shop don't be afraid to give your customer a rough idea of what to expect by way of charge. Believe me, that's what the little woman's worried about! If there's any dissent, better to have it now than after the job is done. By making a few simple checks any competent technician can eliminate as the probable source of trouble the more expensive components such as speaker or power transformer. And what does that leave? Condensers, resistors, small coils. . . . Give the lady a rough estimate. If, as will occasionally happen, you miss by a country mile, get on the phone and explain. She'll respect you more for the interest you show.

Most of us are charging more for television than for straight radio service. That's as it should be and most customers expect it. Again, don't be timid in stating the facts. We in the radio and television business could take a lesson from some of the other service professions. Did you ever watch a plumber operate when he comes into your home? He can make a $200 estimate without batting an eye. Nary a blush, either. The radio technician himself has made his the lowest paid of all service professions largely by his apologetic attitude. We have nothing to apologize for. Ours is a profession that takes brains, skill, and a highly technical knowledge.

Practice a little psychology on your customers. They'll like it. The art of handling people consists chiefly in recognizing their wants, likes and dislikes, and acting accordingly. First

and foremost, people crave respect so treat them with courtesy and genuine interest. Don't act bored, indifferent, or superior. Here is the most common fault of clerks who meet the public today. When the lady drops her set upon the counter and tells you it needs a new condenser—and how much is a condenser, please—don't exhibit contempt for her lack of knowledge but patiently explain that her set contains dozens of condensers of varying sizes, shapes, and functions. Maybe you don't know what's inside of a watch, either!

Don't overlook another courtesy—the statement that should accompany the finished set. Put it in writing! Give your customer a bill itemizing repairs, parts used, and cost breakdown. You're not ashamed of it, are you? A statement is dignified and business-like. People like to know how they spend their money. They feel better if they think their cash outlay is well spent.

One parting needle. When you do get into an argument, take the few minutes that you usually spend afterwards mentally condemning the customer to a fiery oblivion to analyze the situation. What went wrong? What different approach might you have used to prevent the unpleasantness? A little hindsight, later applied, can prevent recurring incidents of this type and the subsequent loss of customers that inevitably follows.

Let's eliminate the squawks. Give this problem a little thought and you'll undoubtedly come up with some ideas of your own. Your customers can be your friends, too. It'll mean more money in your pocket, greater peace of mind, and best of all it doesn't take one cent of additional capital.

—30—

ADDING A PM SPEAKER

By R. L. PARMENTER, W1JXF

HERE IS a little kink that might prove helpful to owners of some models of war surplus receivers. Most of these units had output jacks for phones only. A PM speaker may be used without digging into the "innards" of the receiver.

One of the small transformers that are used on the HS-30 earpiece-type headphones may be used as an output transformer by replacing the headphones with a small PM speaker. There is an impedance mismatch but it is not serious enough to interfere with fair communications quality.

Mount the transformer in the same case as the speaker. A cord with the phone plug will be the only connection coming from the speaker case. Changeover from phones to speaker is made by inserting the proper plug.

Even better quality and output may be obtained by using other transformers, some of which were not originally designed as output transformers. The author has used filament transformers of various sizes as well as a small vibrator-type power transformer for this particular application with fair-to-good results.

—30—

International Short-Wave

(*Continued from page* 60)

which issues a bi-monthly club bulletin. While the chief aim of this new organization is to foster DX-ing in Canada, the club welcomes members (both SWL's and hams) from anywhere in the world. Each year it will have at least one contest reserved for Canadian members. Details can be obtained from R. Orville Lyttle, 140 Lake Street, North Bay, Ontario, Canada, who comments that "the CDXC is *not* an organization for profit, but a club that belongs to all members." The CDXC already has members in four Canadian Provinces, the United States, England, and Northern Ireland.

USA—The *Newark News Radio Club* will hold its annual summer convention and outing on Sunday, June 25, at the home of Vice-President and Mrs. Harold Robinson, Mapine Farm, Lansdale, Pa. Director Dick Daneker, also Lansdale, is helping to plan the session.

* * *

This Month's Schedules

(*NOTE:* By this time, many stations will be operating on Summer Time in which cases you may find schedules *one hour earlier* than listed herein.—KRB)

Algeria—Radio Algerie, 9.57, is fair to poor in Chicago in French 1730-1800 sign-off; French news 1745, and identifies as "Ici Radio Algerie" just prior to sign-off; closes with "La Marseillaise." (Lambach)

Angola—"Radio Clube do Huambo," Nova Lisboa, has dropped its 31-m. channel and has moved to approximately 11.925; heard in South Africa with excellent signal 1315-1530; also has "afternoon" session around 0700-0800; identifies as "Acqui Nova Lisboa, Radio Clube do Huambo" at frequent intervals. (Laubscher) This one is still a good signal afternoons in Conn. (Boice)

Argentina—SRI, Buenos Aires, now transmits daily programs in Swedish at 1225-1330 and in German at 1330-1430 on 15.290. (Radio Sweden)

Australia—VLX2, 6.130, Perth, heard 0315-0330 with sports news, then weather report. (Cox, Dela.)

Austria—The Blue Danube Network, Salzburg, noted back on 9.530 at 1755. (Pearce, England)

Azores—Summer schedule for Ponta Delgada is 1400-1500 on 7.015. (Pearce, England)

Brazil—Grove, Chicago, says PRL5, 11.95, has *not* "replaced" PRL5, 9.770; he recently heard the 11.950 outlet closing 2030 with choral music; the 9.770 outlet closed 2130 (as always) with military band selection (as always).

British Honduras—Ferguson, N.C., says the schedule of ZIK2, 10.598, Belize, varies from day to day but appears approximately 1315-1415.

British Somaliland—Radio Somali, VQ6MI, 7.125, Hargeisha, has brass band recordings from around 0820 for

modulation purposes; has program in Somali *(only)* 0830-0930. (Bluman, Israel, via ISWC, London)

Burma—Rangoon, 6.035, heard in California 1000 with news. (Baker)

Canada—CBNX, 5.97, St. Johns, Newfoundland, noted in Quebec City at 1600. (Gauvreau)

CFVP, Calgary, Alberta, operates on 6.030 at 0830-0200 relaying medium-wave CFCN, 1060 kc., and announces "Dial 1060, CFCN, Calgary"; power is 100 watts and operates into a Hertz antenna 20 ft. high. Station has had reports from all over the world; QRA is CFVP, c/o CFCN, The Voice of the Prairies, Ltd., Toronto General Trust Bldg., Calgary, Alberta, Canada. CBRX, 6.160, Vancouver, British Columbia, heard with news 0000. (CDXC)

China—Another *new* Chinese outlet has been heard on approximately 6.630 at 0845; other Chinese outlets noted in parallel recently at 0915 were 5.985, 6.090, 6.155 with talk in Chinese. (Rosenauer, Calif.)

Cuba—COCH, 9.437, 5 kw., states it is out of verie cards but enclosed rate card as souvenir; QRA is Union Radio, S.A., Prado Num 107, Habana, Cuba. (Taylor, Ill.)

Cyprus—Bluman, Israel, has heard FBS, Middle East (formerly testing on 11.850) more recently on 12.040 testing around 0330, calling Malta and Fayid (Suez Canal Zone). (ISWC, London)

Ecuador—QRA for HC1AC, 6.210, is Radiodifusora La Voz de la Democracia, Apartado 288, Quito, Ecuador. (Taylor, Ill.)

Egypt—SUX, 7.863, Cairo, noted in N.C. from tuning 1608 to sign-off 1620; Arabic and Eastern music. (Ferguson) Also reported by Oskay, N.J.

El Salvador—YSUA, 6.250, has QRA of YSU, Radio Mil Cincuenta, La Avenida Sur No. 50, San Salvador, El Salvador, C.A. (Taylor, Ill.)

France—In connection with changes in long- and medium-wave frequencies according to the Copenhagen Plan, Paris has started broadcasting its *English* program at 1400-1515 on short-wave 6.200 instead of on m.w.; programs are of high entertainment value with selections from the Home Service, serial story, French lessons, a weekly quiz, and so on. (Radio Sweden) Fine signal in Britain. (Pearce)

French Equatorial Africa—Radio Brazzaville's 17.84 channel noted signing off 1600 instead of former 1700. (Balbi, Calif.) ISWC, London, says now has news 0115, 0515 on 15.595; at 1315, 1550 on 11.972, 9.440.

French West Africa—Radio Dakar, 11.897, is now scheduled 0200-0300, 0700-0830, 1320-1800 daily; on 15.340 daily 1400-1530. (ISWC, London)

Gold Coast—A card from Accra states it is using 1.8 kw. and 5 kw., respectively, on 9.640 and 4.915; scheduled 0530-0630 on 9.640, 1028-1255 on 4.915; QRA given as Senior Programmes Officer, P.O. Box 745, Accra, Gold Coast, West Africa. (NATTUGGLAN, Sweden)

Greece—Radio Macronissos, 7.100, has notified a Stockholm DX-er that

reception reports are much appreciated because the station is still experimenting; output is only 80 watts but it is hoped to increase power in the near future; schedule listed 0030-0230, 0530-0800, 1030-1400. (Radio Sweden)

Haiti—4VRW, Port-au-Prince, verified for Hankins, Pa., and others, recently; card lists schedule 0600-0830, 1200-1500, 1800-2200 *except* Sunday when is on the air 1200-1700; confirmed reception on 10.205, stated 4VRW was formerly HH3W and that 4VW, 1350 kc., was formerly HHW; QRA is P.O. Box 117, Port-au-Prince, Haiti.

4VCM, 6.165, is scheduled 1200-1430, 1700-2200; sent nice QSL letter; QRA is Magloire Broadcasting Circuit, P.O. Box 118, Port-au-Prince, Haiti. (Taylor, Ill.)

Holland—Current schedules for the "Happy Station Programs" produced and presented by Eddie Startz are—Sunday, 0930-1100, to East and Near East, 15.22, 6.02; 1600-1730, to Africa and South America, 9.59, 6.02; 2200-2330, to North America, 11.73, 9.59. Tuesday, 0600-0730, to Pacific, Australia, New Zealand, 21.48, 17.77, 15.22, 6.02. Wednesday, 0930-1100, to East and Near East, 15.22, 6.02; 1600-1730, to Africa and South America, 9.59; and 2200-2330, to North America, 9.59. Programs consist of musical entertainment linked by polyglot announcements, "Spotlight on Holland" (local-color news), musical interlude, "Mailbag" (answering listeners' mail by calls to all parts of the world), and musical sign-off.

India—Direct via airmail from AIR, New Delhi, comes this list of current *English* periods—1930, 15.16, 11.85; 2130 (news), 17.78, 15.29, 15.16, 11.83, 11.76, 9.68, 7.275, 7.225; 2315, 17.78, 15.16; 0230, 21.51, 17.84, 17.78, 15.16; 0300 (news), 17.76, 15.29, 11.83; 0730 (news), 17.78, 15.29, 11.83, 9.68; 0830, 17.84, 15.19; 1000, 17.76, 15.21; 1215, 15.21, 11.79; 1400, 11.85, 11.76, 9.62, 7.24. Most of these periods include at least a short newscast.

Indochina—Direct via airmail from Jean Pipon, head, English Department, *Radio France-Asie* ("Voice of France in the Far East," formerly *Radio Saigon*), comes this interesting data about the present set-up of s.w. outlets in Indochina—Under French Authority, *Radio France-Asie,* Saigon, 6.165, 11.830, 1050 kc.; under Vietnamese Authority, "The Voice of Vietnam," Saigon, 7.263, 9.670, *Radio Dalat,* 6.180, *Radio Hue,* 7.205, and *Radio Hanoi,* 6.190; under Cambodian Authority, *Radio Cambodge,* Phnom-Penh, 6.090. *Radio France-Asie* has *English* news on 11.830 (moved here from 11.780 and *not* using 9.524 as had originally planned) daily at 1845, 1945, 0500, 0545, 0900; Listeners' Letter Box is radiated on Friday at 0450 with repeat at 0930. Other languages used include French, Chinese (Mandarin on 11.830, Cantonese on 6.165). QRA for *Radio France-Asie* remains 86, Rue Mac-Mahon, Saigon, Vietnam, Indochina. From other sources, I understand that *Radio France-Asie* is having new QSL cards printed, to bring station data thereon up-to-date.

Indonesia—At the time this was compiled, YDF2, 11.785, was in the clear during the *English* hour for Europe 1400-1500; news around 1402 and 1445 or 1450. (Boice, Conn.) Good signal here in West Virginia.

Makassar, Celebes, 11.084, noted in California 0900-1000 sign-off with fine signal. (Rosenauer) The 9.55 outlet also signs off 1000. (Balbi, Calif.)

Iran—Bluman, Israel, has logged a *new* Iranian station on 4.050 at 1030-1330 relaying *Radio Teheran;* at 1130 has "Voice of America" program in Persian, and at 1300 has local news (presumably in Persian), and then announces a further program for the Issahan region; not definitely identified as yet; *Radio Sweden* reports this one at 2330-0030, 1100-1315.

Iraq—Swedish DX-ers have heard the call "Emisol Al Basra, Iraq," on 11.935 at 0049-0110. (Radio Sweden) "The Voice of Iraq," 7.062, noted by Bluman, Israel, at 0830-1115 in Kurdish; 1115-1200 in *English.* (ISWC, London)

Ireland—At the time this was written, the *new* 100 kw. transmitter at Dublin was not yet on the air, but some days the low-powered transmitter on 17.840 was audible to readable during the 1330-1350 news period.

Israel—When this was compiled, the Overseas Service was operating daily on 9.000 at 1200-1745, with news 1515-1530, and with a special *English* period, sponsored by the World Zionist Organization, at 1700-1745; the latter period originates in Jerusalem and is announced as coming from "IBS, the Israel Broadcasting System"; fair to poor signals here in West Virginia. By this time Israel will be on Summer Time and schedules will probably be *one hour earlier.*

Italy—Radio Italiana, Rome, is reported on a *new* frequency of 11.900 in parallel with 9.630, 11.810 at 1230-1515. (Radio Sweden) Pearce, England, reports the 25-m. channel at 11.890 and believes it may have "replaced" 11.810.

Japan—Tokyo, 6.13, heard irregularly in parallel with 4.91 around 0500, strong in California. (Balbi)

Korea—Hlka, 7.935, heard in Britain 1600-1800 in Korean mostly, but at times in *English.* (Staples)

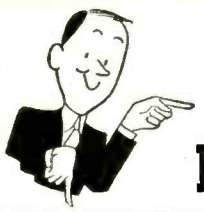
Lebanon—Beirut, 8.036V, has *English* at 1000 weekdays but *not* Sunday. (Pearce, England)

Madagascar—Radio Tananarive, 7.380, noted 1140 with French program. (Pearce, England)

Mexico—The Mexican Government issues a *free* list of its m.w. and s.w. outlets; QRA is Department of Communications and Public Works, Radio Division, Mexico, D.F. (Callarman, Oregon)

Mozambique—Lourenco Marques announces its 25-m. outlet as operating on 11.764; is in use from 2300 (from 0000 on Sunday) to 1000. (Laubscher, South Africa)

New Caledonia—Radio Noumea has



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BC-605 Interphone Amplifier

Easily converted to an ideal intercommunication set for office—home—or factory.

Original—New $4.95
Like New 3.95
(With Schematic)

See April 1950 Radio News for complete conversion data.

All necessary parts and instructions to convert the above to AC operation with one remote station $8.25 additional.

TUBES

Drastically Reduced from 10 to 50%
Nationally Advertised Brands

Type	Net Price	Type	Net Price	Type	Net Price
1A4P	$0.24	6SF5GT	$0.34	38	$0.24
1A6	.19	6S7G	.39	39/44	.24
1B5/25S	.24	6S8GT	.59	49	.39
1B22	1.49	6SG7	.59	50	.39
1B26	2.29	6SF7	.39	56	.24
1B29	.39	6SJ7	.69	57	.24
1B32-532A	2.29	6T7G	.39	76	.24
1C6	.19	6U7G	.29	77	.24
1C7G	.19	6Z7G	.39	211/Vt4L	.29
1D5GP	.24	6ZY5G	.29	316A	.34
1D7G	.19	7C4/1203A	.24	371B	.34
1F4	.24	7E5/1201	.39	700A	7.95
1F5G	.24	10YVT25A	.19	703A	1.49
1H4G	.24	12A6	.34	705A	.79
1J6G	.24	12A6GT	.34	714AY	6.95
1J6GT	.24	12A7	.34	724B	4.95
1P5GT	.24	12A8GT	.19	801A	.39
1V	.24	12F5GT	.29	813	6.95
2A6	.39	12H6	.29	829	6.95
2A7	.24	12J5GT	.24	832	4.95
2C26A	.19	12J7GT	.24	837	1.49
2V3G	.49	12Q7GT	.24	841	.29
2X2/879	.25	12SF5	.24	864	.29
3FP7	.98	12SF5GT	.24	872A	.98
4AP10	.98	12SF7	.24	954	.19
5BP4	2.95	12SH7	.24	955	.34
5CP1	2.95	12SR7	.24	957	.34
5D21	9.95	12SR7GT	.29	1625	.19
5FP7	.95	12SN7GT	.89	1626	.24
6J23	6.95	12Z3	.29	1630	.29
5T4	.49	15R	.19	1642	.29
5W4	.49	19	.59	2050	.89
5Z4	.49	2J22	.24	2051	.49
6AB7	.59	28D7	.34	7193	.19
6AJ5	.89	30SPEC (Vt67)	.59	9002	.34
6B8	.59			9003	.39
6C4	.39			9006	.29
6D8G	.59	30	.24	GL4A21	.29
6F5GT	.39	304TL	1.29	Amperite 10T1	.29
6F6G	.59	32L7GT	.39	Jan CRP72	.98
6H6	.29	33	.24	REL36	.69
6J7GT	.39	34	.24	VR150	.39
6K6G	.59	35/51	.24	VR105	.69
6L5G	.39	36	.24		
6L7G	.39	37	.24		
6R7	.34				

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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**

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Receiver-Transmitter—2 crystal channels—20 to 27.8 MC FM—13 tubes. Metered, Plate and Filament ..... New $14.95
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Used less tubes, vib. & cond. 2.95

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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
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PE 125—12-volt Vibrator Pack ..... New $12.95
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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

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

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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	17.50	24.95
RA 10 DA Receiver	17.50	24.95
T26/APT2 Transmitter	8.95	
RT7/APN1 Transceiver	4.95	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
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BC 442 Less Condenser	1.49	1.95

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APS 13 UHF Antenna, Pair ..... .98
Manual for **BC 312 & 342 J** 1.00
Manual for **SCR 269 G** 2.50
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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
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BC 709 Battery operated lightweight interphone amplifier. Complete with tube and shock mount, but less battery ..... New $3.95
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RTA 1B Transceiver
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12 tube superhet covering frequencies of 150 to 325 KC; 325 to 695 KC; 3400 to 7000 KC in three bands. Complete with dynamotor and tubes, Like New $14.95

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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**

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Used .95 (3 for $2.00)
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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

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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 49c

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	4 for 10.00
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.4 mfd. 1500 VDC. OIL FILLED	.29
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.1x.1x.1—1200 VDC. OIL FILLED	.59
	2 for 1.00
50 mmfd—5KV—5 Amp. Vacuum Cond.	1.19

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moved from 6.000 to 6.035 where it has a definitely better signal; noted 0500 to closing down 0545. (Rosenauer, Balbi, Calif.)

Nicaragua—Stark, Texas, has noted a station on 6.719 around 2230 announcing "Radio Fox en Managua."

Norway—From Arne Halvorsen, Oslo, comes this summer schedule of *Radio Norway*—To Norwegians Abroad, 2000-2100 (Sun. 2000-2115), LKV, 15.17, LKQ, 11.735, LLH, 9.645, to North American waters, North Atlantic; 0600-0700 (Sun. 0600-0715), LLP, 21.67, LLN, 17.825, LKV, 15.17. LKQ, 11.735, to Far East; 0800-0900 (Sun. 0800-0915), LLP, 21.67, LLN, 17.825, LKV, 15.17, LKQ, 11.735, to Indian Ocean; 1400-1500 (Sun. 1400-1515), LLP, 21.67, LKQ, 11.735, LKV, 15.17, LLG, 9.610, to African Waters and South Atlantic; 1800-1900 (Sun. 1800-1915), LKV, 15.17, LKQ, 11.735, LLH, 9.645, to South America. Home Service—0115-0230 (Sun. 0255-0550), LLP, 21.67, LLN, 17.825, LKV, 15.17, LKQ, 11.735, to African Waters and South Atlantic; 1300-1400 (Sun. 1000-1400), LLP, 21.67, LKQ, 11.735, LKV, 15.17, LLG, 9.610 (Sats. 1200-1400), to African Waters and South Atlantic; 1500-1700 (Sun. 1515-1700), LLP, 21.67, LLN, 17.825, LKV, 15.17, LLH, 9.610, to African Waters and South Atlantic. Home Service over the Tromsoe s.w. transmitters—LKJ, 9.540, to North Atlantic, weekdays 0115-0230, Sundays 0255-0945, Saturdays 0115-0320; LKJ, 9.540, to North Sea, weekdays 0520-0740, Saturdays 0250-0735, off Sundays; LLS, 7.210, to North Atlantic and North Sea, weekdays 1045-1700, Sundays 1015-1715, Saturdays 0930-1700. It is emphasized that approximately the last quarter of an hour in the special Norwegian s.w. transmissions is given to Norwegian music or to music by Norwegian artists; "Norway This Week" (*English*) is presented Sundays 0700-0715, 0900-0915, 1500-1515, 1900-1915, 2100-2115.

Pakistan—Dacca seems to have moved from 7.635 to 7.140 where it is heard weakly with news 0700 in parallel with Karachi on 11.548, 11.845. The 2100 newscast appears to be radiated now on 9.645, 15.335.

Philippines—At the time this was compiled, Manila s.w. relay outlets of VOA were scheduled—Manila III, 9.530, 1800-2000 to East Asia; Manila I, 11.890, 0400-0915, 0945-1045 to Far East, 1645-1700 to Korea, and 1800-2000 to East Asia; Manila II, 15.250, 1645-1700 and 1800-2000 to East Asia; Manila II on Tue.-Sat. at 0215-0345 with United Nations Radio on 15.330 to East Asia, daily on 15.330 to East Asia at 0400-0915 and 0945-1045; Manila III, 17.780, 0400-0915, 0945-1045 daily to East Asia; Manila I, 21.570, on Tue.-Sat. at 0335-0345 to South East Asia.

Bacolod City, 4.985, continues to be heard by Rosenauer, Calif., around 0830-0930; some days in Filipino and others in *English*.

DYH3, 6.10, Manila, *Radio Philippines*, heard 0430 onwards; news 0556;

(*Continued on page* 143)

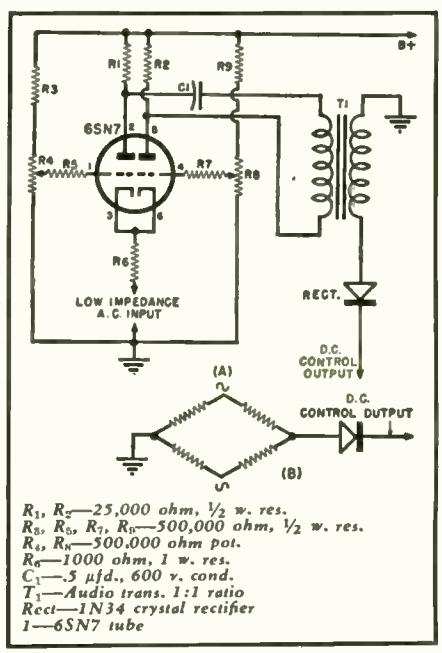
Wheatstone Bridge

(*Continued from page* 61)

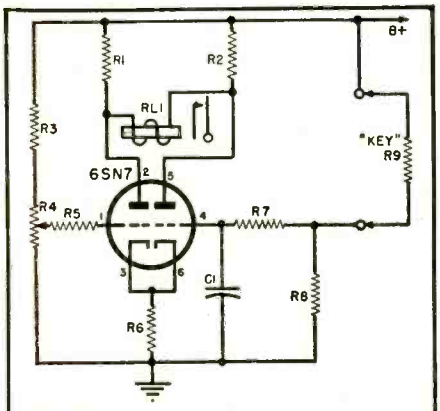
close to the surface and vulnerable to physical attack. A combination lock may have the selecting elements separated from the dial by a fairly long shaft, but this represents problems when space is limited, such as in an ordinary door frame. The electronic lock has the advantage that the "keyhole" may be located virtually any place while the selector circuits and solenoid-operated bar may be located in a well protected place.

A simple form of lock uses a bridge, with one element missing, in order that current will flow through a sensitive relay at all times other than when the "key," a resistance of correct value, is applied across the open ends of the bridge. This has a disadvantage in that an ingenious person may open the lock by means of a variable resistance. This handicap may be overcome by making it necessary to balance two separate bridges simultaneously or by using a time delay circuit, in conjunction with a tube operated relay, to provide a delay of five or ten seconds after the proper combination is reached. A number of other variations could be discussed, but the potential constructor is advised to consider all of the factors before installing a system of this nature. Shock hazard should be considered as well as the matter of stability over long periods, and what happens in the event of power failure. Nevertheless, this system

Fig. 2. (A) Modified a.c. bridge circuit. The a.c. input may be 60 cycles from power line or a higher frequency from an oscillator. One of the potentiometers is used for the reference voltage and the other for signal voltage. (B) Basic a.c. bridge circuit. The a.c. supply should not be grounded. If low impedance circuits are used, the relay may be operated directly from the output of the rectifier.



R_1, R_2—25,000 ohm, ½ w. res.
R_3, R_5, R_7, R_9—500,000 ohm, ½ w. res.
R_4, R_8—500,000 ohm pot.
R_6—1000 ohm, 1 w. res.
C_1—.5 μfd., 600 v. cond.
T_1—Audio trans. 1:1 ratio
Rect—1N34 crystal rectifier
1—6SN7 tube



R_1, R_2—25,000 ohm, ½ w. res.
R_3, R_5, R_8, R_6—500,000 ohm, ½ w. res.
R_4—500,000 ohm pot.
R_7—2500 ohm, 1 w. res.
R_9—5 megohm, ½ w. res.
C_1—.5 µfd., 600 v. cond.
RL_1—1 ma. (d.c.), 8000 ohm relay
1—6SN7 tube

Fig. 3. Diagram of d.c. tube-operated relay set up as an electronic lock with time delay. The grid resistor, R_7, and condenser, C_1, give a delay of approximately 5 seconds. The "key" and R_8 may be replaced by a potentiometer for remote control.

has several aspects of novelty and usefulness which might find application in private clubs and other organizations which distribute a fairly large number of door keys.

Several other applications of the bridge circuit that might appeal to the constructor are suggested. One of these is a variation of the "light organ," a device which automatically turns on vari-colored lights in accordance with the musical content of the output of a radio or phonograph. In this case a portion of the output is rectified and used as the control voltage for a series of bridges and relays, thus turning on the appropriate lights in relation to the amplitude of the music. More elaborate arrangements may be constructed by using frequency division as well. Use of relay control means that nearly any amount of light intensity desired may be obtained by use of the proper size bulbs, however, if small bulbs are used, the lack of thermal inertia may give a somewhat jerky effect. On the other hand, if large lights are used, it may be necessary to take precautions to prevent clicks and pops in the musical reproduction that may result from sudden line voltage variation.

A similar use that may interest those engaged in dramatics or lighting effects, is the use of a relay sequence for remote dimming of spots or floods. Usually a simple sequence involving the adjustment of relay tension or series resistance should suffice. A ten-step system should be adequate for most applications involving large lights as the thermal inertia should make smooth dimming possible. Conventional Nichrome wire may be used as a resistance in series with the light to be dimmed, and the relays set to short out portions of the series resistance. In this manner, voltage across the individual relay contacts will be low, resulting in longer life, and a kil-

owatt or larger dimmer may be built at moderate cost.

Thus far the operation and modifications of the current operating bridge have been discussed. By changing the circuit somewhat, a system may be derived in which a voltage null rather than a current null is produced. One of the best ways to do this is to excite the bridge circuit with an a.c. voltage. Rectification of the bridge output then produces a voltage which is always either positive or negative, depending upon the rectifier connection used, except when the bridge is balanced and zero output occurs. By amplifying the a.c. output of the bridge for a stage or two before rectification, this system may be used to achieve very high sensitivity with stable operation. Voltage controlled operation may be obtained by using the two halves of a 6SN7 as a form of balanced modulator, with zero output occurring when the two sections of the tube are balanced.

Further interesting effects may be obtained by using a radio frequency or supersonic tone to excite the balanced modulator system. It then becomes possible to introduce a considerable amount of modification of audio signals due to nonlinearity of the circuit. —30—

MICROWAVE QUIZ

By ED BUKSTEIN
Northwestern Vocational Institute

1. As defined by the FCC, the microwave spectrum extends from *(a) 3 to 30 mc. (b) 88 to 108 mc. (c) 6.28 to 1592 mc. (d) 3000 to 30,000 mc.*
2. A wavelength of one centimeter corresponds to a frequency of *(a) 186,000 mc. (b) 3000 mc. (c) 108 mc. (d) 30,000 mc.*
3. The microwave spectrum is also referred to as *(a) s.h.f. (b) u.h.f. (c) v.h.f.*
4. The klystron tube employs two sets of grids which are referred to as the *(a) buncher and catcher (b) pitcher and catcher (c) catcher and returner.*
5. An external magnet is used in conjunction with the *(a) rhumbatron (b) ignitron (c) magnetron (d) phanotron.*
6. Velocity modulation is employed in the *(a) klystron (b) pliotron (c) magnetron (d) ignitron.*
7. Electrons are made to follow a curved or spiral path in the *(a) phanotron (b) thyratron (c) magnetron (d) ignitron.*
8. The repeller plate is an element of the *(a) lighthouse tube (b) reflex klystron (c) cavity magnetron.*
9. A waveguide will pass *(a) all frequencies equally (b) all frequencies above a critical value (c) all frequencies below a critical value.*
10. A metallic insulator is a *(a) shorted quarter-wave line (b) a type of thermoplastic material (c) a microwave lens (d) a low-pass filter terminated with a resistive load.*
11. Fig. 1 is a photograph of a *(a) klystron (b) magnetron (c) lighthouse tube.*
12. The term "transit time" refers to *(a) the velocity of light at sea level (b) the length of time a cathode must be heated before plate voltage is applied (c) the time required for electrons to travel from cathode to plate of a tube.*
13. The Barkhausen-Kurz oscillator is *(a) another name for the cavity magnetron (b) a type of oscillator using a diode tube (c) a type of positive grid oscillator.*
14. A parabolic reflector is a *(a) coil placed around the neck of a cathode-ray tube (b) half-wave section of transmission line (c) metallic "dish" used in conjunction with a microwave antenna.*
15. Fig. 2 is a photograph of *(a) reflex klystrons (b) lighthouse tubes (c) electron multiplier tubes (d) magnetrons.*

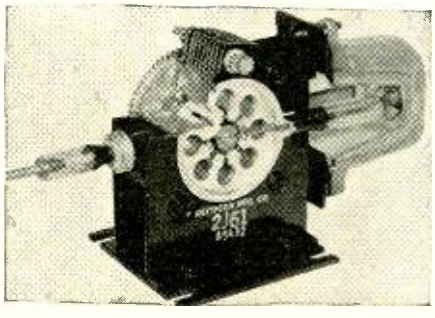
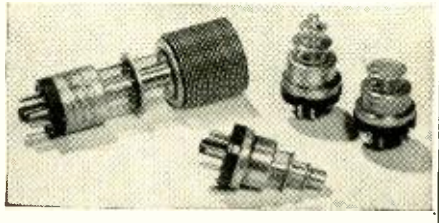


Fig. 1.

(See page 159 for answers.)

Fig. 2.



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B1-1X5	1.5 AMP.	2.95
B1-3X5	3.5 AMP.	4.50
B1-5	5 AMP.	5.95
B1-10	10 AMP.	9.95
B1-20	20 AMP.	15.95
B1-30	30 AMP.	24.95
B1-40	40 AMP.	27.95
B1-50	50 AMP.	32.95

Input 0-36VAC Type No.	Current	Output 0-26 VDC Price
B2-150	150 MA.	$0.98
B2-250	250 MA.	1.25
B2-300	300 MA.	1.50
B2-2	2 AMP.	4.95
B2-3X5	3.5 AMP.	6.95
B2-5	5 AMP.	9.95
B2-10	10 AMP.	15.95
B2-20	20 AMP.	27.95
B2-30	30 AMP.	36.95
B2-40	40 AMP.	44.95

Input 0-115VAC Type No.	Current	Output 0-90 VDC Price
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B6-750	750 MA.	6.95
B6-1X5	1.5 AMP.	10.95
B6-3X5	3.5 AMP.	18.95
B6-5	5 AMP.	24.95
B6-10	10 AMP.	36.95
B6-15	15 AMP.	54.95

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CF-2	2000 MFD	15VDC	1.69
CF-20	2500 MFD	15VDC	1.95
CF-3	1000 MFD	25VDC	1.25
CF-4	2X3500 MFD	25VDC	3.45
CF-6	4000 MFD	30VDC	3.25
CF-7	3000 MFD	35VDC	3.25
CF-8	100 MFD	50VDC	.98
CF-10	500 MFD	50VDC	1.95
CF-16	2000 MFD	50VDC	3.25
CF-21	1200 MFD	90VDC	3.25
CF-9	200 MFD	150VDC	1.69
CF-13	500 MFD	200VDC	3.25

Mounting clamps for above capacitors. .15c ea.

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All Primaries 115VAC 50/60 Cycles

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TXF36-15	36	15	20 lbs.	11.95
TXF36-20	36	20	30 lbs.	17.95
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All TXF Types are Tapped to Deliver 32, 34, 36 Volts, XFC Type is Tapped to Deliver 16, 17, 18 Volts Center Tapped.

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HY10	.02	10	.30	9.95
HY10A	.014	10	.04	7.95
HY20A	.007	20	.02	12.95

Type "A" low resistance chokes are specially suited to circuits requiring excellent voltage regulation.

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Standard Brands

12 Mmfd. 20 Kv $4.95
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Overall length 6½", diameter 2½", terminal diameter ¾", Shpg. wt. 2 lbs.

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Heater voltage 115 V. Norm. open SPST contacts. 15-30 sec. delay. Contact rating 115 V. 3A., 440 V. 2A. Size 3¾"x1¾" diam. Standard 4-prong tube base.....Ea. **98c**

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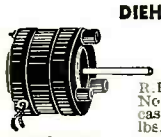
0-300 VDC, Basic 0-1 ma. 2½" rd. Bakelite case. New, in original boxes. Shpg. wt. 2 lbs. Bargain price.....**$2.25**

DIEHL MOTOR



Fan duty, brushless induction type (no TV interference). For 115 VAC 60 cycles, 46 watt. 1800 R.P.M. Shaft ¼" diam. 1" long. Noiseless ball-bearings—heavy cast construction. Shpg. wt. 6 lbs. Brand new.....**$4.50**

D-C PANEL METERS

Attractive, rugged, and reasonably priced. Moving vane solenoid type with accuracy within 5%.

0- 6 Amperes D-C
0-12 Amperes D-C — Any range $2.49 each
0-15 Volts D-C

WESTINGHOUSE AIRCRAFT MOTOR

Brand new—24 VDC reversible. 1/50 H.P. Will also reverse and operate on AC. 4800 RPM continuous duty. Length of leads 18". Dimensions 3½"x2½", shaft ¼" diam. by ⅝" long. Price.....**$2.95**

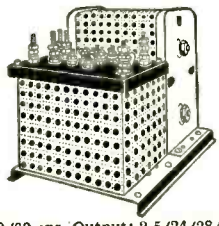
Reversing switch with "off" position. Each.....79c

AUDIO CHOKE

SM Choke Type U7402 Hermetically sealed.
50 Hys. .04 Amps DC
1780 RMS Test Voltage 3½"x3¼"x3¼". Shpg. wt. 6 lbs.....$2.25

DC POWER SUPPLY

Limited quantity— Gov't Surplus



Ready to operate. Full-wave bridge, copper-oxide rectifier, heavy-duty multi-tapped transformer. Input: 85/95/105/115 VAC 50/60 cps. Output: 2.5/24/28/32/36 VDC at 5 amperes, unfiltered.

For wall or bench mounting. Overall dimen. 9"x8¼"x8½" high. Shpg. wt. 30 lbs. Like new. Tested and guaranteed..**$36.00**

Filter Kit. 2% ripple.....$6.65

POWER SUPPLY KITS 24 to 28 VDC Filtered

Designed for continuous duty ground operation and bench testing of aircraft equipment, these kits provide a reliable means of obtaining a source of low-ripple 24 VDC, from a 115 VAC 60 cycle line. Full-wave bridge Selenium Rectifiers insure instantaneous and efficient operation. Adjustment of the DC output voltage is accomplished by transformer primary taps. Ripple is limited to within 2% of the average DC output by choke-input filters.

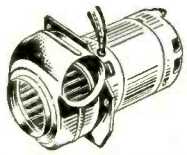
Kit No.	Amperes DC	Net Price
242	2.0	$16.39
245	5.0	22.39
2410	10.0	47.44
2420	20.0	79.44

Write for descriptive Bulletin No. 201.

RECTIFIER KIT No. 612-10 6 and 12 VDC at 10 Amperes

This unit will deliver unfiltered direct current for operation of motors, dynamotors solenoids, relays and similar equipment. Employs full-wave Selenium Rectifier and heavy-duty primary tapped transformer. The two output voltages can be used simultaneously and may be adjusted between 6.7-7.5 VDC and 13-15 VDC under full load. For 115 VAC 60 cycle input. With schematic diagram and instructions. Shpg. wt., 12 lbs...**$15.95**

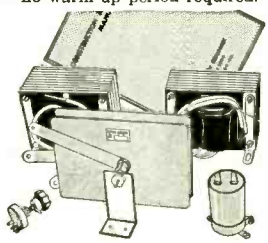
WESTERN ELECTRIC BLOWER



#KS5881—Brand New—Heavy-duty Sirocco type blower, capacitor start, 1/40 H.P., 3400 RPM, 115 VAC, 60 cycles. Displaces 84 CFM. Extremely quiet operation. Opening 2¼", overall size 7½" long, 6" diam. Moisture and fungus resistant. With capacitor. Shpg. wt. 15 lbs. Quantity limited.....**$13.95**

BATTERY ELIMINATOR SIX VOLT KIT

For testing and demonstrating auto radios. Supplies 5-8 volts at 10 amperes continuous duty, 15 amperes intermittent. Step voltage control, ripple less than 3%. Power on instantly—no warm-up period required.



HERE'S WHAT YOU GET:
- Heavy duty Transformer. Type XFC18-14
- Rugged Selenium Rectifier, Type C1-10
- Filter Choke, Type HY1CA
- Filter Condenser, Type CF-2
- Multi-position Tap Switch

A terrific value at.....**$19.50**

Minimum order $3.00. No C.O.D.'s. Add 10% for Prepaid Parcel Post and Handling. Terms: Net 10 days in the presence of approved credit.

All prices subject to change without notice. Prices and delivery F.O.B. our NYC Warehouse.

All merchandise subject to prior sale.

OPAD-GREEN COMPANY

71-3 Warren St.
New York 7, N. Y.
Phone: BEekman 3-7385-6

NEW PORTABLES for the Vacation Market

LUGGAGE-PHONO

Of special interest to the campus crowd is the "Collegiate" portable phonograph recently announced by *Steelman Phonograph & Radio Co., Inc.* of 742 E. Tremont Avenue, New York 57, N. Y.

The new portable is housed in a lightweight, rayon-satin lined traveling bag and is completely removable. When the case is used for carrying the phonograph there is enough additional room to slip in all overnight travel necessities. When the phonograph is removed the case is a separate travel bag with removable mirror and two large pockets and ample room for a travel wardrobe.

The phonograph is a complete 3-speed amplified phonograph with a tone and volume control and a deluxe tone arm. The unit is lightweight and fits easily on a table, dresser, or any other convenient spot. When not in use it can be replaced in the case to keep it dust-free and give it the desired protection.

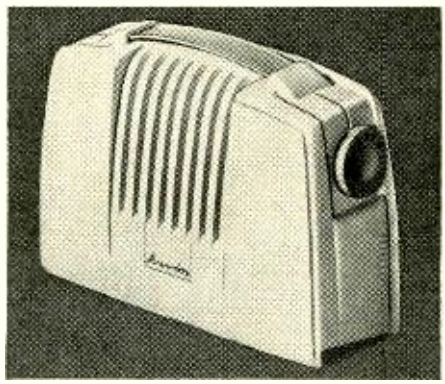
The case measures 8¾" by 12" by 16½" and is available in cream-color simulated rawhide with contrasting dark brown genuine alligator trim.

ARVIN PORTABLE

Noblitt-Sparks Industries, Inc. of Columbus, Indiana is in production on a straight battery-operated portable which will retail in the moderate price class.

Housed in a high-styled, streamlined plastic cabinet, the new *Arvin* Model 446-P has a fluted plastic grille face over neutral-toned grille cloth. The set has semi-recessed control knobs at the top of opposite ends of the case. Numerals and legends are debossed and color filled.

The portable is powered with one 67½ volt "B" battery and two "A" flashlight cells. It has a four-tube circuit with two full intermediate frequency transformers. A 3S4 tube is used for adequate volume and high fidelity tone. The variable condenser is direct-driven by a right hand control knob and the volume control, with



coincidental "on-off" switch, is driven by the knob at the opposite end of the case. The control knobs are milled for finger-tip operation.

The set weighs only three and one-half pounds with batteries.

AIR KING UNIT

Air King Products Co., Inc. of 170 53rd Street, Brooklyn 32, New York has rounded out its line of home receivers with a new polystyrene three-way portable which has been designated the Model A-520A.

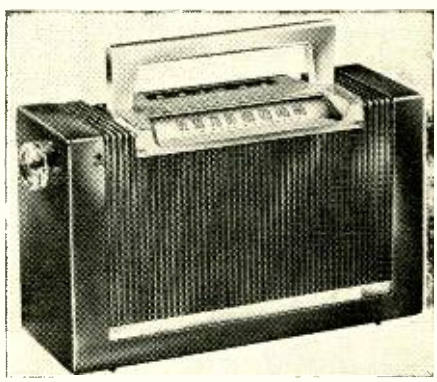
This new portable, which is available in maroon and ivory, features a new battery complement which is said to give power and tone not usually found in a portable set of its size.

Delivery is currently under way on this model.

PERSONAL PORTABLE

A new personal portable, the Model 631, which features the novel "Magnecor" long-distance aerial, has been added to *Philco Corporation's* line of receivers.

The novel tubular built-in aerial is



an integral part of the modern plastic cabinet in which the set is housed. It is designed to operate with a new circuit operating on a.c., d.c., or battery, to bring in distant stations with clear, noise-free tone.

FOR OUR 4th ANNIVERSARY CELEBRATION

NIAGARA SLASHES TUBE PRICES 50% to 90%

ALL BRAND NEW—STANDARD BRANDS

1B22	$ 3.45	6AS6	2.89	713A	1.00	5516	5.95	WL468	6.75	6AB7/1853	.78	6ST7	.88	14B8	.88
1B23	8.45	6C21	24.95	714AY	4.75	5562	10.00	WL532A	1.75	6AC5GT	1.16	6SV7	.88	14C5	.88
1B24	4.49	6F4	5.95	715A/B	6.75	7193	.18	WL562	150.00	6AC7/1852	0.76	6T7G	.97	14C7	.88
1B25A	4.95	6J4	4.95	715C	22.50	8005	4.60	WL616	85.00	6AD6	.88	6U5/G5	.64	14E6	.72
1B26	4.45	7BPI	4.95	717A	.58	8011	2.00	Z225	1.95	6AD7G	1.28	6U6GT	.72	14E7	.88
1B27	3.95	7BP7	4.50	720DY	34.95	8012A	1.25	ZB120	6.95	6AF6G	.78	6U7G	.54	14F7	.68
1B29	.89	7C23	75.00	721A/B	2.60	8013A	1.25	ZB3200	150.00	6AG5	.76	6V6	.96	14F8	.88
1B32	1.95	7C25	90.00	723AB	7.95	8014A	24.95	0A2	1.56	6AG7	.97	6V6GT	.62	14H7	.64
1B38	$4.50	7DP4	17.95	724A/B	2.75	8016	1.10	0A3/VR75	.98	6AH6	1.28	6W7G	.88	14J7	1.06
1B60	4.95	9C28	250.00	725A	6.75	8020	1.25	0A4G	.94	6AJ5	.78	6X4	.58	14N7	.88
1N21	.89	9GP7	15.00	726A/B/C	13.50	8025A	7.95	0B2	1.74	6AK5	.84	6X5GT	.48	14Q7	.56
1N23	.69	9JPI	6.50	728GY	24.95	8026	12.95	0B3/VR90	.64	6AK6	.78	6Y6G	.66	14R7	.66
1P23	1.95	9LP7	15.00	730A	9.75	BR	2.50	0C3/VR105	.78	6AL5	.64	6Y7G	.88	14S7	1.06
1P25	14.50	6NPI	7.95	750TL	49.50	BH	4.95	0D3/VR150	.54	6AL7GT	1.06	6Z7G	1.14	14W7	1.06
1S2I	3.95	10Y	.39	800	1.75	C1A	4.95	0Y4	.88	6AQ5	.58	6ZY5G	.68	14X7	1.06
2API	3.59	10SPEC	.69	801A	.28	C5B	12.95	0Z4	.56	6AQ6	.58	7A4/XXL	.58	14X4	.88
2B22	3.95	10BP4	22.45	802	4.25	C6A	7.50	0Z4G	.56	6AQ7GT	.88	7A5	.72	19	.97
2C4	1.18	10CP4	29.50	803	3.45	C6J	3.75	01A	.24	6AR5	.66	7A6	.66	19T8	1.56
2C21	.25	12DP7	12.50	804	8.50	CEQ72	1.95	1A3	.43	6AS7G	1.95	7A7	.56	22	1.28
2C22	.28	12FP7	14.95	805	3.50	CK1005	.08	1A4	1.08	6AT6	.46	7A8	.72	24A	.66
2C26A	.18	12GP7	12.95	807	1.25	CK1006	.69	1A4P	.96	6AU6	.58	7AD7	1.06	25A6	1.06
2C34	.25	12HP7	12.95	808	1.35	CK1090	2.75	1A5GT	.48	6AV6	.46	7AF7	.72	25A6G	1.06
2C40	2.98	12KP4	49.50	809	2.50	EF50	.35	1A6	.78	6B4G	.88	7AG7	.71	25AC5GT	1.16
2C43	9.50	12LP4	25.50	810	7.75	EL3C	4.95	1A7GT	.66	6B5	1.56	7AH7	.88	25L6GT	.52
2C44	1.75	15E	1.25	811	2.00	F123A	12.50	1B3GT	1.49	6B6G	.78	7B4	.56	25Y5	1.16
2C46	7.50	15R	.50	812	2.50	F128A	70.00	1B4	1.18	6B7	.88	7B5	.72	25Z5	.48
2C51	6.50	23D4	.49	812H	6.90	F631A	125.00	1B5/25S	.88	6B8	.88	7B6	.58	25Z6GT	.48
2D21	1.16	24G	.35	813	6.75	F660	110.00	1B7GT	1.06	6B8G	1.28	7B7	.58	26	.56
2E22	1.25	35T	4.95	814	2.40	FG17	2.75	1C5GT	.66	6BA6	.54	7B8	.72	27	.46
2E24	4.95	45SPEC	.25	815	1.25	FG27A	8.95	1C6	.88	6BE6	.56	7C4/1203A	.36	28D7	.34
2E25A	4.25	53A	24.95	816	1.19	FG32	5.95	1C7G	.88	6BG6G	1.46	7C5	.56	30	.56
2E26	3.95	75TL	3.50	826	.35	FG33	8.95	1D5GP	.96	6BH6	.56	7C6	.72	31	.86
2E30	2.39	100TH	11.00	828	9.95	FG81A	3.75	1D7G	.88	6BJ6	.58	7C7	.58	32	.96
2J21A	10.75	100TS	2.00	829A/B	7.25	FG95	9.95	1D8GT	.94	6C4	.24	7E5/1201	.66	32L7GT	.96
2J26	6.95	101F	4.95	830	2.95	FG104	17.50	1E5GT	1.38	6C5	.46	7E6	.58	33	.68
2J27	13.95	114A	.69	830B	3.25	FG105	9.50	1E7G	1.56	6C5GT	.46	7E7	.68	34	.68
2J30	19.95	114B	1.25	832/A	4.95	FG166	49.50	1F4	.74	6C6	.56	7F7	.68	35/51	.56
2J31	8.95	120	5.95	833A	34.25	FG172A	13.75	1F5G	.74	6C7	1.28	7F8	1.06	35A5	.66
2J32	11.95	121A	2.65	834	5.50	FG190	14.95	1F6	1.56	6C8G	.68	7G7/1232	1.06	35B5	.64
2J33	19.95	203A	16.95	836	1.25	FG238B	160.00	1F7G	1.56	6D6	.16	7H7	.63	35L6GT	.53
2J34	19.50	205B	4.50	837	1.50	GL146	9.75	1G4GT	.68	6D8G	.87	7J7	1.06	35W4	.38
2J36	75.00	205F	4.50	838	2.25	GL415	21.00	1G6GT	.68	6E5	.68	7K7	1.06	35Y4	.48
2J37	12.95	211	.40	841	.30	GL451	4.95	1H4G	.68	6E6	1.06	7L7	.68	35Z3	.56
2J38	12.95	215A	.50	843	.25	GL473	65.00	1H5GT	.53	6F5	.46	7N7	.66	35Z4GT	.43
2J48	24.50	217C	9.80	845/W	4.00	GL502A	1.98	1H6G	.86	6F5GT	.46	7Q7	.58	35Z5GT	.40
2J49	19.50	218	12.50	849A/H	69.50	GL530	49.50	1H6GT	.86	6F6	.64	7R7	.68	36	.39
2J50	29.50	221A	1.75	851	25.00	GL559	5.35	1J6GT	.88	6F6GT	.66	7S7	1.06	37	.34
2J51	4.95	227A	2.65	860	5.75	GL673	11.50	1L4	.54	6F7	.84	7V7	.79	38	.27
2K21	24.50	231D	1.20	861	35.00	GL697	65.00	1LA4	.78	6F8G	.86	7W7	.88	39/44	.26
2K23	24.95	249C	1.75	864	.35	HF100	3.95	1LA6	.88	6G6G	.88	7X7/XXFM	.88	41	.51
2K25	24.95	250R	7.00	865	1.95	HF200	17.95	1LB4	.88	6G8G	.68	7Y4	.56	42	.48
2K28	24.95	250TH	19.50	866A	1.25	HF210	17.95	1LC5	.78	6H6	.46	7Z4	.56	43	.48
3API	4.75	252A	4.95	866JR	1.19	HF300	17.50	1LC6	.56	6H6GT	.46	10	.69	45	.51
3B22	2.50	259A	4.95	872A	1.30	HK254	19.95	1LD5	.78	6J5	.48	12A	.56	45Z3	.56
3B23	4.95	274B	1.00	874	.35	HV18	12.95	1LE3	.88	6J5GT	.48	12A6	.18	45Z5GT	.48
3B24	1.98	275A	7.95	876	.28	HY69	2.75	1LG5	.88	6J6	.76	12A6GT	.18	46	.68
3B24W	2.95	282A/B	9.95	878	1.75	HY312	2.75	1LH4	.64	6J7	.66	12A7	.97	47	.68
3B25	4.80	283A	10.95	884	1.49	HY615	.20	1LN5	.66	6J7GT	.66	12A8GT	.58	49	.88
3B26	1.50	286A	10.95	885	.98	HY1269	2.75	1N5GT	.58	6J8G	1.28	12AH7GT	.84	50	1.56
3B27	1.95	287A	9.95	891	110.00	HYE1148	.35	1P5GT	.66	6K5GT	.96	12AL5	.80	50A5	.68
3B28	5.95	290A	4.95	902PI	3.50	KU23	15.00	1Q5GT	.66	6K6GT	.54	12AT6	.41	50B5	.54
3BPI	2.50	291A	4.95	905	2.75	KU610	9.50	1R5	.68	6K7	.48	12AT7	1.16	50L6GT	.54
3C23	2.25	294A	4.50	922	1.00	ML101	75.00	1S4	.78	6K7GT	.48	12AU6	.66	50Y6GT	.56
3C24	.35	301A	6.95	923	.75	MX408U	.49	1S5	.56	6K8	.78	12AU7	.78	53	.86
3C30	.30	304B	5.95	925	1.40	R100	3.75	1T4	.56	6K8GT	.78	12BA6	.56	56	.43
3C31	3.50	304TH	3.50	931A	2.60	R200	7.95	1T5GT	.78	6L5G	1.06	12BE6	.48	57	.37
3C45	12.80	304TL	1.30	949A	69.50	R1130	12.95	1U4	.58	6L6	1.16	12C8	.48	58	.48
3CPI	1.40	307A	4.95	950	.98	REL36	.55	1U5	.72	6L6G	.86	12F5GT	.57	59	.88
3DPI-A	3.95	310A	7.95	954	.30	RK12	2.50	1V	.68	6L6GA	.86	12H6	.26	70L7GT	1.16
3D21A	1.10	315A	6.95	955	.35	RK19	1.50	2A3	.96	6L7	.78	12J5GT	.26	71A	.66
3EPI	2.50	316A	.50	956	.35	RK20A	7.50	2A3G	1.06	6L7G	1.16	12J7G	.80	75	.52
3E29	7.95	327A	2.50	957	.19	RK21	1.25	2A5	.68	6N6G	1.56	12J7GT	.80	76	.38
3FP7	1.75	331A	14.50	958A	.18	RK22	4.95	2A6	.78	6N7	.78	12K7GT	.53	77	.42
3GPI	4.95	338A	3.75	959	.35	RK23	4.75	2A7	.88	6N7GT	.78	12K8	.58	78	.44
3HP7	3.50	348A	5.95	966A	.99	RK25	4.95	2B7	.88	6P5GT	.96	12K8GT	.66	79	.88
3JP7	7.95	350A/B	2.75	972A	2.95	RK28A	3.95	2V3G	.98	6Q6G	1.06	12Q7GT	.48	80	.38
4-65A	14.50	354C/D	19.95	975A	14.95	RK31	2.50	2X2A	.68	6Q7	.58	12SA7	.56	81	1.28
4-125A	27.50	357B	49.50	991	.23	RK32	3.95	3A4	.36	6Q7GT	.58	12SA7GT	.56	82	.86
4-250A	37.50	371A/B	.50	1603	3.50	RK33	.25	3A5	.98	6R7	.78	12SC7	.56	83	.71
4AI	.98	374A	2.50	1611	1.25	RK34	.25	3A8GT	1.98	6R7GT	.78	12SF5	.56	83V	.88
4API0	4.50	393A	3.50	1612	1.50	RK39	1.75	3B7	.34	6S7	.83	12SF5GT	.56	84/6Z4	.62
4B25	7.90	394A	3.50	1613	.45	RK47	3.95	3D6	.34	6S7G	.88	12SF7	.56	85	.68
4C21	.69	399A	2.50	1614	1.35	RK48A	3.95	3LF4	1.28	6S8GT	1.06	12SF7GT	.56	89	.72
4C35	19.45	400A	3.25	1616	.50	RK51	3.95	3Q4	.58	6SA7	.43	12SG7	.56	89Y	.38
4D22	1.00	401A	1.95	1619	.15	RK52	4.50	3Q5GT	.66	6SA7GT	.43	12SH7	.34	117L7GT	1.28
4D22	9.95	403A/B	1.75	1620	4.95	RK59	1.75	3S4	.66	6SB7Y	.88	12SJ7	.48	117M7GT	1.56
4D32	12.95	417A	9.50	1621	.98	RK60	.79	3V4	.80	6SC7	.58	12SJ7GT	.48	117N7GT	1.36
4E27	12.50	434A	2.75	1622	1.75	RK63	12.95	5A24	.50	6SD7GT	.68	12SK7	.56	117P7GT	1.26
4J26	110.00	446A	1.00	1624	1.05	RK65	24.95	5JP1	24.50	6SF5	.48	12SK7GT	.56	117Z3	.56
5API	1.85	446B	1.95	1625	.35	RK72	.65	5R4GY	1.09	6SF5GT	.54	12SL7GT	.58	117Z4GT	1.16
5AP4	1.85	450TH	24.95	1626	.25	RK73	.65	5T4	.88	6SF7	.58	12SN7GT	.51	117Z6GT	.64
5BPI	1.75	450TL	35.00	1628	4.95	RX21	3.10	5U4G	.56	6SF7GT	.58	12SQ7	.48	FM-1000	1.28
5BP4	2.50	464A	9.50	1629	.19	RX120	8.75	5V4G	.88	6SG7	.58	12SQ7GT	.48	UX120	1.38
5C22	49.50	527	6.50	1630	.49	T21	1.75	5W4	.78	6SG7GT	.58	12SR7	.48	UX200	1.28
5CPI	1.50	531	4.95	1631	1.35	T200	10.95	5W4GT	.66	6SH7	.48	12SR7GT	.48	800I	.36
5CPIA	9.95	532A	4.95	1633	.75	UH50	5.95	5X4G	.58	6SJ7	.56	12Z3	.78	9002	.28
5D21	24.50	631PI	4.95	1634	.79	UX200	.75	5Y3GT	.40	6SJ7GT	.56	12X3	.98	9003	.32
5FP7	1.25	700B/D	19.00	1636	3.50	V70D	6.95	5Y4G	.48	6SK7	.54	14A7/12B7	.68	9004	.36
5GPI	5.50	703A	3.50	1638	.75	VR75	.98	5Z3	.48	6SK7GT	.54	14AF7/XXD	.88	9005	1.90
5HPI	2.95	704	1.49	1641	.45	VR78	.25	5Z4	.78	6SL7GT	.64	14B6	.68	9006	.23
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5HP7	3.95	706AY	18.50	1644	1.49	VR91	1.49	6A6	.88	6SQ7	.43				
5J23	100.00	706CY	18.50	1645	1.98	VR105	.75	6A7	.68	6SQ7GT	.43				
5J29	12.50	706DY	45.00	1649	1.25	VR150	.50	6A8	.78	6SR7	.56				
5JPI	24.50	706EY	45.00	1654	2.40	VT127A	2.00	6A8GT	.80	6SR7GT	.56				
5JP2	9.50	706GY	49.50	1655	1.50	VU111	.50	6AB5/6N5	.88	6SS7	.58				
5LPI	11.95	707A/B	14.00	1665	1.05	WL460	14.95								
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Niagara Radio Supply Corp.

Phone Digby 9-1132-3-4

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The portable has four tubes plus a selenium rectifier. The functionally-styled plastic cabinet, with concealed "Magnecor" aerial and recessed handle, is available in teal green, maroon, Caribbean blue, and Swedish red. The set measures 5⅞" x 9¼" x 3½".

G.E. DELUXE

One of the new receivers to be added to *General Electric Company's* line of portables is the Model 650 deluxe.

This set is an a.c.-d.c. and battery operated unit which is housed in a

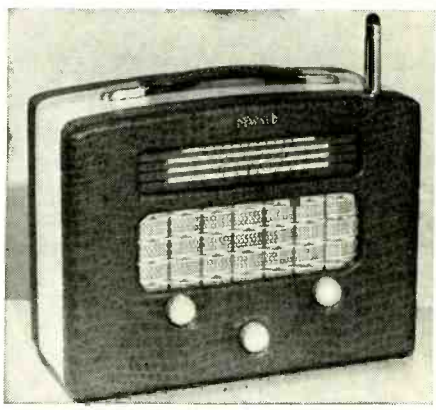
maroon cabinet. The sensitivity of this model is increased by the addition of a tuned r.f. stage. Special attention has been given to the circuit design in order to provide good performance in remote locations.

The set is being manufactured by the company's Receiver Division at Syracuse, New York.

THREE-BAND PORTABLE

Of interest to the traveler is the new three-band portable receiver just released by *DeWald Radio Manufacturing Corp.* of 35-15 37th Avenue, Long Island City 1, New York.

Known as the D-508 luxury portable, the new unit covers from 18-62 meters, 62-125 meters, and 190-560 meters, providing for standard broadcast and two short-wave band coverage.



The set operates on either batteries or 110 and 220 volt power lines.

The portable, which measures 9$^{9}/_{16}$" x 12½" x 5$^{3}/_{16}$", is housed in a leatherette, non-breakable case.

3-SPEED PHONOGRAPH

Tone Products Corporation, 225 West 17th Street, New York, New York has released a three-speed port-

able phonograph unit as one of an extensive line of such instruments.

Known as the Model 148, the new unit is housed in an alligator luggage-type case with saddle-stitched top. The unit plays all sizes of records up to and including 12" discs. The phonograph will handle all three speeds of records, 33⅓, 45, and 78 r.p.m. and employs a single, all-purpose long-life needle. The unit has a super-powered

5" Alnico speaker, full range tone control, constant speed motor, feather-weight tone arm, and no shock hazard. —30—

Ham TV Station

(*Continued from page 57*)

annoying high-frequency noise bands running across the picture horizontally. Care should be taken to select as non-microphonic a tube as possible for this stage. The 10 to 60 $\mu\mu$fd. variable high peaker condenser C_7 adjusts the "tails" or streaking "ghosts" which would follow objects if there were no frequency compensation. Proper adjustment of this control will result in elimination of smears in the picture, at the same time providing the requisite sharpness of detail.

The video phase splitter V_6 has such low plate and cathode loads that their resistance, compared to the shunt effect of the capacity, makes the effect of shunt capacity negligible for these frequencies. Therefore, no peaking coils are needed to maintain good video response.

The 33 ohm resistors in all the grids are to prevent parasitic oscillations.

Many circuit simplifications are possible over those shown. For example, blanking can be directly injected into the video amplifier through decoupling resistors instead of through a coupling diode. Also, it is not necessary to use blocking oscillator transformers; multivibrator saw-tooth generators will perform equally well. Other types of horizontal and vertical output systems can be used. An r.f. type power supply can be used in place of the flyback method of securing high voltage.

Many variations are also possible in the types of tubes used in the equipment. The video amplifier tube types are not necessarily limited to the 6AK5. The 6AU6, 6SG7 or 6AC7 can be used, as well as other similar tubes

having a high figure of merit, which is the ratio of transconductance divided by the input plus output capacities, or: $\frac{g_m}{C_{input} + C_{output}}$

Of course suitable screen voltage, bias voltage, plate load, and peaking coils will have to be substituted for the present ones if different tubes than shown are used. However, 6AG5's, 6AU6's and 6BH6's can be substituted for one another or for the 6AK5's in the present circuit with very little difference in performance.

Similar considerations apply to tube choice for the video phase splitter, taking care that the plate dissipation and the bias and plate voltages are within the tube ratings if other tubes are used.

In the sweep chassis, type 6SN7, 6N7, or pairs of 6C5's may be used instead of the 12AU7, and instead of the 6BG6G tubes, 807's or type 1625's with a different filament supply can be used.

Blanking Generator

The blanking generator and FM sound subcarrier circuits are constructed on a single chassis, as shown in Figs. 6, 7, and 8. Adjustment details on the FM generator will be described later.

While the composite signal from the television station has blanking pulses inherent in it, it is not generally possible to use these pulses in the same manner as the sync, because the amount of "setup" (or difference in amplitude between the black portions of the signal and the blacker-than-black portions used for blanking) is very small and it is difficult to separate this difference. If RMA received picture blanking were used, it is possible that instead of having a pure white flying spot raster there will be some darker portions in it due to scenes having intense blacks in them getting separated along with the blanking information. To avoid this, the blanking is derived from the return traces of the sweeps. Since the blanking obtained in this way is not as wide as in the standard RMA sync, brighter lines at one side of a received amateur picture may be noticed. This does not affect the resolution or quality of the picture. The bright lines may be minimized by proper masking of the raster and picture.

The blanking for the horizontal is obtained from the secondary of the horizontal output transformer where it has the proper polarity and width to blank the end-of-line return of the flying spot. Similarly the vertical blanking is obtained from the output of the vertical output transformer. These blanking signals have much greater amplitude than is needed and are fed to a blanking generator which serves to isolate the blanking signals from the sweep generators and at the same time eliminate amplitude variations in the low-impedance blanking output. The circuit uses a combined cathode follower and clipper.

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FM-87.5 Mc-108.5 MC.

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98	40
108	40

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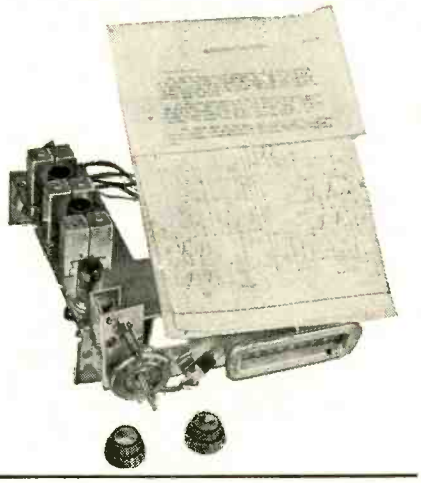
10X
9X



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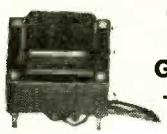

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50x30 150 Volts	.35
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25 MFD 10 Volts	.15
100 MFD 25 Volts	.25
250 MFD 15 Volts	.35
1000 MFD 25 Volts	.45
3000 MFD 10 Volts	.45
10 MFD 450 Volts	.25
20 MFD 450 Volts	.35
30 MFD 450 Volts	.45
40 MFD 450 Volts	.50
10x10 MFD 450 Volts	.45
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30x30 MFD 250V
80x10 MFD 350V
15x10x20 MFD 400V 25V
10x10 MFD 400V
20x20 MFD 400V
25x10 MFD 400V
20x10x20 MFD 400V 350V X 25V
30x10x5 MFD 300V
10x10 MFD 450V
20x10 MFD 450V x 25V
30x30 MFD 450V
20x20x20 450V x 25V
10x10x20 450V 25V
40x40 MFD 450V
10x10x10 MFD 450V
16x16x16 MFD 450V
16x16 MFD 450V
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40 MFD..30c	15 MFD..30c
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	30 MFD..40c
	40 MFD..45c
	80 MFD..50c

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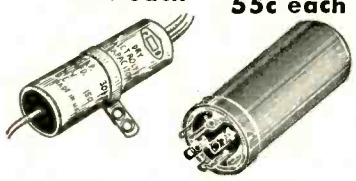
Your Choice 55c each



SPEAKER SPECIALS

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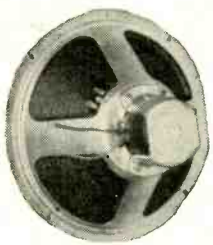

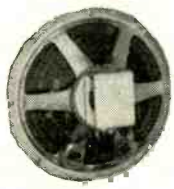

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It will probably be necessary to adjust the amplitude of the blanking fed to the blanking inserter. This is not shown on the diagram but the amplitude may be readily adjusted by tapping down on the load resistor used to feed the blanking voltage output. The level of blanking delivered to the CRT grid of the flying spot scanner is not critical since it does not matter how far negative the grid goes, but should be at least 40 volts peak-to-peak. If insufficient vertical blanking voltage is present then slanted return trace lines will become visible and also a "ghost" on the left of each portion of picture will be seen if there is insufficient horizontal blanking.

Blanking Inserter and Clipper

The blanking inserter and clipper is a part of the modulator chassis and is shown in Figs. 9, 10, and 11. The proper polarity of video signal (black-positive) is fed into the grid circuit of the left hand section of the 12AU7. A 1N34 germanium crystal is used as a d.c. restorer. Input from the blanking generator is fed to the plate circuit of this section. Since the video signal is now black-negative after being amplified by the left hand section of the tube, the negative blanking pulses added to the video signal are superimposed on the black side of the video, making a blacker-than-black voltage. The combined video and blanking signal is now fed into a cathode-follower output stage (the right hand section of the 12AU7), which is also arranged to clip the tops of the blanking pulses.

The purpose of the clipper is to have an undisturbed flat voltage plateau in the blacker-than-black region of the video signal upon which to superimpose the sync information.

The construction of the blanking inserter and clipper is straightforward. The only adjustments required will be the level setting of the blanking input voltage and the level at which the combined video and blanking-signal output is clipped. Clipping control can be obtained by returning the 2.2-megohm resistor at pin 7 to the center arm of a 50,000 ohm potentiometer which is connected between ground and a 30-volt negative source, or derived by a voltage divider from −300 v.

At the clipper output a full video signal capable of giving a picture directly is available. If the same sync as was used on the flying spot scanner is used to sync the sweeps of another CRT (a monitor tube), a duplicate picture of that appearing on the transparency will be obtained. The mixer for video and sound, and the modulator are also built on this same chassis.

How the sync and sound are added to the video signal, how it is modulated, sent out over the air, and received, will be described in next month's article. *(To be continued)*

R & TV NEWS EDITOR ADDRESSES SAPPHIRE CLUB

THE Sapphire Club of Hollywood, California, whose membership is made up of some of the outstanding authorities in the field of audio engineering, recently celebrated its Fourth Anniversary at a dinner meeting held in Hollywood.

In addition to an impressive turnout of charter members, a representative group of guests from the radio, television, and motion picture industries attended the anniversary event.

The principal speaker of the evening, and guest of honor, was Dr. Oliver Read, Editor of RADIO & TELEVISION NEWS, who delivered a talk on the trials and tribulations confronting the editors and publishers of technical magazines. He encouraged members of the Sapphire Club, as individual authorities and engineers, to submit technical articles to magazines because, by so doing, they can offer valuable assistance to their profession.

A technical talk on color television was the high point of his address. The members' interest in the subject was evidenced by the lengthy general discussion and their participation in the question and answer quiz conducted by Dr. Read upon completion of his principal address.

Dr. H. M. Tremaine, vice-president and director of education of the University of Hollywood, acted as chairman of the evening's program as well as of the Fourth Anniversary celebration. Art Partridge of Radio Recorders is the chapter secretary.

—30—

Fourth Anniversary Dinner of the Sapphire Club of Hollywood. Standing at the speakers' table, from left to right, are: Art Partridge, chapter secretary; Oliver Read, editor of RADIO & TELEVISION NEWS; Dr. H. M. Tremaine, vice-president of the University of Hollywood; and Ben M. Klekner, president of the University of Hollywood.

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1N21A .89	4-125A 26.05	350A 1.98	861 9.95	1C7G .89	6AL5 .59	6X4 .57	25Z6GT .43
1N21B 1.39	4-250A 36.25	350B 1.39	864 .29	1D5GP .97	6AQ5 .49	6X5GT .47	26 .49
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1P24 .59	4C35 19.38	446B 1.79	878 1.98	1H4G .55	6B7 .87	7B4 .53	34 .37
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2C22/7193 .15	5AP4 2.95	575A 11.95	908 4.95	1LA4 .79	6BG6G 1.47	7C5 .48	35L6 .52
2C26A .15	5BP1 2.29	631P1 3.75	918 1.49	1LA6 .89	6BH6 .59	7C7 .59	35W4 .39
2C34/RK34 .22	5BP4 2.39	700A 19.95	919 1.95	1LB4 .89	6BJ6 .57	7E5 .67	35Y4 .49
2C39 17.95	5CP1 1.29	700B 19.95	923 .79	1LC5 .69	6C4 .19	7E6 .54	35Z3 .57
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2J22 7.95	5MP1 9.95	707B 14.95	1614 1.35	1S4 .59	6G6G .69	7Y4 .47	45Z5 .55
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Shock Mounting Of Vacuum Tubes Can Be Simple Yet Effective

By ROBERT E. PROUTY

Fig. 1. An "exploded" view of the shock mounting assembly.

Details for constructing a relatively simple, yet mechanically rugged, vacuum tube shock mounting.

IN THIS day of tape recorders and other electronic equipment having high gain input circuits, the problem of shock mounting the input stage becomes quite a problem for manufacturer and home builder alike. Shock mounts invariably seem to develop into complex mechanisms involving springs, counter springs, and what nots. Adequate shock mounting can be relatively simple, yet mechanically rugged. Furthermore, quite effective shock mounts can be manufactured at home, both easily and inexpensively.

Because of its simplicity of design, ease of construction, and satisfactory application to vacuum tube shock mounting problems, the shock mount to be described is believed adequate for most applications.

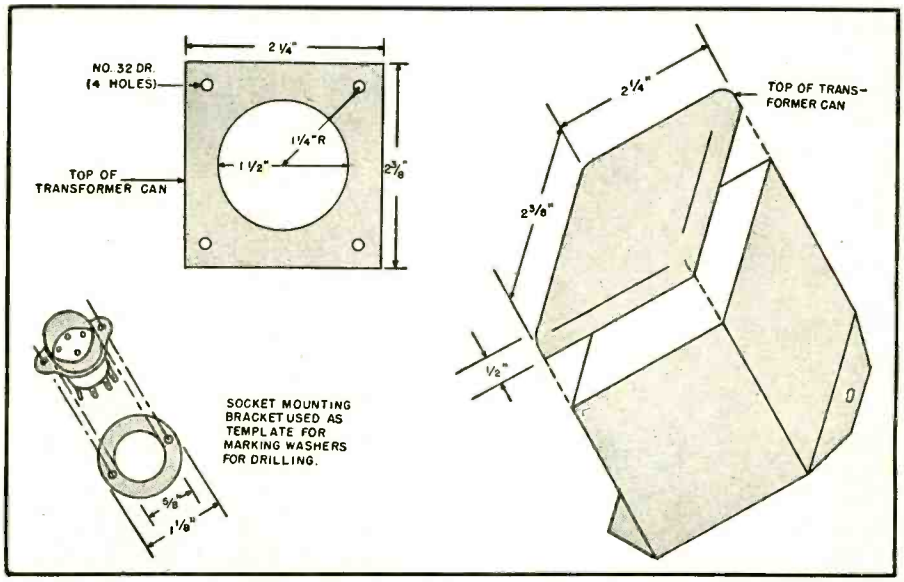
It might be noted at this point that a shock mount can be no better than the flexibility of the connecting lead wires associated with the terminal pins on the shock mounted socket. Additional flexibility can be incorporated into the leads by spiral winding them, as illustrated.

Although adaptable to any standard size tube socket, the dimensions given in the text are for a standard 7-pin shielded miniature socket.

Figs. 4 and 5 show both front and back views of the shock mount as it is installed on the chassis. The particular application illustrated required the input tube to be mounted horizontally rather than in the conventional upright position.

Fig. 1 shows an "exploded" view of the

Fig. 2. Details for constructing a shock mount for a 7-pin shielded miniature tube socket.



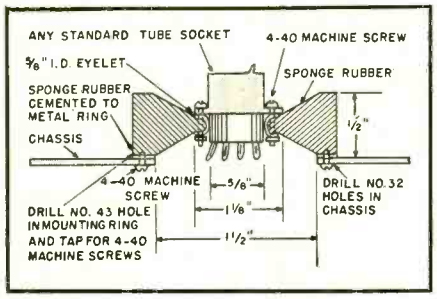


Fig. 3. An elaborated version of the shock mount which provides a "commercial" touch.

assembly. Note that the tube shield can be used as is, or weighted by wrapping with solder, depending upon requirements.

Fig. 2 shows construction layout detail for the shock mount. The cover plate is made by sawing off the top of a standard 2⅜x2¼" transformer can. A pencil line is drawn around the sides of the can ½" down from the top. (If a transformer can is not available, any round or square can lid of appropriate size can be employed, since the cover plate is effectively the mounting bracket.) Establish dead center on the top of the cover plate and cut a 1½" hole. (A 1½" socket punch is recommended for this and the 1½" chassis hole.) Measuring approximately ⅜" in from each corner toward center, mark and drill a No. 32 hole.

Use the completed cover plate as a template for marking the chassis, and cut, or drill, matching holes in the chassis.

Next, cut out a section of ½" sponge rubber to fit snugly inside the cover plate. (The stiffness of the sponge rubber chosen has a very marked effect on the behavior of the shock mount. It should be just stiff enough to support the tube and shield can in an upright position for best results.) With the sponge rubber snugly fitted into the cover plate, again use the cover plate as a template for marking the sponge rubber for cutting. Using an appropriate cork punch, cut a ⅝" hole in the center of the inscribed 1½" circle on the sponge rubber. Be careful that the cork punch does not creep to one side and result in a slanting hole. A satisfactory punch can be made from a 3" or 4" section of thin-walled ⅝" o.d. brass tubing. File the edge flat, and sharpen by sanding or

Fig. 4. Top view of shock mounted tube shown in position on equipment chassis.

filing the sides down until a sharp edge is obtained.

The inside diameter of the two washers used is ⅝". The outside diameter (o.d.) is approximately 1⅛". Use the socket mounting bracket holes as a template for marking the corresponding holes in each washer.

To assemble the shock mount, first place one washer in position on the base of the tube socket. Install two ½" 4-40 machine screws and insert the socket base through the mounting hole in the sponge rubber. Place the second washer in the same manner as the first, and press firmly down until the mounting screws extend far enough through the bottom washer to allow lock washers and nuts to be attached. Tighten the screws until the bottom washer is flush with the base of the tube. (See illustration.) Place the cover plate over the tube side of the socket, insert four ⅜" 4-40 machine screws and secure in position.

To those who wish to add a "commercial" look to their product, the following is suggested: Cut a 1¾" diameter section of sponge rubber, and

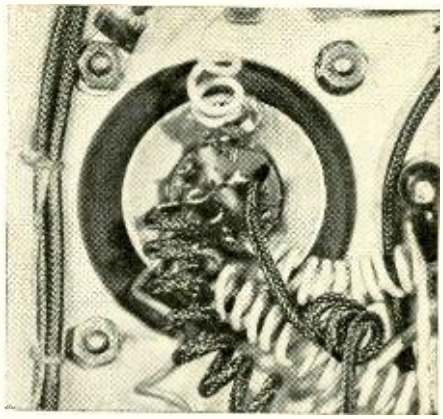


Fig. 5. Bottom view of shock mount assembly.

a ⅝" hole in its center. Drill 3 or 4 equally spaced holes in a 1½x1¾" metal ring (No. 43 drill) and tap for 4-40 machine screws. Insert and affix a ⅝" i.d. metal grommet (eyelet) in the ⅝" hole in the sponge rubber and drill holes for mounting the socket. Cement the sponge rubber to the mounting ring. (See Fig. 3.)

—30—

SIMPLE DESK STAND LETS MIKE RIDE ON RUBBER

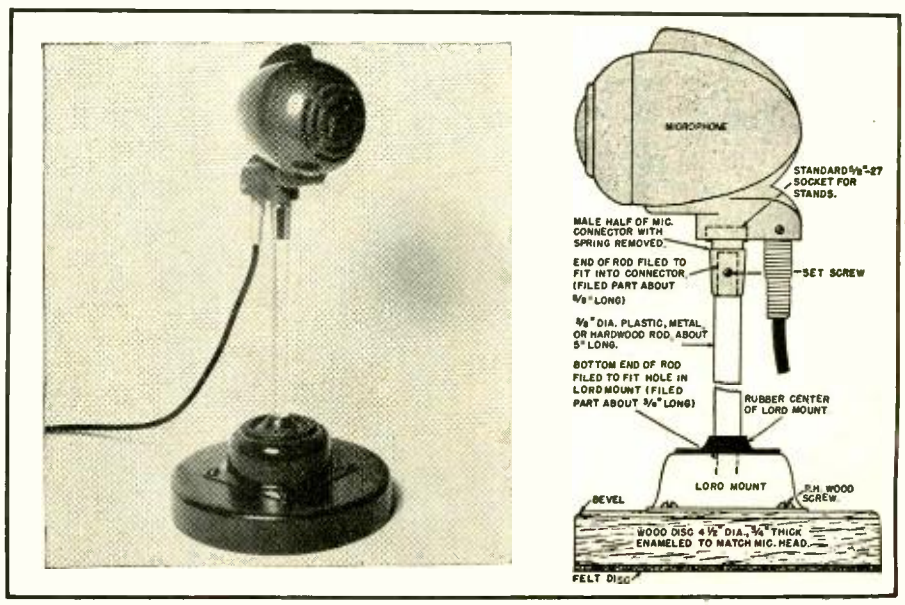
By ARTHUR TRAUFFER

THUMPS, bumps, and vibrations won't spoil your public address reproduction or ham ragchews if you build this simple and economical desk stand that lets your mike float on rubber. Since most microphones are very microphonic, especially when high audio gain is used, you will soon appreciate the fact that the rubber mount is capable of absorbing much of the mechanical shock which would otherwise shock-excite the microphone element.

Construction is very simple and is clearly shown in the photograph and diagram of Fig. 1. It shouldn't cost over 50 or 60 cents to build this unit although it is certainly worth more. A Lord mount of the type shown (these can still be purchased as war surplus) is mounted onto the center of a round hardwood base by means of four round-head wood screws. Give the base and the Lord mount assembly a coat of enamel to match the microphone head and enhance the "professional" appearance of the unit.

A five-inch length of ⅜-inch diameter plastic, metal, or hardwood rod is reduced on one end to fit into the metal sleeve in the center of the Lord mount, and the other end is reduced to fit into the male half of a microphone-cord connector from which the spring has been removed. These mike connectors have standard ⅝-27 threads which fit the threaded sockets in all microphone heads. A felt disc can be glued to the bottom of the wood base to protect polished desk tops. —30—

Fig. 1.



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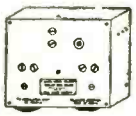

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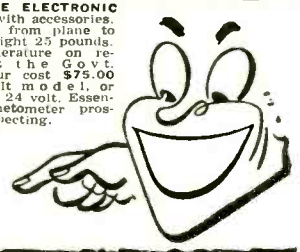

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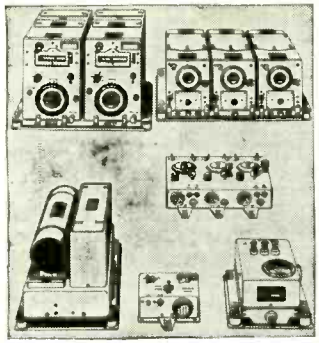

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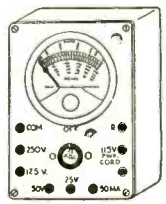

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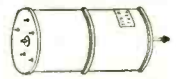
$12.95 TAKES ALL THREE BIG BARGAINS



1. SENSATIONAL, FASCINATING, MYSTERIOUS SELSYNS made by G. E. Company. Two or more connected together work perfectly on 110V AC. Rotation of the shaft of one Selsyn and all others connected to it will rotate exactly as many degrees in the same direction, following unerringly as if the units were connected together by shafting instead of wire. This is true whether you twist the shaft of the master unit a fraction of a revolution or many revolutions. Useful for indicating direction of weather vanes, rotating directional antennas, or controlling innumerable operations from a distance. Complete with diagram and instructions. Matched pair **$4.95. 2. ALUMINUM GEAR BOX** 18x8x7 that contains two powerful electric motors and two matched gear trains, 62 gears in all varying in size from ½ to 4 inches in diameter. This unit is readily converted to rotate a beam antenna or for any other similar use, **$5.00. 3. HOME WORKSHOP AT BARGAIN PRICE.** Accurate and precise 2 speed guaranteed hobby lathe, the essential machine for the home workshop. Sturdy enough for light production work or factory standby service. Supplied with 56" of belting for connecting to any available electric motor or power take-off. Included in this unbelievable offer are such accessories as a ½" drill chuck with specially hardened tool steel jaws, a 4" electric furnace, high speed grinding wheel, a cotton buffing wheel with a large supply of buffing compound, and a 4" steel wire scratch brush. Your cost $6.00. Sole export agent. Distributor inquiries invited.

"DRILLMASTER" ELECTRIC DRILL

Pistol grip electric drill, ideal for hobbyists. Complete with [illegible] grip

Eliminate the danger of fatal shock. Use our G.E. Interlock Safety Switches priced at only **$1.00** each.

NEW G- E. TRANSMITTER

Brand new General Electric BC-375 or BC-191 transmitters, export packed, complete set of spare tubes as well as 10 and

SPECIAL

MF, 24 plate
le cond., 29c or
for 99c

ACRO

Tri-Color TV Tube

(*Continued from page 47*)

mechanical positioning of this yoke. The amplitude of the circular deflection is adjusted to produce the proper convergence angle as required by the mask and phosphor-dot screen. The duration of the sampling period is controlled by a signal having a frequency three times the sampling frequency which is injected into the kinescope cathode circuit. The amplitude and phase of this 10.74 mc. signal are determined by the alignment of a filter circuit which utilizes the third harmonic of the circular-deflection driver tube.

As in the receiver for the three-gun tube, the front panel controls of the single-gun set are the same as those used in a conventional black-and-white receiver. Because a single gun is used in this kinescope, color balance may be achieved by proper deposition of the phosphor dots.

The deflection circuitry and deflection yoke are the same as those employed in the three-gun receiver described in the preceding section.

The kinescope gun which is employed is the same as that used in the commercial type 5TP4 kinescope. Potentials of 18 kilovolts for the final anode and 2.7 kv. for the electrostatic focus electrode are derived from the kickback voltage on the horizontal-deflection output transformer just as in conventional black-and-white receivers. A small auxiliary power unit provides heater and "B+" power for the other added circuits.

Convergence of the circularly deflected beam is produced by a magnetic lens in this single-gun kinescope instead of the electrostatic method employed in the three-gun version. A coil similar to the focus coil normally employed in conventional black-and-white receivers is used for this purpose. The dynamic convergence variation is likewise applied magnetically in this tube and is introduced by means of a smaller auxiliary coil located near the main convergence coil. As in the previous receiver, the dynamic convergence waveforms are derived from the deflection circuits.

NEW TV PRODUCTS on the Market

TV SWEEP GENERATOR

A new sweep signal generator, especially designed for servicing television and FM receivers, has been announced by the Radio Tube Division of *Sylvania Electric Products Inc.* of 500 Fifth Avenue, New York 18, N. Y.

The instrument incorporates electronically controlled sweep circuits and provides good sweep linearity and consequent distortion-free scope patterns. The FM sweep range is from 0 to 600 kc. and the television sweep is from 0 to 15 mc. Fundamental output

frequencies are provided ranging from 2 to 230 mc. in four bands.

Output is at least 100 mv. on all bands and is controlled by a smooth attenuator. Double shielding prevents signal leakage and good frequency stability is assured by a voltage regulated power supply. Wide range phasing control permits adequate adjustment for single oscilloscope response curve. Voltage for driving or synchronizing horizontal oscilloscope deflection is provided.

The new unit measures 11½" x 8¾" x 7" and weighs 12½ pounds.

MOUNTING BRACKETS

Philson Manufacturing Co., Inc. of 60-66 Sackett Street, Brooklyn 31, New York, is now producing a set of chimney mounting brackets which consists of two heavy weight mounting brackets with adjustable eye bolts on each side of both brackets.

The new set comes complete with all parts for mounting masts to the chimney including extra-heavy gauge ¾" hardware straps which are heavily galvanized. The units are riveted with ¼" solid rivets that cannot pull apart. The brackets will fit masts from 1" to 1⅜" in diameter and come packaged in individual sets.

ALLIANCE ROTATOR

The Alliance Manufacturing Company of Alliance, Ohio, is currently running an intensive television and advertising campaign designed to familiarize the public with its "Tenna-Rotor" unit.

Available in two models, the standard and deluxe, these antenna rotators are *Underwriters' Laboratories* approved. A special point-of-sale counter display, designed to tie-in with current advertising, features a miniature antenna which is attached to one of the rotators mounted in the rear of the display. The customer can operate the control case on the counter. New window streamers and other sales aids are also available to dealers.

WINDOW ANTENNA

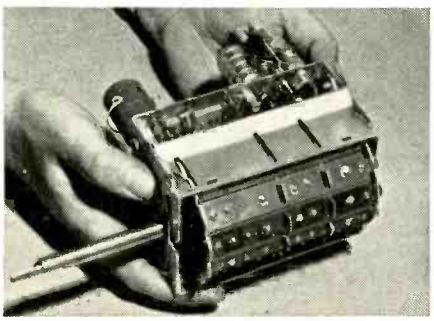
Radion Corporation of 1137 North Milwaukee, Chicago, Illinois, has just introduced a new packaged conical window-mount antenna to fill the gap between portable indoor units and engineered outdoor antennas.

The *Radion* TA-51 comes packaged, fully assembled, and complete with a 15 foot lead. The unit has full 360 degree orientation. It may be adjusted to a universal position for all 13 channels. The new conical model has four triple-chromeplated telescoping dipoles, a triple-chromeplated mast, dielectrically correct bakelite head, and a black oxide swivel base. The unit is completely weatherized and retails in the low priced bracket.

PRINTED TV TUNER

The Tube Department of *Radio Corporation of America* has announced the development of a printed circuit television tuner which is said to provide greatly improved performance, superior reception in fringe areas and in receivers operated with built-in antennas.

A radical departure from conventional wound-coil units, the new tuner utilizes a unique photo-etch process to reproduce the critical circuits. The



process eliminates the complicated process of mechanically winding separate coils and at the same time produces precision circuits of excellent performance.

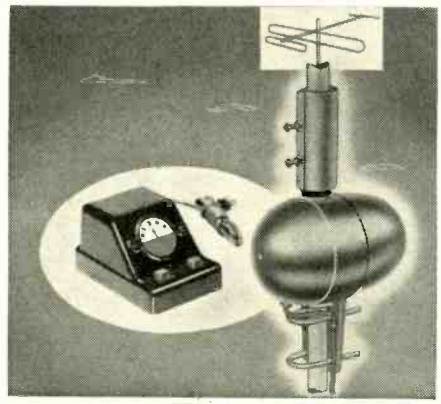
With a tuner design involving twelve channels, each containing four tuner circuits, the printed circuit technique is especially well adapted to its manufacture. In design, the new *RCA* unit is a cylindrical turret-type tuner. The turret assembly employs individual coil strips or segments each containing the printed circuit for a separate television channel. The strips are easily removed for service or replacement. All the tuned circuits are printed with the exception of the oscillator coils for channels two to six.

ANTENNA ROTATOR

The U. S. Devices Corp. of Oak Tree, South Plainfield, New Jersey has entered the antenna rotator field with the introduction of its new unit for rotating FM, television, and ham antennas.

The new unit features the in-line thrust from top mounting through the center shaft of the rotator and down to the mast. It also features a ¾" solid steel rotating shaft, rotating on a ⅝" case hardened steel ball bearing which, in turn, rests on a stainless steel plate.

The assembly is completely weatherproof. It is made entirely of aluminum, bronze, brass, and stainless steel. In addition, the unit is fully lubricated at the factory for life. The rotator uses a heavy duty tandem motor which operates on 110 volt, 60 cycle a.c. with an input of 25 watts. It rotates 370 degrees clockwise or counterclockwise and is instantly reversible from any point. An internal magnetic brake prevents coasting.



Control boxes are made of unbreakable and fireproof plastic in colors to blend with most home furnishings. Two models of the control boxes are available.

NEW TV TUBES

Three new television tube types have been recently added to *Raytheon's* receiving tube line, the 1V2, 6AU5GT, and the 6CB6.

The 1V2 is a miniature type half-wave rectifier. Its principal application will be as a high-voltage rectifier in television receivers. The 6AU5GT is a beam power amplifier intended for use as a horizontal deflection amplifier in video receivers, while the 6CB6 is a miniature type sharp cut-off pentode. This type will be in general use in television sets as an i.f. amplifier, replac-

ing, in many circuits, a type 6AG5 tube.

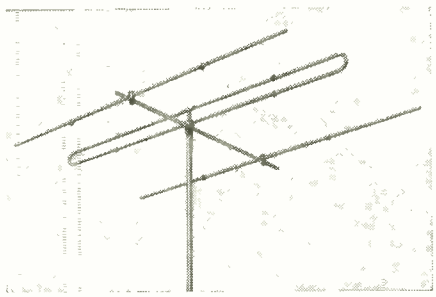
Further details are available from the Radio Receiving Tube Division, *Raytheon Manufacturing Company*, 55 Chapel Street, Newton 58, Massachusetts.

RESONANT ANTENNA

A television antenna which was especially developed for bad locations and fringe areas has just been introduced by *The Cameron Tool & Supply Company* of Cameron, West Virginia as the *Haines* Resonant Antenna.

This antenna features telescoping elements that are calibrated and marked for the various channels, thus the lengths of the director, reflector, and folded dipole can be set properly as well as their spacings from each other.

The low band unit is manufactured in two weights, seven and three and



one-half pounds each, and covers channels two to six. The high band antenna covers channels seven to thirteen inclusive. A molded polystyrene insulator is used in the folded dipole. Mounting clamps are furnished for antennas where stacking is required.

This antenna is also suitable for amateur applications because the elements are adjustable.

DETENT SWITCH CONTROLS

JFD Manufacturing Co., Inc. of 6101 Sixteenth Avenue, Brooklyn 4, New York, is producing four detent switch controls for use as replacements in *RCA, Emerson, Admiral, Air King, Capehart, De Wald, Garod, Philmore, Techmaster, Fada, Olympic, Regal, Packard-Bell, Truetone, Coronado,* and *U. S. Television* video receivers.

The four detents are: No. DT10 (short shaft replacing *RCA* Part No. 71463); No. DT11 (long shaft replacing *RCA* Part No. 72743); No. DT12 (extra long shaft replacing *Admiral* Part No. 76B14); and No. DT13 (all-phenolic shaft replacing *RCA* Part No. 73440).

Detailed information and complete reference charts listing all television receiver makes according to the respective detent required are available from the company.

DISTRIBUTION SYSTEM

The *Brach Manufacturing Corporation* of 200 Central Avenue, Newark, New Jersey, has developed a low-cost multiple TV distribution system which is designed especially for television dealers.

The new "Mul-Tel" system will operate from any antenna and may be installed quickly and easily. No splic-

ing, cutting, or taping is necessary and the entire installation can be completed in just a few minutes without any tools but a screwdriver. In strong signal areas, the system provides the same quality picture and sound to as many as sixteen receivers from a single antenna, according to the company.

Three differently rated units are available to permit proper matching of either 72-ohm or 300-ohm receivers to any good antenna lead-in system where it is desired to operate more than four sets. Transmission can be multiplied by the use of more units. The four-set system is the basic unit.

The system may also be used in garden-type apartment houses or other multiple dwellings, multi-room restaurants, taverns, or clubs.

LOW-PRICED YAGIS

The LaPointe-Plascomold Corporation of Unionville, Connecticut, has announced production on a low priced line of "Vee-D-X" Yagi antennas.

Known as the "J" series, these new antennas feature high gain and pinpoint directivity for fringe area reception applications. Three models are currently available in the new series; the JA, a two-bay, three-element unit; the JB, a four-element antenna; and the JC, a five-element array. Each antenna incorporates clamp type construction and is shipped completely assembled with all elements folded against the boom.

"TELE-BEAMER"

Designed to improve TV, FM or amateur reception, *Koenig Engineering Co.* of 735 Southwest Blvd., Kansas City 3, Kansas, is currently offering a low cost antenna rotator, the "Tele-Beamer."

The new unit will turn the antenna in any direction by push-button action at the compact remote control box. A continuous service direction indicator shows the exact antenna bearing at all times. The rotator will turn all TV masts from ¾" to 2" in diameter and

will carry the highest and heaviest arrays with the addition of the company's radial mast bearing.

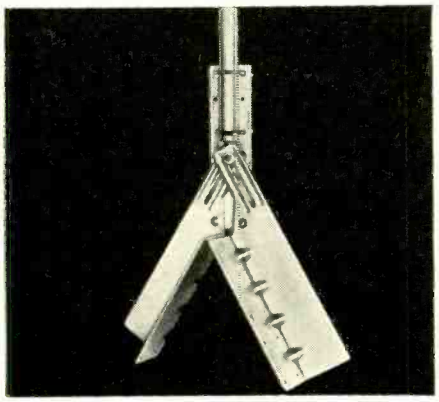
Two motors drive the lifetime lubricated steel and bakelite gears. Electrical stops turn off the motors when the unit reaches one full turn; auto-

matic interlock lets only one motor work at a time. The unit comes complete with instructions for installation.

ROOF MOUNT

T-V Products Company of 152 Sandford Street, Brooklyn 5, New York, is currently marketing a new multi-pitch roof mount unit, the Model RM-5.

This novel scissors-type unit automatically holds the antenna mast in true vertical position regardless of the pitch of the roof. When the mast is inserted, the mast holding section can be either upright or lying along the roof.



The RM-5 is constructed of heavily-plated steel and is engineered to withstand maximum strain. Multiple reinforcing ribs are incorporated into its design to insure strength and durability. The unit comes complete with necessary hardware and instructions.

LIGHTNING ARRESTER

Designed to minimize damage to television sets from lightning and static charges collected on television antennas, *JFD Manufacturing Co., Inc.* of 6101 Sixteenth Avenue, Brooklyn 4, New York, has recently introduced the new "safeTVguard" twin lead lightning arrester.

Made of glazed porcelain, the new unit bears the *Underwriters' Laboratories* seal of approval for both outdoor and indoor use. In addition, it complies with fire insurance regulations of the National Board of Fire Underwriters and the National Electrical Code for outdoor antenna installations.

The arrester can be installed anywhere, on the mast, a grounded pipe, any wall or window sill. No wire stripping or cutting is necessary. The twin lead transmission line is slipped into the slot on the top of the arrester and tightened in place. A 4-foot length of ductile aluminum ground wire is supplied for use when mounting the unit on walls.

Three models of the arrester are available to fit all types of twin lead transmission lines.

NEW TV TOWER

Production on a new all-aluminum home antenna tower has begun at the Brownstown, Indiana plant of *Thompson & Ruby, Inc.*

An unusual feature of this mast is that the riveted tower sections are shipped completely cartoned, ready for the installer to join together. The tower is adaptable to any type of mounting due to its light weight and unique swivel base.

Full information on this new unit is available from the company.

HIGH VOLTAGE COUPLER

Clarostat Mfg. Co., Inc. of Dover, N. H., has announced the availability of a high-voltage coupler and spacer assembly to be used on replacement controls for TV, oscilloscope, and other high-voltage circuits.

The new coupler assembly, 59-186, with a nylon insulator shaft, RN-3", rounds out the current assortment of a dozen "Pick-A-Shafts" or attachable shaft types and may be purchased separately.

The high-voltage insulator sleeve screws on to the control bushing while its threaded metal stud end takes the mounting nut. The nylon shaft with a standard "Pick-A-Shaft" keyed end, slips into the control's slot and is gently tapped to snap it firmly and permanently in place for integral control and shaft combination.

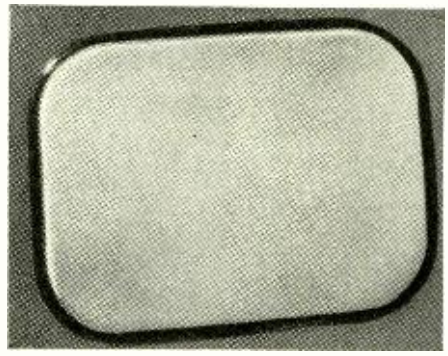
The coupler is rated at 10,000 volts breakdown test and

is available in all of the company's type controls, Types AM and AT.

NEW G.E. TUBE

Production is now under way on a 14" rectangular television picture tube at the *General Electric Company's* Buffalo, New York, tube plant.

The new tube, the 14CP4, has a use-



ful picture area of 99 square inches and a neutral density faceplate for increased picture contrast and detail. The electron gun in the tube is designed to be used with an external ion-trap magnet for prevention of ion-spot blemish.

The maximum ratings of the 14CP4 are: anode voltage, 14,000 volts; grid No. 2, 410 volts; grid No. 1, 125 volts negative and 0 volts positive bias.

Complete details on the new tube are available from the Tube Divisions, of the company at Schenectady, New York.

MASTER ANTENNA

Masta TV Antenna Corporation of 1133 Broadway, New York 10, New York is in production on a new amplified master antenna which includes high gain for all present TV channels, thorough shielding against outside interference, and complete isolation between sets.

The new equipment consists of seven amplifying units, one for each channel in the New York area, each with a specially designed antenna. As a master antenna it will service up to 140 television sets, eliminating many of the antennas presently required and providing each set with clear reception. —30—

94% OF TV SERVICING DONE IN THE FIELD

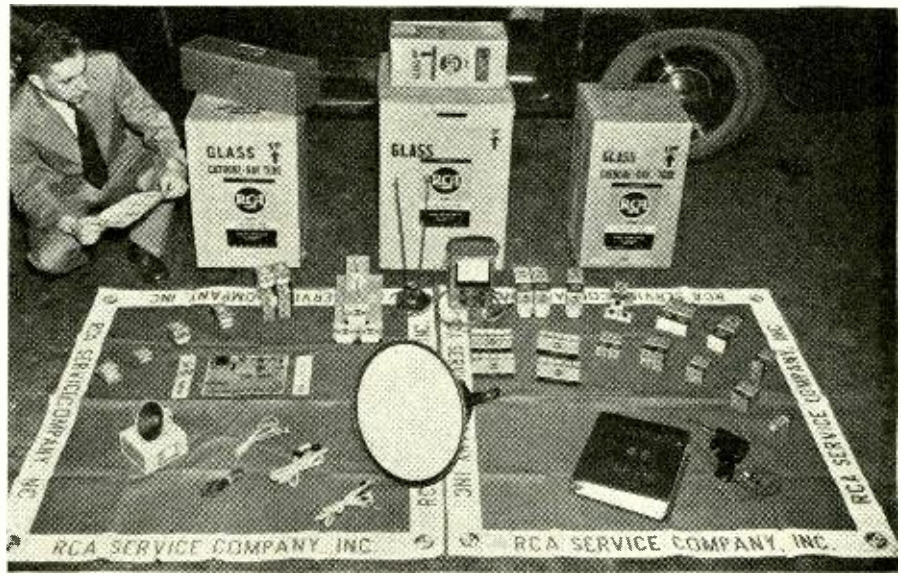
By ROBERT HERTZBERG

WHEN an RCA engineer stated at a recent TV meeting that 94% of all field service calls handled by the nationwide organization of the RCA Service Co. Inc. are completed in the customers' homes, with the assistance of only materials carried in the standard panel truck, I remarked, "Those trucks must be loaded with scopes, sweep and marker generators, and all the other expensive equipment in the catalog."

"Funny thing, everybody has that idea," the engineer said. "Actually, the trucks carry only one test instrument, a standard vacuum-tube voltmeter. Most of the space in the vehicle is taken up with picture-tube cartons. You don't believe me? Come down to Camden and I'll show you."

I went, and was shown. Here is a photograph to convince independent TV service technicians that they don't have to move out half of their shops to do justice to calls from set owners. Besides the basic v.t.v.m., the cargo includes the following: a steel carrying case of common small tools, soldering gun, service manual, a complete assortment of replacement tubes ranging from 7-pin miniatures up to 16-inch picture tubes, loudspeakers, power cords, switch shafts, indoor type antenna, and a handful of small resistors and condensers. That's all! With the exception of the big 16-inchers, all of this stuff certainly can be pushed into the trunk compartment of any postwar sedan; the picture tubes can be put on the rear seat without damaging it. —30—

Equipment carried in a typical RCA Service Co., Inc. television servicing truck. Tubes constitute most of the cargo. Note that only one test instrument, a v.t.v.m., is used.



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.

"AMPROBE" BULLETIN

A 4-page bulletin describing the new pocket-size voltammeter, the "Amprobe," is now available from *Pyramid Instrument Company* of 49 Howard Street, New York 13, New York.

The bulletin lists all pertinent performance and application data on the Model A-5-1 which has seven ranges and will handle conductors up to 1⅛" in diameter. Designed for portable use by service and maintenance personnel, the new unit is housed in a completely insulated case. The scale is visible from any angle and the range is clearly indicated. The movement is a large D'Arsonval jeweled unit with Alnico magnet, completely dust and moisture proofed. A plastic finger trigger opens the jaws and the selector switch is operated with a flip of the finger. Meter accuracy is ± 3 percent full scale.

CARDWELL CAPACITORS

The Allen D. Cardwell Manufacturing Corp. of Plainville, Connecticut, is making available a new and comprehensive catalogue covering its line of variable and fixed air capacitors.

Known as the Catalogue No. 50, the manual covers midget units for v.h.f., single and dual midget capacitors, differential type midgets, heavy duty special units, plug-in fixed air capacitors, midway transmitting units, u.h.f. transmission types, neutralizing units, dual variables, frequency meter precision capacitors, insulated couplings, and miscellaneous accessories.

TV RECEIVER TUBES

Sylvania Electric Products Inc. has issued a 56-page booklet covering tubes used in over 620 models of television receivers.

Listed by make and model and showing the number and type of receiving and picture tubes used, the book also contains a chart showing the percentage of each of the 136 receiving tube types used in TV sets distributed by 85 manufacturers. This reference list is designed to aid television technicians in stocking for future replacements. The reference material in the manual also includes a list of 80 TV set manufacturers and their addresses for use in securing additional servicing information.

Copies of the booklet are being distributed through authorized *Sylvania* distributors.

TV ACCESSORIES

Complete data on the company's line of television antennas, mounting units, and accessories is included in the latest catalogue issued by *Phoenix Electronics, Inc.*, of Lawrence, Massachusetts.

Designed to assist jobbers and dealers, the information on folded dipole, in-line, conical, and double conical antennas; chimney, wall, vent pipe, roof, and universal mounts; standoff insulators, and a wide array of hardware and installation equipment is presented in concise and easily-used form.

RESISTOR DATA

The company's new line of resistors is described in the recently-released Resistor Bulletin 350 issue by *Hardwick, Hindle Inc.* of Newark 5, New Jersey.

Complete specifications, including terminals, wattage ratings, dimensions, and resistance is given on this line of vitreous enamel units. Construction details and application data is also included.

Copies of the new bulletin and full details on the line are available from the company on request.

SHELDON TUBE CHART

A large, easy-to-read wall chart which lists the characteristics of 24 of the cathode-ray television tubes manufactured by the company is now available from *Sheldon Electric Co.* of 68-98 Coit Street, Irvington 11, New Jersey.

The chart is a combined specification and dimension sheet which lists every television tube thus far released by *Sheldon*. One side of the chart shows the tube specifications while the reverse side gives dimensional diagrams on the same tubes.

Copies of the chart are available on request from the company.

EQUIVALENT PARTS

Of interest to service technicians is the newly published catalogue issued by *Crest Transformer,* 1834 West North Avenue, Chicago 22, Illinois, listing equivalent parts for various television receivers.

Over 200 television sets, manufactured by approximately 50 of the leading U.S. video receiver makers, are covered with comprehensive data on the various components. Copies are available without charge when the request is made on company letterhead. Ask for catalogue #50.

TURNER CALATOGUE

An 8-page catalogue, Bulletin No. 949, covering the company's complete line of microphones, is being offered to interested persons by *The Turner Company* of Cedar Rapids, Iowa.

Included in the listing are various models of crystal and dynamic microphones for all types of sound applications. Units for hand-held, floor stand, desk stand, hearing aid and lapel use are listed and described. A group of the company's microphone accessories is also included in the catalogue.

LABORATORY EQUIPMENT

A comprehensive, 90-page catalogue, covering the company's complete line of laboratory equipment for application of radioisotopes to research, industry, medicine, agriculture, etc., has just been issued by *Tracerlab Inc.* of 130 High Street, Boston 10, Massachusetts.

Included in Catalogue B is descriptive material on instruments, Geiger-Mueller tubes, tagged organic and inorganic chemicals, and industrial beta ray thickness gauges. The laboratory instruments feature three different types of scalers, an automatic sample changing system, survey and rate meters, and preamplifiers.

ELECTRONICS DICTIONARY

Allied Radio Corporation of 833 West Jackson Boulevard, Chicago 7, Illinois, has issued a handy and practical dictionary of 2500 terms used in television, radio, and industrial electronics.

Edited by Dr. Harry L. Van Velzer, Associate Professor of Electrical Engineering at the University of Illinois, the new "Dictionary of Electronic Terms" answers the need for an accurate, up-to-date reference source of words used in the electronics field.

Definitions cover mostly modern techniques and equipment but range from many words no longer in general use, retained for historic reasons, to the new language of color television and the electronics of nuclear physics.

Over 125 illustrations and diagrams of components, equipment, and electronic circuits are included, along with an appendix section containing useful radio data.

Copies of "A Dictionary of Electronic Terms" are available from the company at twenty-five cents each, prepaid.

SALES AIDS

A new series of advertising and sales promotional material for use by retailers has been released by *Majestic Radio & Television, Inc.* of 70 Washington Street, Brooklyn 1, New York.

Included in the series are eight newspaper mats, descriptive literature, two new window streamers and a new fluorescent-printed rayon banner.

All of this material is available from local *Majestic* distributors.

DU MONT TUBE CHART

A handy tube chart covering the company's line of "Bent-Gun Teletrons" has just been issued by *Allen B. Du Mont Laboratories, Inc.* of 750 Bloomfield Ave., Clifton, New Jersey.

The new chart presents, in tabular form, all of the essential data on over

fifty different cathode-ray tubes. Included are dimensions, basing data, deflection angle, envelope, contact, ion trap magnet, maximum design center values, and comparative operating conditions.

A copy of the chart and a 4-page data sheet on the company's "Tele-trons" is available on request.

TV BULB DATA

The *American Structural Products Company,* Box 1035, Toledo 1, Ohio, has recently issued a twelve-page book designed to assist television tube and set manufacturers to take full advantage of the new *Kimble* all-glass rectangular television bulbs.

The new booklet contains scale drawings showing all dimensions of the rectangular bulb in 14, 16, and 19 inch sizes and round bulbs in 12½, 16, and 19 inch sizes. It illustrates the advantages of rectangular bulbs over round bulbs by comparisons of area, shape, and completeness of the picture.

Copies of the book are available from the company's Sales Promotion Division.

REFERENCE GUIDE

Hytron Radio & Electronics Corp. of Salem, Massachusetts has recently issued a fourth edition of its handy "Reference Guide for Miniature Tubes."

The miniature tubes of all manufacturers which have been released to date are listed in the new booklet. 132 miniatures are included along with 41 new tubes. There are 70 basing diagrams and a tabulation of comparable prototypes in the standard sized tubes. Copies are free on request.

SAMS SUPPLEMENT

As an added service to "Photofact" subscribers *Howard W. Sams & Co., Inc.,* of 2201 East 46th Street, Indianapolis has recently announced the publication of a 64 page TV data supplement which is being distributed without charge with the purchase of the "Photofact" Set No. 91.

This preliminary data is being released to service technicians in advance of complete coverage of the equipment by regular "Photofact" TV folders. The 64 page supplement consists of double-page schematic diagrams covering over 100 TV models.

The second TV supplement will be issued with "Photofact" Set No. 93.

REPLACEMENT GUIDE

The Rectifier Division of *Sarkes Tarzian Inc.,* 415 North College Avenue, Bloomington, Indiana, has started distribution on a handy replacement guide chart for selenium rectifiers.

The chart lists direct replacement rectifiers for over 100 models manufactured by 39 different companies. The material is tabulated for easy reference with the manufacturer's name, part number, and then the *Sarkes Tarzian* replacement part number.

Copies of this replacement guide are free for the asking. Write the company direct for your guide. —30—

Spot Radio News

(*Continued from page* 18)

variation from the values required for the reception of the present black and white signals. However, interference from other emissions, which do not satisfy either the normal tolerance limits or the offset conditions, were found to be of considerable importance by Chapin, who emphasized that they will tend to become worse because of . . . (1) The filling up of the spectrum which will result in more transmitters and receivers, increasing the probability of interference, and making it increasingly difficult or impossible to handle harmonic or local oscillator radiation problems by allocations problems; and (2) the use of the ultra-highs which will aggravate the oscillator radiation problems.

The probability of in-channel signal interference with the *RCA* color system, was reported by Chapin to be about twice as great as for a standard black and white signal, during preliminary tests. He said that this increased susceptibility appeared to result from the presence of a 3.6 megacycle subcarrier. Chapin then added that the double susceptibility of the *RCA* color signal to interference appeared to require abandonment of the approach to reduction of interference by allocation, and thus the allocation plan might, therefore, be substantially different, depending on the color system involved. Chapin also noted that susceptibility to interference was basic to the dot-sequential system and might become worse, with additional stations, additional receivers and other devices employing radio frequency, such as diathermy and industrial radio-frequency heating equipment. Use of the ultra-high band might also aggravate the situation, he said.

No sooner had Chapin returned to his chair along FCC Staff Row, than cannonading really began, with FCC Attorney Harry Plotkin as the principal fuse setter. The blasts arose during the testimony of RMA Prexy Raymond C. Cosgrove, who told the Commission that he didn't know the attitude of the individual members of the association about possible insistence on the production of receivers which would provide black and white signals under a non-compatible system, such as that fostered by *CBS.* The FCC counsel had pointed out that if the Commission approved a compatible system, there would probably be no problem of continuing manufacture, but if a non-compatible system were selected by the FCC, the official decision would be frustrated unless industry cooperated, and thus compulsory action by the FCC might be necessary.

When the RMA Headman could not supply an appropriate production answer, Plotkin roared out that FCC might call on all manufacturers to appear in Washington and reveal if they would or would not make equip-

ment which could provide reception from the *CBS* system, if it were adopted. The issuance of a subpoena to perhaps General David Sarnoff and Frank Folsom of *RCA* was also suggested by Plotkin, which was immediately protested by *RCA's* attorney and then subsequently pigeon-holed by Commissioner Paul A. Walker, who acting as chairman in the absence of Wayne Coy, declared that there was no need for a subpoena at this time. Plotkin then aimed his questions at Dr. Engstrom who was asked what his company might do if the *CBS* system were approved. He replied that *RCA* probably would make the *CBS*-type models, according to public demand, but his company had no faith in the system.

The arguments for government pressure appeared to stem from the vitriolic statements made earlier by Senator Edwin C. Johnson, during a speech on the Senate floor, when he blasted industry for its attitude towards the FCC and its talk about a Congressional investigation on television. At that time, the fiery Senator said: "If there is to be an investigation of television by Congress, let's have one which goes into monopoly controls. . . . Our committee may decide that the time has come to thoroughly explore what is going on."

Commissioner Jones' tart comments during a luncheon meeting earlier in the year were also recalled as playing a role in the present tirade against industry during the hearings. The Commissioner declared then: "I need not remind you that the Justice Department has taken steps to use the anti-trust laws where it appeared that an art was being suppressed for advancement of private interests and to the prejudice of the interests of the American people. Concerted action by industry groups to delay, if not prevent, the establishment of color television might well lead to the same type of action."

CBS also had entered its plea of industry restraint in an early Spring petition, requesting that the FCC dismiss certain evidence of the RMA, which indicated a . . . "studied course of indifference."

The hammering "we-must-have-an-answer-now" attack also fell on an *A.T.&T.* man, when he appeared to review the coaxial-cable situation. The victim was Frank A. Cowan, head of the engineering and long lines department of the telephone company, who came to testify when the color lines would be available. When told that such lines, with a bandwidth of 4 megacycles would not be available until perhaps in 1952, Madame Commissioner Hennock fired a . . . "too late" commentary at the telephone representative. Cowan declared that it was impossible to promise an earlier installation, unless the broadcasters were prepared to shoulder some of the financial burden of the line-laying. The burying of the wide-band lines would take at least two to three years, he said, but perhaps with the aid of broadcasters could be completed by the end of '51.

As this column was being prepared, the color debate was drawing to a close, to be followed by an equally stormy series of sessions on whether the 470 to 500 megacycle band should be allocated to multi-channel common carrier mobile operation or to television broadcasting. Thus far seven parties have declared that they will testify in these hearings: *Bell Telephone Laboratories,* United States Independent Telephone Association, National Mobile Radio System, *Mutual Telephone Company, Philco,* Television Broadcasters Association and *DuMont.*

A review on this interesting phase of the allocation snarl will appear in our report next month.

A DISASTER COMMUNICATIONS SERVICE will soon be announced in Washington. The plan, which was probed in the '45 allocation plan, will provide for the use of facilities of amateurs, and other non-government and government groups operating fixed, land and mobile stations, all merged into a single integrated service for the handling of emergency communications in times of disaster.

Eight frequencies in the 1750-1800 kilocycle band have been set aside: 1752.5, 1757.5, 1762, 1770, 1778, 1786, 1792.5 and 1797.5. A limit of 1 kilowatt has been set for power, this rep-

resenting the total direct-current plate input power to the amplifier stage, or stages, supplying radio-frequency power to the antenna.

The term disaster, according to the FCC, shall include, but not be limited to, floods, earthquakes, hurricanes, explosions, and consequences of armed attack, but shall exclude strikes.

Authority to operate in this new service will be granted to stations already authorized to operate in other services and will also be granted to new stations.

Commenting on the organization of networks, FCC has revealed that in any particular area there may be several networks and each network may be independent of the others. Wherever there are several networks in the same area, it is expected that all will share the available frequencies. Various networks in different areas, will be expected to try to establish proper liaison arrangements so that in case of need they might all work together.

Here is a vital service with which every amateur should be thoroughly familiar. Contact your local FCC office for complete details. . . . . L.W.

Within the Industry

(*Continued from page 28*)

SARKIS as sales representative in the metropolitan Chicago and metropolitan Milwaukee areas has been announced by *Clarostat Mfg. Co., Inc.* . . . *Noblitt-Sparks Industries, Inc.,* has named two new distributors to handle *Arvin* radio and television receivers. **COASTAL EQUIPMENT CO., INC.** of Houston, Texas, will serve Houston and southeastern Texas while the **H. C. NOLL COMPANY** of Omaha will handle Omaha and other eastern Nebraska cities . . . *John Meck Industries, Inc.* has named **FALL RADIO SUPPLY CO.** of Canton, Ohio and **M. W. ZIMMERMAN** of Springfield, Mass. as distributors in those areas.

* * *

THE NAVY DEPARTMENT has announced a redesignation of the title "Chief of Naval Communications."

Henceforth the post will carry the title "Director, Naval Communications" or "DNC." Rear Admiral John R. Redman, USN, thus becomes the first "DNC" since 1945 when the now-abandoned title was adopted.

* * *

PAUL K. KELLEY, former Export Sales Manager of *Standard Transformer Corporation* of Chicago, died recently in the British-American Hospital in Lima, Peru, after a brief illness.

Mr. Kelley, who was 31, was traveling in South America on business. News of his passing reached the company through a Chicago ham and former associate who had received the news over the air from a ham in Lima.

* * *

LEONARD ASHBACH COMPANY, parent company of *Garod Radio Corporation,* manufacturers of radio and television receivers under the *Garod* and *Majestic* tradenames, has announced the acquisition of a substantial equity interest in *Wilcox-Gay Corporation,* manufacturers of television and recording devices.

Under terms of the transaction Leonard Ashbach will assume chairmanship of the board of the Charlotte, Michigan firm. Plans are now under way for full production and expansion of the *Wilcox-Gay* plant for the manufacture of television receivers, recorders, and TV cabinets.

* * *

PAUL W. NIEF is the new sales manager for *Jewel Radio Corporation* of Long Island City . . . *The Magnavox Company* has named **ROBERT B. BARNES** to the post of district sales manager in the Delaware, eastern Pennsylvania, and southern New Jersey territories . . . The Home Radio Division of *Westinghouse Electric Company* has appointed **W. M. ANDERSON** as southwestern district sales manager with headquarters in Dallas . . . **JAMES F. LUCKER,** youngest member of the *Air King Products Company, Inc.'s* television engineering department, passed away recently in New York . . . **C. J. HASSARD** has been appointed general merchandise manager for the *Bendix Radio and Television Division* . . . The appointment of **ADOLPH S. PEXOLDT, JR.,** as purchasing agent for *Morrison Steel Products, Inc.,* was announced recently by the company . . . **LEONARD C. TRUESDELL** has been elected to the post of vice-president in charge of household radio by *Zenith Radio Corporation.* He joined the company in September of 1949 as sales manager of household radio and television . . . **ARNOLD K. WEBER,** personnel manager of the Camden Plant of *RCA Victor,* was elected president of the South Jersey Manufacturers Association at its annual meeting . . . The newly-created Industrial Television Products Group of the *RCA Engineering Products Department* will be headed by **M. CHARLES BANCA,** according to a recent announcement made by the company . . . The new national merchandising manager of the auto radio division of *Motorola Inc.* is **HOWARD C. HANDWERG** while **J. BENTON MINNICK** has been named national merchandising manager for television . . . **EDWARD E. STOUT** is the new representative of *Raytheon's* broadcast equipment in the northwest territory. He will have offices in Seattle . . . **S. M. DECKER** is the new assistant chief engineer of *Air King Products Co., Inc.'s* television department . . . *Tracerlab, Inc.,* has named **DANA W. ATCHLEY, JR.,** to the post of director of engineering . . . Regional sales in the Midwest area for *Starrett Television Corp.* of New York will be handled by **STUART D. CLAYTON** . . . **ALFRED ZUCKERMAN** has been elevated to the post of vice-president of *David Bogen Co., Inc.* He will continue to serve as chief engineer of the sound equipment firm . . . **NORMAN A. WOODFORD** has assumed the post of sales manager for *North American Philips Company,*

Inc.'s television division . . . **CAPTAIN GEORGE WILBUR McENTIRE** (USAF, Ret.), sales engineer for the *AiResearch Manufacturing Co.* of Los Angeles, died recently in the Veteran's Wadsworth General Hospital after a short illness . . . **HOWARD M. BOYD** has been named sales manager of the Parts Division of *Sylvania Electric Products Inc.* . . . **GEORGE E. FROST** has been appointed manager of the newly-created Products Service Division of *Winchester Repeating Arms Company,* division of *Olin Industries, Inc.* . . . **T. E. SANSOM** and **G. R. ODOM** have been named *General Electric* district representatives with responsibility for the sale of radio communications equipment in the west central district and the Atlantic district respectively . . . *Raytheon Manufacturing Company* has recently promoted three officers of the company. **PERCY L. SPENCER** was named vice-president in charge of the Power Tube Division, **NORMAN B. KRIM** was promoted to the post of vice-president in charge of the Receiving Tube Division, and **ERNEST F. LEATHEM** was named assistant to the president . . . **DR. DONALD B. SINCLAIR** has been appointed chief engineer of *General Radio Company,* succeeding Melville Eastham who retired in February . . . **BARNEY BALABAN** and **EDWIN L. WEISL,** representing *Paramount Pictures Corporation,* were recently elected to the board of directors of *Allen B. Du Mont Laboratories, Inc. Paramount* now holds all the outstanding Class B common stock of the *Du Mont* organization . . . **JAMES WHITE** is the new manager of contract sales for *Air King Products Company, Inc.* . . . *Atwater Television Co.* of Brooklyn has selected **I. R. ROSS** to serve as director of sales for the organization . . . **DONALD E. STEELE** has recently joined the manufacturer's representative firm headed by *Arthur E. Akeroyd.* The company maintains offices in Boston . . . **HARRY ZIMMERMAN,** cabinet engineer for *Bendix Television and Broadcast Receiver Division,* has been named chairman of the Committee on Cabinets and Finishes by the Radio Manufacturers Association . . . **ROBERT C. BENNETT, JR.,** is the new vice-president and sales manager of *National Electric Products Corp.* of Pittsburgh.

—30—

HOW DO YOU FIGURE PROFIT?

By HAROLD J. ASHE

Are you making a fair return on investment plus compensation for your personal services in shop?

HOW do you figure your net profit from your radio and television service shop? Talks with several shop owners and an examination of their books and preparation of their income tax returns have given rise to a strong suspicion that many have delusions of grandeur as to what constitutes their net earnings from business.

Take the case of a fellow we'll call Joe. Joe came out of the Army in 1945 and immediately opened a small service shop in a thriving western community. Joe is really a whiz of a service technician, himself, and he is assisted by another GI who is just as capable. The business has grown rapidly.

In 1948 Joe's net profit, as reported in his income tax return, was $6100. Joe, in his quiet and modest way, feels he has hit the jackpot. After all, before entering the services in 1941, he made about $30 a week working for another shop owner, so he can be pardoned if he feels a slight glow of achievement.

The trouble with Joe is that he is comparing the two unlike periods of 1941 and 1949, and two unlike situations. In 1941 he was working for wages without any investment on his part. In 1949 he is a shop owner with a considerable amount of money tied up in a business of his own. In addition to his own services, his wife helps him in the shop, keeps his books, answers the telephone, and makes herself generally useful in the business. If it were not for his wife's assistance, Joe would be obliged to hire an office girl.

Now the facts of Joe's situation are simply these. He could get a job with another shop for at least $75 a week, with two weeks of paid vacation annually. His wife who has had a wide business experience could easily command at the very least a $35 a week salary. Between them they could have drawn down salaries aggregating $5720 a year.

By rigid economies in his home, Joe has kept ploughing his profits back into the business until, today, he has close to $6000 invested in his small shop. If he did not have this money tied up in his business he could put it out at interest which would bring him $360 a year income without risk or worry.

If Joe and Mrs. Joe worked for wages and drew interest from their savings, they'd have an income of $6080 a year. Now Joe's business operation starts coming into focus. Instead of making $6200 a year profit, Joe and his wife are making $5720 in wages, $360 in interest, and *only $120 in real net profits!*

What is misleading Joe and giving him the illusion of big profits that, in fact, do not exist is his income tax return. In the income tax return he is not permitted to deduct any wage or salary for himself or his wife. The purpose of the income tax return is to determine the amount of income subject to income tax, and in this respect there is no quarrel with the tax return.

However, most individual taxpayers view the tax return as an infallible indication of their *net profits*. To determine the true net profit on his investment, which is the traditional method of calculating net profit, Joe should, for his own information at least, pay himself a salary and also pay one for his wife's services.

It has already been pointed out that Joe would be able to earn a salary of $75 with another shop. There Joe would work 40 hours a week, 50 weeks a year, with pay for 52 weeks. Joe doesn't put in any overtime, or lie awake nights worrying about how to increase business, when working for a salary. He does plenty of that in his own business.

Working for an employer, Joe would be covered by unemployment insurance and have old age benefits. He has neither in his own business. Neither is his wife covered by such benefits.

We are not suggesting that, in view of the foregoing, Joe dispose of his business and seek out an employer. Quite the contrary. We are trying to underscore a situation that is too seldom appreciated by the small shop owner, namely, that he is entitled to something more than a going wage plus 6 per-cent interest on the money he has tied up in his shop as his reward for being in business. Until he understands this circumstance in the con-

duct of his shop, he is actually getting no substantial reward for the risk he is taking in being an independent venturer, but is only selling his time piecemeal.

We do feel that if Joe and the thousands of other Joes operating little service shops around the country get a proper perspective on their operations, they may be persuaded to the conclusion that they, too, have been working only for wages. They may come to a realization that what they have been happily calling their "net profits" are actually illusory.

Considering the time that his wife contributes to the business and the overtime he, himself, puts in, Joe is actually not making hour for hour much more than his employee, though Joe would be shocked if he were aware of this.

What's the answer? First, Joe must continue to determine his net profit from his shop for income tax purposes in the same manner that he has in the past, and that is *not* to deduct wages for himself or his wife.

However, merely *for his own information,* he should scrupulously make wage or salary deductions for both himself and his wife to determine the real net profit accruing to him for his investment and for his managerial services over and above his labor as a technician.

When he does this he may have a true picture of what ownership of the business is worth to him in hard dollars and cents. At this point he may question the soundness of present service charges which are not sufficient to permit a *real profit.* If enough Joes get the same idea there may be a sharp reduction in the throat-cutting and price-slashing that now bedevils shop owners trying to make an honest profit-on-investment over and above full compensation for their personal services in the shop. -30-

NEON LIGHT WITH STROBOSCOPIC DISC

WHEN turntable speeds are checked with a stroboscopic disc, much better indications of the bars on the disc can be had by the use of a neon bulb as the light. The reason for this is that the light from the neon bulb actually goes off completely (at the rate of twice the line frequency); whereas, with the incandescent bulb, the light does not go completely off at the zero voltage instant of the line voltage sine wave because of the resistance of the filament. In other words, the filament will emit light for a minute length of time after it is heated, hence the filament is still emitting light when the sine wave passes thru zero.

The 2-watt, 115-volt neon bulb with the standard size screw base works effectively because it can be directly used in any light socket. The best way to see and appreciate the better results using the neon bulb is to actually try it, and compare it to the incandescent bulb.

Similar results can be had with fluorescent lights, as they also are a gas-filled lamp. . . . . M.K.

500 Watt R.F. Amplifier

(*Continued from page* 45)

vertical plates of the oscilloscope are connected, through a shielded line, to the two or three turns of insulated wire, wound over the center of the antenna coil, which are used for r.f. pickup; the horizontal plates are connected to the modulation transformer secondary through a 50,000 ohm potentiometer and a 0.05 μfd. isolating condenser. The purpose of the potentiometer is to keep the sweep trace within the screen area of the cathode-ray tube while making necessary adjustments.

Apply plate and screen voltage and r.f. excitation to the HK-257-B's and adjust the input coupling so that approximately 6 milliamperes of grid current is obtained. The coupling between the antenna and the amplifier plate tank is adjusted for approximately 110 milliamperes of plate current. Now, feed a 400 cycle audio frequency signal to the speech amplifier microphone input and bring up the gain until a slight movement of the plate current milliammeter is noticed. Set the gain control just below the point where this slight change in plate current occurs. Adjust the 50,000 ohm potentiometer until the sweep trace covers about three-fourths of the diameter of the cathode-ray tube screen. The pattern on the oscilloscope should be triangular with straight sides as shown in Fig. 6. If the pattern is not of the shape indicated, adjust the antenna coupling, the grid excitation and the speech amplifier gain until the desired pattern is obtained. The bias values shown in the table are approximately correct for the plate and screen voltage indicated and these values should not be changed unless the triangular pattern cannot be obtained with the adjustments outlined above. The grid excitation and antenna loading, while not extremely critical, require careful adjustment in a suppressor modulated amplifier.

One of the greatest problems encountered in amateur radio today is interference with other services, particularly television. This type of trouble is likely to become more and more prevalent as the city residential areas become saturated with video receiver installations. The amplifier described if properly constructed, adjusted, and operated in a well-shielded rack should not cause interference in television receivers unless the receiving antenna is located nearby. It has been found that a great deal of television interference from amateur transmitters is due to the excessively large amounts of driving power used in the average rig. This is especially true where doubler amplifiers are used to drive the final amplifier. The doubler is usually operated with large amounts of grid bias in order to obtain better efficiency and

greater output at the operating frequency. It must be remembered that not only second harmonic energy is produced but higher harmonics as well. This high order harmonic signal energy is coupled through the interelectrode capacitance of the final amplifier tubes to the antenna where it is radiated into space. In checking interference of this type it generally will be found that operation of the final amplifier will make but little difference in the interference intensity. This amplifier will tend to reduce this type of interference.

However, if the amplifier is to be operated in a locality where television interference is likely to occur, several precautions may be taken at the time the amplifier is being constructed. First of all, do not use a doubler type of driver stage; use some type of tube which will operate "straight-through" and do any necessary doubling in the previous stages. Doublers should be receiving type tubes, well shielded and operated at very low power inputs. Make certain that all racks and cabinets are grounded. It may be necessary to place an r.f. choke in each leg of the 117 volt a.c. line; if so, the chokes should be placed in a shielded metal box which is connected to ground.

If the interfering signal is being radiated by the antenna, its intensity usually will vary when the antenna coupling is changed or the antenna is removed. If no change is noticed, the interference is probably reaching the television receiver through the house wiring or by radiation from the transmitter wiring. If it is certain that the interference is coming from the transmitting antenna, certain changes in the final amplifier will tend to reduce or eliminate the trouble. A small air-dielectric fixed condenser of approximately 20 $\mu\mu$fd. value may be connected directly from each HK-257-B plate to filament. These condensers may be similar to those used for neutralizing purposes and should be of sufficiently high voltage rating to stand the plate voltage plus the modulation voltage peaks. The leads to the plates and filaments should be extremely short to eliminate any inductance effect. Since these condensers add capacitance to the tank circuit, it will be necessary to readjust the plate tank tuning condenser in order to restore resonance.

The most likely cause of interference from the amplifier itself would be radiation of third harmonic energy since the second harmonic will be cancelled if the two tubes are properly balanced. Fig. 7 shows a trap arrangement used by the author to eliminate a third harmonic signal which caused interference with an FM receiver. In this case, a voltmeter was placed across the receiver discriminator load resistor and the traps were adjusted for minimum reading on the voltmeter.

-30-

LETTERS from our readers

MODEL-T VIDEO

"IN YOUR January issue you have an editorial 'Is Television Going Model T' which we think is one of the best things we have yet read on the subject.

"We enjoy the 'News' every month. Keep up the good work!"

Chet Nowick
Preferred Stores, Inc.
North Pelham, N. Y.

* * *

PROSPECTIVE HAM

"IT HAS been my earnest desire to obtain a ham ticket for many years.

"At this writing I find myself with the available time. As the sales representative of a large corporation, I travel the eastern half of Iowa and the northern portion of Illinois, excluding Chicago. Evenings are spent in all of the large towns in this area. I promise to answer all hams who contact me, and if agreeable with them, to drop around for a look at their rigs when in their cities."

William E. Wheeler
333 South Osborn
Kankakee, Illinois

* * *

MALIGNED HAMS

"WHILE the armed services, government agencies, electronics industry, and a small part of the public generally laud radio amateurs for their various services (traffic handling, contributions to technical development, availability during national emergencies, etc.), the greater part of the public seems to take an extremely dim view of us once they've heard a click on their receivers or observed a flicker on their TV screens—even though the fault, in most instances, lies with inferior radios and TV sets.

"Not infrequently I have heard assertions like 'Those d—— amateurs should be put off the air.' Some of these statements are made with such arrogant airs that they seem to imply an encroachment by amateurs upon public frequencies. Indeed many of these people are quite ignorant of the fact that amateurs are government licensed. I hesitate to contemplate the technical status of radio today had not amateur radio existed—perhaps these people who are so ready to condemn the ham would still be using t.r.f. receivers.

"While most of us are aware that the word 'amateur' denotes one who loves an art for the art's sake alone it unfortunately has the connotation of second or third rater. People, therefore, labor under the delusion that an amateur radio operator is a Peck's Bad Boy surreptitiously diddling in a cellar with a broken light bulb and a hammer, whereas the truth of the matter is quite the opposite. Many hams have attained levels of technical knowledge and skill equalling or surpassing that of some graduate engineers.

"I submit that a considerable part of the scorn evidenced by the public toward hams is brought on by the very name of our hobby—'amateur radio.' I proposed that it be renamed. 'Avoradio,' a composite word comprised of the words 'avocational' and 'radio,' should be of benefit in erasing the described stigma."

Peter N. Saveskie, W5QXH
Baton Rouge, La.

* * *

SERVICE LIABILITY

"I HAVE read RADIO & TELEVISION NEWS with great interest for an extended period of time. Your magazine publishes excellent technical and practical articles. I do believe, however, that you are omitting advice to your readers who are in the radio service and installation business concerning the pitfalls which lie on every side. I refer to the possibility of serious financial loss in the event that these technicians do not have the proper and adequate forms of insurance coverage!

"In New York, for one example, if a radio shop engages to install an antenna, and particularly a television antenna, if he has one employee, he must under the State Workmen's Compensation Law, have compensation insurance, particularly if such employee performs the erection work. You are aware, of course, that the erection of a television antenna, particularly in a fringe area, is a task more hazardous than installing a roof on the same building. The roofer contemplates a large job and, therefore, employs adequate equipment such as safe ladders, scaffolding, life belts, safety stops for the worker's feet to rest on, and other safety devices. We question that the smaller radio shops are so equipped. If they are not, they should abstain from accepting such erection operations, but should arrange with a reliable roofing or similar concern to install the antenna. If the shop persists in such operation and an employee is injured or killed and the employer does not have compensation insurance, he is not only liable for penalties for violating the state law, but is also liable for the medical bills and lost time arising from the injury sustained.

"In the event of death of an employee, he is liable to the dependents of the deceased. These are substantial sums of money, the payment of which can wipe out the effort of a lifetime in building the business. Furthermore, insurance on a risk of this type is gen-

erally undesirable to the many insurance companies because the hazards involved are extreme and the possibility of losses acute.

"This is not the only phase of the insurance problem. Let us assume that in the erection operation the device, which is awkward and bulky to handle, gets out of control and falls. If it falls to the street and injures or kills a passerby, the proprietor is liable for such injury to a member of the public. He is liable also to the owners of any property which may be damaged by the falling material. This coverage is known as Contractors' Bodily Injury and Property Damage Liability insurance.

"In our appraisal of the possibilities of financial loss to the radio service technician, we find additional booby traps. Let us assume that the installer has completed the job and that the equipment is presumably safely and satisfactorily installed. A short time later, a windstorm blows the installation, or part of it, away and someone is injured by the flying parts or someone's property is damaged. Subsequent investigation proves that a relatively unimportant part, a chimney strap for example, was designed for a smaller installation and gave way under a strain beyond its capacity. Similarly a guy wire may have been omitted which would have been required by ordinary consideration of good, safe practice. The victims of the accident have a right of action to recover damages against the person or firm who performed the installation on the theory that the installation should have been strong enough to withstand the strain applied to it by the windstorm. This form of coverage is Products Liability (Completed Operations) insurance.

"It is well-known that until the lucrative rewards of television appeared, the plight of the average radio service technician was not one to be envied. Long hours and relatively low prices were his lot. Now that he has an opportunity to establish himself firmly, it is unfortunate that he has not been informed of his minimum insurance requirements, by a magazine to which he devotes considerable study. It may be that he would purchase protection against these hazards. I hope your magazine will publish a series of articles furnishing such information.

"This letter is not a plug for business but just a helpful bit of advice to the service technician."

C. L. Nunneker, Manager
Compensation Department
The Shelby Mutual Casualty Co.
Shelby, Ohio

* * *

MORE "MODEL T"

"YOUR editorial 'Is Television Going Model T' was not only a masterful piece of writing, but it was a wonderful display of moral courage. How could you ever muster up enough courage to call your shots like that and also put them where they hurt, or where they might do some good? Criticizing TV manufacturers and advertisers is hardly editorial 'cricket,' I'd say.

"At any rate, I admire your bravery in letting these TV makers know that they 'ain't doin' right by the Nells' who purchase the late model TV sets. Such a piece should have some good effect. What you stated in your editorial is something that service technicians have long known, namely, that radio and TV makers are not putting out the best they have, nor the best they know how to make. It is just as well that they know that you and I know that!

"I suppose the present practice of cheapening TV set quality is a throwback from the days of making those $8.95 'service technicians' nightmares' known as a.c.-d.c. midget radios that flooded the country after the set makers stopped making the good, transformer-type, straight a.c. models that we so sadly miss now.

"Curious indeed are the ways of manufacturers! They'll spend large sums for research to develop a product that is better than others. Then, when they have achieved their goal *rigor mortis* sets in, after which follows the process of cheapening the article until it is no longer worthy of purchase.

"Of course, as you stated, we must have 'cheapie' sets, since all can't afford the higher quality grades. But we should also have sets of the better quality for those who want something finer. Moreover, these better sets should be better sets of higher quality

parts and performance, not the same cheap set stuck in a higher priced mahogany cabinet with an astronomical price tag attached. Too many manufacturers have been guilty of this trick.

"To the radio-minded individual it has been quite painful to observe radios of the sturdy, well-made, a.c. type degenerating into the present stock of a.c.-d.c. junk incapable of operating more than a few months before the rectifier or filter condensers peter out. Granted, this feature is profitable for the service technician, but it is still distasteful to him. I can tell you it has left a bad taste in the mouth of more than one customer—this frequent need for repair! It is most unfortunate to hear that TV makers are treading the same path and casting a blemish on tradenames that have been held in high regard by consumers for years. Such practices will not have a very salutary effect on the booming TV industry—in fact they may well 'boom—erang.'"

Dante Amorose
Amorose Radio
Richmond, Va.

* * *

RADAR DATA

"I HAVE a comment to make regarding an item appearing in 'Spot Radio News' in the April issue.

"The writer was reporting on a speech by Commissioner Webster who posed the problem of supplying radar information to small ships.

"It seems to me that this problem could be solved very easily by feeding radar pictures through a low power television transmitter. This transmitter could be low powered and operate on the broadcast band. Since it would have to serve only the area out to sea, the transmission could be directional.

"Then all a ship at sea would have to have aboard to receive the radar service would be a broadcast TV receiver, which when compared to radar equipment would be very inexpensive.

"Other facilities that could be supplied by the shore station could include pictures of the harbor facilities, weather maps, and various other navigational aids. The sound channels could be used to advantage for instructions and weather data."

Roland Meister
54 Maple Street
Gardner, Mass.

* * *

ELECTRONIC ORGAN

"I JUST wanted to let you know that I built the instrument described by Jim Kirk in his article 'A Home-Built Electronic Organ' in the March issue and the little gadget works like a dream.

"I had a little trouble tuning up the organ but I soon found that I had the polarity of the audio transformers reversed and when I switched the leads the thing started oscillating perfectly.

"While it has been fun playing around with this small unit, and I have been using it for over a month now, I am looking forward to seeing an ar-

ticle on the more elaborate unit that Kirk mentioned he was building. I hope that you are planning to give us the dope on this in an early issue!

"Since building and using this organ I have been surprised to find out how many of my friends and acquaintances are interested in this same sort of deal. There isn't an awful lot of information available on how to home-build this kind of unit and I'd like to see you run more articles on the subject. A lot of your readers aren't hams or service technicians—just basement builders like myself—and this sort of article gives us something to get our teeth into and we really have something to show for our efforts.

"Keep up the good work and let's have more articles on audio equipment, and gadgets that we "unlicensed" guys can build and use.

Paul Bradford
Chicago, Illinois

Plans are already under way to carry an article on Mr. Kirk's more ambitious model electronic organ. The new unit covers a 66 note keyboard and can be used to play chords. Watch for it in a forthcoming issue of the magazine. —30—

Audio Amplifier
(*Continued from page* 51)

ily serviced. The signal leads are so short that no shielded wire was necessary.

The power supply was built on a 4" by 9½" by 2⅛" 1/16" brass chassis. It is conventional except for the gimmick of connecting a 6.3 volt filament transformer backwards with a selenium rectifier to provide a bias supply which is isolated from the power line.

Tests were run on the completed amplifier and it was found to perform as had the development model. In the interests of stability, 1000-ohm resistors were inserted in the screen circuits of the 807 tubes to eliminate the possibilities of the screen current rising to a dangerous value and the generation of parasitic oscillations.

It will be noted from the circuit diagram (Fig. 2) that a 100 ohm potentiometer was provided in the cathode circuits of the 807 tubes to balance their plate currents. This unbalance must be less than 5 ma. or the low frequency response of the system will suffer. The plate currents may be metered by breaking the plate voltage returns to each tube and inserting a 0-100 milliammeter; or, a voltmeter can be used to read the voltage drop across each half of the output transformer primary. The former method is preferable but the latter method is adequate. A control is also provided to set the negative bias voltage on the grids of the 807 tubes to minus 32 volts. This control is shown as R_{16} in the schematic diagram of the amplifier shown on page 50.

The output tubes will then draw in the neighborhood of 95 ma. with no signal. Under signal conditions, the

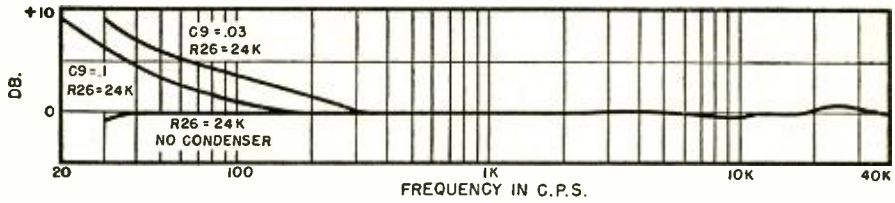


Fig. 4. Low frequency boost possible with various condensers in the main feedback loop.

plate current will swing to as high as 165 ma. for full power output. 807 tubes will vary somewhat, as will any output tubes, and, if possible, two should be chosen that draw nearly the same plate current with the same bias voltage. Any balancing means is a compromise, and the amplifier will be limited by the characteristics of the poorer tube in respect to power output and distortion.

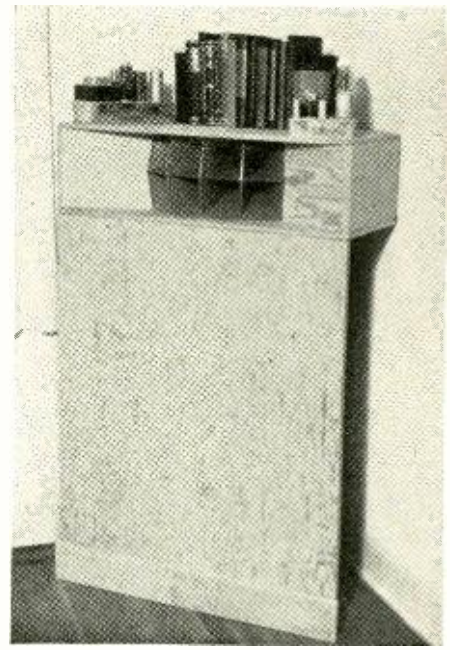
The outside feedback loop was brought out at the output plug, as indicated by the dotted lines in Fig. 2, so that a reactance might be inserted externally to provide a low frequency rise to compensate for speaker or baffle fall-off at very low frequencies. The curves in Fig. 4 show the effect of several condenser values. The amplitude of the boost can be varied by shunting a resistor of appropriate value across C_1.

The amplifier requires about one volt input across 500,000 ohms to drive it to full output. The hum and noise level were down so far that they could not be measured conveniently. It is sufficient to say that when the unit was connected to a highly efficient *Klipsch* type horn-loaded woofer, one could not tell when the unit was turned on.

The amplifier may be driven directly from an FM tuner, in which case the volume control is usually mounted on the tuner. If the amplifier is operated with a reluctance pickup, a preamplifier recommended by the pickup manufacturer can be inserted between the cartridge and this amplifier.

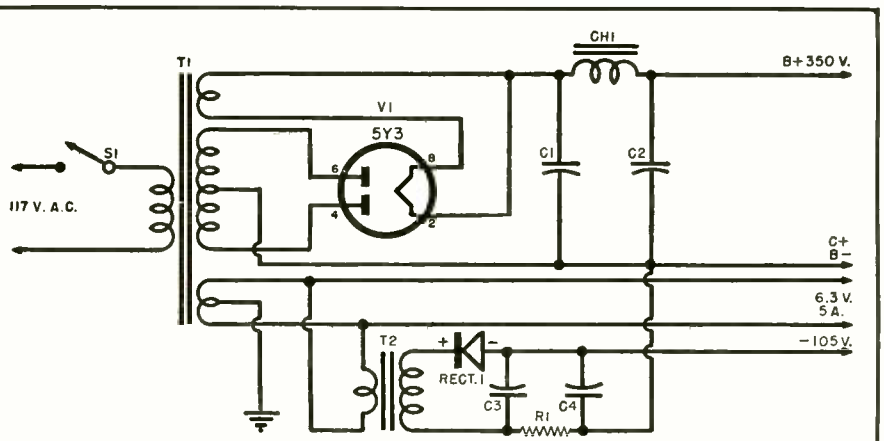
Listening tests were conducted with several FM tuners tuned to live local FM broadcasts over several loudspeakers and the clean, live reproduction was startling. The speakers included an 8" *Altec* 400B in a reflex cabinet, an *Altec* 604B in the *Altec* reflex cabinet, and the large *Klipsch* corner horn woofer with 800 cycles crossover and *Stephens* tweeter. The clean natural reproduction with each speaker was sufficient compensation for the considerable effort expended in the design and development of this unit.

—30—



The amplifier and power supply set atop author's Klipsch-type speaker system.

Fig. 5. Circuit diagram of the power supply unit. Amplifier diagram is shown in Fig. 2.



R_1—Adjust for 105 v. bias (approx. 2000 ohm, 1 w.)
C_1, C_2—40 μfd., 450 v. elec. cond.
C_3, C_4—40 μfd., 150 v. elec. cond.
S_1—S.p.s.t. toggle sw.
T_1—Power trans., 400-0-400 v. @ 200 ma.; 5 v. @ 3 amps.; 6.3 v. @ 5 amps.
T_2—Fil. trans., 6.3 v. @ 2.5 amps.
Rect.$_1$—75 ma. selenium rectifier
CH$_1$—10 hy., 200 ma. filter choke

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A.C.-D.C. Conversion of BC-1206

By OTTO L. WOOLLEY, W8SGG

Make a handy Q5'er or aircraft and weather station receiver from this popular 5-tube surplus superhet.

THE surplus BC-1206 radio receiver is a five tube superhetrodyne covering the frequencies from 195 to 420 kc. It was originally designed to be used as a beacon receiver in aircraft and to be operated from a 28 volt d.c. source. The set is easily converted to a.c.-d.c. operation and is useful for listening to aircraft and weather stations and as a Q5'er. For use as a Q5'er the receiver is tuned to the extreme top of the dial where it will be found that most of the popular i.f. frequencies may be tuned in, the set actually going up to around 475 kc.

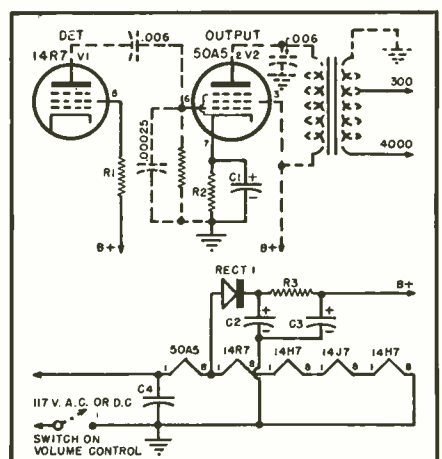
First step in the conversion is the removal of the two chokes and two condensers mounted on the rear of the chassis, leaving the terminal strips in place for tie points for the 117 v. supply. Also remove all connections to the 28D7 output tube socket, and disconnect the two "B+" leads on one lug of the switch leaving the black wire on the remaining lug intact.

Now start with the 14H7 i.f. stage and wire the heaters of the tubes for series operation as shown in the schematic. Bring out a wire from the number 8 pin of the 28D7 socket as a supply line for the d.c. supply. Bring out a wire from the number 3 pin of this socket as a "B+" supply lead into the receiver. These two wires and the filament wires are brought out the hole in the rear of the chassis that originally carried the d.c. supply lines. Wire the 28D7 socket to receive a 50A5 output tube. Connect the two wires that were removed from the switch lug and tape the junction. Connect the vacant switch lug to a ground point on the r.f. tube socket. Make a connection from pin 3 of the 14H7 i.f. tube socket to the unused tie point on the side of the chassis, and connect a 1 megohm, ½ watt resistor between this tie point and the number 5 pin of the 14R7 detector-first audio tube, the original wire to this pin having been removed. The "B+" supply leads (red and white) of both i.f. transformers are brought to the tie point mentioned above. In the original wiring the "B+" leads were connected to the 28 volt points on the heater string and it should be made certain that these leads were removed when wiring the heaters for 117 volt operation.

Mount the power supply components on the rear of the chassis as shown in the photograph and wire according to the schematic diagram. Replace the 28D7 with a 50A5 and the receiver is ready for operation. With the arrangement shown the measured "B+"

Over-all view of converted BC-1206 receiver.

Wiring changes for a.c.-d.c. operation.



R_1—*1 megohm, ½ w. res.*
R_2—*3300 ohm, 1 w. res.*
R_3—*8000 ohm, 1 w. res.*
C_1—*25 μfd., 25 v. elec. cond.*
C_2, C_3—*20/20 μfd., 150 v. elec. cond.*
C_4—*.05 μfd., 400 v. cond.*
Rect.$_1$—*100 ma. selenium rectifier*
1—50A5 tube (replaces 28D7)

supply voltage is 30 volts—very close to the original figure for which the set was designed. Inasmuch as the set is quite lively and has ample headphone volume there isn't much reason for raising the voltage.

The output transformer is tapped at 300 and 4000 ohms, and the tap giving the best volume with the headphones to be used can be selected. The usual precautions that apply to a.c.-d.c. equipment should be observed. The headphones may be insulated by operating the output transformer secondary above ground and insulating the headphone jack from the chassis.

-30-

International Short-Wave

(*Continued from page* 102)

signal weak to fair; is *below* WLKS, 6.105, Kure, Japan. DZH7, 9.73, and BEA8, Nanking, see-saw one another most days, evidently vary in frequency. (Balbi, Calif.)

DYH2, 6.140, noted to after 0830. (Stark, Texas)

A *new* Philippine station is the Republic Broadcasting System, DZI3, 6.110, heard around 0600-1200; noted in the United States and in Australia.

Pitcairn Island—Black, Pa., reports that these calls and frequencies were listed in a QSL from ZKG4 which he received in 1946—ZKG, 8.290 and 12.450; ZKG3, 8.635; ZKG4, 12.110; ZKG5, 17.270 or 7.270. (NNRC) There have been vague reports from overseas sources that Pitcairn Island is now on the air again. *Details would be welcomed.*

Portuguese India—Radio Goa has been heard in the United Kingdom testing on 17.790; frequently mentioned regular daily transmission on 9.615 at 0600-1030. (Radio Australia)

Portuguese West Africa—Sao Tome's CS5SB, 17.677, is scheduled 1000-1200 beamed to Portugal; CS5SA, 9.615, is used 1300-1500 for Africa. (Bluman, Israel, via ISWC, London)

Taiwan—BCAF, approximately 8.996, Taipeh, the Chinese Air Force Station, heard in Calif. 0400; program readable although signal strength was weak. (Rosenauer)

BED4, 11.7246 (measured), is now heard only *after* CHOL, 11.72, signs off at 2400; therefore, the *English* period 2300-2400 is completely covered up. (Treibel, Washington State)

Tangier—Schedules in effect when this was compiled, for the VOA relay stations at Tangiers, were—Tangier II, 6.060, 1700-1730 to Europe; Tangier II, 7.214, 0800-0900 to North Africa (RDF); Tangier I, 11.790, 1500-1730 to Europe; Tangier II, 15.210, 1215-1645, to Europe; Tangier I, 15.250, 1100-1500 to Europe.

Radio International, Societe Africaine de Radiodiffusion, 34 Rue Goya, Tangier, 1238 kc. and 6.110, broadcasting commercial programs in *English,* French, Arabic, Spanish, sent schedule of 0700-0730 *English;* 0730-0815 French; 0815-0900 Spanish; 0900-1100 (close-

The July issue of RADIO & TELEVISION NEWS will be on sale June 30. Be sure to reserve your copy with your Newsdealer.

down) French and Spanish; 1300-1500 Arabic; 1500-1615 French; 1615-1715 Spanish; 1715-1900 (closedown) French and Spanish. (Whitman, Ill.)

Tibet—DeMyer, Mich., has received word from an amateur radio operator in Lhasa confirming that the Tibetan Government has started broadcasting irregularly, radiating on 7.200, usually three times a week—Monday, Wednesday, Friday, with Tibetan, *English,* and Chinese recordings, and occasional Tibetan Government Bulletins in Tibetan, *English,* and Chinese. Time of broadcast, unfortunately, was not stated. I hope to have more details on this one soon.

Turkey—Summer schedules of *Radio Ankara* include *English* over TAQ, 15.195, daily 1345-1400 (news), and Thursdays (talks for the United Kingdom), and Sundays (Mailbag) at 1530-1600.

Radio Ankara soon should have its *new* 100 kw. transmitter on the air when it hopes to extend present schedules, to direct programs to the United States, and perhaps to start a World Friendship Club and to give Turkish-*English* lessons. It recently conducted a contest for radio listeners concerning their knowledge about Turkey and Turkish life.

South Africa—By this time, SABC's commercial ("C") transmitters should be on the air under the call-sign *"Springbok Radio"; English* and Afrikaans will be used—depending on the sponsors; schedule will be 2345-1600, but there may be breaks in the s.w. service when frequencies are changed; it is believed the transmitters will work largely in the 40-, 60-, and 90-m. bands. I hope to have complete details next month.

Johannesburg, 9.523, noted in California 2345. (Moore)

Sweden—Radio Sweden hopes to be on the air with two *new* 100 kw. transmitter early in 1951. (Boice, Conn.) "Sweden Today" (*English*) noted 0815-0830 on SBT, 15.155, good signal. (Fargo, Ga.)

Switzerland—Berne's *summer* schedules are—To Europe, weekdays 0015-0140, Sundays 0155-0140, HER3, 6.165, HEI3, 7.210, HER4, 9.535; Monday to Friday 0500-0830, 1000-1700, Saturdays 0500-1700, Sundays 0245-1700, HER3, 6.165, HER4, 9.535. To Africa, daily 0115-0140 (Sundays from 0155), 0500-0730, 1000-1700, HER6, 15.305, HER8, 21.520, HER6, 15.305. To Australia, New Zealand, Far East, 0215-0440, HEI5, 11.715, HER5, 11.865, HER6, 15.305. To South-East Asia, 0745-0930, HER6, 15.305, HER7, 17.784, HER8, 21.520. To India and Pakistan, 0945-1130, HER5, 11.865, HER7, 17.784. To the Middle East, 1145-1330, HEU3, 9.665, HER5, 11.865. To the United Kingdom and Ireland, 1345-1530, HEU3, 9.665, HER5, 11.865. To Spain and Portugal and South America (first daily transmission), 1545-1715, HEU3, 9.665, HER5, 11.865. To North America 1730-1815 (first daily transmission) and 2030-2300 (second daily transmission), HER5, 11.865, HER6, 15.305,

HER7, 17.784. To South America (second daily transmission), 1830-1900, HER5, 11.865, HER6, 15.305, HER7, 17.784. Has inaugurated several new features for the summer. An illustrated program schedule giving details is available on request to the Swiss Shortwave Service, Berne, Switzerland.

Syria—Damascus is reported using 16.750 daily *except* Sunday with news in Arabic 0940-0950. (Radio Sweden)

Bluman, Israel, says Damascus has moved from 11.750 back to 12.000, and that the former 41-m. channel has moved to 6.950; frequencies of 6.950, 6.000, and 12.000 are now in parallel. Pearce, England, lists Damascus on 6.910 instead of 6.950, heard 1530 with news, announces next *English* for 0610.

Uruguay—Radio Nacional, 6.035, noted for after 1900; listed CXA30 with 5 kw. (Stark, Texas) Location is Montevideo.

USA—Test transmission of AAH, Seattle, Washington, was heard around 1830-1930 on announced 14.867; stated, "This is AAH from Seattle, Washington, a station of the Alaskan Communications Commission, on 14.867 and 10.720"; the 10.720 channel was not audible in New York; played recordings with frequent announcements. (Leinbach)

USSR—Radio Moscow noted on 9.345 at 2000 with chimes; identified at 2035 after trumpet fanfare. (Stark, Texas) Soviet outlet noted on 11.87 in Chinese *after* 0600, good signal. (Balbi, Calif.)

Vatican—HVJ, 15.095, heard irregularly in Italian 0130-0145. (Balbi, Calif.)

Yugoslavia—Bellington, N. Y., received these detailed schedules of *news* periods from *Radio Belgrade*—"morning" session, 9.505, 2300 Bulgarian, 2315 Hungarian, 2330 Rumanian, 2345 French, 0000 German, 0015 Turkish, 0030 Spanish, 0045 Italian, 0100 Greek, 0115 *English;* "afternoon" session, 9.505, 0700 Russian, 0730 Czech, 0800 Bulgarian, 0830 Albanian, 0900 Hungarian; "evening" session, 6.100V, 1100 German, 1115 *English*, 1130 Slovak, 1145 Greek, 1200 French, 1215 Italian, 1230 Russian, 1300 Polish.

* * *

Last Minute Tips

ZNB, Mafeking, Bechuanaland, has moved from 5.900 to an experimental frequency of 8.130 in the 37-m. band. (Laubscher, South Africa)

Dilg, Calif., recently heard an unidentified station on approximately 7.245 between Bombay's 7.240 and Malaya's 7.250; came on 0800 and left around 0810; seemed to be in *English;* weak signal. Possibly *Radio Tibet?*

Since Israel is now on Summer Time, *English* newscasts should be at 0600 on 6.830 (Tel Aviv) and 8.170 (Haifa), and at 1415 on 6.830, 8.170, and 9.000 (Tel Aviv). (Pearce, England)

The Communist-Chinese outlet first on 6.100 and then on 6.090 has moved higher, back to approximately 6.10; signal only fair. (Balbi, Calif.) I have noted improvement lately in the 10.260 Peking outlet; has bad CWQRM but

usually the *English* period 0830-0850 can be read.

At press time, the Communist-Chinese "wanderer" in the low end of the 15-megacycle band was "hovering" around measured 15.068-15.076 where it was overriding the BBC's 15.070 outlet, but with bad heterodyne from the BBC; has news 0830, at good strength; announces as "The Peking Radio," and gives a m.w. frequency, 10.260, and a 19-m. channel that "sounds" like 15.063. If this isn't direct from Peking, it may be a relay from Chungking.

AIR, New Delhi, just airmailed me these current over-all schedules for its s.w. outlets:

Delhi—VUD2, 7.290, 2045-2300; 9.630, 0200-0400; 7.290, 0630-0800; 4.960, 0815-1230. VUD3, 15.290, 2030-2145; 9.630, 2200-2230; 15.290, 0200-0240; 17.760, 0300-0400, 0730-0750; 11.790, 0830-0915; 6.010, 0930-1100; 9.590, 1130-1230. VUD4, 11.830, 2030-2230, 0220-0250, 0300-0320, 0340-0400, 0700-0750, 0830-1100, 1130-1230. VUD5, 15.160, 2030-2200, 2300-2330; 17.840, 0230-0330, 0600-0815, 0830-0915; 17.760, 1000-1040; 11.790, 1100-1230; 9.620, 1400-1500; 15.160, 1930-2015. VUD7, 11.760, 2030-2115, 2130-2200; 9.565, 2215-2310; 15.160, 0230-0330, 0430-0530, 0615-0730; 9.590, 0745-1045; 11.710, 1100-1330; 11.760, 1400-1500; 11.830, 1845-1900, 1945-2000. VUD8, 9.680, 2030-2230; 15.350, 0220-0250; 9.660, 0310-0320, 0340-0350; 9.680, 0700-0750, 0830-1330. VUD9, 11.790, 2030-2115; 7.275, 2130-2230; 11.790, 0220-0240; 15.290, 0300-0400, 0730-0750, 0830-1330. VUD10, 7.225, 2030-2115, 2130-2200, 2215-2310; 17.780, 0230-0330, 0430-0530, 0615-0730; 7.225, 0745-1045; 17.760, 1100-1330; 7.240, 1400-1500; 15.290, 1845-1900, 1945-2000. VUD11, 17.780, 2030-2200, 2300-2330; 21.510, 0230-0330; 15.190, 0600-0815, 0830-0915; 15.210, 1000-1040, 1100-1230; 11.850, 1400-1500, 1930-2015.

Bombay—VUB2, 7.240, 2100-2230; 9.550, 0215-0400; 7.240, 0630-0845; 4.840, 0900-1230. VUB3, 9.550, 2100-2230; 7.240, 0215-0400; 9.550, 0630-0845; 7.240, 0900-1230.

Calcutta—VUC2, 7.210, 2030-2200; 9.530, 0200-0430; 7.210, 0630-0830; 4.880, 0845-1230. VUC3, 9.530, 2000-2200; 7.210, 0200-0430; 9.530, 0630-0830; 7.210, 0845-1230.

Madras—VUM2, 7.260, 2030-2230; 9.590, 0200-0430, 0530-0630; 4.920, 0700-1200. VUM3, 9.590, 2030-2230; 7.260, 0200-0430, 0530-0630, 0700-1200.

According to Magami, Tokyo, summer schedules of *Radio Ankara* are—TAQ, 15.195, 0430-0600, transmission from the Home Service; Thursday, 1530-1600, "Talks on Turkey" (*English*), including recorded music; Sunday, 1530-1600, "Mail Bag" (*English*), including recorded music. TAP, 9.465, daily, 1000 news in Urdu; 1015 recorded music; 1030 news in Arabic; 1045 news in Persian; 1100 transmission from the Home Service; 1130 news in Greek; 1145 news in Rumanian; 1200 commentary in Turkish from the Home Service; 1230 news in

SLIDE FOR LP

BY EDWIN W. HILL
Chief Eng., WDHL

THE LAST few inches of a long "transcription type" pickup arm seem to cost a great deal more than the first few inches do—at least that is a very easy conclusion to reach after comparing the prices of such arms with those of the more common shorter kind that cannot be used with records exceeding 12 inches in diameter.

Among one of his favorite possessions, the author has a two-speed turntable and arm assembly that does double duty as a record player at 78 r.p.m. and a transcription player at 33⅓ r.p.m. Since the dual speed feature was already present, it was logical to want to convert the device to play LP discs also; this, of course, without interfering with its transcription playing ability. The simplest approach would have been the purchase of a pickup arm of the extra long type. However, the cost of those extra inches was such that it was felt that the investment would not be worthwhile.

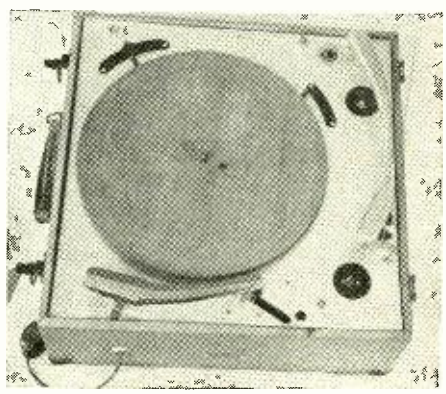
The small *GE* UPX004 arm, with VR cartridge, is excellent for LP's and is also quite reasonably priced. However, if this arm were to be mounted in the conventional manner it would be so close to the turntable that the playing of 16-inch transcriptions would no longer be possible.

The problem was solved by drilling a hole in the motorboard according to the directions supplied with the arm and then extending this hole, away from the turntable, in the form of a slot about 2⅝ inches long. The pickup arm is mounted in this slot and the mounting nut tightened enough so that the arm can just slide back and forth in the slot. Two flat washers, one on each side of the motorboard, will make the sliding operation easier and smoother.

To play LP's the arm is pushed into position next to the turntable. To play transcriptions the arm is slid away from the turntable to the other end of the slot where it is out of the way when a 16-inch transcription is placed on the turntable.

This arrangement can be used with any pickup arm of the short type. The only precaution is that the turntable diameter should not be much greater than 12 inches. —30—

Over-all view of the author's two-speed turntable which was converted for LP use.



Bulgarian; 1245 news in French; 1300 news in Serbo-Croat; 1315 news in Hungarian; 1330 news in German; 1345 news in *English;* 1400 home news in Turkish; 1415-1500 transmission from the Home Service.

Direct from Chang Shui-yu, head of the Service Section, Taiwan Broadcasting Station, the Central Broadcasting Administration, Taiwan Broadcasting District, Taipeh, Taiwan, China, the *International Monitoring Service,* Calif., has received word that "there are about ten broadcasting stations in Taiwan" (presumably, most are m.w.). Stated further, "This station has two short-wave programs—one being 2300-0100 daily, call BED4, 11.725, beamed to the USA, and the other 0500-1100 daily, call BED7, 7.151." T. Y. Woo, long an official of the Central Broadcasting Administration, is now in Taipeh as assistant manager of the China Broadcasting Corporation, Mr. Chang explained.

Summer schedules of *Radio Moscow's* transmissions to North America (*English*), as received from Moscow by the *International Monitoring Service,* Calif., are—1820-1930, 15.23, 11.88, 9.72, 9.67, 11.78, 7.31, 11.96; 2000-2100, 15.23, 11.88, 9.72, 9.67, 9.60, 11.78, 11.96; 2200-2300, 15.41, 15.23, 15.10, 11.88, 9.72, 9.67, 11.96, 11.78.

I have just received a copy of *"OP-AID,"* described by the publishers as "essential data for efficient operation by the amateur radio transmitter or listener," direct from the amalgamated Short Wave Press, 57, Maida Vale, London, W.9, England; price is 25 cents. Topics covered include prefixes, block allocations; amateur prefixes, alphabetical; amateur prefixes, by country; call areas; radio zone boundaries; local time conversion (GMT); mileage table (from London); QSL bureaus of the world; international "Q" code; "Z" code; amateur codes; amateur abbreviations; international Morse Code; the amateur bands; amateur transmitting license; standard frequency transmissions; states and zones charts, and maps of USA and USSR call areas.

At the time this was written, Paris s.w. transmitters were reported off the air; however, Tubb, Texas, had just received word direct from the station that s.w. transmissions were to be resumed shortly.

Radio Scutari, 8.220, Albania, transmits 0700-0900, 1130-1500. (Patrick, England) PZC, 15.405, Paramaribo, Surinam, noted Sundays 1730-1800 with "Bringing Christ to the Nations" (*English*). (Cox, Dela.) *Radio Indonesia,* Makassar, Celebes, 9.550, at least some days has an *English* talk 0530-0535 directed to USA. (Lambach, Ill.)

To July 30, *Radio Sweden* is using these frequencies—1900-2030, 10.780, 15.155; 0015-0230, 6.065, 15.155; 0230-1015, 11.705, 15.155; 1015-1700, 10.780, 15.155; these times are *not exact* times of transmission, since usually there are intervals on weekdays at 0230-0600, 0900-1015; printed schedules are

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mailed on request from Radio Sweden, Stockholm, Sweden.

Reports in at press time from various parts of the world indicated that *Radio Damascus,* Syria, varies around 6.910 to 7.145 in parallel with its other current channels of 6.000, 12.000. *Radio Sweden* reports PSL, 7.935, and PSH, 10.220, Rio de Janeiro, are in parallel 1630-1700 sign-off. And that *Radio Italiana,* Rome, is now using a *new* channel of 17.820 around 0700-0900, 1300-1400; recently I heard a 16-m. outlet (seemed somewhat higher than 17.820) at 1340 with *Radio Italiana* news which must be the *new* outlet.

Lindahl, Calif., flashes that he is hearing YI5KG, 7.090, Baghdad, Iraq, around 1000-1515 but with weak signal.

* * *

Aeknowledgement

Many thanks for the fine reports. Keep them coming to 948 Stewartstown Road, Morgantown, West Virginia, USA. . . . . KRB.

HAM FEST

THE Peoria Amateur Radio Association is holding its annual ham fest on June 11th at Pleasant Valley Park, located near Dunlap, Illinois, and 10½ miles from Peoria on Route 91.

Full details on the affair are available from H. C. Sever, W9FM, club secretary, 1018 W. McClure, Peoria, Ill.

★ ★ ★

Q.C.W.A. MEETS

THE Quarter Century Wireless Association will hold its sixth semi-annual dinner meeting on Friday, June 9th at the 71st Regiment Armory, 34th Street at Park Avenue in New York.

Famous hams of yesteryear will be guest speakers for the event. In addition, various types of entertainment have been planned. The dinner, which will begin promptly at 6:30 p.m., is $3.50 per person. Reservations by non-members should be made with John DiBlasi, W2FX, 259 West 14th Street, New York.

★ ★ ★

ANNUAL PICNIC

THE annual picnic of the Indiana Radio Club Council will be held at Turkey Run State Park on Sunday June 18th.

One feature of the get-together will be the awarding of the 1950 plaque to the outstanding amateur of 1950 in Indiana.

★ ★ ★

RADIO CLUBS PICNIC

JULY 16th has been set as the date for the Fourth Annual Weldon Springs Picnic sponsored by the Cenois Amateur Radio Club, Central Illinois Radio Club of Bloomington, Inc., Clinton Radio Club, Twin-Cities Radio Club, and the Sangamon Valley Radio Club.

This big ham event will be held at Weldon Springs State Park, 4 miles east of Clinton, Illinois. Families are invited to attend and are asked to bring their own picnic lunches. Soft drinks will be served free of charge. A "White Elephant" sale will be a feature of the event.

Full details are available from H. F. Lund, W9KQL, 3135 South Fifth, Springfield, Illinois. -30-

Mac's Service Shop

(Continued from page 48)

be moistened by applying the acetone with long curved eye-droppers."

"Where do you get those?"

"You make them, or have someone else do it for you. Jennie, the girl who lives next door to us, works in a hospital laboratory, and she makes them for me by heating the end of a glass tube over a Bunsen burner and then drawing it out and curving it to agree with sketches I give her; but you can do the same thing in any gas flame.

"When acetone is properly applied through these droppers, it softens the spider and takes the side-pressure off the coil. Then I turn the infra-red heat lamp on the speaker and give the spider a quick drying. After it is thoroughly dry, the shims are removed; and almost invariably the coil is found to be perfectly centered. As a double check, though, I keep the radio playing at low volume—where the rubbing-voice-coil type of distortion is most apparent—while I again heat the speaker with the heat lamp. Then I turn the set off and let it cool down. If no rubbing shows up under either 'hot' or 'cold' conditions, I feel confident the job will be satisfactory."

"Don't you find some of them in which the voice coil is out of line—sort of cocked on the pole piece?"

"Yes, and they are the really tough ones. They are the cases where the front of the coil form touches the pole piece on one side and the rear of the form touches it on the opposite side. In that case I use my shims that have had one end dipped into varnish and allowed to harden so that the end of the shim is appreciably thicker than the rest of it. One of these thickened tips is worked into the space where the rear of the voice coil sleeve is resting against the center pole, and another is used to separate the front of the form from the pole. Straight shims are used at the other two quadrant positions. In addition to softening the spider, I also use acetone very cautiously to soften the union of the voice coil form with the cone proper, being very sure that none of the fluid runs down inside or outside the coil."

"That sounds like a good bit of trouble. Is it worth it?"

"I think so. In the telling it sounds more complicated than it is. I have kept a close check on these repair jobs, and less than four per-cent of them have given trouble again—which compares very favorably with new speaker installation jobs.

"Quite often installing a new speaker means that it must be ordered from a distributor with a consequent delay in getting the set back to the customer. The cost is much less, too. That is quite an item on those small sets. The cost of installing a new speaker is such a substantial percentage of the cost of the whole radio that the owner quite often decides simply to junk the set."

Barney stretched until his muscles cracked and gave a prodigious yawn. "Man, am I sleepy," he said. "It was such a wonderful evening last night with such a big full moon that—"

"That you kept Margie out until the wee small hours explaining the wonders of observational astronomy to her," Mac interrupted.

"I was about to say," Barney continued with quiet dignity, "that I blew Mom to a drive-in picture show and then took her for a long ride afterward. In the future, Mr. McGregor, don't be so quick to jump to conclusions!"

—30—

Diode Applications

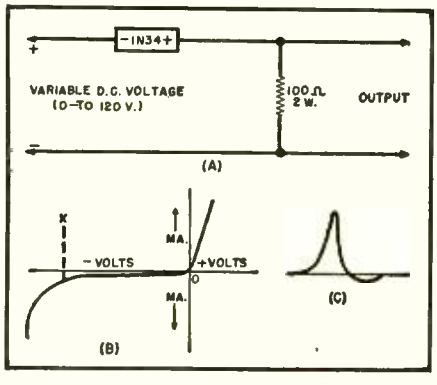
(*Continued from page 65*)

between 75 and about 115 volts for the 1N34.

In Fig. 7, a 1N34 diode is "back-connected" in series with a variable-voltage (zero to 120 v.) d.c. power supply and 100-ohm fixed resistor. The voltage is increased slowly by manual adjustment of the power supply to approach point "X" on the crystal conduction curve. As the voltage is raised, the reverse current increases slowly and non-linearly and is restricted to microamperes. The crystal accordingly "sees" almost the full supply voltage at each low-voltage point, because the voltage drop across resistor R is small. At the instant that the voltage corresponding to point "X" is reached, however, the crystal suddenly draws a much larger current (10 to 20 milliamperes). The increased current causes an appreciable voltage drop across the resistor, and this reduces the voltage across the crystal. The crystal then draws less current, and the resulting drop across the resistor decreases, increasing the crystal voltage. A repetitive process sets in. If the supply voltage is held in the vicinity of point "X" the crystal current accordingly will rise and fall rhythmically at a rate determined chiefly by the voltage at point "X" and the value of the fixed resistor. Thus, an oscillator containing only resistance ("R"-oscillator) is obtained.

The output waveform takes the shape of rather steep "spikes," as

Fig. 7. Germanium oscillator using resistance and voltage exclusively.



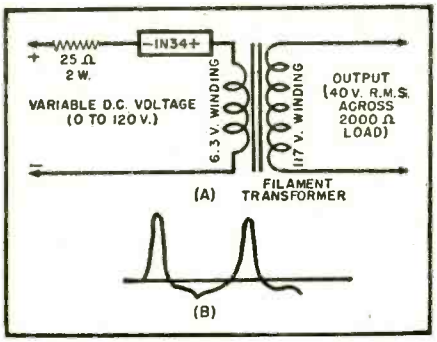


Fig. 8. Crystal interrupter. An input voltage of 85 to 110 volts d.c. will give an output of 1 to 400 c.p.s. at 40 volts r.m.s. across 2000 ohm load.

shown in Fig. 7. The frequency can be shifted over a range of several hundred cycles by adjustment of the input voltage slightly above point "X." Adjustment of the circuit is simple: A pair of headphones or a.c. vacuum tube voltmeter can be capacitance-coupled across the 100 ohm resistor, after which, simply adjust the d.c. supply voltage slowly until the circuit breaks into oscillation.

Signal voltage can be capacitance-coupled out of the oscillator from across the resistor.

Crystal-Diode Interrupter

The same principle explained in the preceding oscillator section is utilized in the circuit in Fig. 8. Here, the same type of oscillation is obtained by the combination of d.c. voltage, fixed resistor, and crystal conduction characteristic. The transformer winding, connected in series with the crystal, has negligible resistance.

As the current rises and falls in the crystal circuit, as a result of oscillation, a voltage is induced across the secondary winding of the transformer. The crystal thus acts as a non-mechanical primary-circuit interrupter.

With the combination shown in Fig. 8, an output of 40 volts r.m.s was obtained across a pair of 2000 ohm headphones as a load. The frequency was adjustable between 1 and 400 cycles per second by varying the d.c. supply voltage between 85 and 110 volts. The higher frequency corresponds to the higher voltage. The waveform is "spiked," as shown in the pattern in Fig. 8. —30—

AFCA NEWS

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.

AFCA CHAPTER NEWS

Baltimore

Two hundred members of the Baltimore Chapter visited the *Glenn Martin* aircraft plant on March 22nd, where they were guests of the *Martin* management for dinner and a discussion, illustrated with movies, on guided missile and rocket projects.

The *Martin* chief of electronics, John Pearce, welcomed the AFCA members and outlined the guided missiles program in general terms. Electronics takes a major part in all *Martin* special weapons developments, Mr. Pearce said, but it is a phase of operation which is all classified, leaving only broad details for discussion. In this vein the electronics chief said that it was confidently expected that a range of 4000 to 5000 miles would soon be made practicable for guided missiles, and that they would be heat or acoustic sensitive and capable of self-guidance to certain points.

Prior to movies shown of the Gorgon IV ramjet projectile and the Viking rocket these developments were described by R. W. Sanford and W. G. Purdy of the *Martin* engineering department. After the showing a question period was conducted by W. B. Bergen, chief engineer.

Kentucky

A tour of the U. S. Naval Reserve Training Station at Lexington was featured at the Kentucky Chapter's March 10th meeting.

Sixty-five members and guests attended dinner at Capps Coach House in Lexington and then went on to the training station where they were welcomed by Lieutenant Commander W. H. Bargeloh who had made the arrangements for the chapter visit. At the conclusion of the inspection which covered all phases of the station's training facilities, two movies were shown—one on the subject of radar and the other on an atom bomb test.

A sub-chapter of the Kentucky Chapter has been organized in the Louisville area to be known as the Louisville-Fort Knox Sub-Chapter.

Captain Stephen A. Cisler, Jr., USMCR, vice-president of radio station WKYW, Louisville, was chosen to serve as the sub-chapter's first president. Perry W. Esten, chief engineer, radio station WGRC, Louisville, was elected secretary-treasurer.

New York

Brig. General Raymond C. Maude, Assistant Chief of the Air Force Development Division, was guest speaker at the March 22nd meeting of the New York Chapter at the 71st Regiment Armory. He discussed the mission and organization of the development division of the Air Force and reviewed some of the operations during World War II which led to the present emphasis on development activities in the Air Force.

"We feel that the one national resource in which we may maintain world superiority is in our technology and in the application of this technology to the national defense," General Maude said. "This technical superiority can only be maintained through the closest relationship of industry, research organizations and institutes, and the armed forces. We will always want to depend on scientific and research organizations such as our universities for the preponderance of basic research. In the field of applied research and development the armed forces must, however, play a leading role. The Air Force is responsible for establishing military requirements in

General Maude concluded his address with the following: "To a greater degree than ever before, we plan to solicit the active partnership of the civilian technical competence of this nation. You must provide the link between the needs of the uniformed services and the civilian scientific world. Your continuing awareness of the problems of national defense is the basic tool for creating the technical superiority we so sorely need. Officers in the military services can plan, study, analyze, and test weapons systems of tomorrow, become proficient in their application and provide operating personnel. But you, the aware and informed citizens, translating your technical competence into the application of technology to warfare and your social consciousness into political action which preserves an adequate force for national security, must furnish the broad base on which a modern Air Force is erected. Nothing less than this enlightened partnership of science and the military will suffice to uphold our way of life and our survival as a nation."

Chapter President Thompson H. Mitchell of *RCA Communications*, introduced a number of well-known members in the communications field. They included Maj. Gen. Harry C. Ingles, former Chief Signal Officer of the Army, and now President of *RCA Communications;* George W. Bailey, Executive Secretary of the IRE and President of the ARRL; Captain Roy W. M. Graham, USN, Chief of Staff of the Eastern Sea Frontier; Colonel Robert T. Yeager, USAF, Communications Officer of the First Air Force; Rear Admiral S. F. Patten of *Du Mont Television;* Dr. H. H. Beverage, radio engineer and inventor; D. F. McClure, Asst. Vice-President, *New York Telephone Co.*

The meeting concluded with the showing of three new Air Force training films. The first two, entitled "Air Power," showed the development of combat aircraft and its fire power. The story of atomic energy was depicted in the last film.

Philadelphia

The absolute dependence of all components of peace-time as well as wartime society upon communications was stressed in an address by Brig. General Hugh Hester before the Philadelphia Chapter on March 30th.

The business of the meeting was devoted to a discussion of the proposed agenda for the chapter presidents' conference to be held at the AFCA convention in May, which was submitted to each chapter by Col. George P. Dixon, AFCA Executive Secretary.

A film entitled "Industrial Mobilization" concluded the program for the evening.

Sacramento

The U. S. Geological Survey Photogrammetric Laboratory in Sacramento was the scene of the chapter's meeting on February 28th. In the layman's

language "Photogrammetry" is defined as the science of preparing detailed contour maps from aerial photographs. By the use of this process, the U. S. Geological Survey is presently engaged in the preparation of topographical maps of the United States and its possessions. The Sacramento laboratories perform that phase of the operation pertaining to the Western United States, Alaska, and Hawaii.

Approximately one hundred members and guests of the Sacramento Chapter were conducted through the photogrammetric laboratories in small groups of six or eight at a time, thus enabling them to view at close range the intricate processes involved in the piecing together of these gigantic jigsaw puzzles. Scientific production line methods are employed in the preparation of these valuable and minutely accurate maps.

Arrangements for this tour were made by Paul E. Shaad, program chairman for the Sacramento Chapter. The program was made possible through the courtesy of C. A. Ecklund, Pacific Regional Engineer, and D. H. Rutledge, Chief, Photogrammetric Section, U. S. Geological Survey.

San Francisco

The reorganization of the San Francisco Chapter was completed on March 31st with the election of new officers as follows: President—Harry E. Austin of *RCA Communications;* 1st Vice-President—George LeBlanc, *Pacific Tel & Tel;* 2nd Vice-President—Jackson Fairchild, *Westinghouse;* Secretary—C. L. Wickstrom, *Pacific Tel & Tel;* Treasurer—W. G. Damerow, *Pacific Gas & Electric.*

Among the new members signed up by the chapter is the *Lenkurt Electric Company* of San Carlos, manufacturers of carrier current equipment and components.

Seattle

The first 1950 meeting of the Seattle Chapter, held at the American Legion Hall on February 21st, also inaugurated the chapter's third year of activity as an AFCA unit.

Outgoing president Maurice F. Kerr opened the meeting by introducing various guests and then formally installed the newly elected officers as follows: President—Clarence D. Lawrence; 1st Vice-President—Marshall James; 2nd Vice-President—Hershal Wandling; Treasurer—Joe Gregory; Secretary—Clarence C. Bodine who was reelected for a second term.

President Lawrence then took over the chair and outlined plans for 1950. A general discussion followed as to the best suited programs for meetings. It was decided to arrange demonstrations of commercial equipment and to present talks on technical subjects so that non-technical members might become better informed.

STUDENT CHAPTERS

Texas Technological College

Lt. Col. Wayne P. Litz, Chief, ROTC Affairs Section, Office of the Chief

Linearity Test

(*Continued from page 67*)

considerable variations in linearity and consequent tone color are possible. Other causes of nonlinearity may occur, but in any event they may be easily checked with the test setup previously described. In this case the attenuator on the output of the audio oscillator is varied from minimum to maximum and the diagonal scope trace observed for change of direction. Alteration of the axis indicates nonlinearity as illustrated by *N* and *O* of Fig. 2.

As mentioned at the first of this article, this scope technique may be used as an easy means of checking frequency response. This method was suggested by Goodell as a means of making rapid frequency checks with an audio oscillator having an uneven frequency output. If the equipment under test is flat then the direction of the trace will remain unchanged even though the length will fluctuate according to the signal generator variations. If frequency boost or attenuation is present in the equipment under test, then the axis of the trace will alter in a manner similar to that described in the previously mentioned linearity test. It should be noted however that this technique will lead to inaccurate results if appreciable nonlinearity is present in the equipment under test as any gain variation in the audio oscillator may be multiplied by any nonlinearity.

Although phase shift is often not considered of great importance, except in feedback loops and similar applications, there appears to be at least one instance in which it can assume significant proportions. This case is in the event that intermodulation distortion is present in the original signal and distortion of the same general nature is present in the reproducing amplifier. If no phase shift is present, then the characteristics of the input signal and the amplifier will tend to coincide and little further degradation of the signal will take place. However, if appreciable low frequency phase shift occurs, a previously undistorted section of the high frequency components may be now superimposed on the peaks of the low frequencies and undergo resultant modulation in the amplifier stages with consequent additional degradation of the reproduction. That situations of this nature are not uncommon is emphasized by the recent assertion that some conventional shellac recordings may contain up to thirty per-cent intermodulation distortion.

In conclusion, the reader will undoubtedly find that the ability of the oscilloscope to graphically render input-output relationships provides a rapid and convenient means of observing a wide number of characteristics of audio equipment.

—30—

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MISCELLANEOUS

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ANSWERS TO "MICROWAVE QUIZ" PAGE 104

1. d	4. a	7. c	10. a	13. c
2. d	5. c	8. b	11. b	14. c
3. a	6. a	9. b	12. c	15. b

SCORING TABLE

15 correct	excellent
13 to 14 correct	very good
10 to 12 correct	good
8 to 9 correct	fair
7 or less correct	poor

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66, 104 (Right)	General Electric Company
81	MARS
83	Bell Telephone Laboratories
104 (Left)	Raytheon Manufacturing Co.
155	Steven J. Stadler

ERRATA

The caption for the cover photograph, appearing on page 4 of the May issue, incorrectly referred to the kit Mr. Andrea was showing his daughter as a "Neutrodyne" kit. This is, of course, in error as the kit shown is one of the new Andrea "build-it-yourself" television kits. We are indeed sorry that this error occurred.

* * *

In Fig. 10 of the article "Simplified Ham TV Station," page 38 of the May issue, the parts list accompanying the diagram should show the wattage of resistors R_{10} and R_{11} as 2 watts instead of ½ watt.

* * *

An error appears in the article "The Mini-Rack Modulator" published in the April issue. In the diagram of Fig. 2, page 43, the shorting relay for the modulation transformer is incorrectly shown. The lead from the top of the modulation transformer secondary should go to R_{17} as well as the relay contact. The lead from the plates of the 5R4GY should be connected to the relay arm instead of R_{17}.

INDEX OF Advertisers

JUNE 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.

Mobile Antenna

(*Continued from page 63*)

is quite handy and is very inexpensive to build. This "Blooper" is built in a plastic dish to show the parts. The calibration scale was scratched on the plastic and markings filled with ink. The frequency range is from 3.5 to 8.3 mc. This unit is a regenerative oscillator with the values of the grid leak and condenser chosen so that the oscillations are periodically interrupted. These interruptions are at an audio rate and result in an audio tone in the headphones. The action of the grid leak and condenser is that they charge up and bias the grid negatively enough to cut off the plate current. When the condenser discharges through the grid leak the plate starts to conduct again and the oscillations build up and charge the condenser and the process is repeated. When the grid inductance is coupled to a tuned circuit and the grid circuit of the "Blooper" is tuned through the frequency of the external tuned circuit, the audio tone in the headphones will stop. The tone stops because the power taken from the grid circuit by the external tuned circuit lowers the r.f. energy in the "Blooper" grid circuit and keeps the bias from reaching a high enough value to block the grid. The plate voltage of the 6J5 must be adjusted for proper operation. The adjustment should start at 0 volts and the voltage raised until the audio tone is audible in the phones. A potentiometer across 50 volts or so will do the trick very well. On the "Blooper" used here the plate voltage was only 5 volts.

The unit can be calibrated by listening to the output of the "Blooper" on a general coverage receiver. The receiver should have a short antenna and the "Blooper" signal kept as weak as possible. There will be several audible signals at the correct frequency due to the oscillations being interrupted at an audio rate.

The results with the "Blooper" were exactly the same as those with the grid dip meter.

After the antenna has been adjusted to the proper operating frequency with either the grid dip meter or the "Blooper" the antenna should be coupled through a low impedance line to the transmitter. At the transmitter a two- or three-turn link will be sufficient for coupling to the output stage. Use of transmitters with internal loading inductances is not recommended and these loading inductances are not necessary if the antenna has been adjusted to the correct frequency. It is best to pick out an operating frequency in the 75 meter band and cut your antenna for it. Moving from one end of the band to the other will require readjustment of the antenna length. Remember you are using low power and that radiating system must be efficient! —30—

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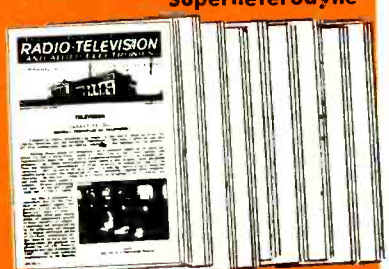

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