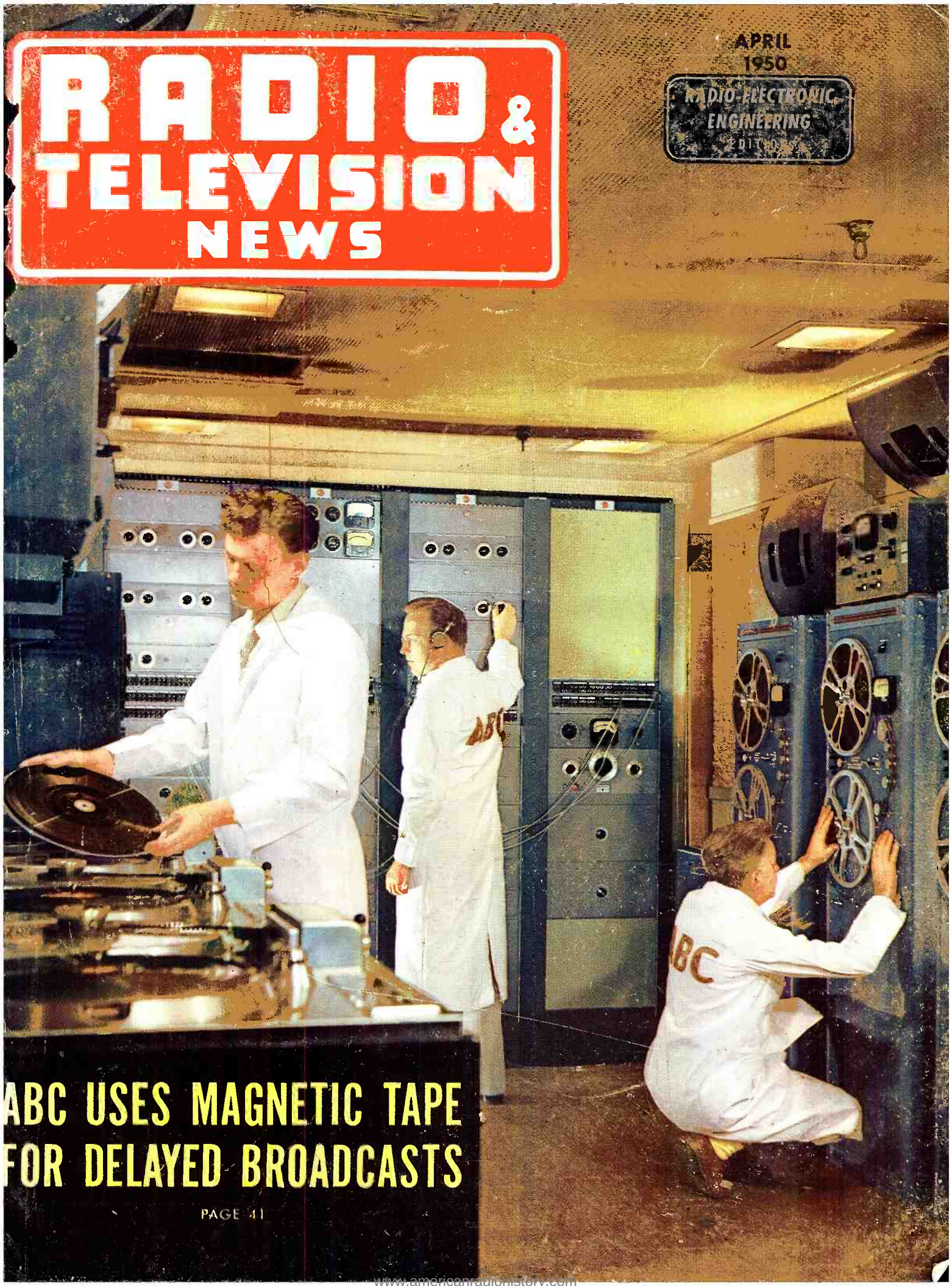
RADIO & TELEVISION NEWS

APRIL
1950

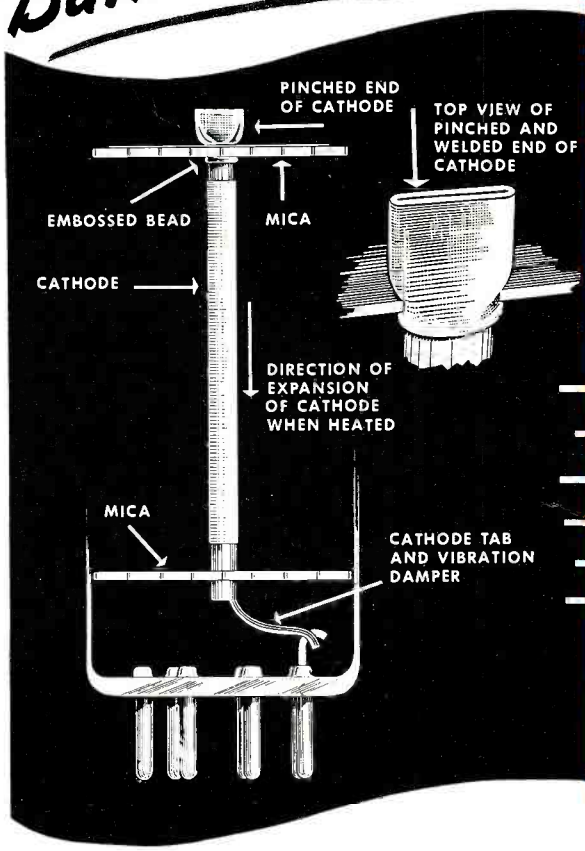
RADIO-ELECTRONIC ENGINEERING EDITION

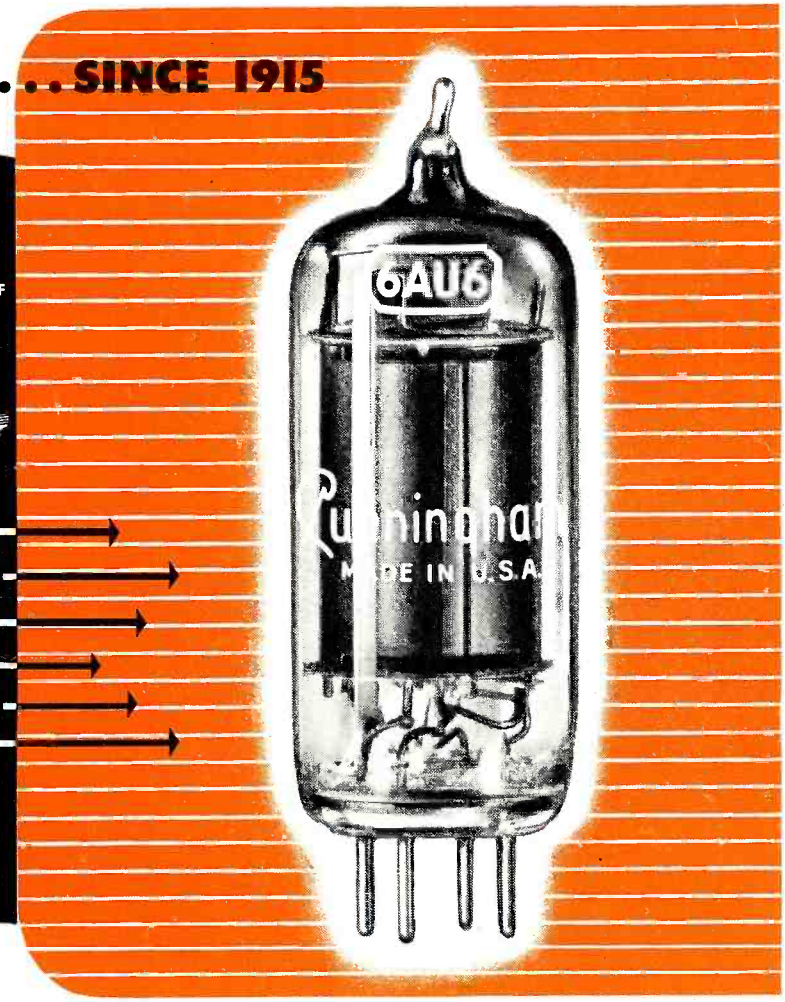


ABC USES MAGNETIC TAPE FOR DELAYED BROADCASTS

PAGE 41

Built for Service . . . SINCE 1915





he inside story of Cunningham quality

1. How Cunningham "Inverted" Pinched Cathodes Minimize Microphonics

Engineering progress is part and parcel of Cunningham quality. For instance . . . unlike most tubes Cunninghams use "*inverted*" *pinched cathodes* to minimize microphonics by preventing cathode vibration or displacement.

These important features are achieved by clamping the mica firmly between the embossed bead and the pinched top end of the cathode. This arrangement holds the upper end of the cathode rigidly, but permits the heated cathode to expand freely downward through the bottom mica without producing cathode strain. The lower end of the cathode is prevented from vibrating by means of the damping tab connected between the cathode and a stem lead.

The "inverted" pinched cathode is only one of the many improvements which account for the *first-line* quality of Cunningham tubes. It serves to explain why experienced servicemen use Cunninghams consistently.

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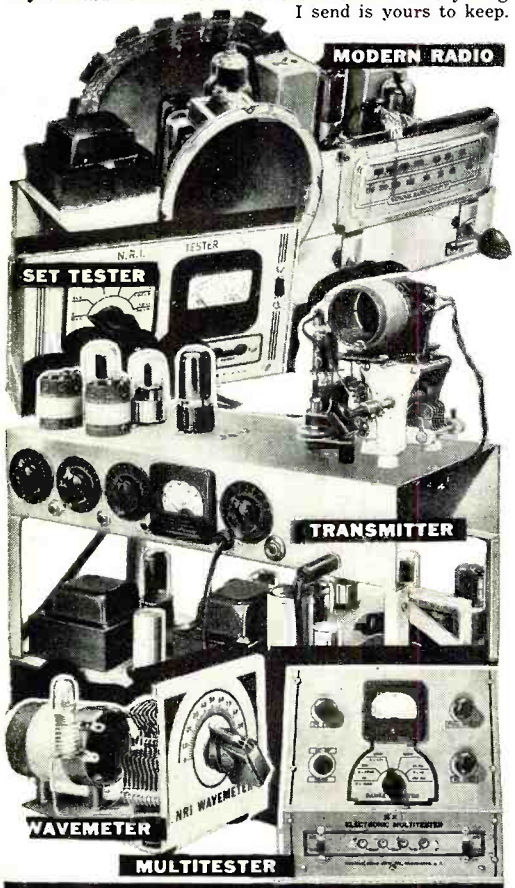

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COVER PHOTO: J. J. Barry, Wm. Thomas, and B. H. Speirs record off-the-line programs at ABC's Central Division, Chicago, for later broadcast to network outlets. (Kodachrome by Arthur E. Haug)

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APRIL, 1950

DEPARTMENTS

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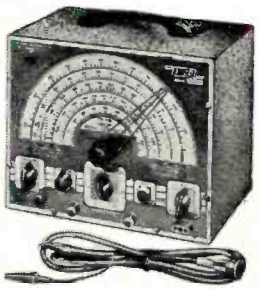

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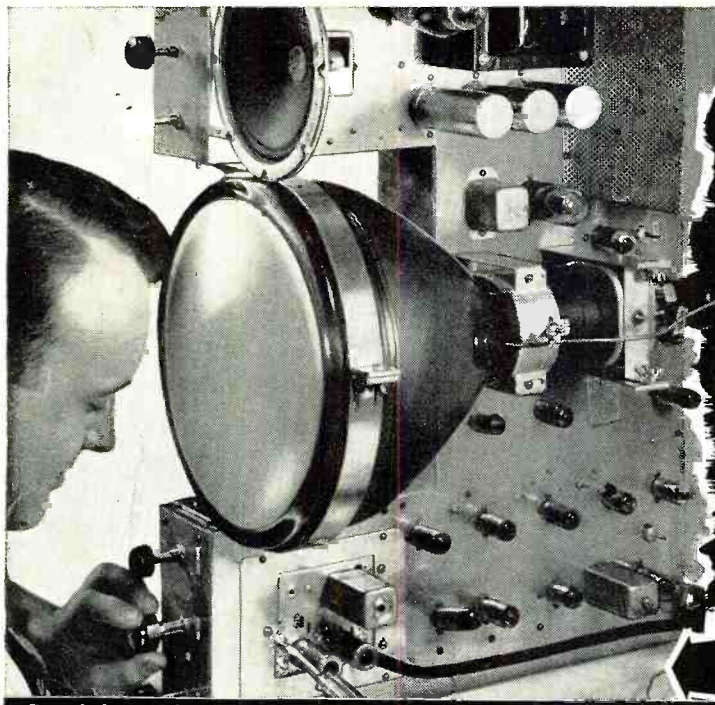

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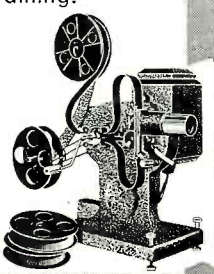
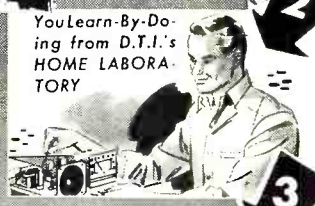
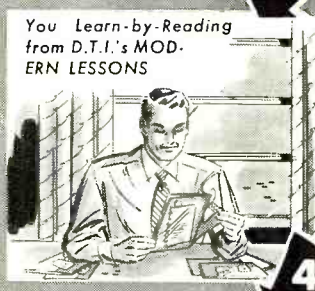
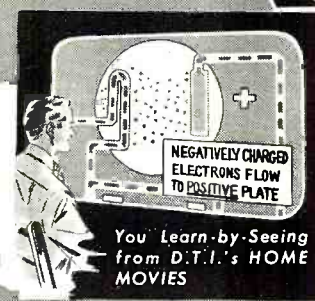
6 Tube Radio Receiver









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For the RECORD

BY THE EDITOR

OUR EXPANDING COMMUNICATIONS

IT IS generally agreed that there is plenty of opportunity for trained technicians in the rapidly expanding television field. We have stressed the necessity for adequate training many times. It is also agreed that the public itself is demanding more service than can often be given. Television itself as an entertainment medium has become so important to many families that they are ready to sacrifice any other form of entertainment as long as they are able to follow their weekly programs.

There are many radio, television, and engineering schools in the United States supplying a vast army of new technical talent in radio, electronics, and television. In spite of this new blood, there still remains a critical shortage of qualified technicians.

Everyone is not concentrating on television. There still remains a huge radio market that will provide a lucrative source of income for many years to come, as well as a greatly expanding communications industry.

We believe that there is still a bright future for the aggressive "radioman"; for example, during last year alone there were a total of nearly 650,000 radio operators in the following classifications: Aircraft, Amateur, Citizens, and Commercial. These radio services continue to grow in spite of the terrific impact of television and the drain on available technicians.

Mobile radio has mushroomed to well over 200,000 units. Operation of more than 300,000 transmitters are covered in nonbroadcast radio authorizations by the *Federal Communications Commission*. Of these, there are approximately 100,000 fixed or land stations and over 220,000 portable or mobile units.

In the classification Safety and Special Services, are a total of nearly 300,000 units comprising 196,000 portable or mobile and 26,000 common carrier transmitters. In addition there are the 2200 fixed or land stations and about 24,000 additional portable or mobile units.

Most radiomen are not too familiar with the many applications for radio communications and as a result fail to discover the many opportunities in Aircraft, Ground Aviation, Police, Fire, Forestry, Highway Maintenance, Special Emergencies, Ship, Postal and Marine Relay, Radar, Railroad, Transit Utilities, Busses and Trucks, Taxicabs, Power, Petroleum, and Industrial Services.

All of the above services require both operating and maintenance personnel. Even local radio service technicians are often called in to handle service on equipment designed for the above applications.

There are several other fields of opportunity, some old and some new. They include Common Carriers, such as: International Fixed Public Service (Telephone and Telegraph), Domestic Public Land Mobile Service, and Domestic Fixed Public Service, to name only a few.

There will always be many opportunities in Manufacturing (Industry) for trained engineers in Television, Industrial Electronics, and Radio. The public is still purchasing radio receivers in substantial quantities and nearly all of these units will eventually require maintenance and replacement of tubes and parts. One need only look at the figures compiled by RMA during the past year to appreciate that the opportunities for radio service technicians will be at hand for many years. During 1949 over 9,680,000 radio receiving sets were produced as compared to the 2,413,897 television sets produced during the same period.

As a matter of record, many dealers complained that they could not get sufficient radio sets to meet the demands of their customers, in spite of the fact that nearly 10,000,000 sets were produced.

There are plenty of opportunities to earn a livelihood in our Industry for trained personnel, but there is plenty of competition for the untrained.

In addition to the strictly radio and communications fields, there are many opportunities in the field of industrial electronics for the trained man. As the subject of industrial electronics is so closely allied to that of radio, any competent radioman can quickly gain the needed knowledge.

Manufacturers frequently prefer to have this type of maintenance handled on a contract basis, rather than to depend on their own maintenance departments. Payment for services is prompt and adequate.

* * *

HAM CONTEST

THE contest launched by this publication in January 1949 closed officially March 1, 1950.

As explained in the rules, the judges will determine the official licensed status of all new licensees by the Spring 1950 edition of the *Radio Amateur Callbook*. As soon as decisions are reached the winners will be notified by mail . . . . . O.R.

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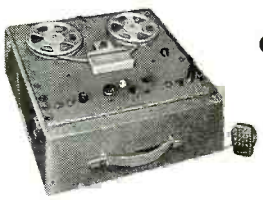

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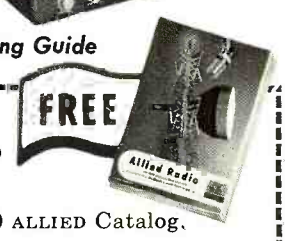

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5—Radio Spots

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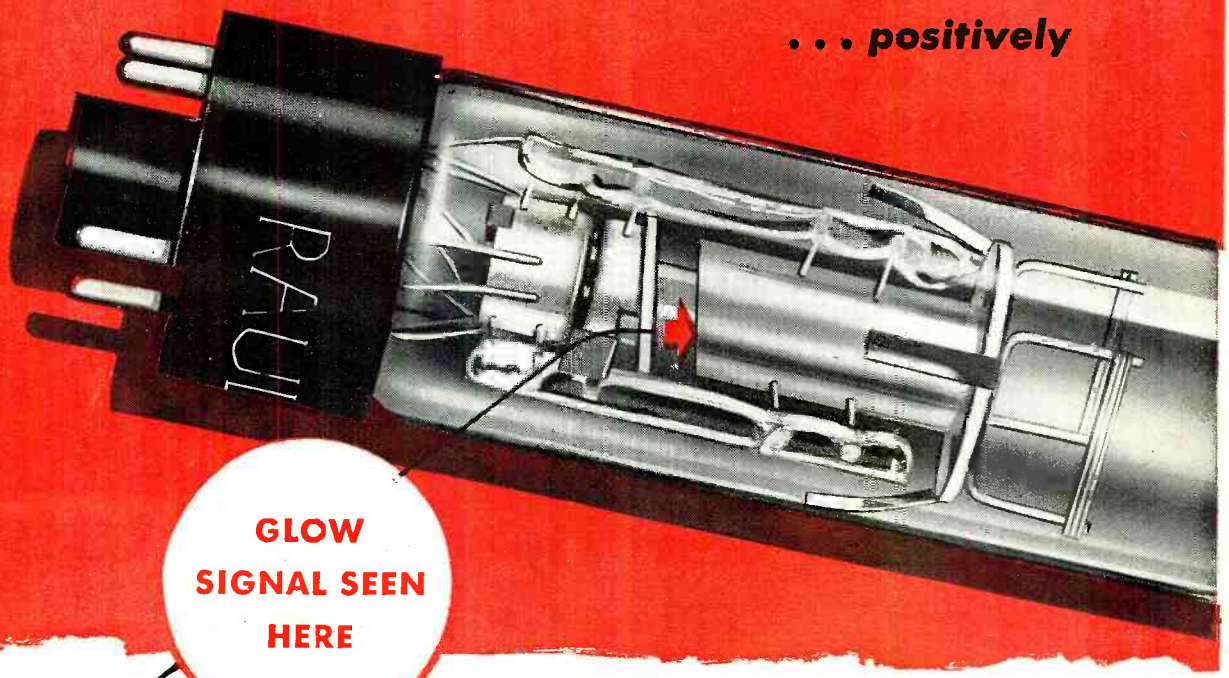

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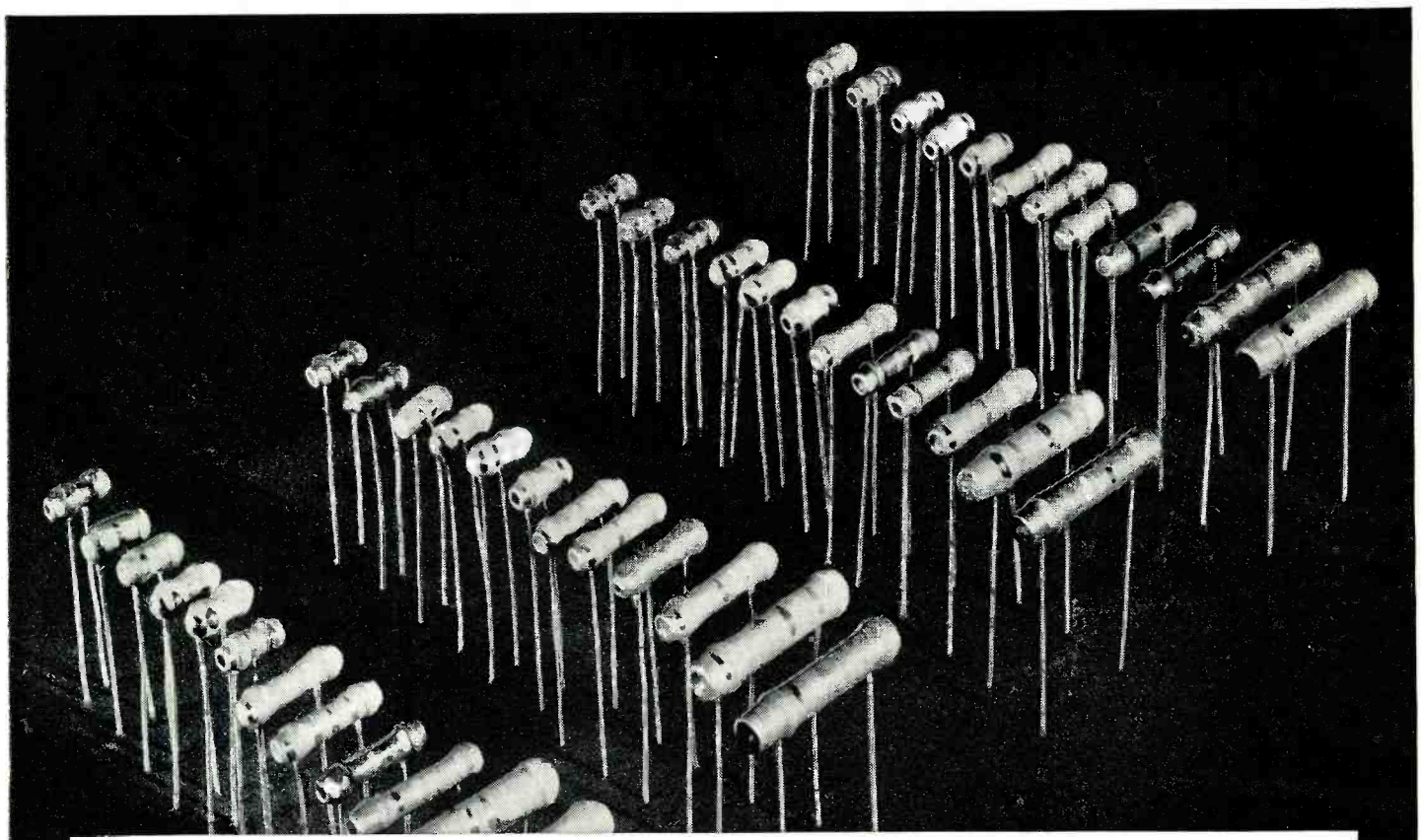

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15MMF	D6-150	180MMF	D6-181	1,500MMF	D6-152
18MMF	D6-180	200MMF	D6-201	1,800MMF	D6-182
20MMF	D6-200	220MMF	D6-221	2,000MMF	D6-202
25MMF	D6-250	250MMF	D6-251	2,200MMF	D6-222
27MMF	D6-270	270MMF	D6-271	2,500MMF	D6-252
33MMF	D6-330	300MMF	D6-301	2,700MMF	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
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"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.

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Spot Radio News

★ *Presenting latest information on the Radio Industry.*

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

THE COLOR IN TELEVISION saga entered what every one prays will be the final chapter as the first days of Spring approached, with experts pouring into the Commerce Auditorium in the nation's capital to voice their views, views that will make headline news in the days to come.

Reappearing to testify, and in many instances offer vigorous rebuttal to many points, were the two representative groups of industry, JTAC (Joint Technical Advisory Committee) and RMA, and ten others in and out of industry which included *RCA, CBS, CTI,* Dr. Charles Willard Geer, *Philco, Du Mont, Webster-Chicago, American Television, A.T.&T.,* and *Western Union.*

Testimony this time appeared to be more conclusive, covering not only the actual results of systems, which in the earlier sessions were mere paper projects, but new procedures, also demonstrated, which were not even mentioned in the hearings of '49. *RCA,* for instance, revealed its new color method, which had received its first viewing a few weeks prior to the '50 recall, at a special show for the press in the Washington studios of *NBC,* with programs originating in the Wardman Park Hotel color studios. A highlight of the showing, viewed on 10-inch and 16-inch television receivers, was the absence of instability which had affected earlier demonstrations. The use of brief synchronizing radio pulses did the trick, according to the boys in the lab who perfected the method. They pointed out that when these pulses reached the receiver, they served to automatically lock the three primary colors into perfect phase. Specifically, the method involved the use of a 10 to 15-cycle burst of signal at a sampling frequency, which was adjusted to follow the horizontal sync signal. This burst controlled an oscillator in the receiver, directing the *correct* color signals to each of the three picture tubes used in the system.

Dr. E. W. Engstrom, in charge of research at *RCA,* presided at the showing and pointed out that the new color setup had six features, high definition pictures (claimed to be 70 per-cent greater in detail than the mechanical sequential system), unlimited picture size and brightness, flickerless pictures without color breakup, automatic color phasing (described above), complete compatibility with present black and white TV, and all electronic, with no mechanical or moving parts.

"These characteristics are of major importance to the public," Dr. Engstrom emphasized, "for they mean that color TV can be introduced with no disruption to the present service."

CBS' testimony also was quite revealing and a bit on the explosive side, with reports of a long list of tests made on a variety of fronts. At the Walker Building demonstrations, *CBS* reps pointed out that Senators, members of the House and their wives appeared and were quite enthusiastic. At a series of special demonstrations, members of the Cabinet, the Supreme Court and the Defense Department, also appeared, according to *CBS* spokesmen. And at a test at the National Art Gallery, members of the Condon committee and two members of the FCC appeared; Newbern Smith, chief of the Central Radio Propagation Section of the Bureau of Standards; George Bailey, executive secretary of the IRE; W. L. Everitt, dean of the College of Engineering of the University of Illinois; Don Fink, JTAC chairman; and FCC members Frieda B. Hennock and Robert F. Jones.

In an effort to keep pace with *RCA, CBS* also indicated that they, too, could provide color with electronic circuitry, using a single multicolor tube. At the last session, a tri-color tube was hinted at by *RCA,* and the actual tube was scheduled for presentation before the Commission in the late Spring. The *CBS* tube was described as being usable without any change in standards which they had previously recommended.

Color Television, Inc., the third of the contenders for the standards' prize, also presented substantial test testimony, describing the results of transmissions over KPIX, operating on channel five, in San Francisco, California. Seven tests were involved in the viewing, the receivers all located in the Bay area. Plans for additional tests in a downtown hotel in San Francisco were also detailed.

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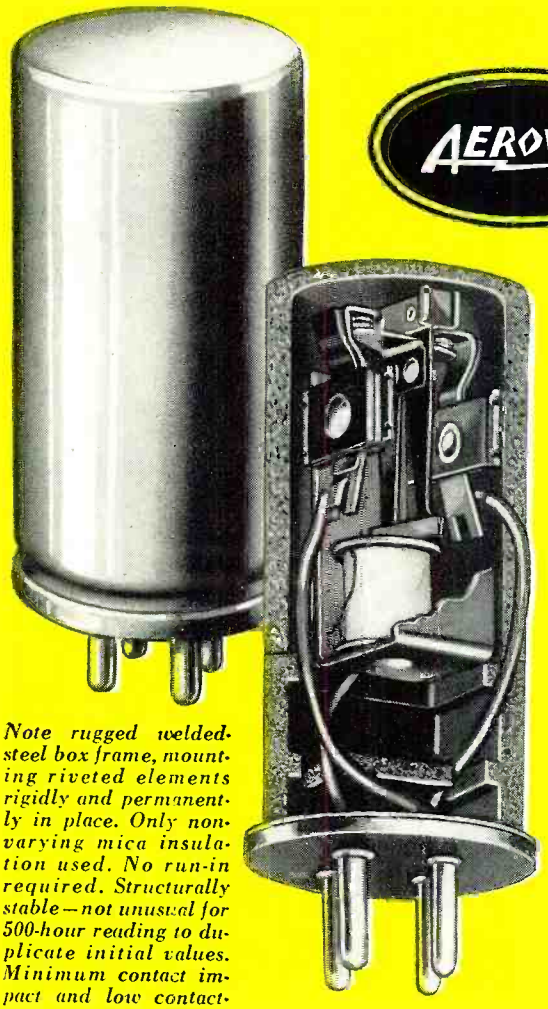

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In special interviews in Washington and New York, Arthur S. Matthews, *CTI* prexy, told the newsmen that in the line-sequential system which they used, only minor changes were required in the regular black and white transmission equipment. At the camera, three pictures (red, green and blue) are taken simultaneously by means of a special three-lens optical system, he said, with the 525-line standard being used at the receiving end.

"We feel that the picture our system puts out is good enough, but the important thing is that the system has not reached its limitations and more improvements are possible," Matthews went on to say. "If the FCC does not approve our method, there are other uses, such as closed circuit work in hospitals, in which our technique could be applied without serious difficulties."

Industry, in the form of RMA, JTAC and experts from pioneering companies in TV, was quite bold, too, in its in and out-of-court testimony. RMA's official commentary had been preceded by the general distribution of a booklet, entitled "Is Color Television Ready for the Home?" which was about the bluntest report on the controversy to date. In the report, the association disclosed that the majority of the television set manufacturers have urged that *no* color broadcasting standards be approved by the FCC until the proposed systems have been thoroughly field tested. This, they said, is the only way to determine whether color reception is basically satisfactory under everyday conditions, as contrasted with the carefully controlled demonstration setups which have been used so far by all the sponsors. Once basic standards are set, the report continued, they cannot be changed without involving obsolescence of every piece of transmitting equipment and every receiving set then in existence. When standards are set, all future improvements must be within the framework of those standards, RMA went on to say in their appraisal of the situation. Accordingly they added, the original framework must be a sound one, one suitable for years to come. And since color television will need not one, but a dozen such standards, the harm that could be done by over-hasty action is apparent. Answering the question as to whether all broadcasts would be made in color, when color TV becomes available, RMA boomed a decided *no,* citing the case of the motion picture industry, where at least 85 per-cent of all feature pictures are still produced in black and white, even though the color processes were developed years ago.

In an extensive survey of the *CBS* system, RMA declared that pictures broadcast over the proposed *Columbia* setup would have a definition of only 405 lines, as compared with 525

(*Continued on page* 125)

APRIL 1950

RADIO & TELEVISION NEWS

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APRIL, 1950

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COVER PHOTO—Courtesy of General Electric

Dr. Albert W. Hull of the General Electric Research Laboratory, who has been credited with the invention of more types of electron tubes than any other man, has retired from his post as assistant director of the laboratory, but will continue to serve as a consultant. The cover photo is a recent portrait taken of Dr. Hull in his laboratory.

Fig. 1. Interior view of the trailer containing the multiple channel cathode-ray installation.

Multiple Channel Cathode-Ray Instrumentation

24 channels are available for simultaneous recording of dynamic or transient phenomena.

By J. N. Van SCOYOC and G. F. WARNKE
Armour Research Foundation of Illinois Institute of Technology

MULTIPLE channel oscillography finds one of its greatest uses in the recording of dynamic and transient phenomena of a non-electrical nature. Many experiments can be repeated only to a statistical accuracy, if indeed they are repeatable at all. In such cases it becomes necessary to obtain the time "history" of the experiment by means of a number of simultaneous recordings; the number of data channels depending on the variable elements, cross checks required, or the size and shape of the object or field being investigated. Electrical measurements are usually reproducible enough not to fall into this category.

This article is based on a paper presented at the 1949 National Electronics Conference.

General

The design, construction, and use of multiple channel instrumentation is inherently more complicated than its single channel counterpart because of the following problems:

1. *Identification of Simultaneity*—When two or more measurements are taken some relative time reference must be supplied, with an accuracy required in the interpretation of the records.
2. *Recording of Data*—Since observation of non-repetitive phenomena is practically impossible, it is necessary to record the measurements in a form that will permit checking and evaluation on a vastly expanded time scale as well as permanence for repeated reference.
3. *Operation*—Manual control of more than two operations becomes difficult, and as the speed and number of operations is increased automatic control becomes necessary. This must be well timed and completely automatic to eliminate as far as possible the error element introduced by operators.
4. *Identification of Records*—Since many records are being taken at the same time, and often several in quick succession, with considerable time elapsing between recording and analysis, it is necessary to make provision for permanent positive identification of the records.
5. *Versatility*—Since the utility of the equipment generally depends on the number of applications to which it can be adapted it is necessary that the basic units be designed and constructed in such fashion that modification is simple.

There are two basic methods that may be used in multiple channel oscillographic recording. In the first, a still picture is taken, using commonly triggered horizontal sweeps on all cathode-ray tubes. Although all sweeps start at one time they may be of different durations so that expanded or contracted time records may be obtained. If the time scale is important, timing marks must be introduced in the form of x, y, or z axis markers.

In the second method a sweep is not used but a spot is photographed on continuously moving film. In this way the film provides the time axis, and variations in time scale are obtained by running the cameras at different speeds. An additional method of recording timing markers is available in this system, this being the use of pulsed glow tubes which can provide a common time scale for a group of traces.

For either of the above systems multiple beam tubes or nests of single beam tubes can be used. This reduces the number of cameras necessary and sim-

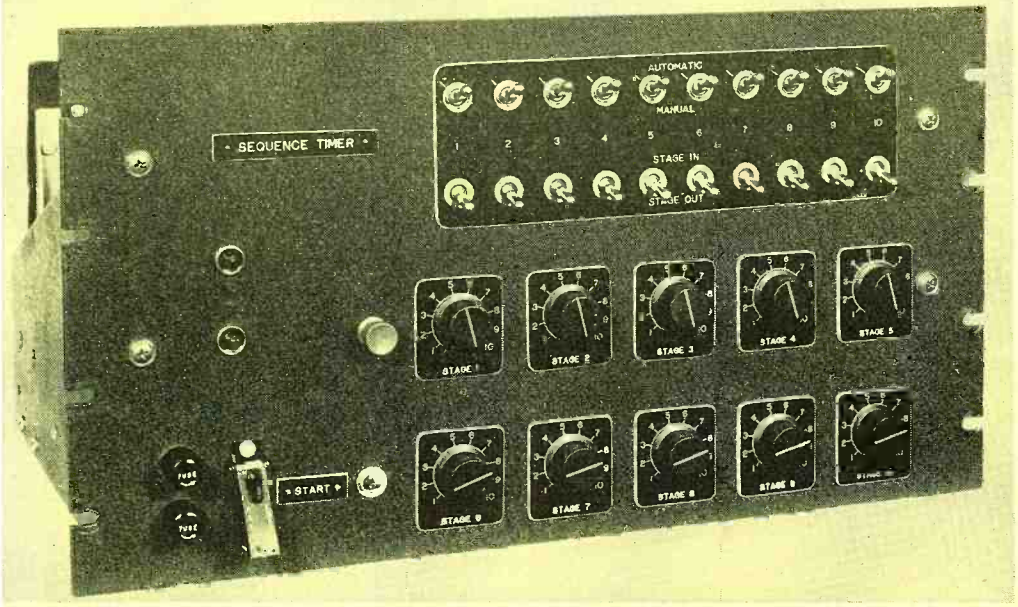


Fig. 2. Front view of the sequence timer control panel.

plifies processing and analysis of the records.

A recently completed 24 channel unit will be described to illustrate the functioning of a system which employs single beam tubes photographed by continuously moving film cameras. Some of the more specific technical problems such as elimination of cross-talk and hum, grounding circuits, etc., will not be discussed for lack of space.

In order to be able to conduct experiments in the field, remote from laboratory facilities, the twenty-four channels of oscillographic instrumentation, along with necessary auxiliary equipment and service and maintenance facilities, were mounted in an air conditioned semi-trailer. Fig. 1 shows an interior view of the installation. All units are relay rack mounted on a shock mounted frame. Space is provided behind the rack so that testing or maintenance can be accomplished without removal of the units. The twenty-four channels are arranged in six bays of four channels each, all identical. The center bay contains control equipment common to all channels. This figure will be referred to after a description of the operation of the system is given.

The functional block diagram shown in Fig. 3 illustrates the operation of a typical channel and the units common to all channels.

Resistance strain gauge or piezoelectric gauge input circuits are connected to the terminal unit which incorporates matching networks and acts as a junction point for input, calibration and amplifier circuits. In the case of strain gauge input, the bridge power supply is used to supply current to the strain gauge bridge circuits.

Input signals are fed to the amplifier, which operates from the amplifier power supply, and thence to the oscilloscope unit. The oscilloscope unit derives all its operating voltages from the oscilloscope power supply. The camera records the signals from four cathode-ray tubes of one oscilloscope unit on one 35 mm. continuously moving film. The controlling relay and power connections for the camera are located in the amplifier power supply unit.

Interval timer A derives its frequency from a secondary frequency standard and supplies timing pulses to one glow modulator tube in each of the six oscilloscope units.

Interval timer B supplies timing pulses derived from a tuning fork to all cathode-ray tubes and to one glow modulator tube in each four channel oscilloscope unit. It also provides a vertical sweep for test purposes and a zero time pulse for establishing a simultaneous point on all records.

Two glow tubes are provided for each oscilloscope unit (see Fig. 7), each of which records a timing trace along the outside edge of each film record as shown in Fig. 11. Two timing records of different frequencies are thus recorded which may be used to:

1. Interpolate time intervals or periods.
2. Facilitate counting of long time periods while maintaining short period accuracy.
3. Check one frequency source against the other.
4. Eliminate timing errors due to irregularities in film speed.
5. Provide baselines for amplitude measurements.

The accuracy of the frequency of the secondary frequency standard or the tuning fork may be checked by comparison with signals broadcast by WWV which are picked up in the receiver supplied.

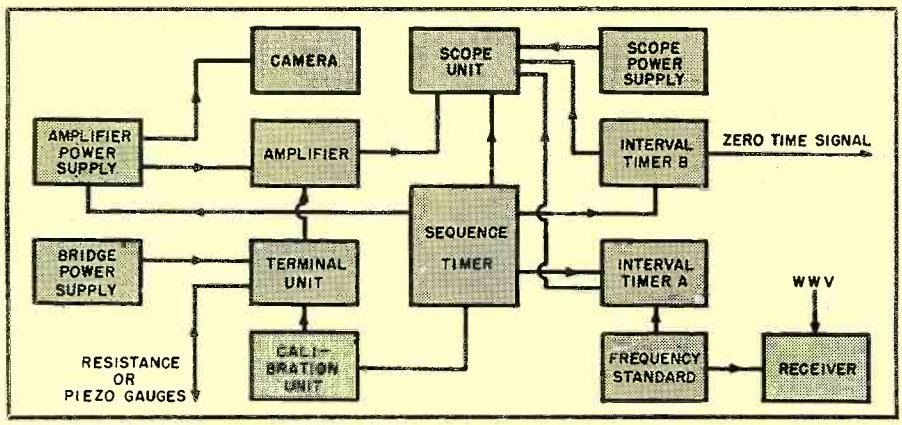
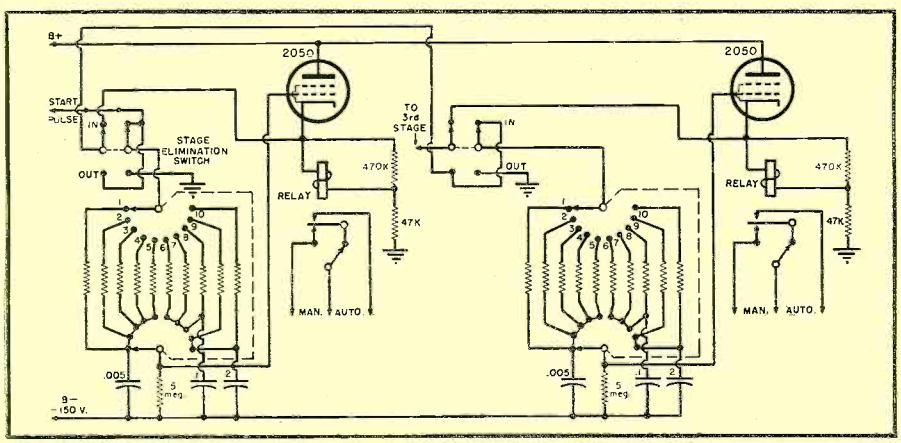


Fig. 3. Functional block diagram of a typical channel.

Fig. 4. Basic schematic diagram of the sequence timer.



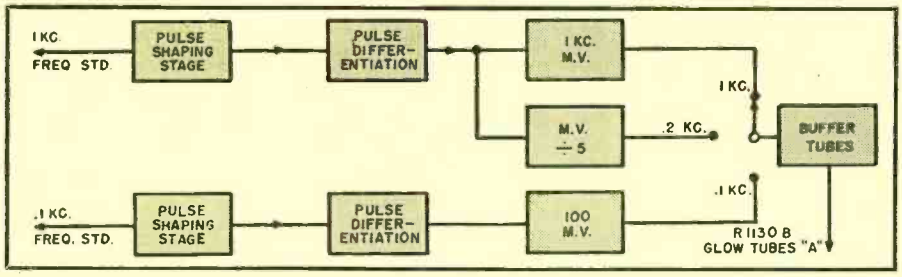


Fig. 5. Block diagram of interval timer A.

The sequence timer automatically controls all equipment operation during test, and since we have discussed the functional interdependence of all the instrumentation units, a description of the operation of this timer is in order.

Two of ten identical stages of thyratron delay circuits are shown in Fig. 4. Selection of ten time delays ranging from 10 milliseconds to 2 seconds is provided for each of the ten stages by means of *R-C* networks. Relays are used in the cathode circuits of the thyratrons, and the triggering voltage for the succeeding stage is derived from the thyratron cathode rather than from the relay. This prevents the relay time errors from being cumulative. Any stage may be bypassed by means of the stage elimination switch provided, and manual simulation of all automatic relay operations may be obtained by means of switches in the relay circuits.

The arrangement of these controls on the front panel of the unit is shown in Fig. 2. The top row of toggle switches controls the manual operation of each stage, while the bottom row of toggle switches is used to eliminate any stage which controls an operation unwanted for the particular test. The rotary switches are used to select appropriate time delays for each thyratron stage. Start and stop buttons are provided although the unit can be remotely controlled if it is so desired.

The arrangement for recording may best be described by reference to Fig. 7 which shows the front panel of the oscilloscope unit. Four 3 inch cathode-ray tubes are nested together to decrease the area of the field to be photographed. The vertical center lines of the tubes are two inches apart to provide one inch deflection on either side of center without overlap of traces. Two glow modulator tubes are mounted, one in either corner, on the horizontal center line of the two rows of tubes and a counter is mounted in the lower left corner. This counter is edge lighted by a concealed lamp for photographic identification of the record.

The cast aluminum frame supports a 45 degree front surface mirror. The camera is mounted on the front panel of the amplifier power supply below this unit with the lens vertical; the picture being taken by means of the 45 degree mirror. Tube face to film distance is such as to obtain a 9 to 1 reduction. The advantages of this system are its rigidity, freedom from differential vibration and saving of space.

Each channel is provided with individual intensity, focus and vertical positioning controls to take care of individual tube variations but all tubes are brightened simultaneously by one relay control. Three such units, twelve cathode-ray tubes, are supplied by one well regulated high voltage source

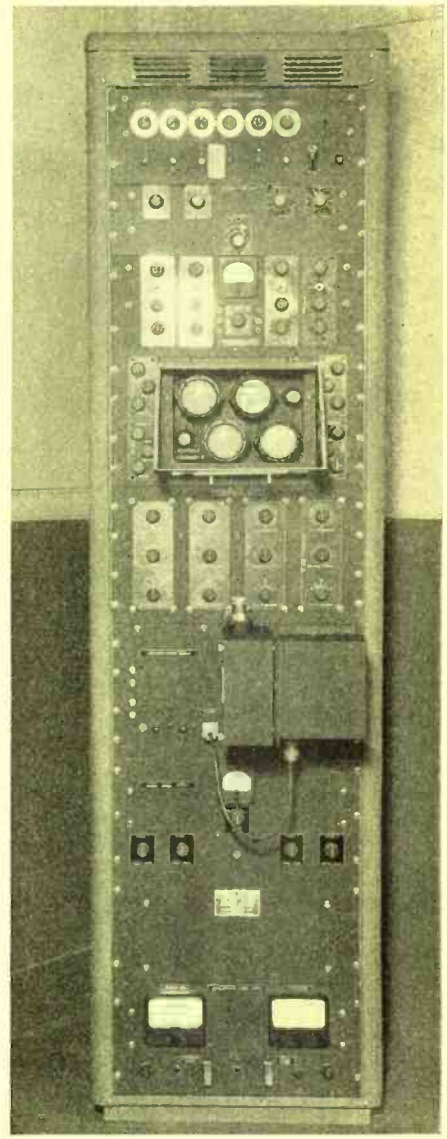


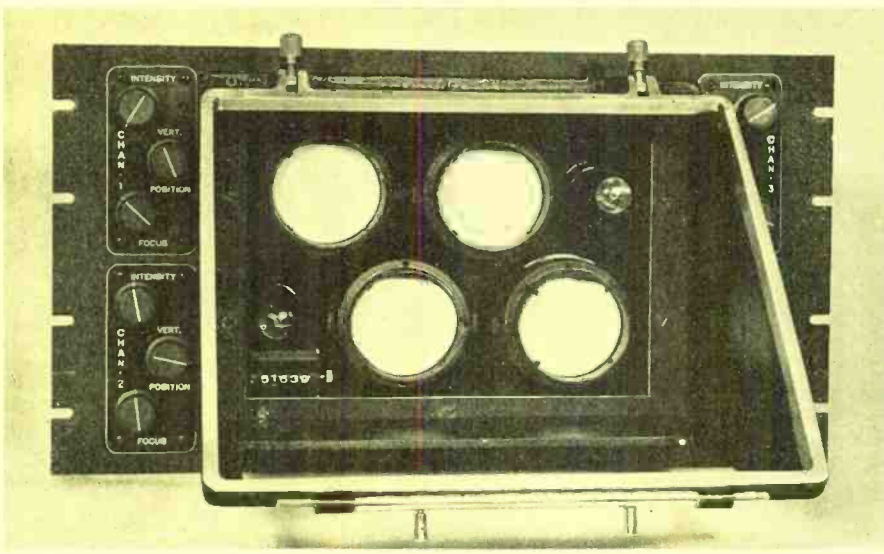
Fig. 6. Front view of a completely assembled 4-channel unit.

which is capable of delivering 2000 volts + and — with respect to the second anode. The second anode of these tubes is not at ground potential but is designed to operate at approximately 320 volts above ground because of the direct coupling of the amplifiers.

The modulated glow tube in the upper right corner (Fig. 7) is the tube referred to as glow tube "A", being supplied by interval timer A, while the one in the lower left corner, "B", is supplied by interval timer B and is used for the zero time indication. A brief description of the timing unit operation will be facilitated by reference to Fig. 5 which shows a block schematic of interval timer A.

The 1000 and 100 cycle sine wave inputs, derived from a frequency standard, are amplified, clipped and differentiated. These pulses are used to trigger multivibrators which are of the single shot type. This prevents off-frequency pulses being generated and recorded if the frequency standard

Fig. 7. Front view of an oscilloscope showing mirror mount (mirror removed).



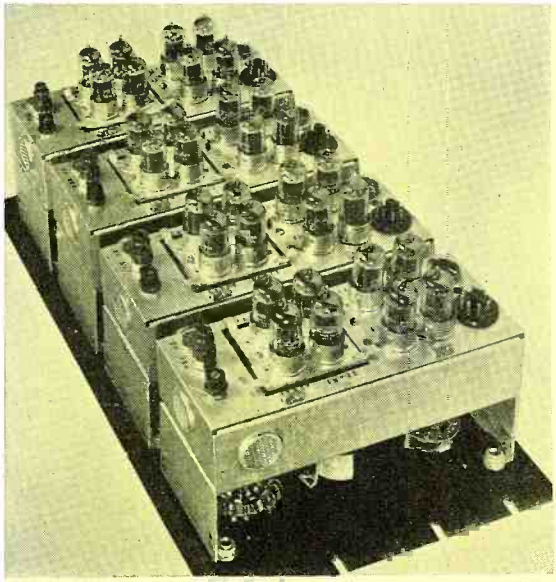


Fig. 8. The amplifiers which form the connecting link between the input circuits and the cathode-ray tubes are arranged in groups of four, as shown.

fails. A buffer tube is provided for each of the six glow tubes supplied from this timer. By six three position switches any one of three frequencies may be independently selected for each glow tube.

Fig. 9 shows a block diagram of interval timer B. Two sweep circuits are provided, one a conventional sawtooth sweep and the other a multivibrator. This latter is used when high intensity traces are being focused to avoid possible burning of a line on the screen. The square wave produces a high velocity of spot travel across the usable portion of the tube face with the area of high intensity being off the face of the tube. Either of these signals is amplified and fed into push-pull cathode followers which provide low impedance output to the long interconnecting cables.

A 1000 cycle, temperature compensated tuning fork is used as a frequency source for the timing pulses in this unit. The sinusoidal output of the tuning fork is amplified, clipped, and differentiated, these differentiated pulses being used to trigger two multivibrators. The first multivibrator has a 1000 cycle repetition rate with adjustable pulse width and is connected to all the cathode-ray tube vertical plates at the same time the sweep is removed, by means of a sequence timer controlled relay. The effect of this is to produce small timing pips on all traces. The second multivibrator divides by two and has an output of 500 cycle pulses which are applied to the control grids of six buffer tubes supplying glow modulator tubes *B* in each oscilloscope unit.

These glow modulator tubes do not operate until initiated by the zero time pulse circuit which operates as follows. A pulse provided by an external device such as a fuse or switch triggers a multivibrator which simultaneously applies a pulse to the buffer tube and fires a thyratron completing the ground circuit of the glow modulator tubes enabling them to fire. The duration of the zero time pulse is adjustable and, after it ends, the 500 cycle pulses are recorded. The effect of the timing pulses on the vertical plates is shown in Fig. 11. The timing traces along the edge of the film are those supplied by the glow tubes while the timing pips on the four traces are supplied by the 1 kc. multivibrator of interval timer B.

The recording cameras used were specially designed for the instrumentation. The motor and transmission are permanently mounted while the magazine is separately removable to facilitate handling. Film speeds of 0.6 ft./second to 10 ft./second are available and the lens has adjustable focus and aperture.

The amplifiers form the connecting link between input circuits and cathode-ray tubes and are also arranged in groups of four as shown in Fig. 8. Both d.c. and a.c. amplification are provided, the latter through the use of a preamplifier cascaded with the d.c. amplifier. The d.c. amplifier may be used by itself, having a maximum gain of 50,000 variable 40 db. in 2 db. steps and a frequency response from 0 to 50 kc., or the combination of preamplifier and d.c. amplifier having a maximum gain of 2,000,000 with a frequency response from 0.2 cycle to 50 kc. The preamplifier has 20 db. of attenuation in 5 db. steps. These amplifiers embody a new input stage which permits use

(*Continued on page* 26)

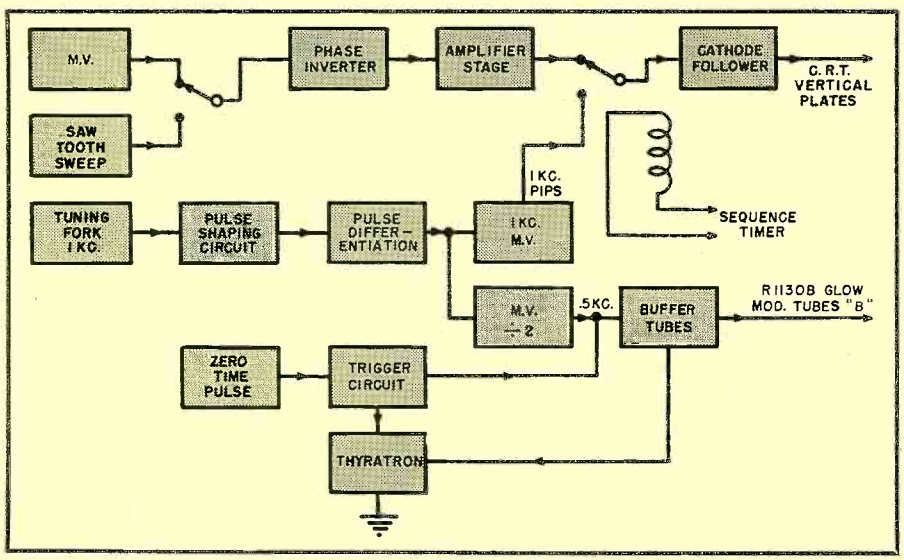


Fig. 9. Block diagram of interval timer B.

Fig. 10. Four channel record showing timing markers.

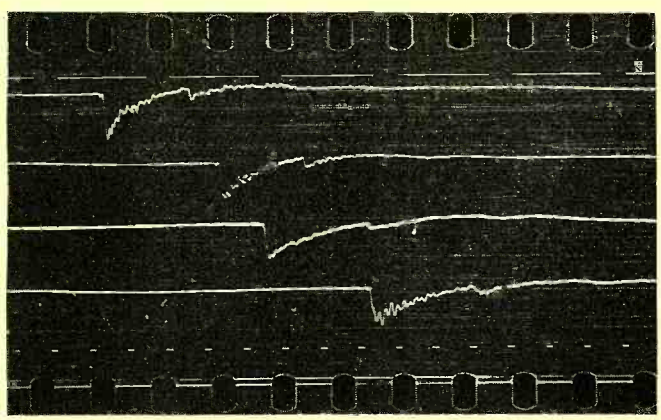
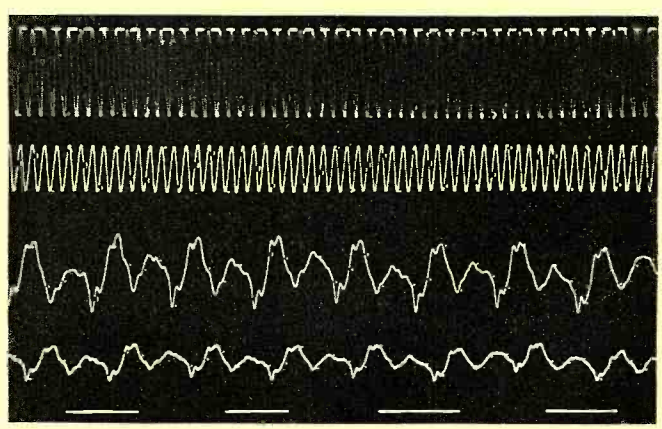
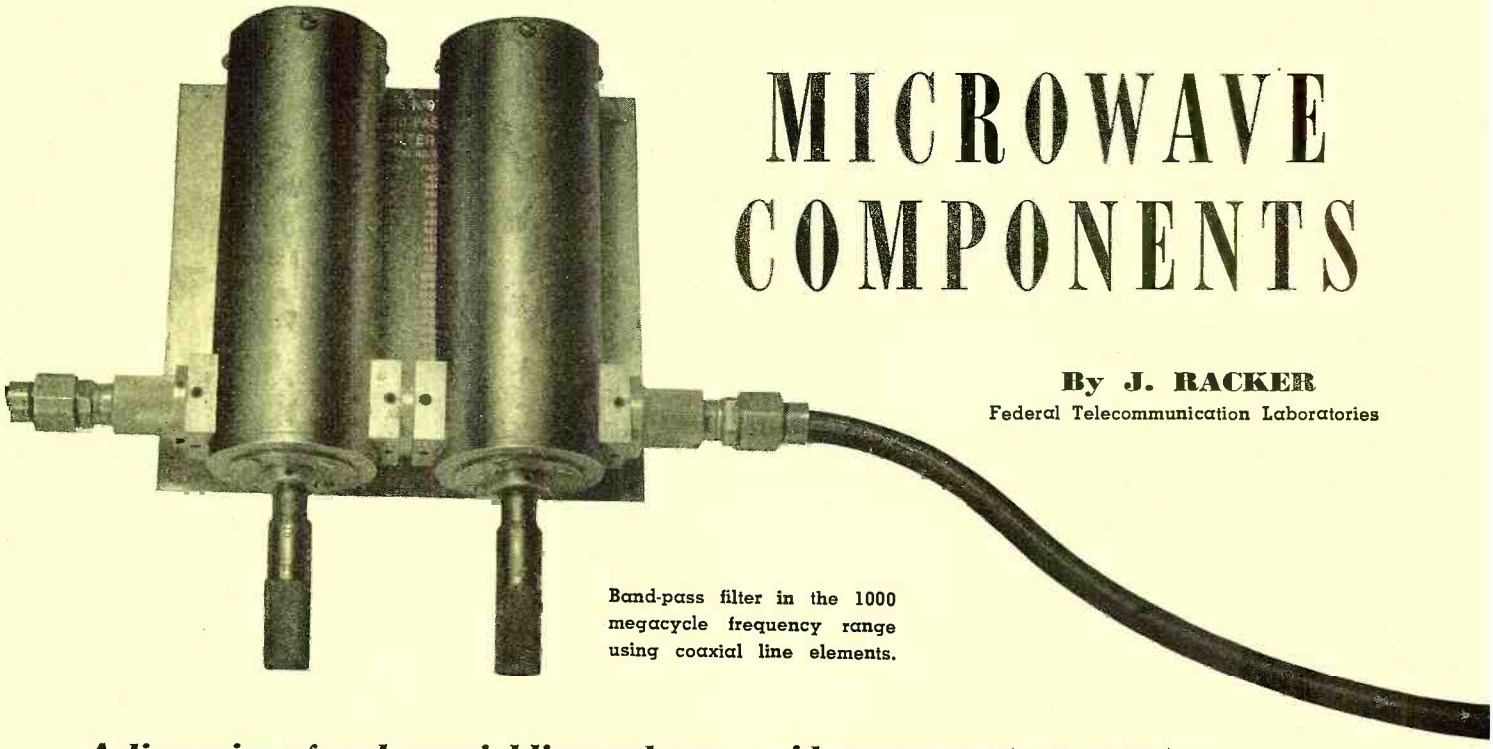


Fig. 11. The effect of timing pulses on vertical plates.



MICROWAVE COMPONENTS

By J. RACKER
Federal Telecommunication Laboratories



Band-pass filter in the 1000 megacycle frequency range using coaxial line elements.

A discussion of such coaxial line and wave guide components as quarter wave transformers, stub transformers, resonant lines and filters, etc.

IN the discussion given in the previous articles [1, 2] frequent reference has been made to the use of transmission lines as transformers, inductive and capacitive elements, filters, and other components. All of the general equations developed for transmission lines also apply when these lines are used as circuit elements. However, there is a major difference in approach between the use of transmission lines for the transfer of energy (as considered in the last article) and their use as components. This difference is: In the former case the problem is primarily one of selecting the best available manufactured line, while in the latter case the engineer must frequently actually design and build appropriate lines to meet his individual requirements. It is therefore necessary, in considering element design, to delve into the details of transmission line construction. Hence, a separate article on microwave components.

Coaxial Line Elements— Quarter Wave Transformer

This article, as the previous one, will be divided into two general sections; one considering the use of coaxial line elements for frequencies up to about 2000 mc. and the other, the utilization of wave guides for frequencies above 2000 mc. Coaxial line elements will be considered first, starting with quarter-wave transformers.

It has been shown that two purely resistive impedances can be matched to each other through the use of a quarter-wave transformer whose characteristic impedance is equal to:

$$Z_{oT} = \sqrt{R_0 R_L} \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

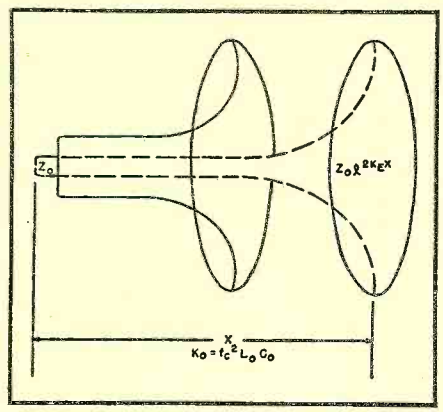
where R_o is impedance at sending end and R_L is load resistance. The characteristic impedance of a coaxial line is equal to:

$$Z_0 = \frac{138}{\sqrt{K}} \log_{10} \frac{D}{d} \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

where D is outer conductor diameter, d is inner conductor diameter, and K is the dielectric constant. This equation is plotted on the nomograph on page 32.

Generally, the problem is to match a line with characteristic impedance, Z_o, to a load representing a complex impedance. In considering the input impedance of such a line versus distance from the load, it will be found that for each half wavelength of line traversed, two points of purely resistive impedance exist; one equal to $Z_o\eta_v$ (η_v voltage standing-wave ratio) located at maximum voltage points, and the other equal to Z_o/η_v located where voltage minimums occur.

Fig. 1. Ideal exponential coaxial line.



It is usually more convenient to select a point of minimum resistance rather than the one of $Z_o\eta_v$, since in this case the characteristic impedance of the transformer required is less than that of the line. A line of lesser impedance can be obtained readily by utilizing a "sleeve" within the existing line as shown in Figs. 2A and B, while to increase the impedance involves increasing the outer diameter or decreasing the inner diameter, neither of which can be done simply.

The procedure for matching with a quarter-wave sleeve is as follows:

1. Measure the voltage standing-wave ratio at the input and determine the location of a minimum voltage point.

2. Design a sleeve which is a quarter of a wave long and whose diameters are equal to:

a) If sleeve is on inner conductor, its outer diameter d_1 should be:

$$d_1 = \frac{D}{\left(\frac{D}{d}\right)^{\eta_v - \frac{1}{2}}} \quad . \quad . \quad . \quad . \quad . \quad (3)$$

(derived from Eqts. (1) and (2) and the equation for voltage standing wave ratio[1]).

b) If sleeve is inside the outer conductor, its inner diameter should be:

$$D_1 = d\left(\frac{D}{d}\right)^{\eta_v - \frac{1}{2}} \quad . \quad . \quad . \quad . \quad (4)$$

3. Insert this sleeve in the line at a position where the end of the sleeve facing the load is at the point previously determined to be a voltage minimum or an integral number of half waves from this position.

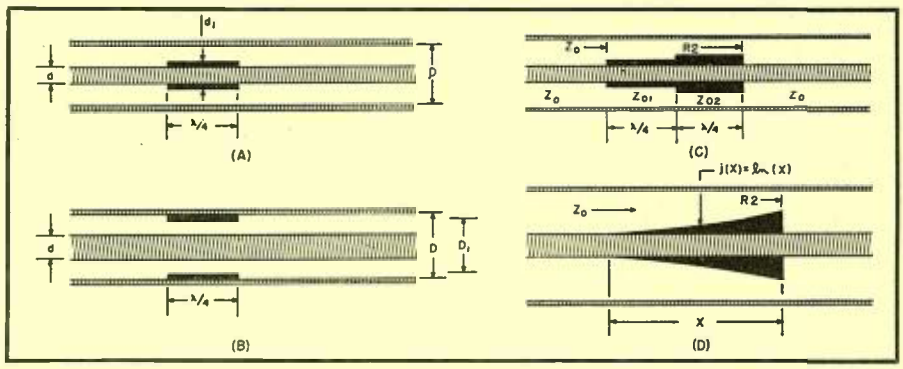


Fig. 2. (A) and (B) Quarter wave "sleeve" transformers. (C) Double sleeve transformer. (D) Tapered section matching Z_0 to R_2.

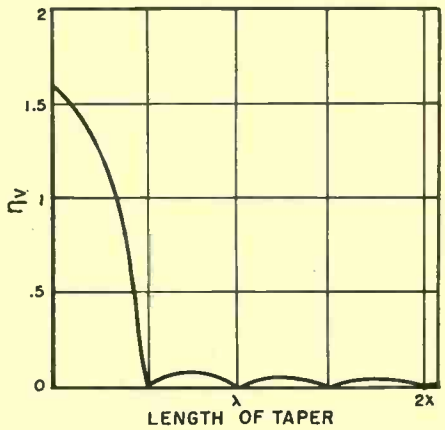


Fig. 3. Voltage standing wave ratio introduced by tapered section of coaxial line from 75 to 46 ohms.

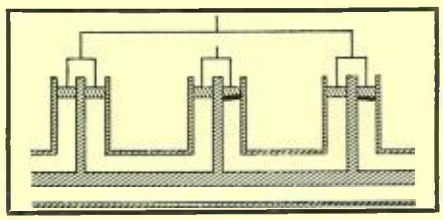


Fig. 4. Triple stub transformer.

A single quarter-wave sleeve used as a transformer has the disadvantage that it is resonant, i.e., it matches perfectly at one frequency only. The bandwidth over which the match is good can be extended by using two or more quarter-wave sleeves placed together and properly chosen in size.

A double-sleeve transformer such as the one shown in Fig. 2C should meet the following relationships:

$$\frac{Z_0}{R_2} = \frac{Z_{01}^2}{Z_{02}^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

and

$$\left(\frac{Z_0}{Z_{01}}\right)^2 = \frac{Z_{01}}{Z_{02}} = \left(\frac{Z_{02}}{R_2}\right)^2 \quad . \quad . \quad . \quad (6)$$

For a three-sleeve network the relationships between successive sleeves should be:

$$Z_0 R_2 = \frac{(Z_{01})^2 (Z_{03})^2}{(Z_{02})^2} \quad . \quad . \quad . \quad . \quad . \quad (7)$$

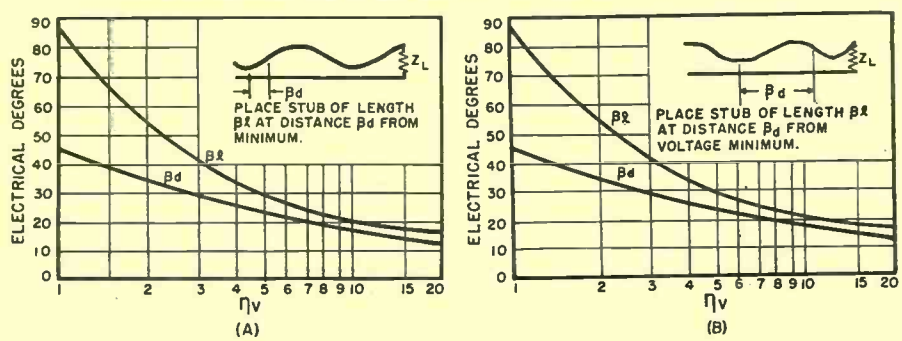
$$\left(\frac{Z_0}{Z_{01}}\right)^3 = \frac{Z_{01}}{Z_{02}} = \frac{Z_{02}}{Z_{03}} = \left(\frac{Z_{03}}{R_2}\right)^3 \quad . \quad (8)$$

As more and more sleeves are used, the matching network is made less and less frequency sensitive, the limit being reached as the impedance variation approaches that of an exponential line. An exponential line, which effects reflectionless matching between two resistive impedances that is independent of frequency, is defined as a line whose characteristic impedance varies in accordance with the following equation:

$$Z_x = Z_0 e^{2K_0 x} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (9)$$

where Z_x is the characteristic impedance at point x, and Z_0 is the characteristic impedance of the line at the point $x = 0$. (K_0 constant of equation determines cutoff frequency f_c by $f_c^2 = K_0^2/L_0C_0$). Fig. 1 is a graphic presentation of a coaxial exponential line.

Fig. 5. Impedance matching stub length (for distance Bd) for single stub transformer. (A) is for inductive and (B) a capacitive load.



Since both inner and outer diameter of such a line must be varied, it would be mechanically difficult to connect such a line to two coaxial sections of equal diameter. However, by making a sleeve whose inner conductor diameter varies logarithmically starting with a characteristic impedance of Z_0 and ending with that of R_2, it is possible to achieve a very broad band matching network. Such a sleeve is shown in Fig. 2D, and this section is usually referred to as a tapered line.

The reflection introduced by a tapered line is given by:

$$\frac{V_2}{V_1} = \frac{\lambda (.434) \log_{10} \frac{R_2}{Z_0}}{j 8 \pi x} \left(1 - e^{-\frac{4 \pi j x}{\lambda}}\right) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (10)$$

The variation of reflection with length of taper as calculated by this formula is illustrated in Fig. 3 for a taper from 46 ohms to 75 ohms.

Stub Transformers

Thus far we have considered matching two resistive impedances, assuming that no reactance exists. However, in many cases it may be simpler to choose a point along the line whose input impedance is equal to $Z_0 + jX$. Then by placing a reactance of equal magnitude to X, but opposite polarity at this point, the reactive component is tuned out and the input impedance becomes equal to Z_0. This is achieved through the use of stub transformers.

Shorted stub sections of line in shunt with the main transmission line, as shown in Fig. 6A, act as shunting reactances. Since this reactance varies in accordance with the following relation:

$$Z_{in} = j Z_0 \tan \beta l \quad . \quad . \quad . \quad . \quad . \quad . \quad (11)$$

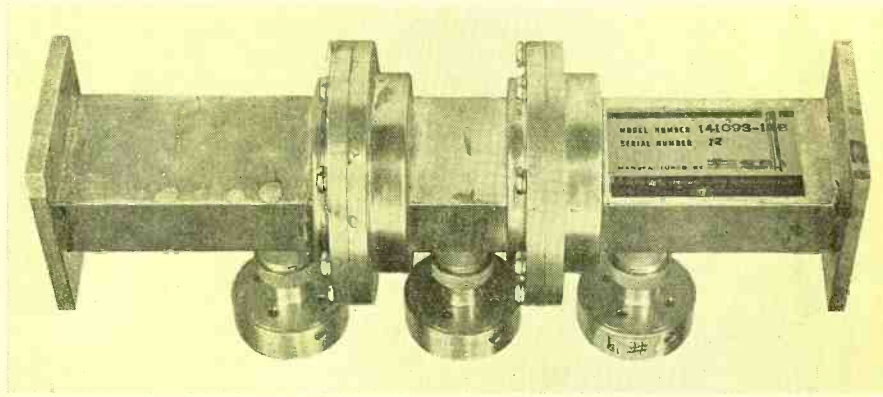
The reactance may be either inductive or capacitive and have any value between zero and infinity (neglecting losses).

The points along the line whose input impedance has a resistive component equal to Z_0 can be determined from the *Smith* calculator (as described in previous article). For example, if the load Z_L were located at a point on the circle shown in Fig. 6B, the points corresponding to A and B represent a resistive component equal to Z_0. The stub for matching should be located at either A or B. If at point A, the input admittance of the stub should be capacitive and of magnitude X to balance out the inductive component of the input impedance of the line. Similarly, if the point B is chosen, an inductive stub should be used.

A correlation exists between standing-wave ratio, position of stub, and length of stub. Figs. 5A and B give the stub position and length in electrical degrees for any standing wave ratio η_v. As indicated on these curves, η_v

should be measured from a minimum toward the load. The shorting bar in the stub can be made adjustable for fine tuning after stub is placed in position.

A transformer suitable for matching any two impedances can be constructed by placing three adjustable shorting stubs in shunt with the line, as shown in Fig. 4, spaced a quarter-wave apart and ganging the first and third adjustable stubs. This transformer has only two adjustments which are varied by the trial-and-error method until a minimum standing-wave ratio is achieved.



Typical band-pass filter using wave guide elements.

Resonant Lines and Filters

It has been shown in the article "Microwave Techniques", that a quarter-wave shorted line is equivalent to a parallel resonant tuned circuit, while a quarter length open circuited line is equivalent to a series resonant circuit. Hence, it is seen that coaxial lines can be used as a tuned circuit or filter.

The expression derived in the first article assumed the existence of lossless lines. This is equivalent of considering a tuned circuit with no resistance. For many purposes it is possible to neglect the attenuation of the line; however, when designing a resonant line for use in an oscillator or filter, the losses in the line must be considered to obtain the actual impedance and bandwidth of the circuit.

The most convenient parameter to use for determining the bandwidth and impedance of resonant lines is the Q. The Q of any line is defined to be:

$$Q = 2\pi \frac{\text{Peak energy storage}}{\text{Energy dissipated per cycle}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (12)$$

and in a coaxial line is:

$$Q = \frac{\omega\sqrt{L\,C}}{2\,\alpha_T} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (13)$$

where

$L = .46\ \mu_1 \log_{10} b/a \times 10^{-6}$ henries/meter

$C = \frac{.241\varepsilon_1}{\log_{10} b/a} \times 10^{-10}$ farad/ meter

α_T is line attenuation as given in previous article[2].

The parallel and series resonant impedances may be expressed in terms of Q by the following relationships:

$$Z = \frac{Z_0\,\beta l}{2\,Q} \text{ (series)} \quad . \quad . \quad . \quad . \quad . \quad . \quad (14)$$

$$Z = \frac{2\,Z_0\,Q}{\beta l} \text{ (parallel)} \quad . \quad . \quad . \quad . \quad (15)$$

Defining the bandwidth as $(\omega\text{-}\omega_0)$, with ω the angular frequency at which the input impedance is $\sqrt{2}$ times the series resonant impedance, and $1/\sqrt{2}$ of the parallel resonant frequency, the relation between bandwidth and Q is given by:

$$Q = \frac{\omega_0}{2(\omega - \omega_0)} = \frac{f_0}{2\,\Delta f} \quad . \quad . \quad . \quad . \quad (16)$$

In general, the Q of a line is increased by increasing either the size of the conductors or the spacing between conductors. Increasing the size of conductors decreases the skin effect, whereas increasing the spacing between conductors increases the inductance per unit length.

It can be shown that the attenuation constant of a coaxial line becomes a minimum when D/d is equal to 3.6. This corresponds to a characteristic impedance of 77 ohms. Since the factor $\omega\sqrt{LC}$ is independent of D and d, the maximum Q likewise occurs when D/d is 3.6. Fig. 7 plots the Q of air-dielectric copper coaxial lines as a function of frequency for various sizes of lines, all having the optimum value of $D/d = 3.6$.

Where a high degree of power must be handled by the coaxial resonant line, such as when it is used in a transmitter output stage, the dimensions of the line should also be selected on the basis of power handling capability. The theoretical power that can be handled by an air-dielectric line using the breakdown voltage as 15,000 v./cm. is equal to: (*Continued on page* 18)

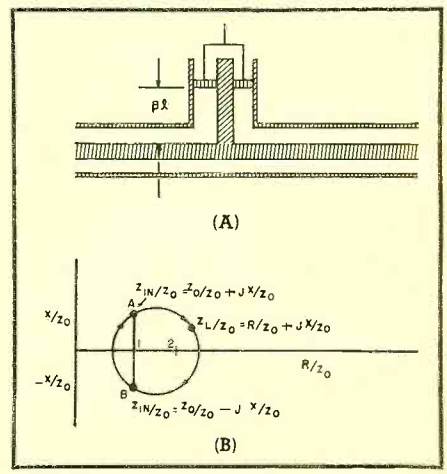
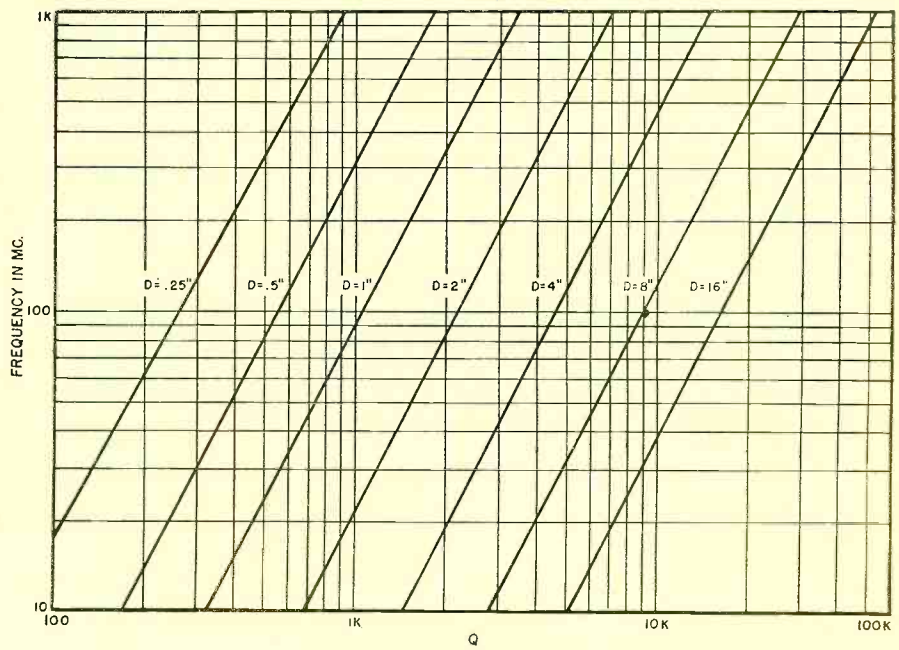


Fig. 6. (A) Single stub transformer. (B) Typical normalized impedance diagram showing location of points where resistance component is equal to Z_0.

Fig. 7. Q of copper coaxial lines with optimum D/d ratio of 3.6.



D.C. AMPLIFIER OF IMPROVED STABILITY

By
SAMUEL FREEDMAN

The d.c. to be amplified modulates an a.c. signal. This a.c. signal is then amplified and rectified.

THE MAIN purposes of this type of amplifier are to provide a more stable method of and an electronic system and apparatus for amplification, indication and measurement of direct current as well as slowly fluctuating d.c. not readily attained with conventional so-called direct current amplifiers.

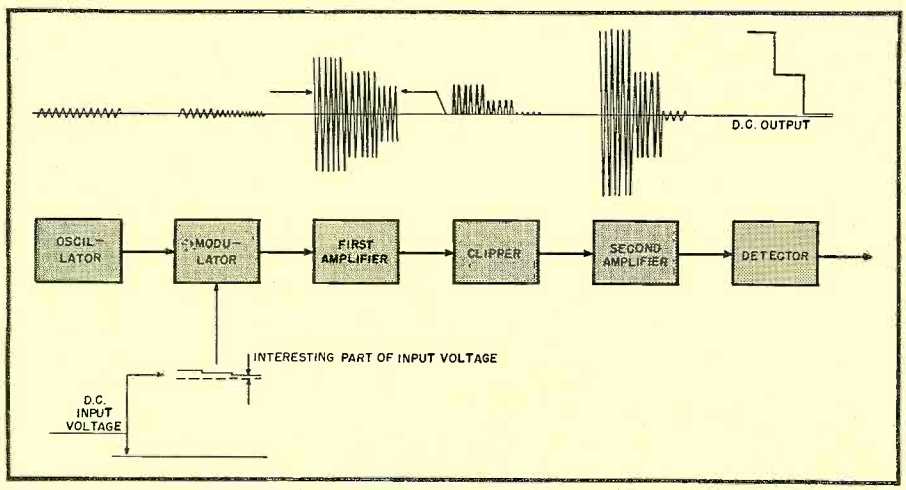
Ordinary direct current amplifiers depend upon direct coupling between the output of one vacuum tube stage and the input of the next stage, wherein the direct current or varying voltage under test is directly applied to the tubes. This often results in false and erratic indications due to the picking up of spurious currents and to small plate or filament voltage fluctuation occurring in the vacuum tube circuits themselves.

The d.c. amplifier described in this article is designed to have greater stability and dependability, as well as increased voltage amplification. It achieves this by incorporating certain conventional frequency techniques, such as the employment of the principles of intermediate frequency stages as used in radio receiving systems between the various amplifying sections. The amplification of direct current is obtained by generating an alternating current by means of a suitable oscillator and modulating this alternating current with the direct current where amplification is desired. The result is an amplitude modulated signal with the direct current as its envelope of modulation. This signal is then amplified by means of a suitable high gain alternating current amplifier, detected and translated.

Fig. 1 shows a block diagram of the major components of this amplifier. Fig. 2. shows a circuit diagram of the entire amplifier. A set of circuit values is indicated although the tuned circuits may be any value depending on the desired frequency of the oscillator.

Referring to the major block components in the sequence given in Fig. 1, operation can be described as follows:

Fig. 1. Block diagram showing basic operating principles of the d.c. amplifier.



Oscillator

The oscillator comprises a tube (V_1 Type 6SF5). The oscillation needs to be small but constant in amplitude. Any convenient frequency may be employed for interstage coupling by means of tuned circuits commonly used in i.f. or r.f. interstage coupling techniques. The amplitude stability is very important. In the figure, the circuit of the oscillator coil T_1 is a tuned grid circuit with a coupling coil to provide the necessary feedback in the plate circuit. The oscillator can, if desired, be any other convenient type of oscillating circuit. A proper amount of negative feedback is injected in the cathode by the 1000 ohm resistor. This negative feedback tends to keep the amplitude of the oscillation small and to increase the amplitude stability. "OSCILLATOR CONTROL" potentiometer in the plate circuit provides means of adjusting the amplitude of the output without affecting the stability of the oscillator. Switch B provides means to switch the coupling circuit on and off without changing the previous adjustments. The coupling circuit as shown in the figure is of the double-tuned type marked T_2. The coupling should be loose enough so as to prevent the small load changes due to adjustments in the following circuits from affecting the amplitude of the oscillations. The tuned circuits are the usual i.f. circuits tuned, trimmed, coupled and shielded as currently used in i.f. techniques. The filter section comprising a .05 μfd. condenser and 3000 ohm resistor in the plate circuit helps in keeping constant the amplitude of the oscillation.

Modulator

The modulator consists in Fig. 2 of a type 6SK7 tube (V_2) which has a remote cutoff characteristic that makes

it possible to have the variations of output amplitude proportional to the variations of grid bias. This happens where the characteristic curve follows closely enough the square law (i.e. where the current is proportional to the square of the signal voltage). The average value of the grid bias should therefore be kept around that point. This means that the adjustment of the modulator must be always kept at the point of best linearity. This may not be the same as the point corresponding to the desired amplification of the small voltage fluctuations. This is possible by means of the "AMPLIFIER CONTROL" potentiometer which covers all values of d.c. input signals from 0 to 100 volts. A 2 meg. resistor in the input circuit provides a d.c. connection for the grid during the preliminary adjustments when no signal is present at the input terminals. The 10k resistor in the plate circuit in connection with the meter and Switch A in position #1 makes it possible to adjust the "AMPLIFIER CONTROL" until the operating point falls in the square law portion of the characteristic curve. In this particular circuit version, the meter is set to 50 which will show that the right current corresponding to the proper bias is flowing through the tube. Tube V_2 in addition to serving as modulator is also the first amplifier indicated in Fig. 1 by virtue of being connected to tuned circuit T_3.

Voltage Regulating Section

In this circuit version, two voltage regulating tubes of the VR105 type (V_3 and V_6) provide good regulation of the cathode voltage across the "AMPLIFIER CONTROL" potentiometer, as well as good regulation of the screen voltage of V_2. The 4000 ohm resistor in series with the tubes up to the B supply is the ballast resistor. This voltage regulating section is also connected with the following stage to provide a similar control of the cathode and screen voltages of the clipper tube V_4 (type 6SJ7).

Clipper

Since the best operating point of the modulator with respect to linearity does not correspond to the best operating point with respect to the gain of small fluctuations, a clipper tube is used to eliminate everything except the abnormal amplitude fluctuations that represent the desired signal. The use of a sharp cutoff pentode (6SJ7) V_4 provides a sharp clipping of the input oscillation if the grid bias is beyond cutoff. In this case only a part of the positive peak of each oscillation draws current to the plate. The tuned plate circuit T_4 functions as a class C amplifier thereby making V_4 also function as the second amplifier as shown in block diagram (Fig. 1). The grid bias is adjusted by means of the "CLIPPING CONTROL" potentiometer. The 10k ohm resistor in the plate circuit in connection with the meter and the switch A in position #2 helps in finding out the proper bias. In the circuit version shown it will be about 10 volts although the optimum value is determined by experimentation.

Detector

An ordinary biased detector using a pentode of the 6SJ7 type (V_5) may be used to reproduce the amplified d.c. signal on the meter when switch A is connected in position #3. "DETECTOR CONTROL" potentiometer is used to have zero current with zero signal. This is indicated on the meter when switch A is in the "READING" or #3 position. In the event greater sensitivity is desired, the meter may be arranged in a bridge circuit or in connection with other suitable modifications thereof, since a bridge circuit is more sensitive than a simple meter arrangement.

Alignment

Referring to Fig. 2, the unit may be aligned by adhering to the following sequence of instructions:

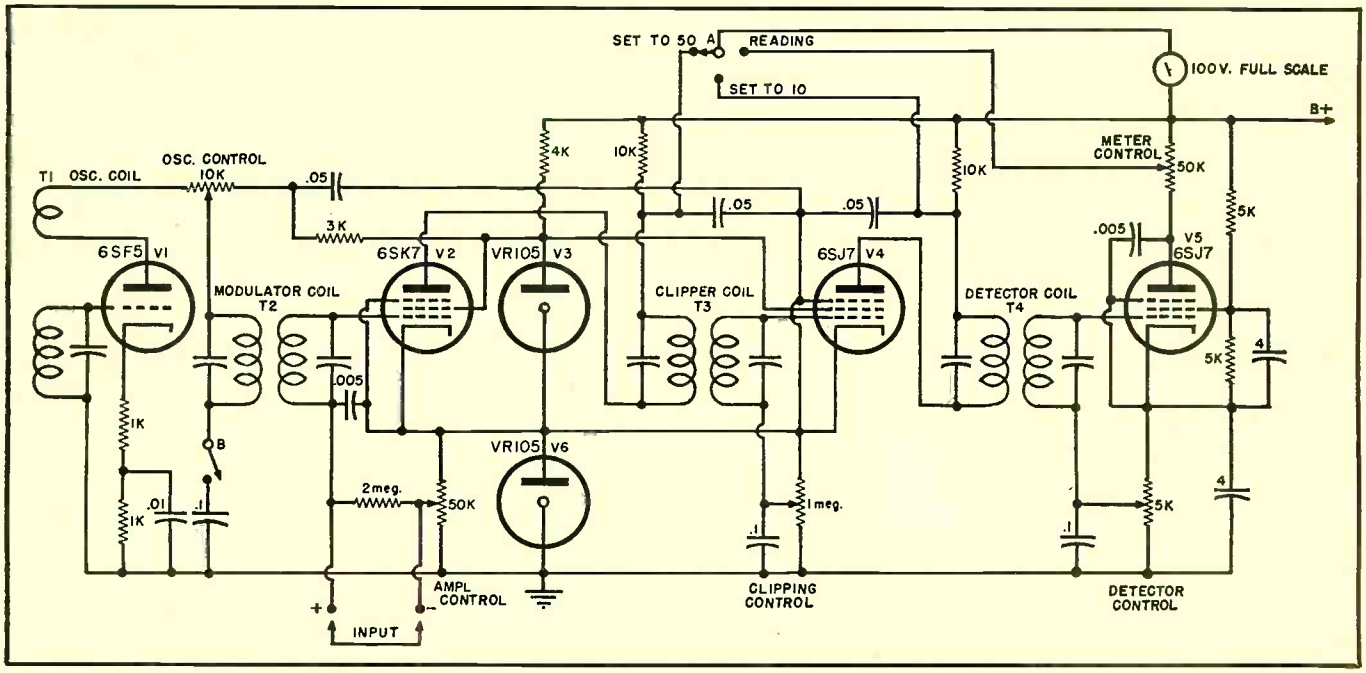


Fig. 2. Complete circuit diagram for the d.c. amplifier, including some component values.

1. Throw switch A in the "set to 50" position # 1 (to the left in Fig. 2).
2. Throw switch B "on".
3. Turn potentiometer "OSCILLATOR CONTROL" P1 all the way to the right and then bring slightly back.
4. Adjust "AMPLIFIER CONTROL" potentiometer to read 50 on the meter.
5. Throw switch B to the "off" position.
6. Throw switch A in the "set to 10" position #2.
7. Adjust "CLIPPING CONTROL" potentiometer to read ZERO. The adjustment should not be allowed to go below zero. It should be stopped when the meter reaches zero.
8. Throw switch B in the "on" position.
9. Adjust potentiometer "OSC. CONTROL" to read 10.
10. Throw switch A in the "READING" position #3.

(*Continued on page* 31)

Forced Air Cooling for ELECTRONIC EQUIPMENT

Basic principles and practical methods for the correct design of air cooling systems.

By B. E. PARKER
Engineering Head, FM dept., Gates Radio Co.

THE primary purpose of any air-cooling system is either to remove heat or to prevent heat concentration at some specific point. This may be done by making use of natural thermal circulation or by forced air. Amplifiers and small transmitters are usually cooled by the natural thermal circulation resulting from the draft created by the rising of the hot air. Louvres and ventilator holes at the bottom and top of the enclosure permit the air to circulate through the cabinet, over the hot components and thence out. This is satisfactory only where the amount of heat dissipated is relatively small.

Where a large amount of heat must be removed, some form of forced air circulation is used. Fig. 1 is an example of an efficient system of the forced draft type. In this particular system turbulence is purposely created in order to flush all parts of the cabinet. This system is most effective when the heat radiating components (mostly plate and filament dissipation of the various tubes) are well separated. It has the advantage of removing relatively large amounts of air at comparatively low velocity, which produces little noise. In this particular example the cabinet tends to serve as a quieting chamber, and a baffle plate at the top further serves in muffling the air noise.

In this, as in all air cooling systems, the hot air must be expelled from the cabinet and replaced with cool air, otherwise the heat will be merely distributed throughout the cabinet by the blower or fan.

Fig. 1. Cooling system of a well-known 1 kw. broadcast transmitter.

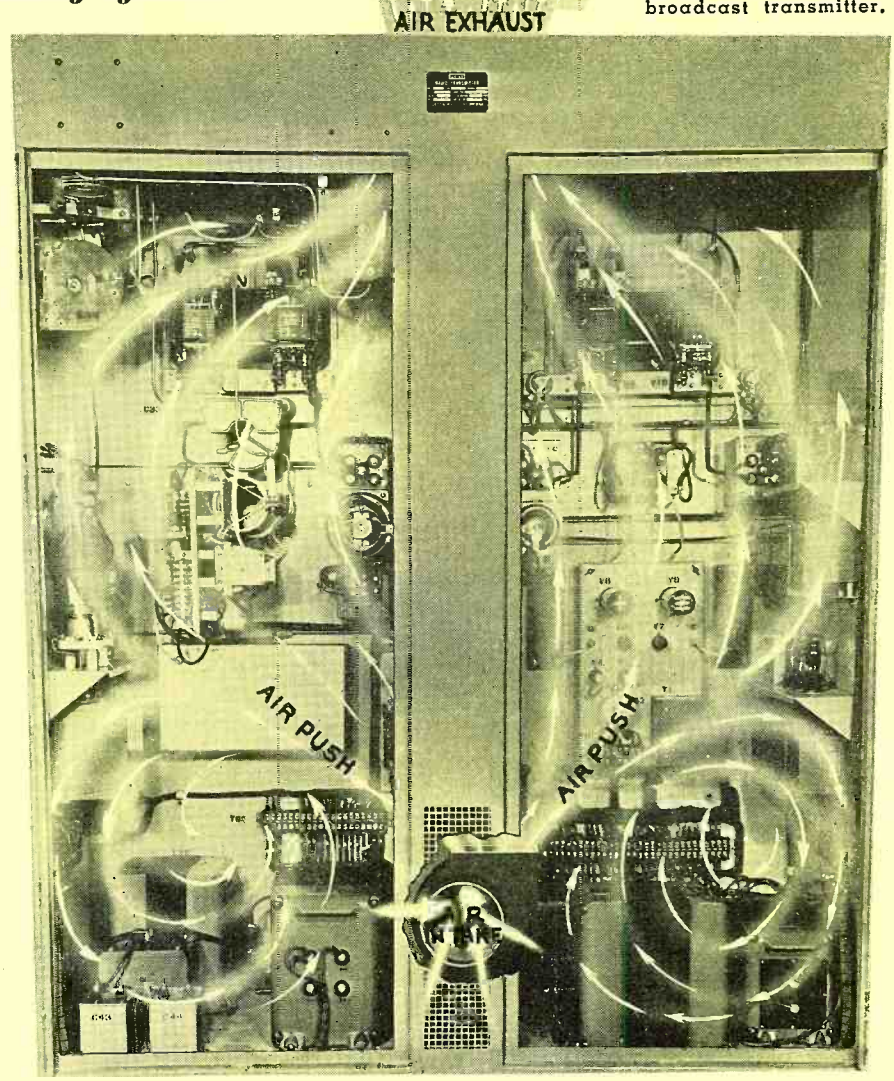
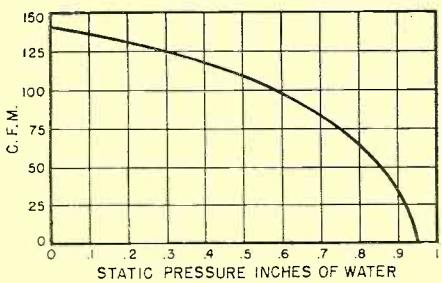


Fig. 2. Performance curve of the Fasco model 50749 blower.



While a blower or fan placed at the air outlet would be equally as effective, the air noise level would be much higher and the effectiveness of the dust filter at the air intake would be largely defeated. When the blower is located at the air intake, the cabinet is pressurized, preventing entry of dust and dirt through the small cracks due to doors and other necessary openings.

The tube handbook or manual usually makes a specific recommendation for cooling the tube used. In general it is unwise to depart radically from these recommendations unless the tube manufacturer is consulted regarding the intended change. Tube data sheets are usually available from the manufacturer or supplier which give the amount of air, the pressure drop, and maximum seal temperature for the tube. Most companies have tube application engineers who will gladly supply the above information since all this is available from the tests made at the time of tube design.

Where the cooling required is merely

a blast of air directed at the seals, the cooling system is relatively simple as a blower giving the required c.f.m. (cubic feet per minute) is sufficient.

Fig. 4 shows a 1 kw. FM transmitter using a pair of 4-400A tubes in which the cooling system is somewhat complicated due to seal cooling at both the base and anode. The manufacturer's bulletin shows that 14 c.f.m. per tube passing through the base, up over the plate seal is required. This amount of air will result in a pressure drop of .25 inches water column when used with the recommended socket and air chimney assembly. Fig. 6 illustrates graphically this cooling system as developed in the *Eimac* laboratories especially for this series of internal anode tubes.

The pressurized lower chamber serves to equalize the pressure for both tubes and to muffle the blower noise to a negligible amount. The air passes up through holes in the base of each tube, across filament and grid seals, out through the side of the base flange, up between the pyrex chimney and the tube envelope, at which point it is deflected across the anode seal.

The blower used in the transmitter shown in Fig. 4 has air volume and pressure capabilities several times in excess of the recommended tube requirements. The extra air is used in flushing the upper chamber and quickly forcing the hot air out through the top of the cabinet. This was easily accomplished by placing "bleeder" holes in the deck between the chimney and the tube base.

The measured pressure at the bottom of the tubes was .625 inches water column. This represents a safety factor of 150% above the tube manufacturer's rating, which was found by later tests to be most conservative. In fact the air inlet to the blower was obstructed until the pressure dropped to .15 inches water column. This pressure resulted in an anode seal temperature of 150°C with grid and filament seals 10 to 20 degrees cooler. The blower used has the performance curve shown in Fig. 2. From the curve it will be seen that with a pressure of .625 inches the blower will deliver 90 c.f.m. of air.

With the widespread use of external anode tubes, a pressurized system providing a steady stream through the anode fins has become popular in FM, television, and high power broadcast transmitters. Fig. 5 is a typical example of this type of cooling used in a recently announced 5 kw. broadcast transmitter.

Three *Eimac* type 3X2500F3 triodes are employed. Two tubes serve as the class B modulator, shown on the right. One tube, extreme left, is used as the modulated Class C r.f. power amplifier. The blank socket to the right of it is used for an additional r.f. tube to increase the power output to 10 kw. when desired by the station operator.

The tube manufacturer's bulletin specifies an airflow of 120 c.f.m. through the anode cooler. This will result in a pressure drop of 1.6 inches water column. In addition a minimum of 3 c.f.m. must be directed toward the filament stem structure, between the inner and outer filament conductors. Referring to Fig. 5 it will be seen how this is accomplished with a single blower cooling all three anodes as well as the filament seals. By means of a large blower in the lower right hand corner, just out of sight, the air is conducted by the heavy canvas duct up to the pressurized chamber which serves as the deck. The air is distributed by this chamber to the bottoms of the ceramic bowls which support the anode socket connections. The air passes up through the cooling fins of the tubes and on out through the top of the cabinet expelling the heated air. For 5 kw. operation, the unused tube socket is blocked off to prevent the escape of air and a consequent loss of air pressure.

Air for the filament seal requirements is provided by half inch tubing serving as air ducts. Referring to Fig. 5 it will be seen that these ducts extend up from the pressurized chamber and terminate in nozzles which force the air down into the space between the inner and outer filament conductors.

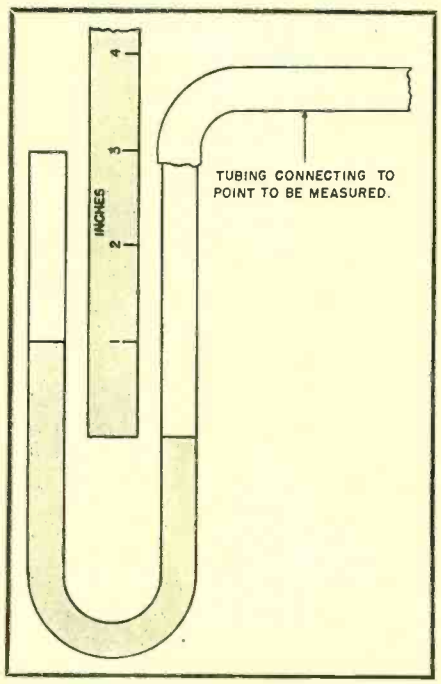


Fig. 3. Simple manometer construction.

Final measurements showed a pressure of 1.7 inches water column at the base of the tubes. In actuality, this was adjusted to this pressure value by bleeding off considerable air from one end of the pressurized chamber for flushing an adjacent cabinet. Temperature of the tube seals and anode coolers was well under 150°C for continuous operation at full output.

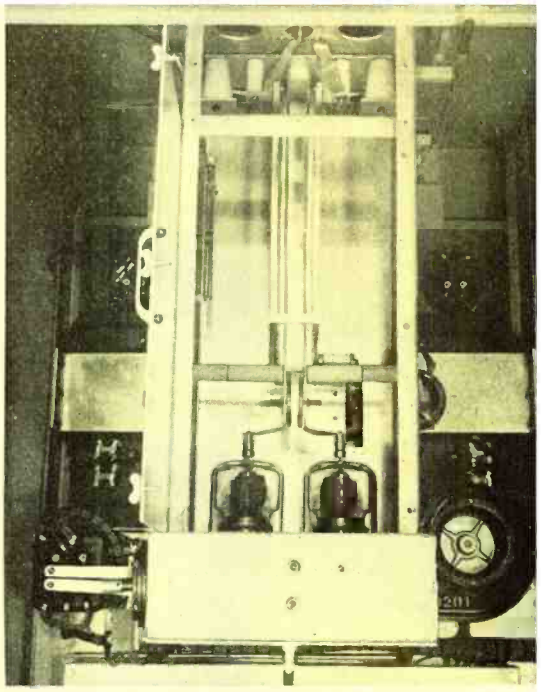


Fig. 4. Typical air cooling system used with internal anode tubes.

The blower used for this system has a certified rating of 1.75 inches pressure at 800 c.f.m. This provides better than 400 c.f.m. for other purposes.

The selection of the blower depends largely on two factors, the air volume required in cubic feet per minute, and the air pressure at which it must work. Fig. 2 is the performance curve of a *Fasco* model 50749 blower. It is plotted as air volume in c.f.m. against air pressure in inches water column. Working into a static pressure of .625 inches, it will deliver a guaranteed volume of 90 c.f.m. This is the operating point for the blower used in the *Gates* 1 kw. FM transmitter shown in Fig. 4. If this blower is used in some other application where the pressure is only .3 inches, it will deliver 125 c.f.m.; or should it be allowed to exhaust in free space, the air

(*Continued on page* 27)

Fig. 5. Cooling system of 5 kw. transmitter using external anode tubes.

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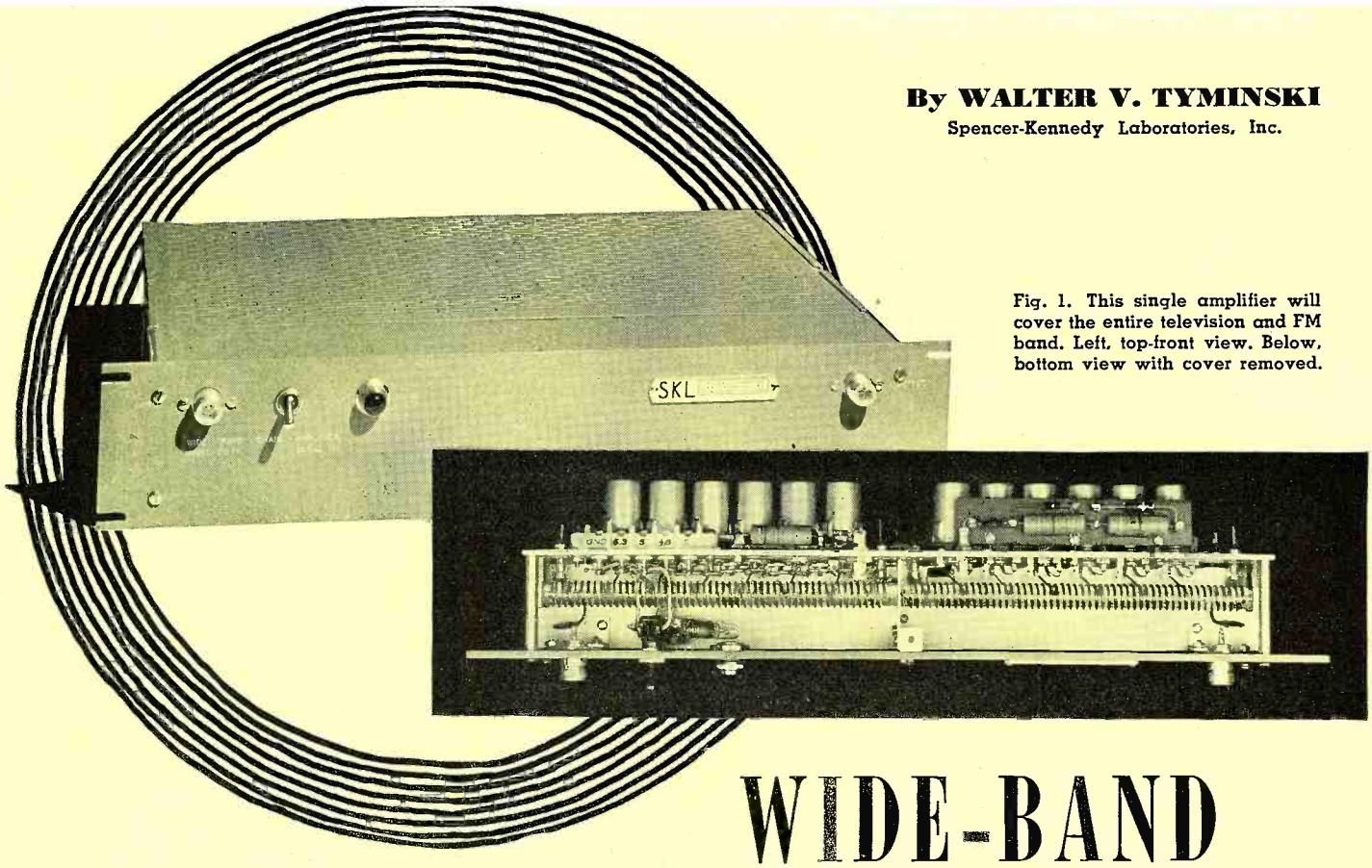


Fig. 1. This single amplifier will cover the entire television and FM band. Left, top-front view. Below, bottom view with cover removed.

WIDE-BAND CHAIN AMPLIFIER FOR TV

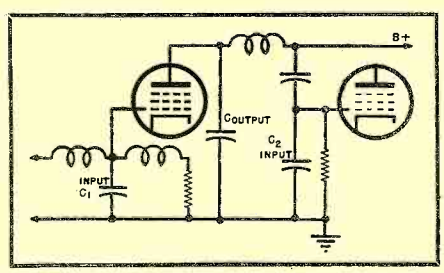
The chain amplifier principle can be applied in producing an amplifier with a bandwidth of 200 mc.

In many applications it is necessary to amplify a television signal before the picture quality is acceptable. Using conventional amplifier design a booster amplifier can be built to cover the bandwidth of an individual channel and a switching arrangement can be provided to cover the television spectrum. This solution is considered satisfactory by most individual users even though there is an additional control to manipulate. But many other uses require that the booster be placed at a remote position, such as directly at the antenna, and this necessitates the use of a non-tunable system. Individual channel amplifiers can be used with a means of combining the outputs into a common transmission line, but in some metropolitan areas where as many as seven television amplifiers and an additional one for FM would be needed, this method becomes complex and expensive. Another solution is the use of one amplifier to cover the entire television and FM band, and such an amplifier will be described in this paper. (See Fig. 1).

Experience with conventional amplifiers has shown that increased bandwidth is obtained at the expense of decreased gain. One of the coupling systems designed to increase bandwidth is the low-pass filter illustrated in Fig. 2 in which the output and input capacities are used as elements. For a given tube, the gain can be increased by raising the value of the line impedance, but this results in a smaller bandwidth. Conversely, decreasing the plate load reduces the gain, but increases the bandwidth. There is a theoretical gain-bandwidth product which cannot be exceeded no matter how complex a coupling system is devised for cascading stages.

The solution is to increase the transconductance without increasing the tube capacities. In conventional tubes this is difficult because once the cathode emission has been made as large as practical, further increases in transconductance are usually obtained by placing the grid closer to the cathode. But this smaller physical separation results in a higher value of input capacitance. Placing tubes in parallel does not help because while the transconductance is doubled the input and output capacities are also doubled. One solution is the use of a new type of tube construction such as a secondary emission type tube, but these tubes are still relatively expensive and a method of using conventional tubes is to be preferred. Percival, in his British patent, suggested that more than one tube be used per stage with the tube capacities arranged in filter sections as shown in Fig. 3. This effectively adds the transconductance without increasing the tube capacities.

Fig. 2. Filter type coupling using tube input and output capacities.



An analogy can be drawn between the filter containing the input capacities and a regular transmission line. When a wave enters the input terminals (AA of Fig. 3) it travels down the line and excites each grid in turn. Since the line is terminated in its characteristic impedance the entire wave is absorbed in the termination and there is no reflection. The individual tube then am-

plifies its grid voltage and a plate current of G_mE_g is available at the plates, where E_g is the grid voltage. While it is convenient to consider the grid line from a voltage standpoint, a current analysis is preferable for the plate line. Each of the tubes can be considered a constant current generator which feeds a current to the junction of the output capacity and the two inductances. (Fig. 6). A portion of the current flows through the capacity to ground, but the remainder splits, half going toward each termination. If the plate and grid filters are designed to have the same cut-off frequency the phase shift per section will be the same in both lines. The portions of the currents moving toward the load will add in phase because the signal has traversed the same number of filter sections regardless of the path considered. Thus, the total current in the load is n times the contribution of each tube, where n is the number of tubes used. The currents moving toward the reverse termination (CC in Fig. 3) are not in phase because of the different number of sections encountered in the parallel paths, and no useful output is available at this point. But, to avoid reflections the output must be matched at both ends and thus the reverse termination cannot be omitted.

The gain per tube is $G_mZ_p/2$ and the gain per stage is $nG_mZ_p/2$ where n is the number of tubes in the stage. In this type of amplifier there is an additive effect and thus an individual tube can have a gain of less than unity while the combination of tubes have any desired gain. This feature makes the chain type of amplifier especially attractive. From the standpoint of economy the tubes should be arranged such that a "stage" or "chain" has a gain of $e(2.72)$. For additional gain the stages should then be cascaded. The essential difference between chain amplifiers and the conventional amplifier is that in the former more than one tube is used per stage while in the latter, individual tubes are cascaded. Stagger-tuned amplifiers are not in reality distributed amplifiers in the sense that a number of different responses are multiplied, while in the chain amplifier each tube amplifies the entire bandwidth in the same manner and the individual responses are added in the load.

Design Parameters

There are a number of filter section arrangements that can be used but the low-pass constant k type filter was chosen because of the simplicity of construction and the rising gain that is obtained with increasing frequency. In television applications the transmission lines and associated system usually have a rising loss characteristic with frequency and the amplifier compensates in part for this loss to make the over-all response flatter. The theoretical gain of this arrangement is:

$$\frac{nG_mR_p}{2\sqrt{1-x^2}} \quad \ldots\ldots\ldots \quad (1)$$

where n = no. of tubes
G_m = tube transconductance
$R_p = \sqrt{L_p/C_p}$
L_p = inductance element of plate line filter
C_p = capacitance element of plate line filter
$x = f/f_c$
f = actual frequency
f_c = cut-off freq. of filter

This function is plotted in Fig. 4. But in practice, it will be found that the gain will not rise as much as shown. The resistive component of the input impedance of a tube decreases with frequency and the loading produced on the line decreases the over-all gain. Other effects that reduce the gain in practice are such things as skin effect, transit time, and lead inductance.

The design equations for a low-pass constant k filter are shown in Fig. 7. A study of these equations shows that the greatest bandwidth and gain can be obtained by making the capacitance as small as possible. In the grid line the lowest value of capacitance possible is the combination of the input capacity together with the associated strays. It can be used directly as a filter element. A choice of the cut-off frequency determines the value of the inductance and thus the characteristic resistance of the line. Previously it was mentioned that plate and grid lines must have the same cut-off frequency but not necessarily the same characteristic impedance. But when amplifier stages are cascaded it is more convenient to have the same value of impedance for each line. The plate line should then have the same value of inductance and capacitance as the grid line. Since the output capacity of pentodes is lower than the input capacity a padding capacitor must be added in the plate line whose value is the difference between the tube input and output capacity.

Filter theory requires that the load be matched to the line so that there are no reflected signals from the terminations. The necessary value of impedance is determined from an analysis of a single section terminated in Z_c, with the input impedance also being equal to Z_c. For the filter section used in this amplifier the value of impedance is $Z_c = R_c\sqrt{1-x^2}$. This impedance is purely resistive in the pass band, starting out at $Z_c = R$ for zero frequency and decreasing to zero at cut-off. In the stop band the impedance is a pure inductive reactance which increases with

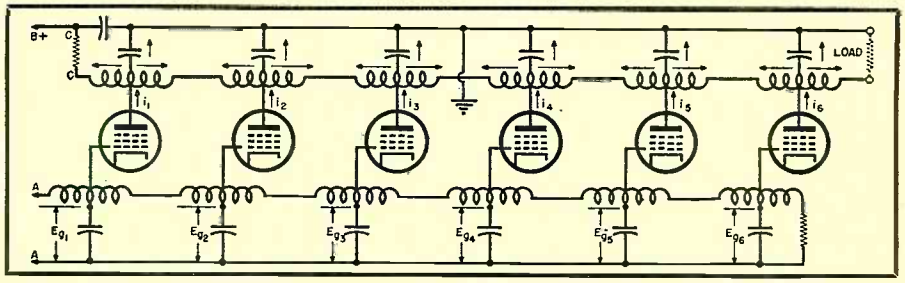


Fig. 3. Schematic diagram of a typical wide band chain amplifier stage.

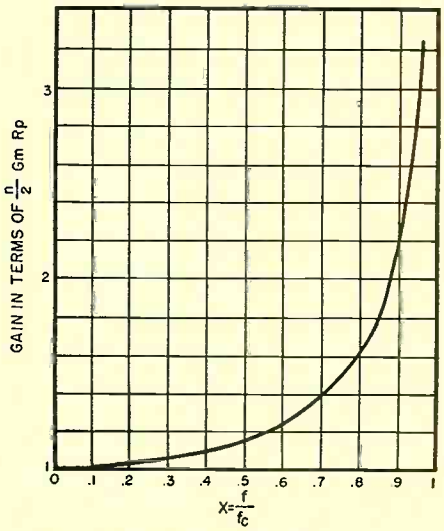
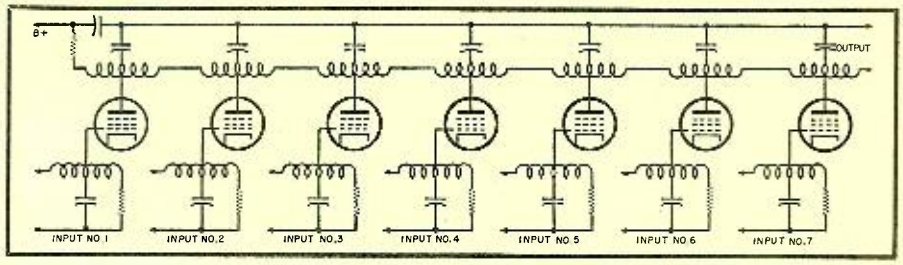


Fig. 4. Plot of theoretical gain frequency response of chain amplifier using constant K low pass filter sections.

Fig. 5. Combining several inputs into common output for use as an antenna coupler.



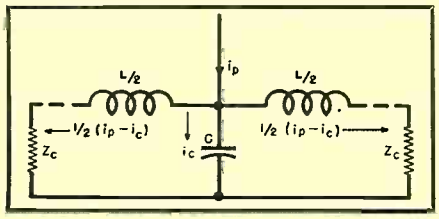


Fig. 6. Method of plate current division.

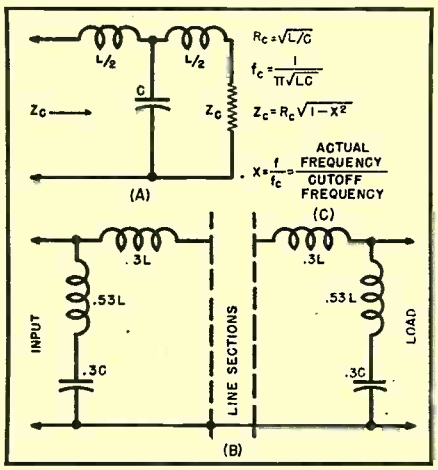


Fig. 7. (A) Typical series section filter. (B) M derived terminating sections to match constant resistance generator and load to the filter. (C) Design equations for the end and intermediate sections.

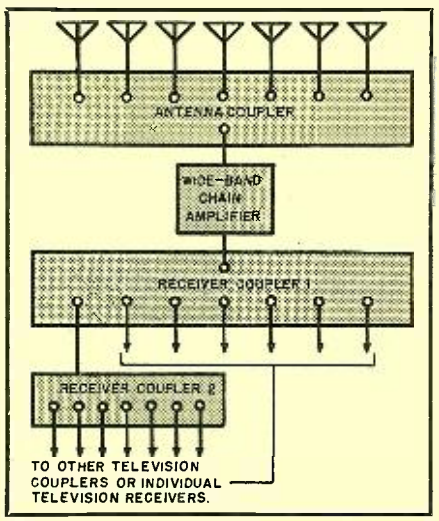


Fig. 8. Multiple television installation with as many receiver couplers and multipliers as necessary in the particular installation.

frequency. Since the impedance is not constant with frequency a constant resistance is not a good match, and if used, will result in reflected signals the magnitude of which will rise with frequency. This reflection in the grid line would cause a portion of the current propagated towards the load to be reflected. The effect of mismatches is to cause a standing wave in the gain frequency response of the amplifier. Thus the line termination must be made to look like a falling resistance with frequency. This can be done by using conventional half section filters as shown in Fig. 7 together with the design equations. The input, which is usually applied to a generator of constant impedance with frequency, is matched to the line in the same way.

An amplifier using the principles described was constructed and is shown in Fig. 1. The cut-off frequency is 250 mc., and a line impedance of 180 ohms was used so as to obtain a nominal voltage gain of 9 db. for a stage using six tubes. In the model shown, two stages were cascaded so as to provide a total gain of 18 db. Since 180 ohms is not a common television impedance, transformers were provided to bring the input and output of the amplifier to an impedance level of 72 ohms. Since the input transformer is used in the step-up position while the output transformer is used in the step-down position, with both transformers having the same turns ratio, the over-all gain of the transformers is unity. Almost any impedance can be obtained by the use of transformers and this is particularly simple in the case of unbalanced impedances because a simple autotransformer winding will suffice.

Uses

The wide-band chain amplifier has several advantages over conventional amplifiers, some of which are:

(1) One chain amplifier can amplify the twelve television channels, both old and new FM bands, the short wave frequencies, and even the broadcast band if desired. Using conventional amplifiers a large number of individual amplifiers would be needed to accomplish the same purpose.

(2) Tube failure in a chain amplifier is not fatal to the system, but merely results in a slightly reduced gain without appreciably affecting the form of the gain frequency response. In a conventional amplifier, tube failure means complete loss of the signal.

(3) The chain is extremely stable and will not drift appreciably even under wide temperature conditions.

(4) When individual channel amplifiers are used, amplification of a television signal through any of the other channel amplifiers will produce multiple images such as ghosts, because of the different time delays of the ampliers. This cannot happen in a chain amplifier.

(5) Unlike the chain amplifier, the use of several channel amplifiers increases the possibility of cross-modulation. Weak signals of other stations may produce an objectionable amount of cross-modulation in the output of the individual amplifier and the picture quality is impaired.

An amplifier of the wide-band type finds extensive applications in radar, oscillography, nuclear physics, television testing and distribution systems, and general laboratory measurements. Pulses, transients and low-level antenna signals can be amplified to useful levels by cascading several stages. The sensitivity of vacuum tube voltmeters and oscilloscopes can be made greater by the amount of gain provided in the amplifier. The output voltage of wide-band oscillators, signal, sweep and pulse generators can be increased with a convenience and stability no tuned amplifier can provide.

In many television installations it is found that a simple antenna system consisting of a separate low and high band antenna connected by a divider network is satisfactory. In these applications the amplifier can be inserted in the single transmission line. Other installations require a more elaborate antenna system and in the ideal case an individual channel antenna would be provided. This antenna could be cut for the desired frequency and then oriented for best signal reception. When more than one antenna is used the outputs must be combined before being applied to the amplifier. The other alternative is to run an individual line from each antenna and then switch the receiver input to the desired antenna. If amplification is desired the amplifier can be placed between the switch and the receiver. But this system requires a large amount of cable plus the nuisance of another control. Thus, the more convenient arrangement would be to combine the antenna outputs and run only one transmission line to the receiver.

There are a number of methods of

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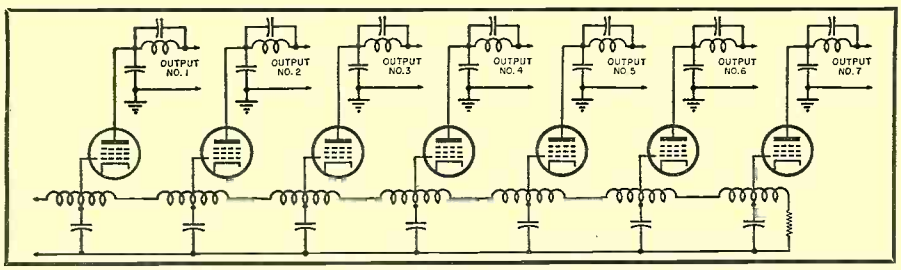
Fig. 9. Plate line altered to provide a number of outputs from a single input.



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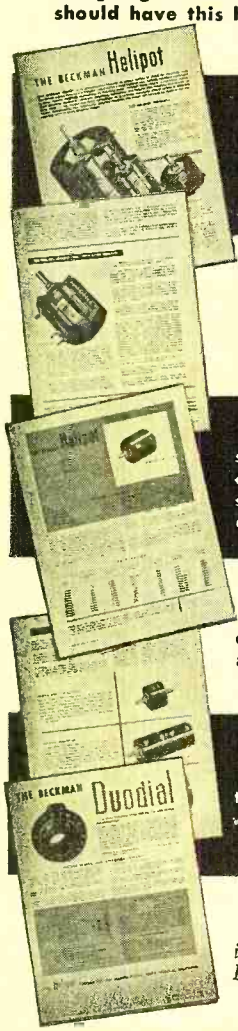

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Microwave Comp.

(*Continued from page 9*)

$$P_{max} = 4.05 \times 10^5 \, d^2 \log_{10} D/d \quad . \quad . \quad (17)$$

In practice, it is necessary to limit maximum power to considerably less than maximum limit due to higher gradients at stub supports and terminating joints.

In many practical applications, the input to the line will have a capacitive reactance, as shown in Fig. 8, in which case the line must be foreshortened to cancel out this reactance. This is done by making the reactance of the line equal and opposite to that of the capacity, or:

$$\tan \beta l = -\frac{1}{Z_0 \omega_0 C} \text{(shorted)} \quad . \quad . \quad (18)$$

$$\tan \beta l = Z_0 \omega_0 C \text{ (open)} \quad . \quad . \quad . \quad . \quad (19)$$

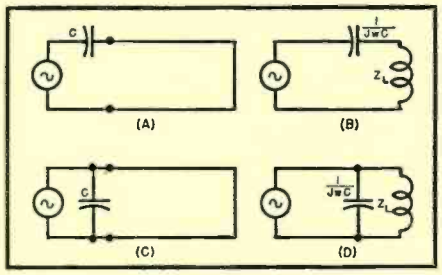


Fig. 8. Resonant lines (A) and (C) with capacitive inputs. Equivalent circuits are shown in (B) and (D).

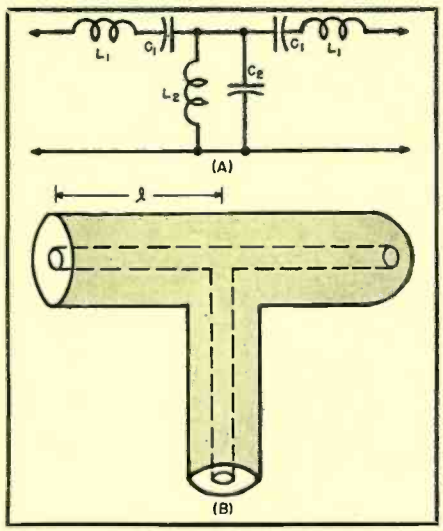


Fig. 9. (A) Coaxial line equivalent of simple "T" filter (B).

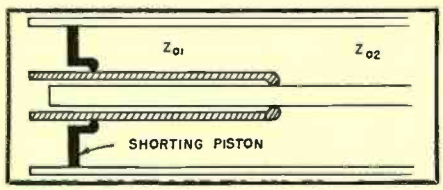


Fig. 10. Dual impedance line.

Filter Networks Using Transmission-Line Elements

Resonant lines are used in a microwave system as narrow band filters. Many of the expressions that have been derived for tuned circuits at ordinary radio frequencies can be applied with equal accuracy to resonant lines at microwave frequencies. In fact, the general procedure in the design of any type of filter usually begins with determining the filter parameters on the basis of lumped constant elements in the conventional manner, and then calculating the coaxial line elements that will duplicate the filter configuration desired.

The simplest filter is, of course, the resonant line. The loss in such a line is given by the following expression:

$$\text{Db. loss} = 10 \log_{10} \frac{Q_u}{Q_u - Q_L} \quad . \quad . \quad (20)$$

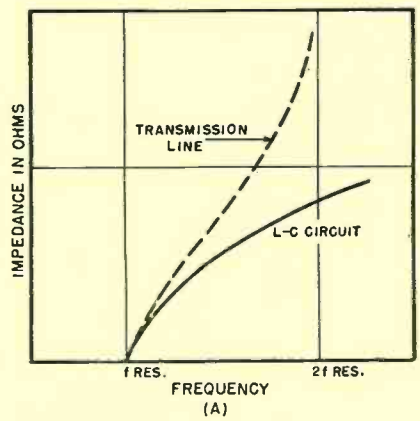
where Q_u is the unloaded Q of the line and Q_L is the loaded Q.

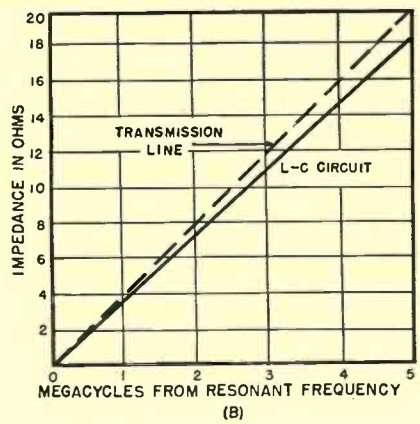
Another simple filter is the band pass "T" filter shown in Fig. 9A. An equivalent coaxial line circuit is shown in Fig. 9B. The length, l, of the series arm is chosen so that the circuit will resonate at the frequency $f_0 = 1/2\pi\sqrt{L_1 C_1}$. The parameters of the line are chosen so that its equivalent inductance and capacitance at f_0 is equal to L_1 and C_1 respectively. The shunt arm is similarly designed to resonate at $f_0 = 1/2\pi\sqrt{L_2 C_2}$, and have equivalent inductance and capacitance to L_2 and C_2 at this frequency.

It should be noted that the off-resonance impedance of Fig. 9A is not exactly equal to that of Fig. 9B. The reason for this is that the impedance variation of a coaxial line is a tangential function, while that of a lumped constant element is linear. This difference, shown in Fig. 11A for an LC circuit, may or may not be important depending upon the individual application.

There are a number of methods that can be used to minimize this effect. Again the one used will be primarily a function of the results desired. For example, it is possible to minimize the impedance variation near the resonant frequency by using a dual impedance line such as the one shown in Fig. 10. The impedance variation of this line compared to that of a lumped constant circuit is shown in Fig. 11B.

Fig. 11. Impedance vs. frequency for (A) single impedance resonant line and L-C circuit and (B) dual impedance line and L-C circuit.





Wave Guide Elements—Inductive and Capacitive Windows

If a wave guide contains a non-uniform discontinuity such as the step discontinuity of Fig. 12, a certain portion of the energy will be reflected and cause standing waves. Such a discontinuity corresponds to a reactance. Normally the discontinuities are made symmetrical to the parallel walls and are called windows. For a TE_{10} mode, a window parallel to the "b" side of the guide[2] represents an inductance; a window parallel to the "a" side a capacity, as shown in Fig. 13.

A window is used in much the same manner as a stub in coaxial lines. In the article on "Microwave Transmission Lines", the method of matching a wave guide to any load was discussed, and as indicated in this article, normalized susceptance is the most convenient parameter to employ. The theoretical normalized susceptance of an inductive window is:

$$B = -\frac{\lambda_g}{a} \cot^2 \frac{\pi r}{2a} \quad . \quad . \quad . \quad . \quad . \quad (21)$$

λ_g is the guide wavelength, and r the opening of the window. The actual susceptance obtained from a window is somewhat greater than the theoretical value. This is because of the finite thickness of the window which is not included in the simple theory and effectively increases the susceptance of the window.

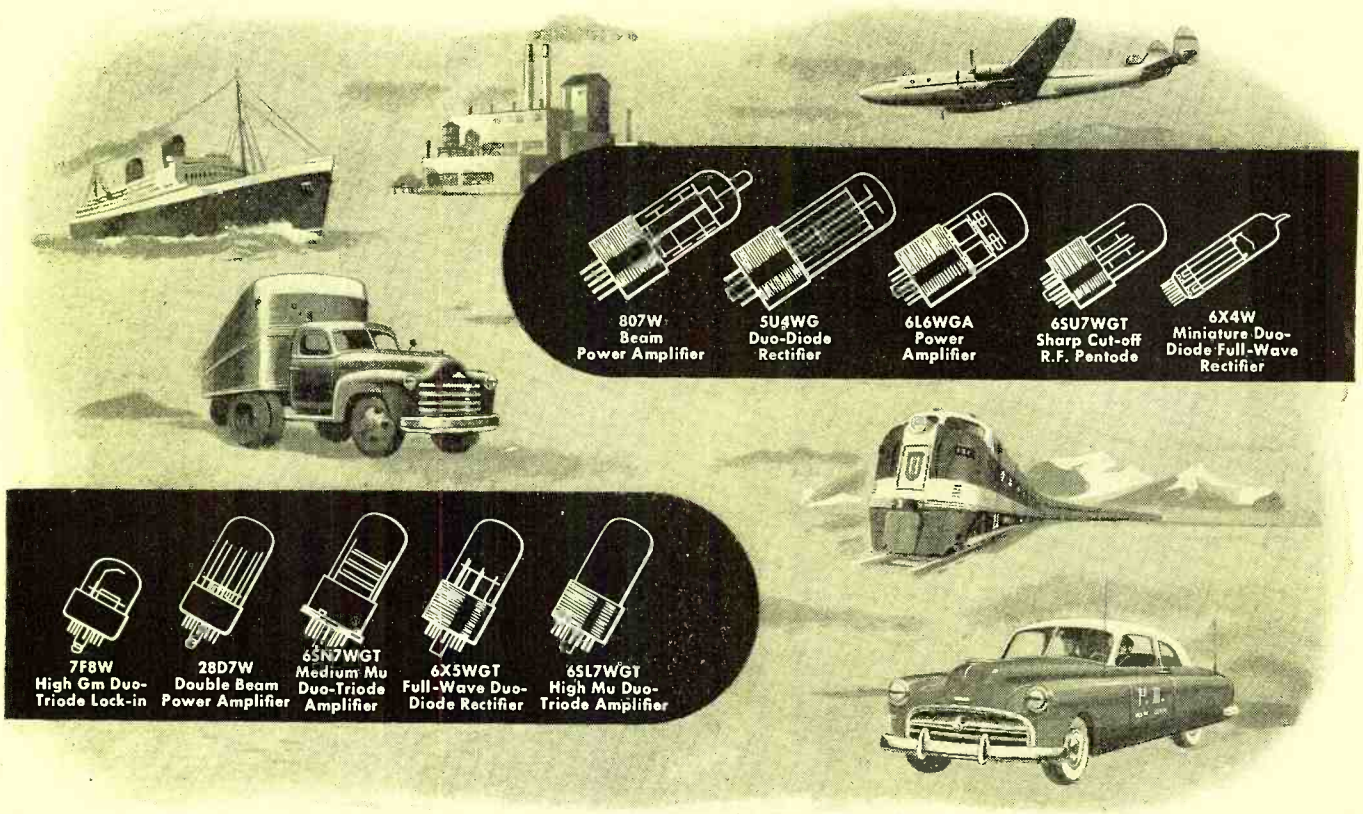
The normalized susceptance of a capacitive window, assuming a window of zero thickness, is:

$$B_0 = \frac{1.7\, b}{\lambda_g} \log_{10} \operatorname{cosec} \frac{\pi r}{2b} \quad . \quad . \quad (22)$$

The thickness of the window has an appreciable effect in this case. An ex-

10 T mes More Rugged-

New Sylvania shock-tested tubes withstand shocks greater than 400 G's



Ideal for industrial radio applications... for aircraft... buses... trains... police cars... or wherever shock and vibration are problems

Troublesome problems of tube failure resulting from shock or heavy vibration are now being solved . . . for keeps . . . by these new Sylvania "Ruggedized" or "W" tubes.

Originally designed to government specifications to withstand shock and vibration caused by artillery action, these tubes keep operating under vibration up to 2-½ G's . . . withstand shocks more than 400 times the force of gravity.

A dozen new design techniques have gone into the perfection of these tubes. More than that, they are *precision*-built from precision parts. Exhaustive lab and field tests have definitely proved them as much as 10 times more rugged than ordinary tubes. Electrical characteristics are similar to those of standard types.

Note too, their reduced overall length and their straight glass bulbs . . . features which make possible smaller and more compact equipment design.

Maximum ratings and other characteristics of these new "Ruggedized" types are available from Sylvania Electric Products Inc., Dept. R2304, Emporium, Pa.

CHECK THESE 10 "RUGGEDIZED" FEATURES for longer life and better performance

1. Double thickness micas
2. Heavier side-rod supports
3. Shorter leads
4. Straight glass bulb
5. Flat, circular header
6. Fewer internal connectors
7. Shorter elements
8. Reduced overall height
9. Additional mount supports
10. Low-loss phenolic base

SYLVANIA ELECTRIC

RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS

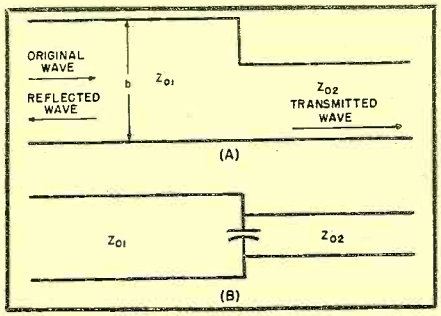


Fig. 12. (A) Wave guide with step discontinuity. (B) Equivalent circuit.

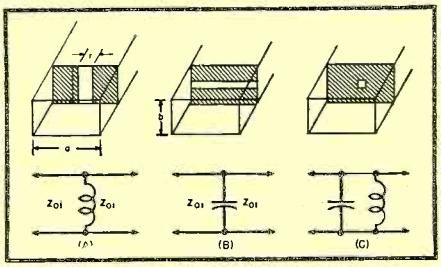


Fig. 13. Three types of wave guide windows and their equivalent circuits.

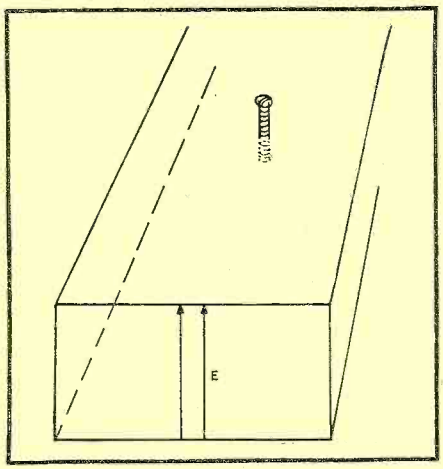


Fig. 14. Tuning screw in wave guide.

pression which provides results that are much closer to actual values is the following:

$$B = B_0 + \frac{2\pi w}{\lambda_g}\left(\frac{b}{r} - \frac{r}{b}\right) \quad . \quad . \quad (23)$$

where w is the window thickness, and B_0 the normalized susceptance for $w=0$.

The capacitive window is limited in application to low power systems because it greatly enhances the possibilities of breakdown.

Tuning Screws

A tuning screw is a cylindrical probe extending into the wave guide parallel to the electric field as shown in Fig. 14. The screw acts essentially as a shunting reactance in the guide. The magnitude of susceptance varies with depth into the guide. Short lengths of probe are equivalent to shunting capacities, the susceptance increasing with depth until a length of approximately a quarter-wave is reached in which case the resonance occurs and substantially all of the incident wave is reflected. For still greater lengths the screw becomes inductive. In most applications it is used in the capacitive region. The sharpness of resonance is a function of the diameter of the screw and higher Q's are found with smaller diameters. Typical measured susceptance of this screw as a function of r is shown in Fig. 16.

Three tuning screws separated from each other by one-quarter of a wavelength is a commonly used combination for broad tuning. To match a load to a line, the center screw and only one of the outer screws are varied.

Quarter-Wave Transformer

A quarter-wave transformer in a wave guide can be achieved by reducing the dimensions of the wave guide by a quarter-wave section whose dimensions are calculated from the following expression:

$$\frac{Z_{0T}}{Z_0} = \frac{b_T\, a\, \lambda_{gT}}{b\, a_T\, \lambda_g} \quad . \quad . \quad . \quad . \quad . \quad (24)$$

In addition to the change in characteristic impedance, a shunt susceptance is introduced at each junction, which may be calculated from Eqts. (23) and (22). These susceptances must then be tuned out by methods indicated previously.

A more practical method of achieving a quarter-wave transformer is through use of the asymmetrical capacitive transformer shown in Fig. 17. The input admittance seen at the generator side when the load end is matched is given by:

$$\frac{Y}{Y_0} \approx \left(\frac{b}{b_T}\right)^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad (25)$$

This type of transformer has the advantage that it can be slipped into the guide, just as a sleeve, and adjusted for minimum standing-wave ratio by drilling a small hole in the center of the guide and positioning transformer with a dielectric rod.

Wave Guide Cavity Resonators

As in the case of the resonant coaxial line, it is possible to design a wave guide so that it will act as a tuned circuit, or resonate, at the desired frequency. Such a wave guide, which usually takes the form of an enclosed box, shown in Fig. 15A, is called a cavity. (Resonant coaxial lines are also sometimes referred to as cavities but usually a "cavity" implies an enclosed wave guide.)

Much of the material given for coaxial line resonators holds true for the guide cavity with the exception that all three dimensions of the guide must be properly designed to propagate the mode desired with maximum efficiency. The a and b dimensions are governed to a large degree by the same factors, i.e., cut-off frequency and attenuation for mode desired, that were described in the last article for transmission of energy. The z dimension determines the frequency of resonance. The expression for the resonant wavelength of a rectangular cavity is given by:

$$\lambda = \frac{2}{\sqrt{\left(\frac{l}{z}\right)^2 + \left(\frac{m}{a}\right)^2 + \left(\frac{n}{b}\right)^2}} \quad (26)$$

where l is the number of half wavelengths down the guide in "z" direction. For a $TE_{1,0,1}$ (last subscript representing half wavelengths in the z direction) $l = m = 1$, and $z = a$,

$$\lambda = \sqrt{2\,a} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (27)$$

The Q of a wave guide must be worked out individually for each type of mode used, starting with the definition given by Eqt. (12). In general, the Q will be proportional to:

$$Q \approx \frac{1}{\delta}\frac{V_{0L}}{S} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (28)$$

where V_{0L} is volume of guide and S is its surface, and δ is the r.f. resistance of guide conductor.

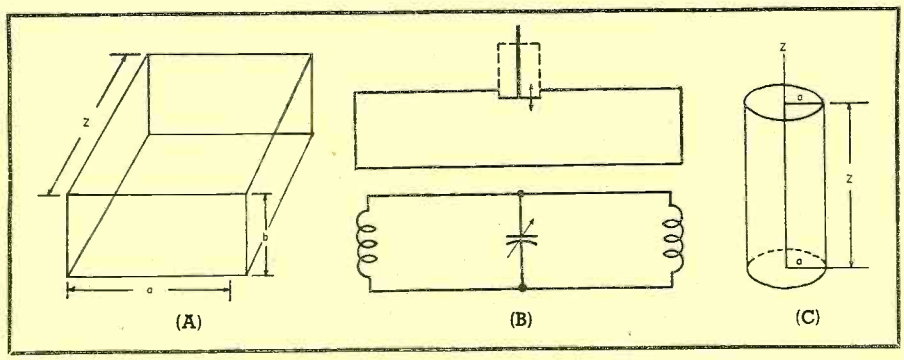
The Q of the cavity defined by equation (27) is:

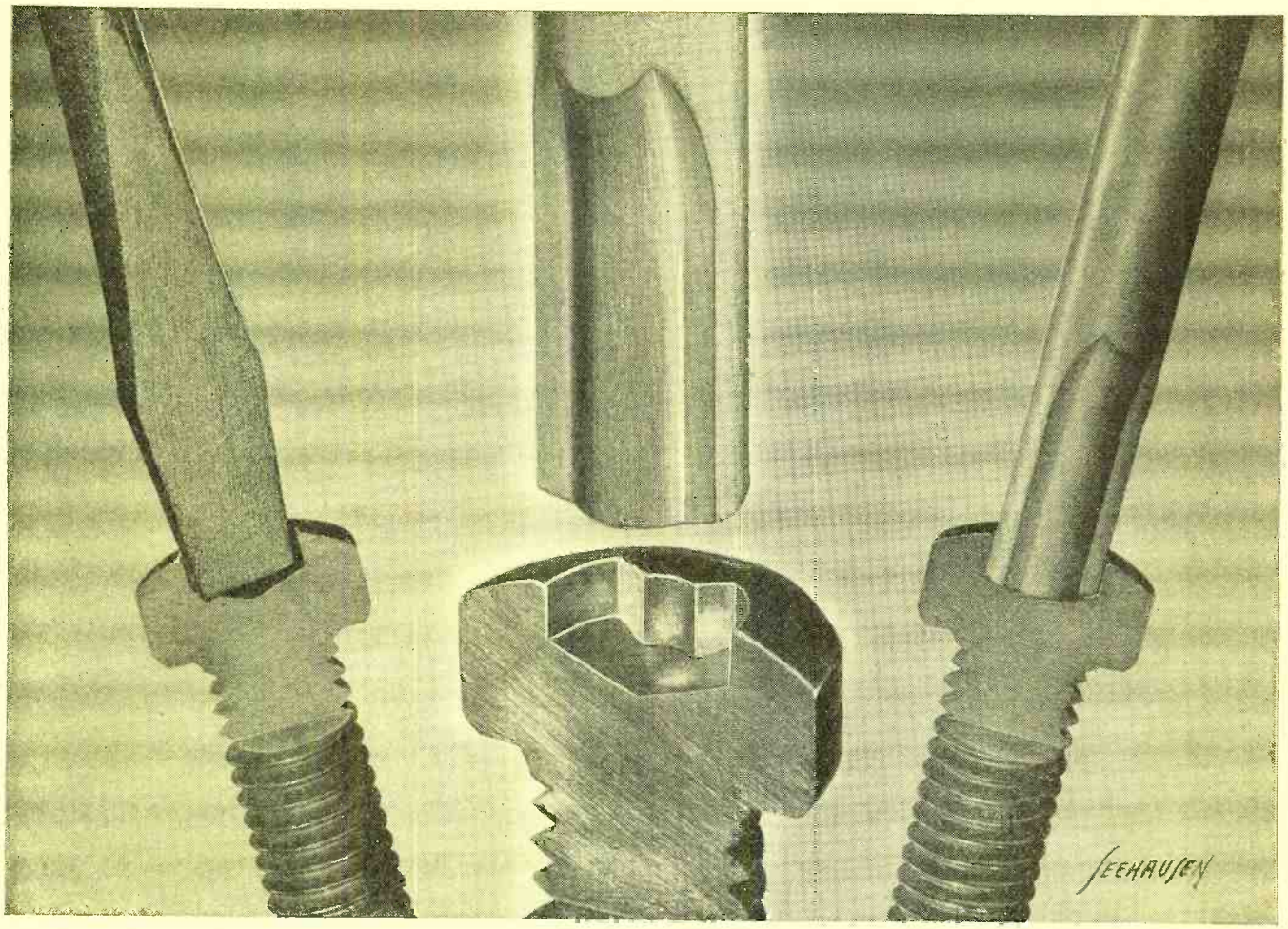
$$Q = .353\,\frac{\lambda}{\delta}\,\frac{1}{1 + \frac{a}{2\,b}} \quad . \quad . \quad . \quad (29$$

The shunt impedance of this cavity at resonance is given by:

(*Continued on page* 30)

Fig. 15. (A) Rectangular wave guide cavity. (B) Reentrant cavity and equivalent circuit. (C) Cylindrical wave guide cavity.





Here's How CLUTCH HEAD Brings New Safety, New Speed in Line Assembly

Q. What is the main cause of driver skidding? **A.** *"Ride-out" as set up by tapered driving.*

Q. How does CLUTCH HEAD overcome this "ride-out"? **A.** *By elimination of the tapered recess.*

Q. How does the CLUTCH HEAD engagement differ? **A.** *With straight sides of driver matching straight recess walls.*

Q. What safety benefit results from this engagement? **A.** *No slippage, so no damage to operators or work.*

Q. Does this eliminate need for end pressure? **A.** *Yes. No "ride-out" to combat; no end pressure; no skids.*

Q. Do CLUTCH HEAD users support this skid-free claim? **A.** *Many. Norge says "Cabinet damage eliminated."*

Q. What of this feature as a fatigue factor? **A.** *Effortless driving means more screws driven per day.*

Q. How does the Center Pivot Column add to safer driving? **A.** *It prevents canting by guiding bit into dead-center entry.*

Q. Why is CLUTCH HEAD "America's Most Modern Screw"? **A.** *Because it has features unmatched by any other screw.*

Q. What are these features?

A. *They include a recess engagement to match the ruggedness of the Type "A" Bit construction for driving up to 214,000 screws . . . non-stop; simple 60-second bit reconditioning; the Lock-On for easy one-handed driving, and basic design for common screwdriver operation.*

CLUTCH HEAD SCREWS

Q. And how may we check them?

A. *You may check all of these features by sending for package assortment of screws, sample Type "A" Bit, and illustrated Brochure. These will come to you by mail and will give you an understanding why CLUTCH HEAD users report 15% to 50% increases in assembly production.*

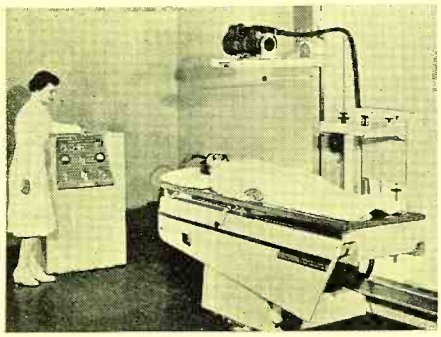
UNITED SCREW AND BOLT CORPORATION

CLEVELAND 2 CHICAGO 8 NEW YORK 7

NEWS BRIEFS

ELECTRONIC DEVELOPMENT

In a recent article on "Electrical and Allied Developments of 1949" published by *General Electric Company* was included the outstanding design of an x-



ray machine based on the building-block principle which will permit the physician's x-ray facilities to grow as his practice grows.

The complete unit shown actually consists of 15 subassemblies, which can be added to one another according to the scope of the physician's x-ray work and practice. The basic unit is composed of table top, table frame, legs, and Bucky diaphragm. When used with a mobile or portable type of x-ray tube-transformer assembly, it comprises the simplest unit for radiography. As his practice grows, the physician may add a special higher-powered tube and transformer, together with floor rail on which the tube can be moved alongside the table.

The same building-block system applies to fluoroscopy. The fluoroscopic carriage containing shutters and screen may be incorporated. Later a spot-film device for making radiographs of views as seen with the fluoroscope may be added.

LAUD ENGINEERING SCIENTISTS

In a recent address to the Machine Design Division of The American Society of Mechanical Engineers, Joseph B. Armitage, a director-at-large of the society and vice president of *Kearney & Trecker Corp.*, Milwaukee, Wisc., pointed out the tremendous advance in electronics during the war and its application to peacetime uses.

According to Mr. Armitage, although the great majority of our research men and scientists are still at work devising instruments of war, the relatively small portion of technical men available to apply the results of the engineering progress of the last ten years to peacetime uses have done a marvelous job.

EFFECT OF SHOCK ON ELECTRON TUBES

Members of the American Institute of Electrical Engineers learned at their recent Winter General Meeting of exhaustive scientific studies of electrical noise produced in electron tubes as a result of shock and vibration.

Lester Feinstein of the Product Development Laboratories, *Sylvania Electric Products Inc.*, Kew Gardens, New York, who revealed the study, said that structural causes of microphonism in electron tubes stem principally from rattle of elements, motion of the mount

as a unit and resonance of tube elements. Laboratory studies which he revealed were carried on for the development of new types of subminiature tubes.

Experimental procedures used in which methods and equipments have been developed to impart controlled motion to tubes and for measurement of electrical response were outlined. Included in methods which Mr. Feinstein reported were electromagnetic vibration tests run at either constant velocity or constant acceleration throughout a range between 25 and 10,000 cycles.

RADIO DISTURBANCE WARNINGS

The radio disturbance warning notices broadcast regularly from radio station WWV of the National Bureau of Standards are based on comprehensive observations of radio, ionospheric, solar, and geomagnetic phenomena at stations throughout the world.

Warnings are given in code following the time announcements at 19 and 49

minutes past each hour. A series of N's signifies that radio propagation conditions are normal, a series of U's that they are unstable, and a series of W's that they are disturbed or are expected to become so within 12 hours.

The direction of arrival of radio waves from transatlantic stations is measured with the instrument shown.

SYLVANIA ABSORBS COLONIAL

Sylvania Electric Products Inc., has absorbed its wholly-owned subsidiary, *Colonial Radio Corporation*, manufacturers of radio and television sets. The operations will be continued in Buffalo, New York, as the Colonial Radio and Television Division.

E. E. Lewis, formerly president of *Colonial*, has been elected vice-president of *Sylvania* in charge of the Colonial Radio and Television Division, and the personnel and policies will continue unchanged.

X-RAY MICROSCOPE

A microscope which makes it possible to examine directly minute details of internal structure in materials through

which light cannot pass has been announced by *General Electric's* Research Laboratory.

Miss Charlys M. Lucht, who developed the x-ray microscope in collaboration with other *GE* scientists, is shown

(*Continued on page* 30)

EL-MENCO CAPACITORS

Hold!

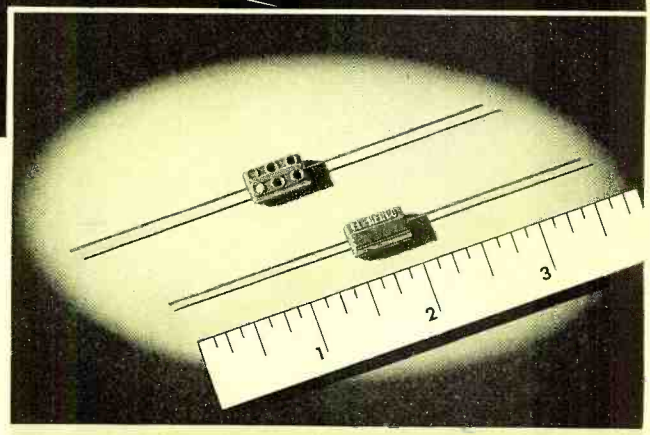
UNDER STRAIN

In capacitors performance depends on dielectric strength to withstand strain. Before *El-Menco* capacitors leave the factory they must pass severe tests for dielectric strength — at *double the working voltage*, insulation resistance and for capacity value. El-Menco fixed mica condensers meet and beat strict Army-Navy standards. That's why you can rely on El-Menco performance in *your* product.

SO ALWAYS

Specify Pretested Capacitors by El-Menco . . .

THEY HOLD UNDER STRAIN



CM 15 MINIATURE CAPACITOR

Actual Size 9/32" x 1/2" x 3/16". For Radio, Television and Other Electronic Applications.

2 to 420 mmf. capacity at 500v DCw.

2 to 525 mmf. capacity at 300v DCw.

Temp. Co-efficient ±50 parts per million per degree C for most capacity values.

6-dot color coded

THE
ELECTRO MOTIVE MFG. CO., Inc.
WILLIMANTIC **CONNECTICUT**

Write on your firm letterhead for Catalog and Samples

El-Menco

MOLDED MICA **MICA TRIMMER**

CAPACITORS

FOREIGN RADIO AND ELECTRONIC MANUFACTURERS COMMUNICATE DIRECT WITH OUR EXPORT DEPT. AT WILLIMANTIC, CONN. FOR INFORMATION.

ARCO ELECTRONICS, INC. 135 Liberty St., New York, N. Y.—Sole Agent for Jobbers and Distributors in U.S. and Canada

NEW PRODUCTS

AIR METER

Hastings Instrument Company of Hampton, Virginia has announced that its Model G Air-Meter is the first electrical anemometer to be free of the effects of rate of change of temperature.

This instrument provides instantaneous, direct, accurate readings of air velocities from 5 to 6000 feet per minute with an expanded scale in the low velocity ranges, and is now available with built-in temperature compensation to prevent momentary error in velocity reading when the probe is subjected to sudden changes of temperature.

A group of practical accessories is available, including a carrying case with battery operated power pack for use when 110 volt a.c. power supply is not available. For those now using *Hastings* Air-Meters, special probes which compensate for rate of change of temperature are available.

ELECTRONIC RELAY

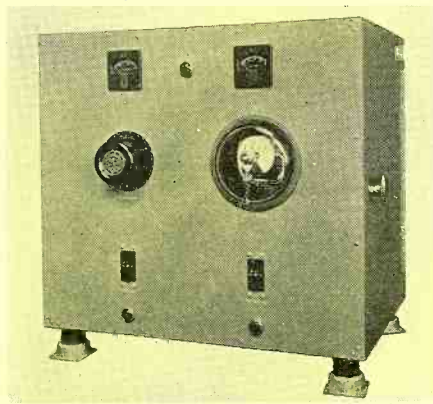
Servo-Tek Products Co., 4 Godwin Ave., Peterson 1, N. J., has developed an electronic relay system to provide super sensitivity in industrial control applications. This miniature unit, which mounts on a standard 4" electrical connection box, incorporates simplicity of design and a minimum number of components.

The unit operates from the 115 volt 50-60 cycle line and uses no filament to draw standby power with the relay circuit energized. The load relay contacts are arranged to permit a choice of either opening or closing a circuit, or simultaneously to open one circuit and close another.

Additional data is available on request and the manufacturer will assist in application problems.

TV POWER CONTROL

RCA Engineering Products Department, Camden, N. J., has added to their TV equipment line a power control unit for mobile television pickup equipment which provides power consumption readings and permits regulation of both input and output voltages from a central point in the mobile unit.



The control unit, consisting of transformers, circuit breakers, and other control apparatus for manually regulating both input and output voltages, is housed in a shock-mounted cabinet designed for mounting in the television truck.

Shown is the front view of the power control unit capable of operating from any two-wire system providing input voltages between 100 and 120 volts, or between 200 and 220 volts, 60 cycles at 5 kva.

AIR-COOLED TRANSFORMER

Larger-sized, air-cooled transformers, identified as *AmerTran* Type GS, are now being manufactured by the *American Transformer Company*, Newark, N. J. They are manufactured in standard ratings from 15 to 200 kva., single-phase, 60 cycles, and with either 240/480- or 600-volt, high-voltage windings. Low-voltage windings which are rated 120/240 volts are suitable for supplying lighting, motor and distribution loads.

According to the manufacturer, *AmerTran* Type GS provides adequate and

convenient accommodations for wiring connections in all types of installations without the need of specially fabricated fittings. In installing transformers for single-phase service, ample space for all required wiring is available in a large built-in wiring compartment located at the top of the transformer directly above a terminal board to which coil leads are connected.

MINIATURE POTENTIOMETERS

High precision miniature potentiometers are now being offered by *Technology Instrument Corporation*, 1058 Main Street, Waltham 54, Mass. Only 7/8" in diameter, and 3/8" in depth, these miniature potentiometers are available in resistance ranges of 100 to 25,000 ohms.

The accuracy of total resistance may be specified as close as ± 1%, and linearity to ± 0.8% of total resistance as required. These units may be ganged together with adjusting clamp ring to permit individual phasing.

Additional information may be obtained by writing direct to the company.

BETA GAMMA MONITOR

Model 2610A, beta-gamma portable count-rate meter, is being offered by the *Nuclear Instrument and Chemical Corp.*, 223 West Erie St., Chicago, Illinois. This model is housed in a water-tight

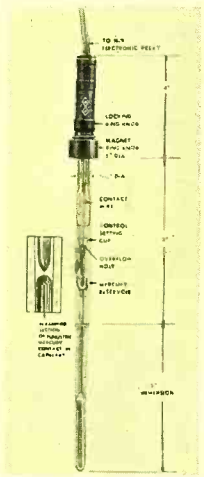
case and incorporates a proven electrical circuit which has been manufactured by the company for several years.

The interior is tropicalized to eliminate effects of humidity or other adverse atmospheric conditions. The probe is also water-tight and contains a plug-in type Geiger tube to facilitate servicing. Internal parts are arranged for ease in servicing and circuit components are mounted in the cover. The easy-to-read meter is calibrated in both milliroentgens per hour and in counts per minute.

The instrument is supplied complete with an attached radioactive source for checking calibration, batteries and crystal earphones.

THERMO-REGULATOR

The H-B Instrument Co., 2633 Trenton Ave., Philadelphia 25, Pa., has announced their Quick-Set Thermo-regulator on which the control setting can be varied over a wide range in a matter of seconds. Once set within 10° F. of the control temperature, adjustments of several degrees down to 0.01 and even smaller under favorable conditions, are made by merely turning a ring knob.



The compact, self-controlled Quick-Set Regulator fits into the medium to be controlled and, through an *H-B* Electronic Relay, can handle up to 30 amperes at 110 volts a.c. One model covers a range from approximately plus 30° to 600° F. or higher. Another model covers a range from minus 38° F. to about 50° F.

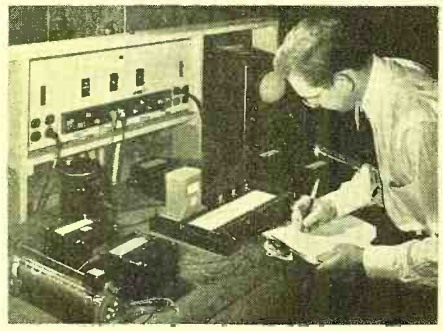
Full particulars may be obtained by writing to Dept. T-65.

DEMONSTRATION UNIT

A demonstration magnetic amplifier for educational purposes in schools and industry is being introduced by *Vickers Electric Division*, of *Vickers Incorporated*, 1815 Locust St., St. Louis 3, Missouri.

This unit is arranged so that all basic single-phase self-saturating circuits may be studied. By arrangement of the external connections either d.c. or a.c. output is available and either d.c. or a.c. control power may be used. Aside from the basic purpose to show the principle of the high-performance self-saturating magnetic amplifier, the new demonstration unit may be used in operating control circuits.

Reference material and bulletins included with each unit give the wiring diagrams of several control circuits, as well as a series of laboratory experiments arranged to help the student



determine magnetic amplifier static characteristics, internal impedance and optimum load, dynamic characteristics, and types of control circuits.

All colleges, universities, laboratories and other groups who are interested in the *Vickers* Demonstration Magnetic Amplifier are invited to write for complete details.

MAGNETIC CORE MATERIAL

Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa., has developed two magnetic core materials for transductor application. These materials, Hipersil and Hipernik V, have rectangular, very narrow hysterisis loops, and are especially suited for electronic applications such as magnetic amplifiers, saturable reactors, and the new type of contact rectifiers.

Available in several thicknesses of lamination for various frequency and response requirements, the materials can be supplied in continuous toroidal or rectangular and butt-joint cores.

For further information, write direct to *Westinghouse*.

FREQUENCY-DEVIATION MONITOR

Motorola Inc., 4545 Augusta Blvd., Chicago 51, Illinois, is now offering to operators of 2-way FM radio systems a highly sensitive frequency-deviation monitor to measure the relative strength

of signals being transmitted, the magnitude of frequency modulation, and the error displacement of the signal from its assigned center frequency.

Designed for 117 volt, 60 cycle oper-

(*Continued on page* 31)

Personals

GABRIEL V. BUREAU has been appointed field engineer for the equipment sales department of the Radio Tube Division, *Sylvania Electric Products Inc.*, New York, N. Y. Mr. Bureau was formerly technical commercial manager for the *North American Philips* Co., and assistant sales manager for the *Amperex Electronics Corp.* He received his B.S. in electrical engineering from the University of Southern California and is a member of the IRE and AIEE.

LAWRENCE L. FERGUSON, assistant executive engineer at *General Electric Company*, has been appointed to take charge of the West Milton Area Project at West Milton, N. Y., where an experimental atomic power plant is under construction as part of the *GE* laboratory facilities. Mr. Ferguson, who is a graduate of the California Institute of Technology, will be responsible for coordinating all phases of design and construction.

B. K. V. FRENCH has been appointed application engineer of the Electronic Parts Division of *Allen B. Du Mont Labs., Inc.*, with headquarters in the East Paterson plant. Mr. French began his active radio career in 1923 with *Federal Telegraph & Telephone* as development engineer and has been associated with *American Bosch, RCA, Case Electric*, and *P. R. Mallory Co.* He is a Senior Member of IRE and a member of The Radio Club of America.

RALPH E. GOULD, chief of the time section at the National Bureau of Standards, has retired after over thirty-one years of service. Mr. Gould is the author of many articles in Bureau of Standards' and other publications concerning the technical aspects of time computation and the construction and testing of timepieces. Mr. Gould will devote his time to duties as Secretary of the Horological Institute of America.

R. L. GROVE has been appointed chief engineer of *Cornell-Dubilier's* Ceramic Division in New Bedford, Mass. Mr. Grove, a graduate of Ceramic Engineering from the University of Illinois, was previously with *Westinghouse Electric Corporation* as Ceramic Engineer in the company's electrical porcelain plant at Derry, Pa., and more recently with the *Centralab Division* of *Globe Union, Inc.*, Milwaukee, Wisconsin.

DR. JOHN McELHINNEY recently joined the staff of the Radiation Physics Laboratory of the National Bureau of Standards where he will use the Bureau's new 50-million volt betatron for research in nuclear reactions and high-energy x-rays. Dr. McElhinney is co-author of several articles concerning the thresholds of photo-nuclear reactions and is a member of the American Physical Society, Sigma Xi, and Phi Kappa Phi.

Instrumentation

(*Continued from page* 6)

of single ended, push-pull, or differential input.

Various types of input circuits may be used with the amplifiers and the recording system considered here. However, the present equipment was constructed specifically to use strain gauge and piezoelectric transducers. Strain gauges are normally employed in Wheatstone bridge circuits which are often referred to as full, half, or quarter bridges to designate the number of strain gauges employed, the remainder of the circuit being composed of fixed precision resistors.

Since the effect of strain on the gauges is to increase or reduce their resistance the same effect may be obtained by inserting resistance in series or in shunt with one of the gauges. The shunt method was adopted in this instrumentation as a means of calibration. The calibration steps are recorded immediately before the test record is taken and form a reference for analyzing the record that eliminates calculation of:

1. Amplifier gain.
2. Oscilloscope sensitivity.
3. Bridge current.

A piezo gauge input is normally single ended and requires extremely high input impedance, the input impedance of the amplifiers being 100 megohms and the remainder of the input cables, condensers, switches, etc., exhibiting an input shunt resistance in excess of 1000 megohms. A charge calibration is imposed on the circuit immediately before firing. This makes possible computation of blast pressures without necessity of determining cable shunt capacitances, signal attenuation, amplifier gain, etc.

Immediately after this calibration is applied the blast is fired and Fig. 10 shows a sample four channel record taken during recent tests. The outside timing markers are provided by the pulsed glow tubes. The pressure peaks occur at different times due to the varied positions of the input transducers, which were in this case Tourmaline crystal gauges.

The basic operation of the units has been traced from recording system to input networks, but the preliminary discussion of the physical layout was rather sketchy. Let us take another look at Fig. 1. Each of six bays of instrument units consists of the following, from top to bottom:

1. Calibration Unit.
2. Terminal Unit.
3. Oscilloscope Unit.
4. Amplifier Unit.
5. Amplifier Power Supply.
6. Bridge Power Supply.

Bays 2 and 6 contain oscilloscope power supplies. The central bay contains all the control equipment, or units whose function is common to all operations. A truck, used for transporting and reeling necessary cables, is shown in the background.

Each of these bays may be used separately as a four channel unit, with the addition of control units if desired.

Conclusion

The equipment described above fulfills in design and practice the necessary requisites for a versatile, smoothly operating, multichannel cathode-ray oscillographic unit. The complete versatility of the basic unit has not been discussed at length, but suffice it to say that with minor redesign a great number of uses can be accommodated.

The twenty-four channel mobile oscillographic measuring unit was designed and constructed for the Ballistic Research Laboratories of Aberdeen Proving Ground. The authors wish to acknowledge the aid and assistance rendered by Dr. C. W. Lampson and Messrs. C. L. Adams and W. E. Curtis of that organization.

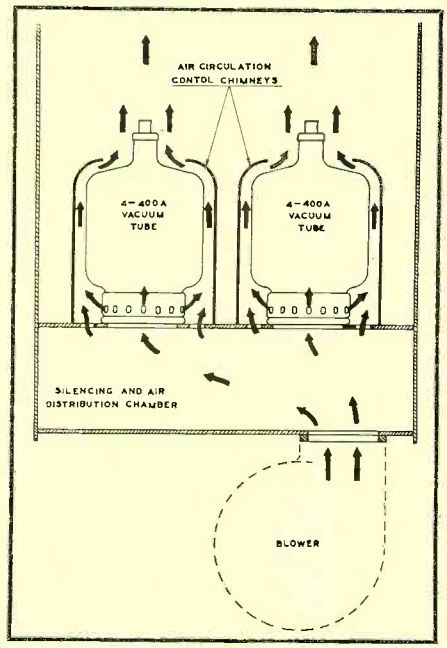


Fig. 6. Air path of system using internal anode tubes shown in Fig. 2.

Forced Air Cooling

(*Continued from page* 13)

volume would increase to 140 c.f.m. Most blower manufacturers include curves of this nature in their catalogues or bulletins. Where they are not included, they are almost always obtainable from their engineering or sales departments.

Since most radio laboratories do not have facilities for readily measuring the actual performance curves of the blower, it is wise to choose a blower manufactured and measured under NAFM or made by a reputable manufacturer who will guarantee the performance curve. A rough check may be made by checking the pressure at the point where the blower ceases to deliver air. For the blower of Fig. 4 this will be approximately .95 inches water column. The output of the blower should be exhausted into a cardboard box sealed sufficiently tight to prevent air leakage at the cracks or at the blower outlet connection. The pressure developed inside the box should then be measured by means of a manometer. If there is excessive leakage past the air rotor or the motor speed is too low resulting in low tip velocity, then it will be impossible to build up pressure to this point.

Noise is another factor which must often be considered. This is especially true in locations such as studios where the noise level must be relatively low at all times. In general, it will be found that high pressure cooling systems will result in higher noise levels. This is due to the high tip velocity necessary in generating the required air pressure. Low pressure systems, such as Fig. 1, have relatively low tip velocity and consequent low noise. This particular example has a pressure drop of only .125 inches water column at the rated volume flow of 400 c.f.m. In low pressure systems the air rotor turns at relatively low speeds, seldom more than 1800 r.p.m. and delivers a volume which is dependent on the physical size of the blower. High pressure blowers operate at high tip velocity or high peripheral speed and have less space between the air rotor and the housing resulting in the higher noise level.

Upon completion of the initial model, it is mandatory that the cooling system be checked as to its actual performance. This is not as difficult as it might seem and can be accomplished readily with quantitative results.

Obviously the first step is to measure the static pressure at the point specified by the tube manufacturer. A simple "U" tube manometer is sufficient for this measurement. A suitable unit may be purchased or may be made on the spot. A manometer sufficiently good for the static pressure measurements may be made by bending a short length of uniform cross-sectional area glass tubing into a "U" shape. Fig. 3 illustrates such a unit. Inside diameter should be on the order of one-fourth inch to minimize errors due to surface tension. Glass tubing of the required type is readily available from chemical supply houses or neon sign companies.

The measurement is essentially a wa-

Fig. 7. Pressure type air interlock sw.

ter displacement process. One end of the tubing is left open, the other end is fastened by means of an air tight hose connection to the pressure point to be measured. The air pressure difference between the outside air and the pressurized chamber displaces the water. The difference between the water level of both legs of the tube represents the static pressure in inches water column and is measured directly in inches. In making the measurements it should be borne in mind that the tubing must be held in a vertical position for accurate results, and that the pressure is measured between the levels in the legs. For example, a static pressure of 1 inch would push the level of one leg up a half inch and that of the other leg down a half inch.

If the static pressure measured is equal to or greater than the tube manufacturer recommends, it may be safely assumed that the tube is being sufficiently cooled providing there are no obstructions past the tube which could introduce a pressure drop.

A further check is often desirable, however, and most conservative engineers or manufacturers do so as a matter of policy. This may be accomplished effectively by measuring the actual seal temperature and temperature of the anode coolers. This is difficult to do even at low frequencies due to inability to establish good heat conductivity between the seal under measurement and the thermometer bulb. In fact, such measurements may be so unreliable as to make them useless. At v.h.f. it is next to impossible to use bulb type thermometers due to the electrical conductivity of the mercury column or chemical used in the indicator column.

Fig. 8. Vane type air interlock switch.

Chemicals have been developed which can be smeared directly on the spot to be measured and which will change color or crystallize when a given temperature is reached. One of these which has found ready acceptance in the tube industry is *Tempilac*. It may be purchased in a wide variety of temperature ranges. A small brush may be used to dab it on the spot to be checked. When the temperature reaches the melting point of the *Tempilac*, say 150°C, it may be observed melting and crystallizing. The crystals remain as mute evidence that the temperature of that particular spot has at some time reached or exceeded 150°C.

Safety Or Protection Devices

Where forced air cooling is required it is mandatory that some kind of safety protection be provided to prevent damage to the tubes or equipment should some part of the cooling system fail.

In the past, air velocity type switches have been popular as an air interlock. These are usually of the vane type. The air blowing past and against the vane actuates a switch which removes the high voltage to the tubes. Upon failure of this air stream the air pressure against the vane will drop actuating the switch. These types of air interlock switches are operated by the movement of the air stream only. Fig. 8 illustrates a modern example of a positive air interlock switch of this nature.

Interlocks of this type are used in cooling systems having relatively large air volume with low pressure. They can not afford protection should air leakage occur after the point where the switch is placed. They do have the advantage of affording protection should an obstruction occur any place in the air stream sufficient to reduce the air flow to a predetermined value.

Pressure actuated air switches have become popular with the increasing use of external anode tube cooling systems. Fig. 7 illustrates a pressure interlock developed by *Coral Designs* which has proved popular in electronic applications having air pressure from .2 inches up. It is essentially a diaphragm instrument having a large cross-sectional area diaphragm which actuates a snap-action switch at a predetermined pressure. The large cross-sectional area of the diaphragm makes possible positive action at low pressure. The transmitter shown in Fig. 4 employs a switch of this type. It may be seen mounted on the left side of the lower pressure chamber. The *Gates* BC-5B shown in Fig. 5 also uses an interlock of this type mounted in the center of the rear side of the pressurized chamber.

TECHNICAL BOOKS

"COMMUNICATION CIRCUIT FUNDAMENTALS" by Carl E. Smith. Published by *McGraw-Hill Book Company*, 330 W. 42nd St., New York, N. Y. 401 pages. $5.00.

This book is the second of four books designed for a complete course in radio and communication engineering prepared by the author for home study. The first book of the series was Applied Mathematics for Radio and Communication Engineers, which contained material prerequisite for a complete understanding of this text.

This is an important new text in circuit fundamentals for students, operators, technicians, and engineers. It covers the physics of circuit elements, including vacuum tubes, and presents the fundamentals of a.c. and d.c. circuits. Circuit constants are discussed first and then used in a treatment of d.c. circuits. After a study of magnetism, inductance, and capacitance, the principles of alternating currents are treated.

Although the text was planned to serve as a study of fundamentals in residence or correspondence courses, it should also prove of value for reading or reference for those who do not have the time to undertake a complete course.

"ELECTRON-TUBE CIRCUITS" by Samuel Seely, Prof. Electrical Engineering, Syracuse University. Published by *McGraw-Hill Book Company*, 330 W. 42nd St., New York 18, N. Y. 529 pages. $6.00.

This college text is the outgrowth of several courses organized by the author on electron-tube circuits and applications that covered many of the important circuits in use during the second world war. It seeks to give a clear analytical method in the study of electron-tube circuits, and presents for study the various classes of circuits which find widespread application.

Examples indicating the procedure for combining circuits of various types to achieve either one or a multiplicity of operations is an important feature of this book. A discussion of tube circuits for performing mathematical operations and of those developed in connection with radar applications is found to be considerably more in detail than found in most textbooks of today.

The student should have completed his basic studies in a.c. circuit theory and basic electronics before undertaking a study of this material. The instructor will find that sufficient diversity exists to allow a choice of topics to satisfy almost any course requirements.

Wide-Band Amplifier

(*Continued from page* 16)

combining antenna outputs such as transformers, cathode followers, filter networks and stub arrangements. The wide-band amplifier can also be modified to provide a number of inputs with a common output. This can be accomplished by keeping the same arrangement in the plate line but changing the grid line. The simplest change is to enter the grid line after each filter section, and terminate the filter in its characteristic impedance, such as shown in Fig. 5. Thus each tube can be used for a separate input. The operation is similar to that previously described except that each tube has a different input. The signal applied to input No. 1 of Fig. 5 will excite the grid of the first tube and a current carrying this signal will travel toward the line and appear as a voltage at the receiver. Similarly, a signal applied to the input of the other tubes will also appear at the load and in this manner the output of the separate generators, in this case receiving antennas, are combined into a single transmission line. The use of this system provides nearly infinite attenuation between generators, thus eliminating interaction between antennas through the coupling unit. The receiving antenna's bandwidth can be sharpened in the stop band by using *m*-derived band pass sections in the grid line while using the conventional low-pass filter section in the plate. Thus any undesired frequencies received on the individual antennas will be further discriminated against. For further flexibility a method of gain control for each input can be added to the antenna coupler. This can be accomplished by use of resistance pads, variation of grid bias, or a variation of plate and screen voltages.

Many apartment house owners will not allow individual tenants to install antenna systems because of the large numbers of antennas that would have to be accommodated. This not only provides an unsightly appearance but breeds discontent because all of the positions on the roof do not provide good television reception. Also, interaction between antennas and receivers is likely to take place, all to the detriment of the picture quality of the reproduced signal.

But many of these same owners will agree to the installation of a master antenna system to which the individual sets can be connected. The problem then becomes one of splitting the single output into a number of loads. Additional amplification will usually be found necessary even in metropolitan areas because of the considerable loss found in long transmission line runs. The individual receivers must also be isolated from one another so as to minimize interaction between receivers. Numerous multiple installations have been engineered and the problem has been solved in a number of ways. Some installers have used resistance pads (of about 30 db.) in each outlet so that the path between receivers would have a total of twice that amount. Others have used transformers, cathode followers, filter arrangements, and the like. The wide-band amplifier can also be used in this application by what amounts to the inverse solution of the antenna coupling problem.

In providing a receiver coupler the grid line remains as in the amplifier but the plate line is altered to provide a number of outputs from a single input as shown in Fig. 9. The input signal produces the same grid voltage at each tube and a current appears in the plate line. The currents now, instead of being combined in a single output, each go into their individual load, thus providing a number of outputs from the single input. The outputs are isolated from one another and from the input by an almost infinite impedance and thus no interaction can take place through the coupler.

Thus the wide-band amplifier technique can be used to combine a number of inputs into a common line, amplify the entire spectrum, and then to split the output into a number of loads. This problem is exactly the one encountered in the multiple television installations (See Fig. 8) and is also applicable to the testing and repairing of television receivers with a minimum of equipment. A number of signal generators can be located at a central point and the outputs can be combined, amplified to the desired level, and then distributed to the test positions. The tester has available several channel signals at the one outlet, without the necessity of providing individual generators at each outlet and without switching. Each set can be aligned at one position without signal generator switching or the necessity of having different test positions for each channel. This is a similar problem to the multiple installation of television receivers and Fig. 8 applies with signal generators substituted for receiving antennas, and test positions for TV outlets.

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News Briefs

(*Continued from page 22*)

demonstrating an experimental machine. On the far right, contained in a cylinder, is the x-ray source. The x-rays come from the aperture in the cylinder, pass through the sample, and are then magnified by two mirrors contained in the unit on which Miss Lucht's fingers rest. The magnified x-ray image is finally cast on a photographic film mounted behind the optical system to the right.

GE scientists believe that x-ray microscopes may someday compete with electron microscopes and make possible examination of live specimens at much higher magnifications than ever before.

ELECTRONIC TORCH

Dr. J. D. Cobine, scientist of the *General Electric* Research Laboratory, has developed an electronic torch which can melt firebrick and even tungsten which melts at 3370 degrees centigrade. The flame consists of nitrogen being passed through a high-frequency arc.

The arc is formed by radio waves at the extremely high frequency of one thousand megacycles, generated by a magnetron tube. Dr. Cobine, shown melting a quartz rod in the flame, explained that the radio waves break up

nitrogen molecules which consist of two atoms into individual atoms. When these atoms reunite to form molecules again, heat is released.

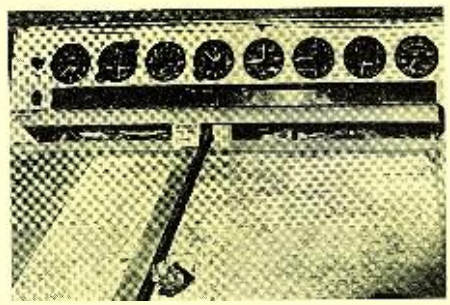
No uses have been found as yet for the extremely hot torch which is still at the laboratory stage of development.

JET PILOT TRAINER

From Wright-Patterson Air Force Base, Dayton, Ohio, comes the announcement of the new "Linktronic" trainer which is the latest device in training equipment for jet pilots providing indoctrination in the use of radio navigation systems.

The compartment of this new trainer looks exactly like the cockpit of a modern, single-engine, jet fighter. The gauges and indicators operate and register just as they would in a real plane.

The eight instruments across the trainer's panel shown are synchronized to those in the cockpit so that the instructor is at all times able to follow the student's performance. The lights below the instruments flash to indicate error, result of error, and operating



condition of the plane, while the flight recorder pen, mounted on a traveling arm, records simulated cross-country flights up to 1000 miles.

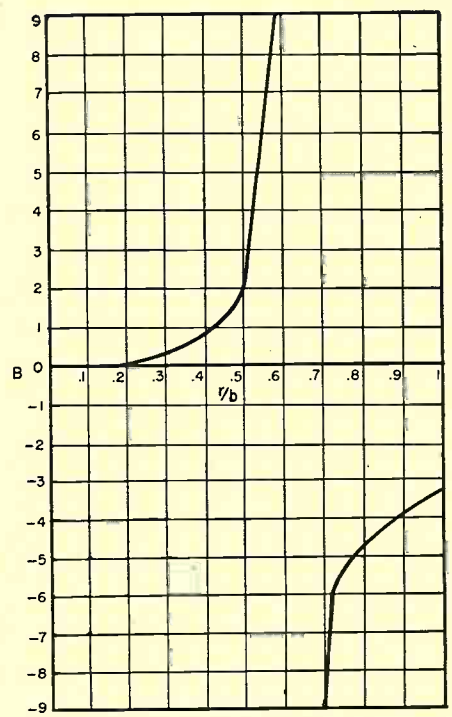
Microwave Comp.

(*Continued from page 20*)

$$R = 120\,\frac{\lambda}{\delta}\,\frac{b}{a}\,\frac{1}{1+\frac{a}{2b}} \quad . \quad . \quad . \quad (30)$$

In practice it has been found that finer tuning and stabler performances can in some cases be obtained using a reentrant cavity such as the one shown in Fig. 15B. In this case the center discontinuity acts as a capacitance and the two side arms act as inductances. By varying the depth of the discontinuity,

Fig. 16. Typical normalized susceptance vs. screw length curve (x = 5.5 cm., b = .872", a = 1.872", and screw diameter = .126").



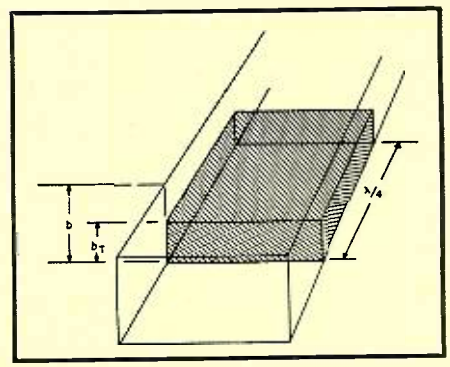


Fig. 17. Asymmetrical capacitive quarter-wave transformer.

the cavity can be made to resonate over a relatively wide range of frequencies.

Cylindrical cavities, such as the one shown in Fig. 15C, are employed in many applications. The characteristics of these cavities, which in many cases depend upon roots of Bessel Functions, are summarized below:

$$\lambda = \frac{1}{\sqrt{\left(\frac{1}{3.42}\right)^2 + \left(\frac{1}{2z}\right)^2}}$$

for $H_{1,1,1}$ mode . . . . . (31)

$$\lambda = \frac{1}{\sqrt{\left(\frac{1}{2.61\,a}\right)^2 + \left(\frac{1}{2z}\right)^2}}$$

for $E_{1,0,1}$ mode . . . . . (32)

$$\lambda = \frac{1}{\sqrt{\left(\frac{1}{1.64\,a}\right)^2 + \left(\frac{1}{2z}\right)^2}}$$

for $H_{1,0,1}$ and $E_{1,1,1}$ modes . . . (33)

$$Q \text{ (for TE modes half-wave long)} = \frac{Z_0}{\delta} \times \frac{\left(u'_{n,m} + \frac{\pi a}{2z}\right)^2 \left(1 - \frac{n}{u'_{n,m}}\right)}{\left(\frac{z}{a}\,u'_{n,m} + \frac{a^2\pi^2}{4z^2} + \frac{a(2-a)\pi^2 n^2}{4z^2 u'_{n,m}}\right)} \quad (34)$$

$$Q = \frac{a}{\lambda}\,\frac{1}{1+\frac{a}{z}} \text{ for TM modes, } n \neq 0 \quad (35)$$

If $n = 0$, Q is given by:

$$Q = \frac{a}{\lambda}\,\frac{1}{1+\frac{a}{2z}} \text{ (TM mode, } n = 0) \quad (36)$$

The use of many of the components described in this article will be clarified as the design of microwave equipment is covered.

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New Products

(*Continued from page* 25)

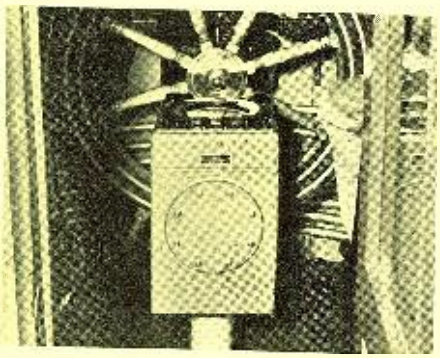
ation, the unit monitors up to five carrier frequencies in either the 25-50 mc. band or the 152-174 mc. band. Additional frequencies may be monitored by the simple exchange of control crystals.

An important part of the *Motorola* monitor is an AM receiver pre-tuned to Washington, D. C. station WWV, by which the monitor may be accurately checked and calibrated.

MARINE RADAR

Raytheon Manufacturing Co., Waltham, Mass., has introduced the newest in its series of commercial marine radar equipments, the Mariners Pathfinder Jr., designed to meet the demands of operators of tugs, ferries, fishing vessels, yachts and other smaller craft for a compact, low-power drain and lower cost radar.

The system, comprised of an antenna, transmitter-receiver and indicator, operates on a wavelength of 3.2 centimeters. The Mariners Pathfinder Jr. has a minimum range of 75 yards and a maximum of 20 miles. Range accuracy is within 2 per-cent and bearing accuracy is within 2 degrees. This unit is available for vessels equipped with 32-volt d.c., 110-volt d.c., 220-volt d.c. or 115-volt a.c. power systems. Power consumption in all cases is less than 750 watts.

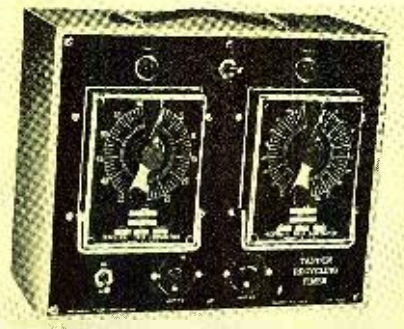


Photograph showing the indicator of Mariners Pathfinder Jr. radar installed in wheelhouse of the tug "Eileen Ross" illustrates compactness of the equipment.

DUAL TIMING DEVICE

Two individual timing elements, each able to control a specific operation, accommodated in a single housing is the Tandem Recycling Timer manufactured by *Industrial Timer Corporation*, Newark, N. J.

When the timer dials are set to the respective time intervals required, each cycle of operation will follow the other continuously in regular sequence. ON and OFF Toggle Switch, Load Control Switch and Pilot Lamp are integrated with other components to give a compact, clean-cut, portable assembly. The complete control cabinet measures 11½ x 9 x 7 inches and contains two sockets into which the timing elements are plugged so that they control a single-pole, double-throw load relay. The contact circuit of this relay is unpowered, permitting application of the particular voltage and current necessary for test or production.



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7, 9 . . . . . Federal Telecommunication Laboratories
12, 13 . . . . . Gates Radio Company
14 . . . Spencer-Kennedy Laboratories

D. C. Amplifier

(*Continued from page* 11)

11. Throw switch B in the "off" position.

12. Adjust "DETECTOR CONTROL" potentiometer to read ZERO. Do not allow to go below zero.

13. Throw switch B in the "on" position.

Now the d.c. amplifier is ready to function. Operations (1) to (13) are made before the amplifier is used and represents the basic alignment of the amplifier. They do not need to be repeated every time. They are made with no d.c. signal at the input terminals. The potentiometers involved in operation 7, 9 and 12 must never be touched again except for checking the alignment periodically by repeating all of the above operations.

Operating Instructions

To operate the d.c. amplifier after once aligned in accordance with the alignment instructions above, the following are the sequences:

(1). Throw switch "A" in the "set to 50" position No. 1.

(2). Turn the "AMPLIFIER CONTROL" potentiometer all the way down.

(3) Connect the terminals "input". The right polarity must be used. No reading is possible with wrong polarity.

(4) Turn the "AMPLIFIER CONTROL" potentiometer up to read 50 again. This position will be reached sooner than 4 of the alignment procedure. It should therefore be done carefully.

(5). Throw the switch "A" in the "Reading" position No. 3.

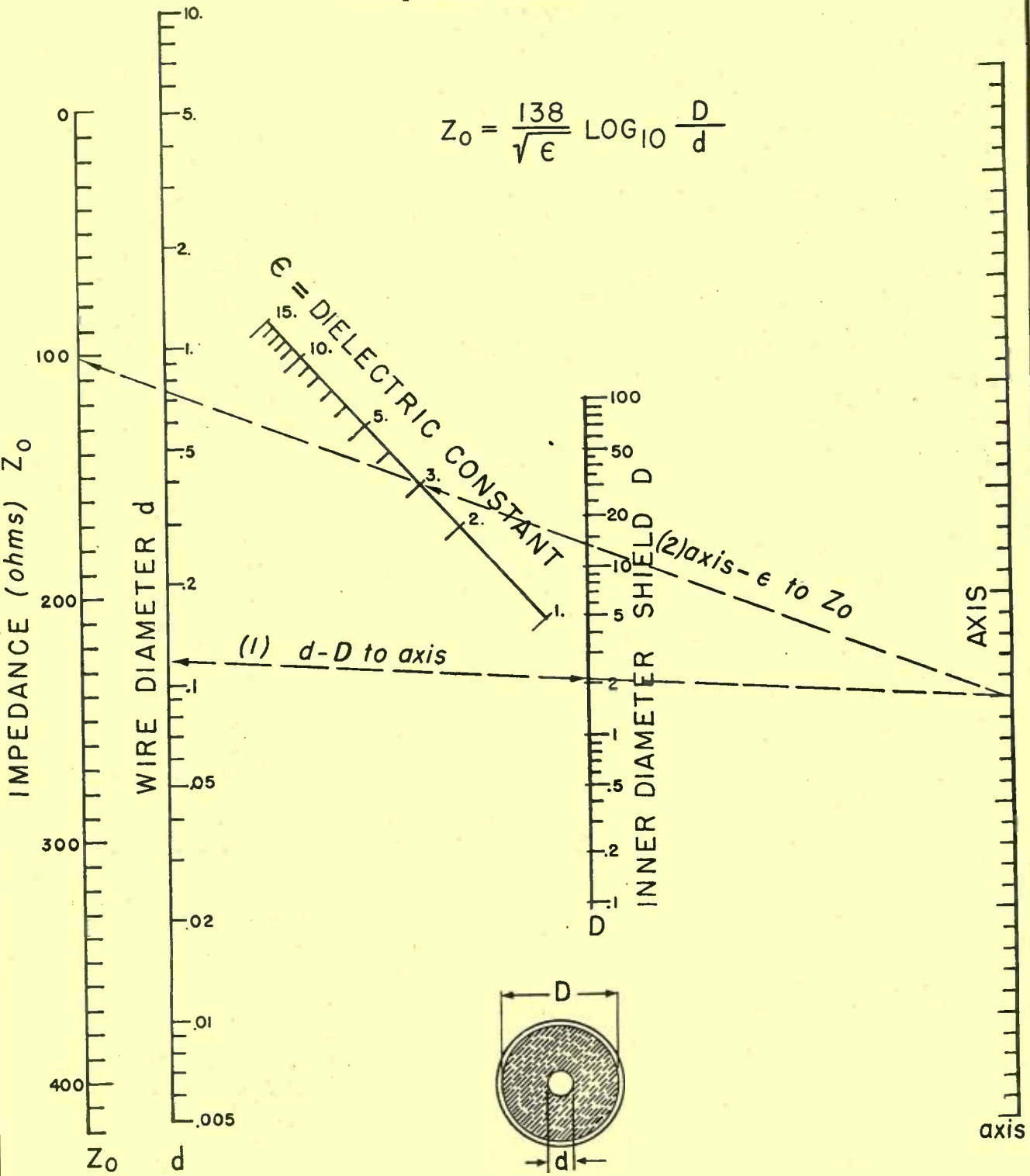
(6). Adjust the "METER CONTROL" potentiometer to read 50. Now any increase of the d.c. signal will increase the reading while any decrease will decrease the reading a proportional amount.

The meter may be calibrated by checking with known signals in case an actual measure is required instead of only an indication of d.c. voltage change. The maximum d.c. input voltage is 100 volts. The meter is a voltmeter with 100 volts full scale deflection and having an internal resistance as high as possible.

CHARACTERISTIC IMPEDANCE OF LINES

This chart gives theoretically exact values for solid dielectric concentric lines for any scale of dimensions if lossless dielectric (completely filling space between conductors) and perfect conductors are assumed.

$$Z_0 = \frac{138}{\sqrt{\epsilon}} \log_{10} \frac{D}{d}$$



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MONEY BACK? 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 sole judge. Plain enough?

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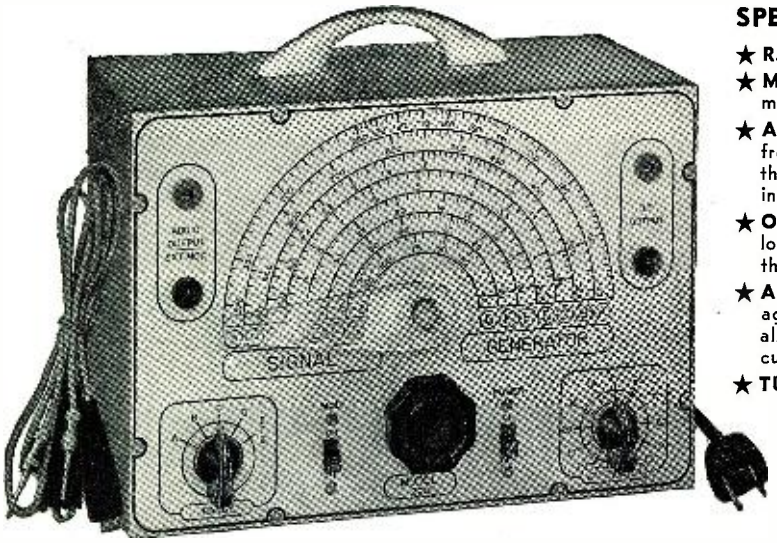
KITS? *We have discontinued advertising Test Equipment in kit form.* After handling kits for a period of three months, we have come to the conclusion that it is impractical to successfully complete instrument kits at home without the expensive calibration standards and other equipment available when instruments are factory produced.

THE NEW MODEL 200

AM and FM SIGNAL GENERATOR



SPECIFICATIONS

★ **R.F. FREQUENCY RANGES:** 100 Kilocycles to 150 Megacylces.

★ **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 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 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.

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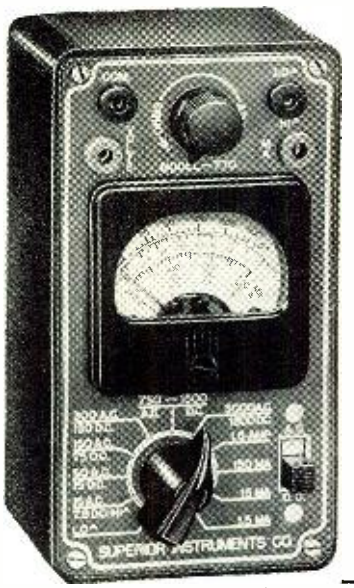

Superior's new model 770

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.

The Model 770 comes complete with self-contained batteries, test leads and all operating instructions.

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

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Superior's new model 670

SUPER-METER

***A COMBINATION* VOLT-OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS**

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts.
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5 Amperes
RESISTANCE: 0 to 500/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to .2 Mfd. .1 to 4 Mfd. (Quality test for electrolytics)
REACTANCE: 700 to 27,000 Ohms 13,000 Ohms to 3 Megohms
INDUCTANCE: 1.75 to 70 Henries 35 to 8,000 Henries
DECIBELS: —10 to + 18 + 10 to + 38 + 30 to + 58

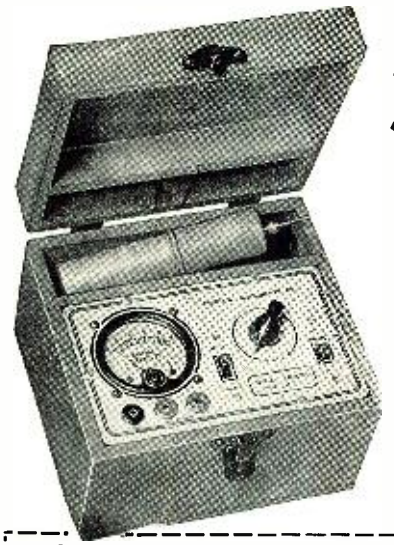
ADDED FEATURE:

The Model 670 includes a special GOOD-BAD scale for checking the quality of electrolytic condensers at a test potential of 150 Volts.

The Model 670 comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions. Sizes 5½" x 7½" x 3".

$28.40 NET

The model CA-11



SIGNAL TRACER

SIMPLE TO OPERATE . . . BECAUSE IT HAS ONLY ONE CONNECTING CABLE—NO TUNING CONTROLS!

Introduced in 1939-1940 Signal Tracing, the "short-cut" method of Radio Servicing quickly became established as the accepted method of localizing the cause of trouble in defective radio receivers. Most of the pre-war testers (including ours) were bulky, requiring a number of connections before the unit was "set for operation" and included a tuned amplifier, which had to be "returned" to compensate for signal shift.

The new Model CA-11 affords all the advantages offered by the pre-war models and only weighs 5 lbs. and measures 5" x 6" x 7". Always ready for immediate use without the necessity of connecting cables, this amazingly versatile unit has NO TUNING CONTROLS.

FEATURES

★ **SIMPLE TO OPERATE**—only 1 connecting cable—NO TUNING CONTROLS
★ **HIGHLY SENSITIVE**—uses an improved Vacuum Tube Voltmeter circuit. Tube and resistor-capacity network are built into the Detector Probe.
★ **COMPLETELY PORTABLE**—weighs 5 lbs. and measures 5" x 6" x 7".
★ Comparative Signal Intensity readings are indicated directly on the meter as the Detector Probe is moved to follow the Signal from Antenna to Speaker.
★ Provision is made for insertion of phones.

The Model CA-11 comes housed in a beautiful hand-rubbed wooden cabinet. Complete with Probe, test leads and instructions.

$13.50 NET

GENERAL ELECTRONIC DISTRIBUTING CO. DEPT. RN-4, 98 PARK PLACE, NEW YORK 7, N. Y. RN-4

GENTLEMEN: PLEASE RUSH THE MATERIAL LISTED BELOW:

Quantity	MODEL	PRICE
	TOTAL	

Name_____

Address_____

City_____ Zone_____ State_____

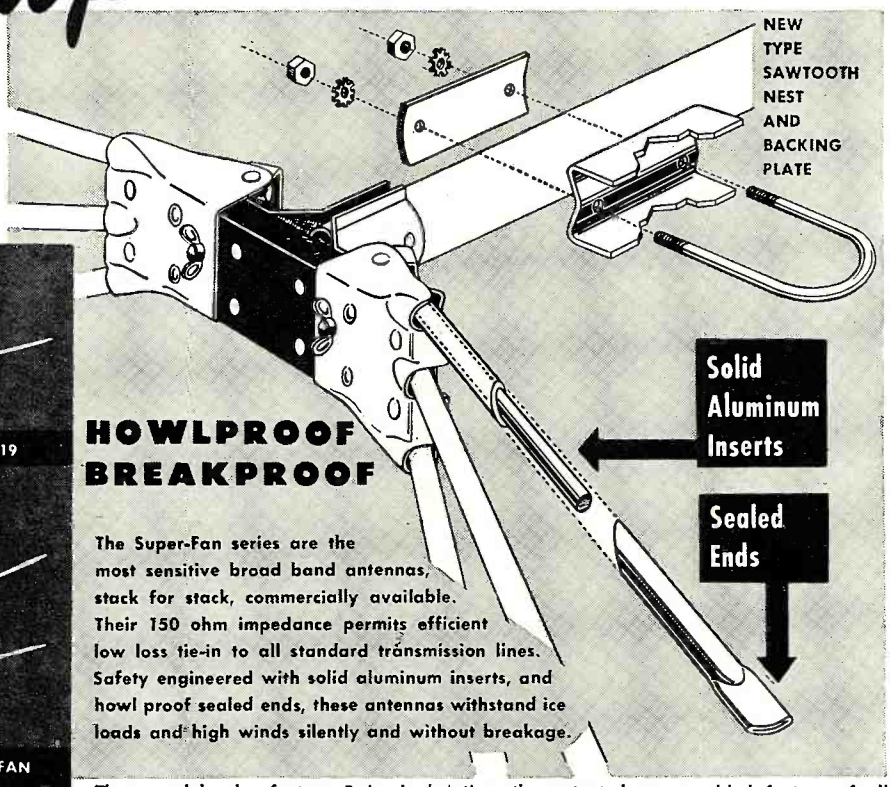
$.....
(Payment in Full Enclosed)

$.....
(Deposit Enclosed—Ship Balance C.O.D.)

CHANNEL MASTER'S *Super-Fan!*

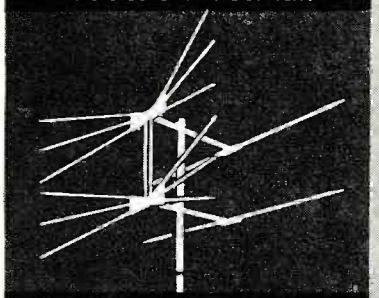
• STRENGTH • RIGIDITY • SENSITIVITY

SUPERSEDES THE BM 312 FAN FLECTOR SERIES

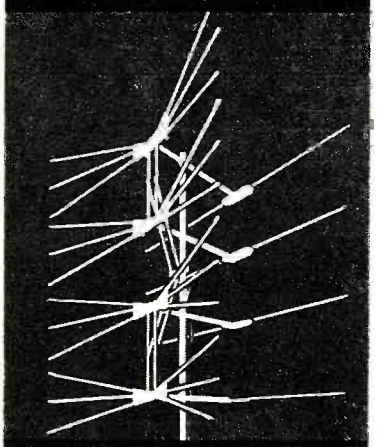


- LOWER PRICES
- SMALLER BOX
- SUPERIOR PREASSEMBLY

BM 313 SUPER-FAN LIST 12.19



BM 313X2 STACKED SUPER-FAN LIST 26.25



BM 313X4 DOUBLE STACKED SUPER-FAN LIST 57.10

HOWLPROOF BREAKPROOF

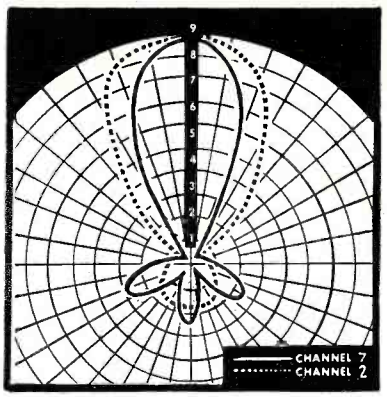
The Super-Fan series are the most sensitive broad band antennas, stack for stack, commercially available. Their 150 ohm impedance permits efficient low loss tie-in to all standard transmission lines. Safety engineered with solid aluminum inserts, and howl proof sealed ends, these antennas withstand ice 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.

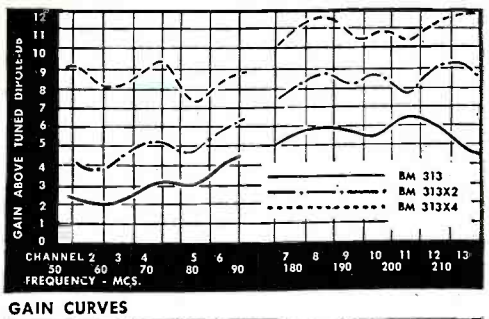
A TELEVISION SET IS NO BETTER THAN ITS ANTENNA
THERE IS NO BETTER ANTENNA THAN THE SUPER-FAN

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	4.7
313X2	4.8	5.0	6.1	5.7	6.8	9.0	9.7	9.3	9.4	8.8	9.8	10.0
313X4	9.0	8.2	9.0	7.5	8.5	11.0	11.4	10.6	10.8	10.3	11.3	11.9

GAIN IN DB. ABOVE TUNED DIPOLE

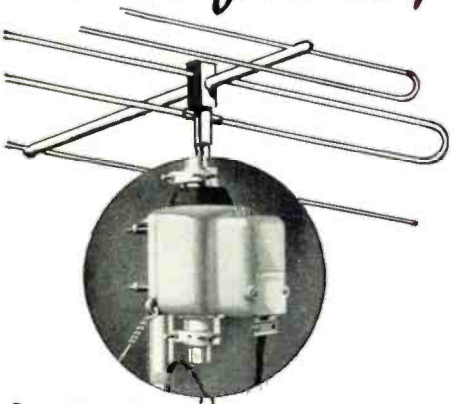
CHANNEL MASTER Corp.

FIRST IN PREASSEMBLED ANTENNAS

ELLENVILLE, N. Y.

No wonder ALLIANCE TENNA-ROTOR

is the fastest profit maker in television today!



Tenna-Rotor comes complete in one package!
Both standard Model ATR and Deluxe Model DIR available!

New Model DIR as illustrated has indicator control case to show compass direction!

There's Only One TENNA-ROTOR! Here's Why!

1 **Only Tenna-Rotor** blankets the nation with advertising . . . every week your customers see Alliance film demonstrations right in their homes!

2 **Only Tenna-Rotor** can point to nearly 200,000 satisfied users from *coast to coast!*

3 **Only Tenna-Rotor** has *Underwriters' Laboratories approval* and a *one year guarantee!*

4 **Only Tenna-Rotor** has special 4-conductor cable with "ZIP" feature for faster, easier installations!

E. T. L. Laboratory tests prove operation in sub-zero, rain and icy weather!

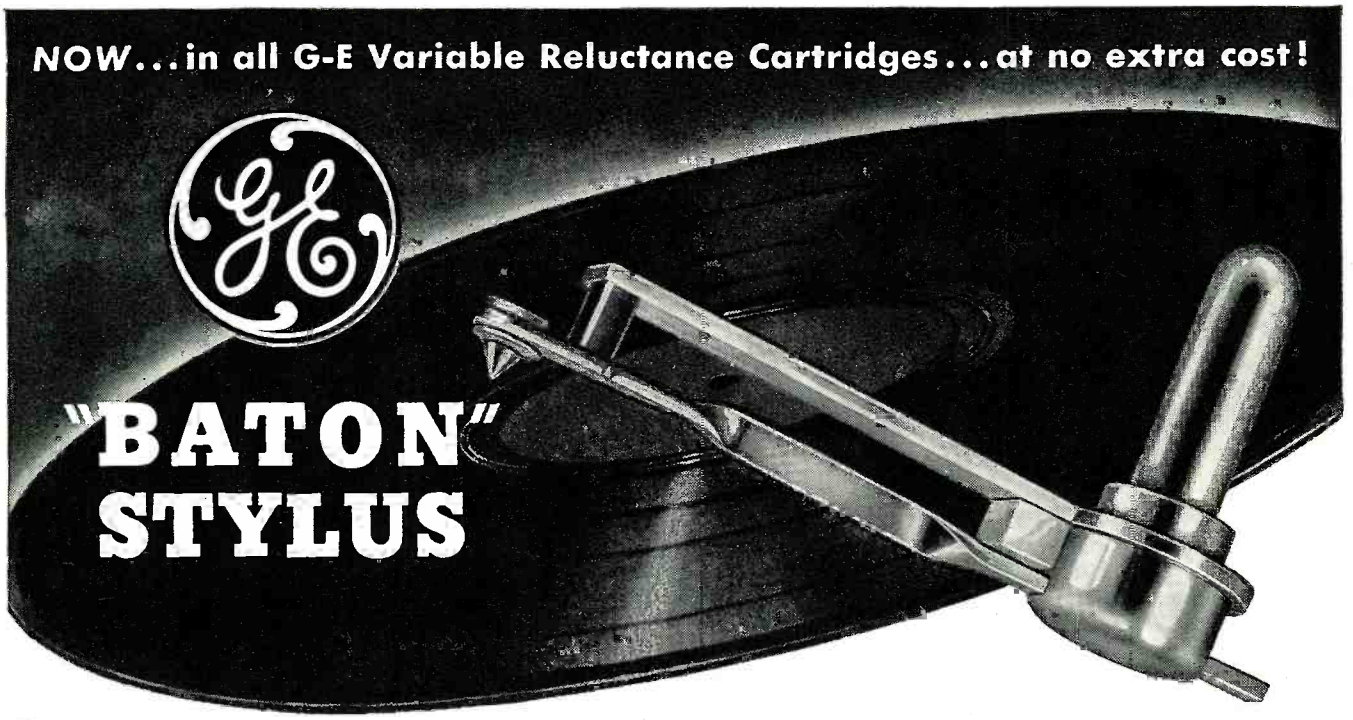
alliance
TENNA • ROTOR

Trade Mark Reg. U. S. Pat. Off.

ALLIANCE MANUFACTURING COMPANY • ALLIANCE, OHIO

Makers of Alliance Phonomotors and Powr-Pakt Motors

NOW...in all G-E Variable Reluctance Cartridges...at no extra cost!



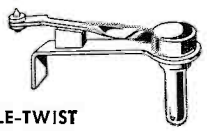
"BATON" STYLUS

An Exciting New Discovery in High Fidelity Reproduction!

THERE'S terrific sales appeal—as well as listening pleasure—in this revolutionary General Electric Stylus! Like a baton in the hands of a skilled symphony conductor, it brings out the full tonal quality of recorded music as you've never heard it before!

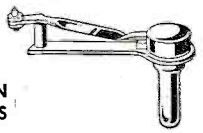
Its feather-light tip, on the end of a dual-twist cantilever arm, follows every curve and dip of the record groove with a compliance so delicate it picks up frequencies through 10,000 cycles per second! The blasting, buzz, and hum so annoying in most record reproduction are virtually wiped out. Above all—the tone fidelity of the Baton Stylus is unsurpassed by any other commercially available unit! Equipped with diamond or sapphire tip, it fits any G-E replaceable stylus cartridge.

HOW COMPLIANT CAN A NEEDLE BE?



SINGLE-TWIST STYLUS

Until the development of the Baton Stylus, this model afforded unsurpassed fidelity. The single-twist arm and single damping block were designed for a tracking pressure of 21 grams. It was recognized, however, that lighter pressure would lengthen both record life and stylus life.



BATON STYLUS

Bending and twisting to every undulation of the record groove, this stylus reproduces each tone value with amazing clarity. Tracks at 6 grams—thus providing *the maximum degree of compliance that may be used successfully with commercially available tone arms.* Double damping blocks filter out superfluous vibrations.

Dealers and Servicemen!

There's a big market for the Baton Stylus among present users of General Electric cartridges. Hi-fi fans and record enthusiasts everywhere will want this sensational new model in their phonograph tone arms. Be sure you get your share of this business... the coupon below can open the door to new customers, new sales, new profits.

FREE *Baton Stylus Folder!*

General Electric Company, Section 940
Electronics Park, Syracuse, New York

Send me FREE folder on the new Baton Stylus.

NAME_____

ADDRESS_____

CITY_____ STATE_____

You can put your confidence in—

GENERAL ELECTRIC

ANOTHER *HYTRON FIRST* YOU'LL BE BUYING SOON

new HYTRON 12BH7

does more for less

- *Ideal Sweep Amplifier*
- *Higher-Perveance Twin Triode*
- *Designed for TV*
- *Permits Lower-Cost TV Sets*
- *Another Hytron TV First*

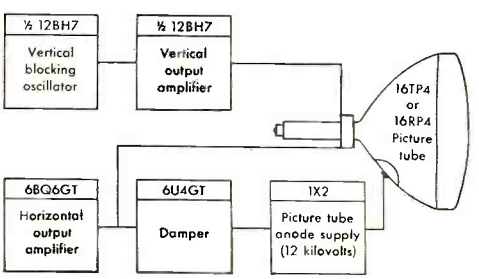
Here's another Hytron original you'll be buying soon. New 12BH7 twin triode is enthusiastically hailed as tops for sweep circuits by leading makers of TV sets. One half 12BH7 sweeps wide-angle 16-inch picture tube at 14 kilovolts. One section alone matches performance of: Paralleled 6SN7GT. Or equivalent single triode. Or triode-connected beam pentode. Other half of 12BH7 is free for other uses—such as blocking oscillator.

How does Hytron do it? Higher perveance (lower tube loss)? Yes. Also the Hytron 12BH7 is: designed for TV. Rated for TV. Tested for TV. Again a Hytron TV first. Again a Hytron contribution to lower-cost TV for the mass market. Watch for the 12BH7. Write for Bulletin E-149.

AND NOW THE HYTRON 16TP4 Another Hytron 16-inch rectangular picture tube. Follows closely on heels of original Hytron rectangular tube, the 16RP4. Write for Bulletin E-150 for complete data. Watch also for early announcements of new Hytron 14-inch and 19-inch rectangular tubes.

MODERN LOW-COST 16-IN. DESIGN

A Hytron contribution to lower TV costs. All-Hytron: 1X2, 6BQ6GT, 6U4GT, 12BH7, 16TP4 or 16RP4. For application and circuit details, write for Bulletin E-151.



OLDEST MANUFACTURER OF RECEIVING TUBES

HYTRON

RADIO AND ELECTRONICS CORP.

MAIN OFFICE: SALEM, MASSACHUSETTS

HYTRON RADIO TUBES

Within the INDUSTRY

CHARLES GREENWOOD ROBERTS, JR., product manager for radio and television broadcast equipment in *General Electric Company's* commercial equipment division, died recently in Syracuse after a short illness.

Well-known in the broadcast equipment industry both here and abroad, Mr. Roberts joined *General Electric* in 1928 upon graduation from Union College. He transferred to the international division of *Radio Corporation of America* in 1930 where he was engaged in new product development and sales. In this capacity, Mr. Roberts traveled all over the world.

In 1935 he was loaned to the *Phillips Company* of Holland as a sales advisor and then rejoined *General Electric* in 1942. He later became manager of the electronics and merchandise department for the *International General Electric Company,* a position he held until 1948 when he was assigned to sales work in the Electronics Department.

* * *

ROBERT D. HICKOK, president and founder of *The Hickok Electrical Instrument Company,* passed away recently in Cleveland, Ohio, at the age of 70.

An active RMA member and a Fellow of The American Institute of Electrical Engineers, Mr. Hickok was a well-known figure in the electrical industry. Throughout the past 40 years of manufacturing he was actively interested in his company and its engineering department.

Mr. Hickok started his career as a watchmaker in Greenville, Michigan. He moved to Atlanta, Georgia, and founded the company which bears his name in 1910. In 1913 the company was moved to Cleveland where the two main *Hickok* plants are now operating.

His son, Robert D. Hickok, Jr., has been named president of the firm to succeed his father.

* * *

WILLIAM DUBILIER, founder and technical director of *Cornell-Dubilier Electric Corporation,* has been awarded the Chevalier Cross of the French Legion of Honor for his outstanding contributions to the development of the French and International electrical industry and for his humanitarian activities.

This is the third honor that France has bestowed on Mr. Dubilier within a year. He previously received the Honorary Medal of the Association des Ingenieurs-Docteurs de France and the Diploma of the Officer of the Academy and the Order of Academic Palms decreed by the French Government.

* * *

PAUL H. ECKSTEIN has rejoined *The Hallicrafters Company* of Chicago as television sales manager. He was formerly associated with the company's home radio division as sales manager.

Mr. Eckstein returns to *Hallicrafters* from the *Gibson Refrigerator Company* of Greenville, Michigan, where he was assistant general sales manager responsible for the company's field organization. He was also associated with *Westinghouse* and *Stewart-Warner* during his 24 years in major appliance merchandising.

At the same time, the company also announced the appointment of Harold J. Adler to the post of chief television engineer for the *Hallicrafters* line of video receivers. Mr. Adler will be in direct charge of all television chassis development. He has been active in the television field since 1932 when, as a consulting engineer, he began experimenting with the scanning disc.

For the past 16 years he has been associated with *Sentinel Radio* of Chicago as chief engineer on both radio and television.

* * *

TELEVISION ZOOMAR CORPORATION, manufacturer of the *Zoomar* lens, has moved its offices to 500 Fifth Avenue, New York . . . **AMERICAN TRANSFORMER COMPANY** has consolidated operations, including its general offices, under one roof in a large and modern building located at 285 Emmet Street, Newark 5, New Jersey . . . **EMERSON RADIO & PHONOGRAPH CORPORATION** has purchased the *Continental Can Building* in Jersey City, New Jersey, which will give the radio firm an additional 450,000 square feet of production space for the manufacture of radio and TV receivers . . . The Broadcast Receiver and Television Division of **BENDIX AVIATION CORPORATION** has acquired additional factory space which will double the company's output capacity for video receivers . . . **ALLEN B. DU MONT LABORATORIES, INC.** has opened a re-

Brush has it!

MIKES AND PHONES THAT ARE "CRYSTAL CLEAR"

HAND OR DESK MICROPHONE (BA-116)

Rugged dependability and uniform frequency response. Unbeaten in its price range for PA, home, institutional and industrial use. Use in hand or on desk without need of stand. But also equipped for use with standard 5/8" 27 thread stand. Brown metallic finish, 8' cable. List, $14.75.

"VIBROMIKE" (VM-1)

Miniature contact-type microphone with unusually wide frequency response. 7/8" x 3/4" x 5/8". Output volume from .05 to .1 volt or higher. Complete with mounting clamp and 25' cable. List, $19.50.

NEW MICROPHONE (BA-109) FOR PA, HOME AND AMATEUR

A beautiful new microphone for applications that require natural reproduction of both music and voices. Uses an advanced development of the "Acousticel" cartridge pioneered by Brush. Pickup pattern non-directional in the horizontal plane. Essentially flat frequency response from 40 to 10,000 cps. Designed for use with 5/8" 27 thread stand. Finished in maroon plastic and brushed chromium . . . . . List, $22.50.

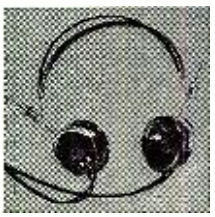
GENERAL PURPOSE MICROPHONE (BA-106)

Using the exclusive "Acousticel" cartridge. Vibration, shock, low frequency wind noise or humidity do not affect the high fidelity. Excellent for general use. Output level Minus 50 db. below 1 volt/bar . . . . List, $19.75.

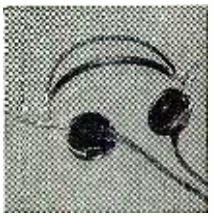
LAPEL MIKE (BL-2)

Virtually flat response. Small and rugged. Can be used as hand or instrument mike, as well as lapel. 1½" x 2¼". Complete with 25' cable. List . . . . . $25.00.

Monitor with a Brush Phone



High fidelity Model "A-1", $18.00



Model "A" general purpose, $12.00

Model "A" single phone, $6.45

Model "A" lorgnette phone, $9.75

"BA-303" Hushatone $9.75

You can get it!

Brush products are distributed all over U. S. A. If your own radio parts jobber does not have it, write to us and we will send you name of nearest jobber.

THE BRUSH DEVELOPMENT COMPANY

3405 Perkins Avenue • Cleveland 14, Ohio

gional receiver sales office at 30½ Highland Park Village, Dallas 5, Texas . . . **CORNING GLASS WORKS** has expanded its research and development facilities through the construction of a new Pilot Plant and a new Engineering Building at Corning, New York. The Pilot Plant facilities will be used initially for the development of new production methods for television bulbs . . . **STEVENS MANUFACTURING COMPANY, INC.** has moved to a new plant at 69 South Walnut Street, Mansfield, Ohio which will provide enlarged facilities for all of the company's operations . . . **RADIO MERCHANDISE SALES, INC.** has moved its factory and offices to 1165 Southern Boulevard, New York 59, New York. The move was necessitated by a greatly increased demand for the company's line of television products . . . **THE A. W. HAYDON COMPANY** of Waterbury, Connecticut consolidated all of its engineering, manufacturing, and administrative departments under a single roof when it recently moved to new quarters at 232 North Elm Street . . . **FEDERATED PURCHASER INCORPORATED** has taken new enlarged quarters at 66-68 Day Street in New York City. The company was formerly located at 80 Park Place . . . **THE RAY-DYNE MANUFACTURING CORPORATION** has opened a new plant at White Rock, S. C. for the production of cabinets and the company's line of radios and phonographs . . . **REEVES SOUNDCRAFT CORP.** has moved its sales office to a new three-story building at 35-54 36th Street, Long Island City in order to accommodate production facilities for its new line of magnetic recording tape as well as its sales department. The new building will also house *Reevesound Co., Inc.* as well as the sales office for the company's two *Soundcraft* subsidiaries, *Tele-Video Corp.* and *Airdesign, Inc.*

* * *

JOHN H. HAUSER, former assistant manager of distributor sales at Emporium, Pa., has been transferred to the Chicago Sales Office of the Radio Tube Division of *Sylvania Electric Products Inc.*

He will direct and coordinate distributor sales activities in 24 midwestern and southern states which include five of the company's sales divisions. Mr. Hauser joined the company's distributor sales department in 1941 and during the war served as production engineer in charge of product simplification in the cathode-ray department.

* * *

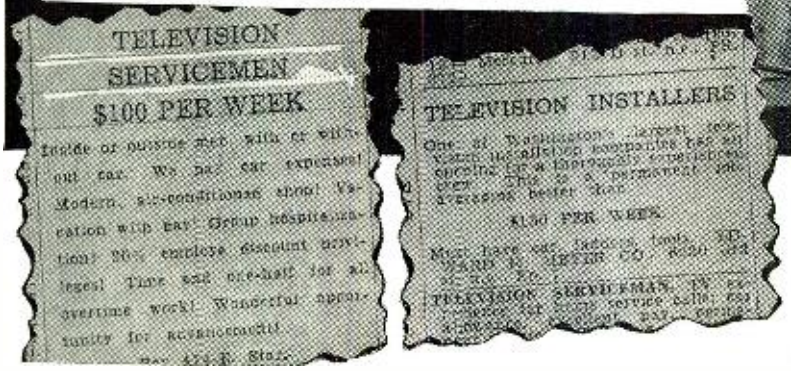
AUDIO ENGINEERING SOCIETY, San Francisco Section, has elected a new slate of officers for 1950.

Named at a recent meeting were: Ross H. Snyder, KJBS-FM, chairman; Walter T. Selsted, *Ampex Electric*

(*Continued on page* 110)

To a $60 a week man interested in earning $100 a week and more in

ELEVISION and FM SERVICING



CREI can show you how to qualify for jobs like these!

QUALIFIED TV REPAIRMEN are in demand. The ads shown (taken from a single issue of the Washington *Sunday Star*) prove it. Every area with TV stations has openings for servicemen. Every area with TV stations planned (750 stations by 1955 is a conservative estimate) will have more openings.

Anyone in the field—if he is to get ahead—needs to know how to use test equipment, how a TV set works, why it works, and how to make it work better. You can't repair "by ear" anymore. You need *knowledge*. CREI's practical course in TV-FM servicing provides it. Designed by teaching specialists, taught by practical TV instructors, reviewed and checked by qualified service experts, KEPT UP-TO-DATE through daily contact with CREI's affiliated retail sales-and-servicing stores (one of Washington's largest retailers of TV sets), the CREI course equips you to qualify for the $100-a-week jobs.

TV is developing fast. Now's the time to get on the bandwagon! CREI offers you—in one practical course at a popular price—greater earnings and a secure future. Don't delay. Start your training now—and start applying your new-found knowledge in your daily work. The facts are yours for the asking. Mail the coupon now for complete data.

Veterans: *CREI training is available under the G.I. Bill. For most veterans, July 25, 1951 is the deadline. ACT NOW!*

FREE SAMPLE LESSON

"Television & FM Trouble Shooting" devoted to live, "dollar-and-cents", practical practice based on day-to-day servicing problems. Read this interesting lesson! See for yourself how CREI training can help you. Mail coupon for sample lesson, free booklet and details.

THE THREE BASIC CREI COURSES:

★ **PRACTICAL RADIO ENGINEERING**
Fundamental course in all phases of radio-electronics

★ **PRACTICAL TELEVISION ENGINEERING**
Specialized training for professional radiomen

★ **TELEVISION AND FM SERVICING**
Streamlined course for men in "top-third" of field

ALSO AVAILABLE IN RESIDENCE SCHOOL COURSES

CAPITOL RADIO ENGINEERING INSTITUTE

An Accredited Technical Institute Founded in 1927

Dept. 114B, 16th Street & Park Road, N. W.
Washington 10, D. C.

Branch Offices
New York (7) 170 Broadway • San Francisco (2) 760 Market St.

MAIL COUPON FOR FREE BOOKLET

CAPITOL RADIO ENGINEERING INSTITUTE
Dept. 114B, 16th & Park Rd., N. W., Washington 10, D. C.

Gentlemen: Send me FREE SAMPLE LESSON and 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
- ☐ Aeronautical Radio Engineering
- ☐ Broadcast Radio Engineering (AM, FM, TV)
- ☐ Radio-Electronics in Industry

☐ I AM ENTITLED TO TRAINING UNDER G.I. BILL.

NAME..... AGE.....

ADDRESS.....

CITY..... ZONE..... STATE.....

☐ SEND DETAILS ON RESIDENCE SCHOOL.

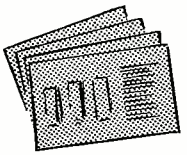
SAVE 25 TO 52%

BY BUILDING YOUR OWN ABORATORY PRECISION TEST INSTRUMENTS!

order your **EICO** INSTRUMENT KITS direct from *Lafayette Radio*

"You build 'em in one evening— they last a lifetime"

Complete with STEP BY STEP INSTRUCTIONS and EASY-TO-FOLLOW DIAGRAMS



Each EICO kit fully guaranteed to operate perfectly when assembled according to the simple directions.

NEW TV-FM SWEEP SIGNAL GENERATOR KIT

EICO

Model 360-K

$29.95

Crystal marker oscillator with variable amplitude. Covers all TV and FM alignment frequencies between 500 kc. and 228 mc. Sweepwidth variable from 0-30 mc., with mechanical inductive sweep. Extremely wide sweepwidth allows gain comparison of adjacent RF TV Channels. Provides for injection of external signal generator marker. Phasing control included. Vernier dial calibrated in frequencies. Complete with tubes (6X5GT, 12AU7, 2—6C4). In sturdy steel case. Less Crystal. Size: 10 x 8 x 6¾". 110-125 v., 60 cycle AC. Shpg. wt., 12 lbs. IN KIT FORM.

No. 32P24370: Lafayette's Price $29.95

No. 32P24371: 5 Mc. Crystal for above $3.95

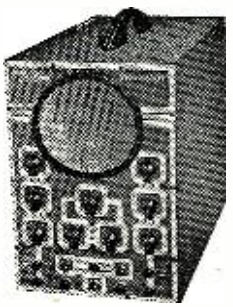
NEW 5" OSCILLOSCOPE KIT

Push-Pull, Wide-Range, High Sensitivity!

EICO

Model 425-K

$39.95



All-new laboratory precision scope has Push-Pull deflection and .05 to .1 volts per inch sensitivity. Wide range, flat from 5 cps to 500 kc. with full gain setting, useful to 2½ mc. Wide-range, multi-vibrator, sweep circuit from 15 cps to 75,000 cps. Direct connection to plates of CRT available at rear of cabinet. Z axis intensity modulation feature included. Size: 8½" x 17" x 13" high. Complete with 3—6SN7, 2—6J5, 2 of 5Y3, 5BP1 CRT. 110-125 v., 60 cycles AC. Shpg. wt., 30 lbs. IN KIT FORM.

No. 32P24552: Lafayette's Price: $39.95

VACUUM TUBE VOLTMETER KIT

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Tops in workbench versatility—15 different ranges! AC and DC ranges: 0/5/10/100/500/1000 volts. (Use HVP-1 probe to get 30,000 volt range.) Electronic ohmmeter ranges from .2 ohms to 1000 megs in 5 steps. Uses double triode balanced bridge circuit. New features include Zero Center for TV discriminator alignment. 26 Meg. DC input impedance. Accurate 4½" meter cannot burn out. Sturdy portable steel case with etched, rubproof panel. 110-125 v., AC, 60 cycles. Size: 9½" x 6" x 5". Shpg. wt., 10 lbs. IN KIT FORM.

No. 32P24540: Lafayette's Price: $23.95

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EICO

Model 320-K

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For FM, AM alignment and to provide TV marker frequencies. Highly stable Hartley oscillator has range of 150 kc. to 102 mc. with fundamentals to 34 mc. Colpitts audio oscillator supplies **pure 400 cycle sine wave** voltage for modulation. Use audio oscillator voltage to test distortion in audio equipment, bridge measurements, etc. In sturdy steel case. Size 10 x 8 x 4¾". 110-125 v., 60 cycles AC. Shpg. wt., 10 lbs. IN KIT FORM.

No. 32P24562: Lafayette's Price: $19.95

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(Not a Kit)

EICO Model HVP-1 $6.95

Measures up to 30,000 volts. Special HV Multiplier Resistor for all 20,000 ohms per volt meters with 1000 or 5000 volt scales and most VTVM's. Lucite head, plywood bakelite handle, large flashguards for additional safety. Assembled, ready to use. Supplied for 221-K VTVM unless other instrument is specified. Shpg. wt., 1 lb.

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EICO Model P-75K $3.75

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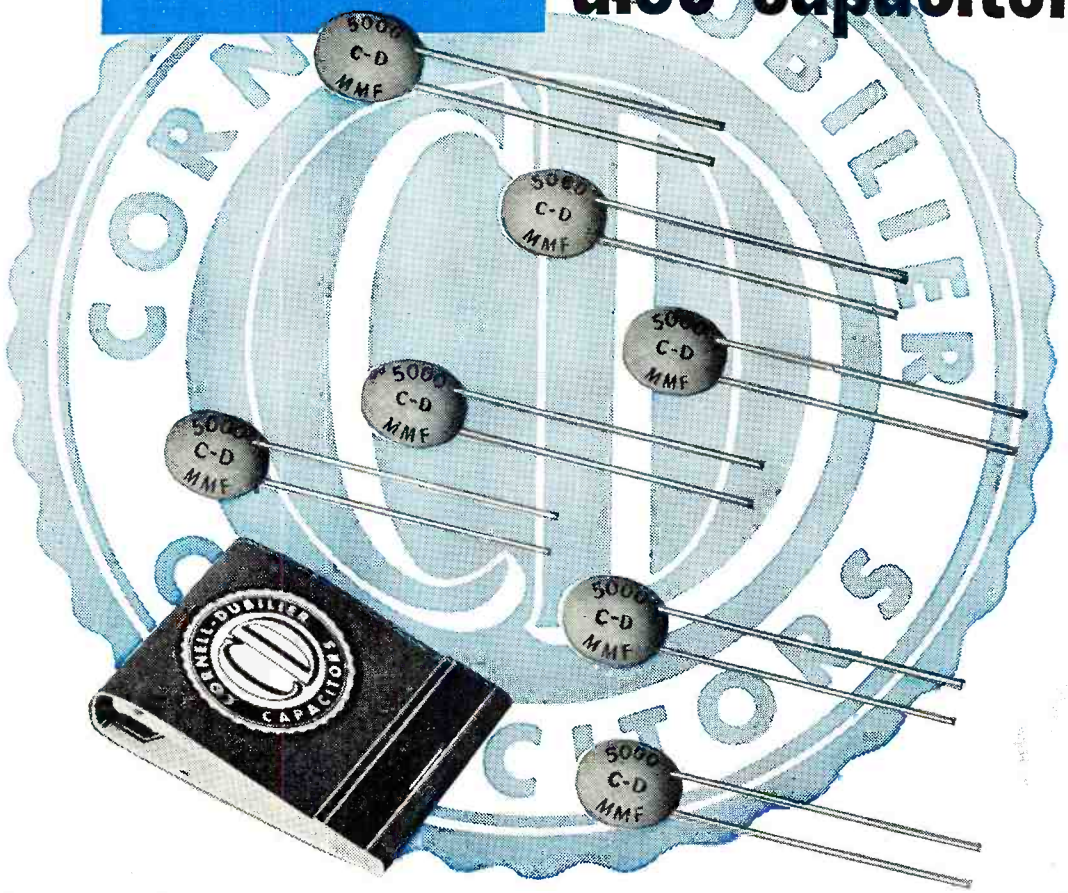

NOW—take advantage of these new, space-saving, miniature ceramic disc capacitors, designed for bypass and coupling in ultra-compact assemblies. These ceramics incorporate the same dependable performance built into the highly specialized C-D ceramic capacitors, used for years by the world's largest manufacturers of instruments and transmitter equipment.

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TV AND FM ANTENNAS — ROTATORS — CONVERTERS

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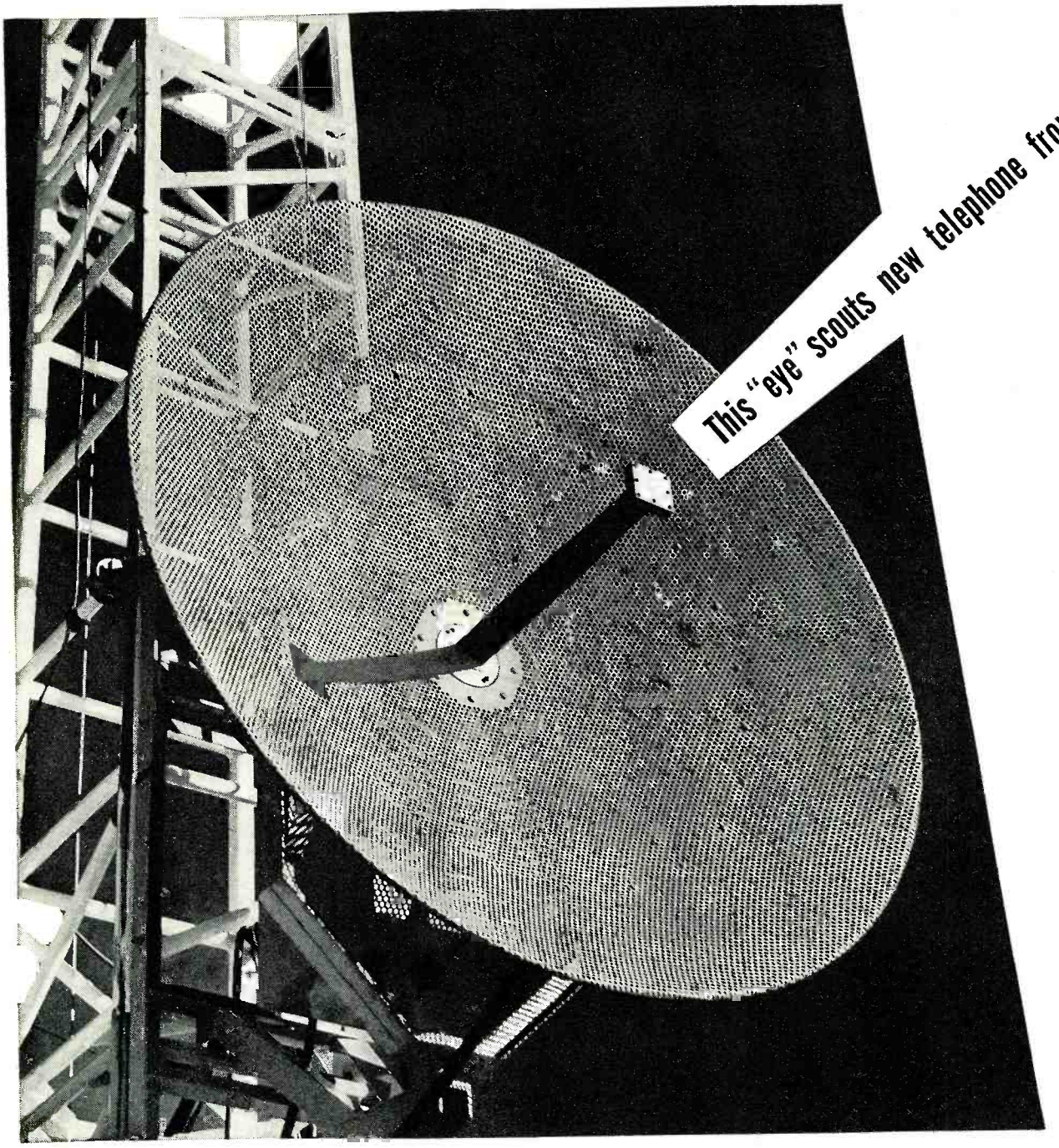

This "eye" scouts new telephone frontiers

Throughout history, scouting parties have gone out ahead of man, ahead of settlements, ahead of civilization itself. Today, Bell System scouts are engaged in a new kind of exploration — charting a path for microwaves — using equipment specially designed by Bell Telephone Laboratories.

The portable tower shown is constructed of light sections of aluminum and in a few hours may be built up to 200 feet. Gliding on rollers, the "dish," with its microwave transmitter or receiver, is quickly positioned for line-of-sight transmission, then oriented through electric motors controlled from the ground.

Test signals show how terrain and local climate can interfere with microwave transmission. Step by step, Bell's explorers avoid the obstacles and find the best course for radio relay systems which will carry television pictures or hundreds of simultaneous telephone conversations.

A radio relay link similar to the one between New York and Boston will be opened this year between New York and Chicago. Later it will be extended, perhaps into a nation-wide network — another example of the way Bell Telephone Laboratories scientists help make the world's best telephone system still better each year, and at lowest cost.

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BROWN DEVIL RESISTORS

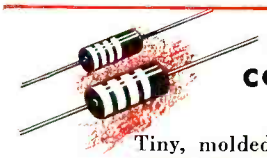
Sturdy, wire-wound, vitreous-enameled resistors for voltage dropping, bias units, bleeders, etc. In 5, 10, and 20-watts; values to 100,000 ohms.

FIXED RESISTORS

Resistance wire is wound over a ceramic core, permanently locked in place, insulated and protected by Ohmite vitreous enamel. In 25, 50, 100, 160, and 200-watt stock sizes; values from 1 to 250,000 ohms.

DIVIDOHM RESISTORS

You can quickly adjust these handy vitreous-enameled resistors to the exact resistance you want, or put on taps wherever needed for multi-tap resistors and voltage dividers. In sizes from 10 to 200 watts, to 100,000 ohms.



LITTLE DEVIL COMPOSITION RESISTORS

Tiny, molded, fixed resistors—individually marked with resistance and wattage rating—½, 1, and 2-watt sizes, ±10% tol. Also ±5% tol. 10 Ohms to 22 megohms.

DUMMY ANTENNA RESISTORS

For loading transmitters or other r.f. sources. New, rugged, vitreous-enameled units are practically non-reactive within their recommended frequency range. 100 And 250-watt sizes, 52 to 600 ohms, ±5%.

MOLDED COMPOSITION POTENTIOMETER

A high-quality, 2-watt unit with a good margin of safety. Resistance element is solid molded—not a film. The noise level is low and decreases with use.

CLOSE CONTROL RHEOSTATS

Insure permanently smooth, close control. Widely used in industry. All ceramic, vitreous enameled; 25, 50, 75, 100, 150, 225, 300, 500, 750, and 1000-watt sizes.

DIRECTION INDICATOR POTENTIOMETER

Compact, low cost. Used in a simple potentiometer circuit as a transmitting element to remotely indicate the position of a rotary-beam antenna.

HIGH-CURRENT TAP SWITCHES

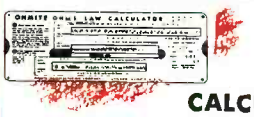
Compact, all-ceramic, multipoint, rotary selectors for a-c use. Self-cleaning, silver-to-silver contacts. Rated at 10, 15, 25, 50, and 100 amperes. Two or more can be mounted in tandem.

POWER LINE CHOKES

Keep r.f. currents from going out over the power line and causing interference with radio receivers. Also used to stop incoming r.f. interference. Has a ceramic core and moistureproof coating. In 5, 10, and 20 amps.

RADIO FREQUENCY CHOKES

Single-layer wound on low power-factor steatite or bakelite cores, with moistureproof coating. Seven stock sizes for all frequencies, 3 to 520 mc. Two units rated 600 ma, others rated 1000 ma.



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Figures ohms, watts, volts, amps—quickly, easily, with one setting of the slide. Has all computing scales on one side. Resistor color code on back. Send 25c in coin.

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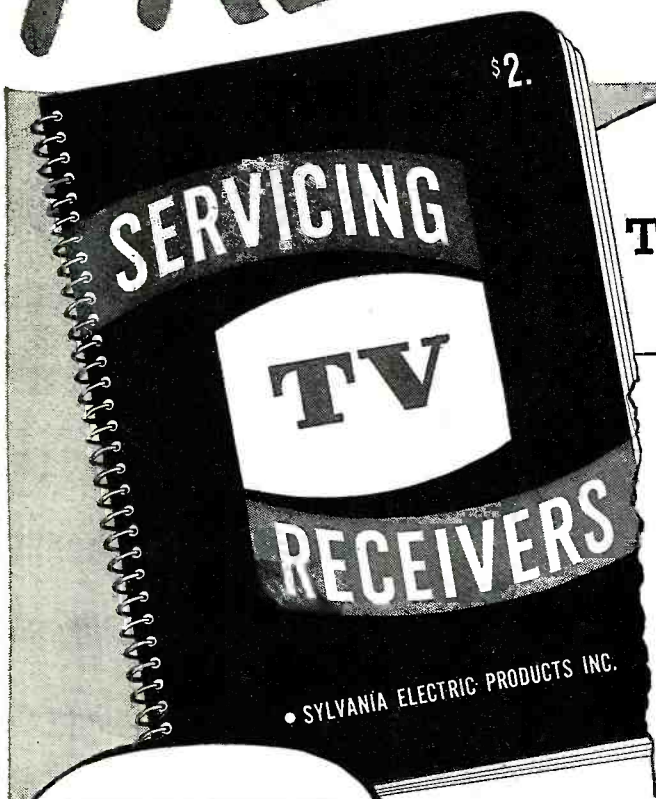
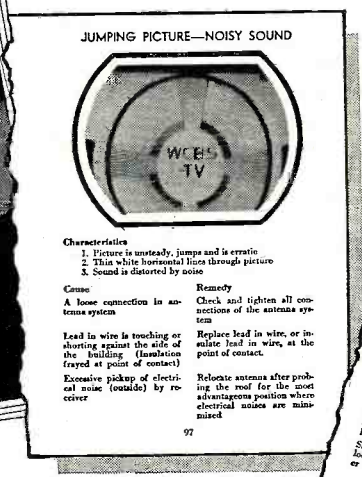


The clearest and most complete Television Servicing Book ever printed


JUMPING PICTURE—NOISY SOUND

Characteristics
1. Picture is unsteady, jumps and is erratic
2. Thin white horizontal lines through picture
3. Sound is distorted by noise

Cause	Remedy
A loose connection in antenna system	Check and tighten all connections of the antenna system
Lead in wire is touching or shorting against the side of the building (Insulation frayed at point of contact)	Replace lead in wire, or insulate lead in wire, at the point of contact.
Excessive pickup of electrical noise (outside) by receiver	Relocate antenna after probing the roof for the most advantageous position where electrical noises are minimized

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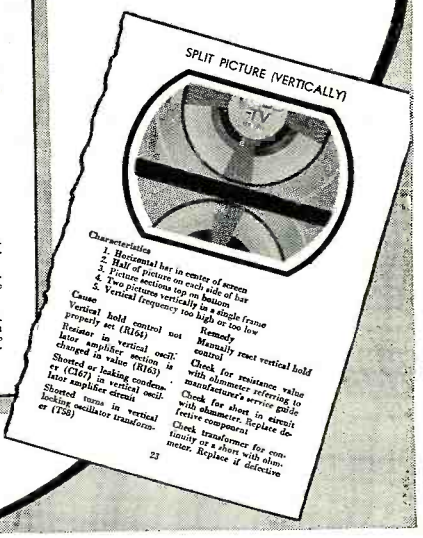
SPLIT PICTURE (VERTICALLY)

Characteristics
1. Horizontal bar in center of screen
2. Half of picture on each side of bar
3. Picture sections top on bottom
4. Two pictures vertically in a single frame
5. Vertical frequency too high or too low

Cause	Remedy
Vertical hold control not properly set (R166)	Manually react vertical hold control
Resistor in vertical oscillator amplifier section changed in value (R160)	Check for resistance value with ohmmeter referring to manufacturer's service guide
Shorted or leaking condenser (C167) in vertical oscillator amplifier circuit	Check for shorts in circuit with ohmmeter. Replace defective component
Shorted turns in vertical blocking oscillator transformer (T58)	Check transformer for continuity or a short with ohmmeter. Replace if defective

23

Here are 2 sample pages from "Servicing Television Receivers." Note the easy-to-read type arrangement and the simplified photographic instructions.

FREE

during April, May, June, July and August

HERE at last is a guidebook to help simplify TV set service for you. You'll be amazed how it will enable you to quickly identify trouble . . . solve tricky problems.

Contains more than 100 pages with scores of actual photographs and easy-to-read diagrams, to help you increase and improve your TV set repair business.

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This valuable book is yours absolutely free, from your regular Sylvania distributor, with your order of 100 Sylvania receiving tubes . . . or just 3 TV Sylvania picture tubes. Spirally bound with a sturdy board cover to stay open and lie flat on your bench.

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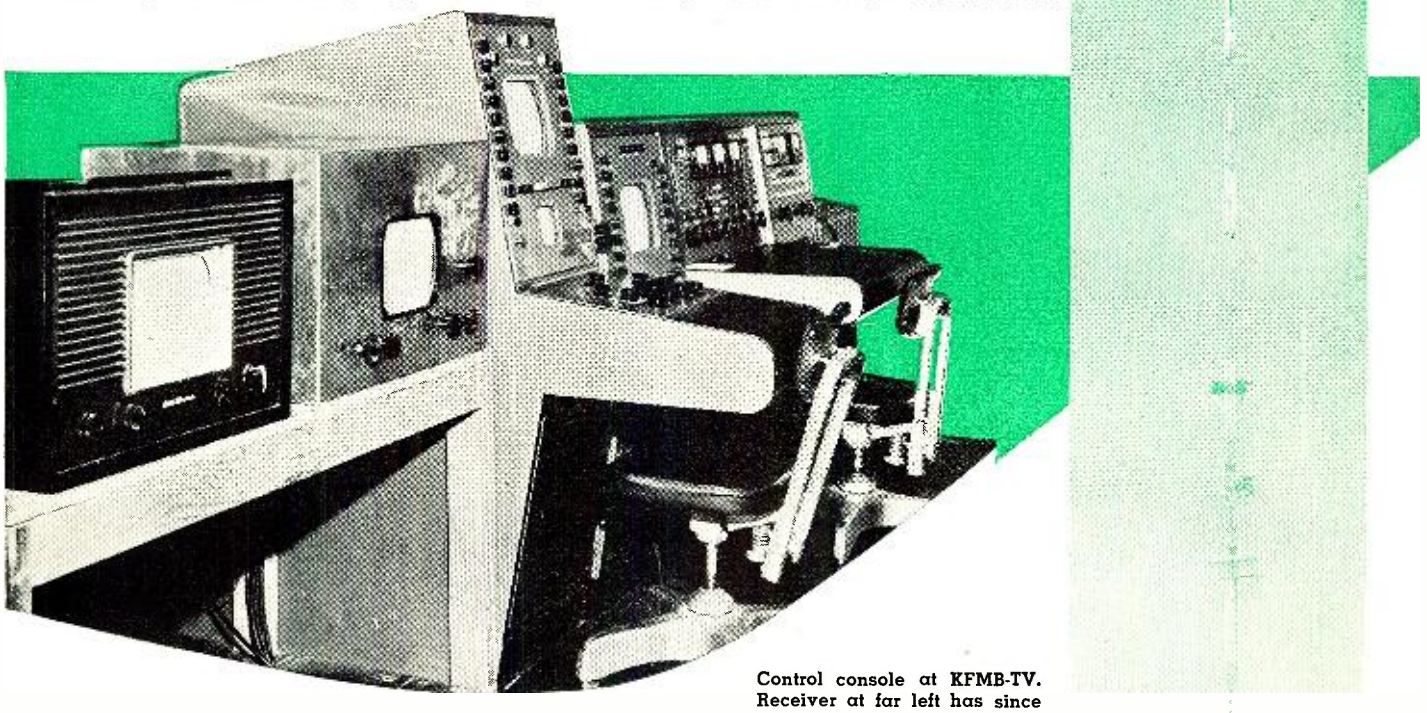
Quickly answers scores of questions

- Shows more than 80 actual photos of screen test patterns. Shows how to identify trouble by pattern behavior.
- Gives simple, concise instructions for making repairs, proper adjustments.
- Contains complete circuit diagrams of typical television receiver.
- Explains latest television developments such as "Intercarrier sound."
- Tells about television test equipment and what each instrument will do.
- Provides a practical dictionary of television set trouble.

SYLVANIA ELECTRIC

RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES, SIGN TUBING; LIGHT BULBS; PHOTOLAMPS

PUTTING TV ON THE AIR



Control console at KFMB-TV. Receiver at far left has since been replaced with a shielded unit. The receivers are used for picking up programs from Los Angeles for relay. Large unit in center is camera control console with monitor unit and master control desk beyond. Turntable is barely visible at the right. The transmitter for Station KFMB-TV is located atop Mount Soledad, on the edge of the Pacific Ocean near La Jolla, California. Small enclosure on the top of the building houses microwave dish. Space has been provided for a second receiving dish if future operations warrant.

By

CHARLES F. ABEL

Engineer, KFMB-TV

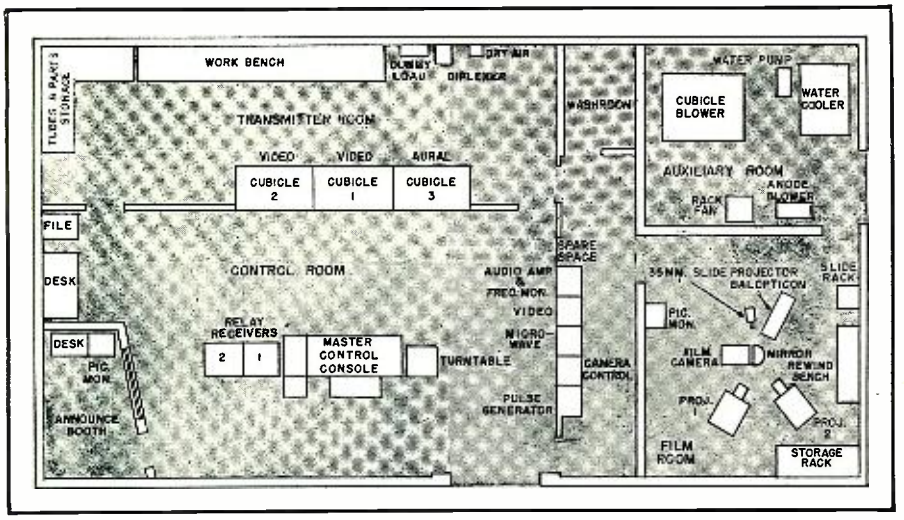
KFMB-TV beams its programs via microwave relay from San Diego to Mount Soledad. All film and slide material originates at transmitter site.

NO DOUBT you have or in the future will, sit in a television studio and watch a live video show being produced. As you watch the timed and exact movements of the camera crew and production staff you may be tempted to say to yourself, "simple, anybody can do it." But television isn't simple! To convince you that there is more to it than meets the eye, let's step behind the scenes and see what really takes place in a television station.

All the components used in regular radio broadcasting are required in television plus an extensive illumination system, camera chain, video monitoring equipment, microwave relay system, and the video transmitter, located at a specially chosen spot permitting line-of-sight transmission to the largest possible receiving area. KFMB-TV in San Diego, California is unique among television stations in that steps were taken in its design to reduce required personnel and equipment as far as possible by making several deviations from standard station planning. Some of the more important changes were the inclusion of the film equipment room in the transmitter building, and adapting the transmitter operating console as the master control console enabling all audio and video switching to be done at the transmitter. This arrangement permits the studio to remain dead during afternoon periods when films are telecast. That these changes have proved successful are borne out by the fact that performance of KFMB-TV has brought many favorable comments and congratulations to its owner-manager, Jack Gross. Despite this planned economy in men and equipment the station still requires 10 men, not including writers, cast, or musicians, and has in operation more than 1000 tubes during the production of a live TV show. Live programs are dispatched via microwave relay and telephone line from the studios in downtown San Diego to the transmitter located atop Mount Soledad, just outside La Jolla, some 10 airline miles away. Microwave signals from the studio are picked up by a specially housed parabolic antenna located atop the transmitter building.

Selection of the transmitter building site is of primary importance. Other conditions being equal, the higher the antenna, the greater the coverage. The top of KFMB-TV's antenna is just a little over 1000 feet above sea level. Since San Diego is a coastal city, it rises, saucer like, away from the coast where the station is located, providing excellent coverage. To the north of La Jolla the coastline curves gently westward for a distance of more than 100 miles, providing over-water "line-of-sight" reception for much of this area. The transmitter building is a concrete brick and redwood structure and is 750 feet above sea level (the antenna and mast tower some 250 feet above the building site).

Inside the transmitter building are several rooms which have been specifically designed for various items of telecasting equipment, including a utility room, film equipment room, washroom, work shop, emergency announcing booth and master control, and transmitter room. Sitting at the control desk the operator sees five inclosed equipment racks to his right. The first of these racks contains the frequency monitors for both the aural and visual transmitters, as well as the program amplifier, monitor amplifier, and five audio amplifiers. All incoming audio lines terminate in a patch panel included in this rack. From this point connection can be made to any of the six lines which feed audio to the main operating console. Gen-



Layout of transmitter building at station KFMB-TV, San Diego, California.

eral purpose video amplifiers occupy part of the space in the second inclosed rack. Also included is the video and sync mixing amplifier, a high capacity, well regulated, low voltage power supply, the master switches for the film machines and equipment in the other racks and the video patch panel where all incoming video signals are terminated. Three coax lines feed video signals from this point to the master console; two of these are program lines while the third is used for monitoring purposes.

Incoming microwave signals are fed into the microwave receiver control unit which is located in a third inclosed rack along with the microwave receiver power supply. Also in this rack is a power supply for the audio amplifiers plus relays for switching sound from film projectors and a relay for automatic picture fade. Camera equipment contained in the fourth rack includes a regulated, low voltage power supply, a high voltage supply used for beam acceleration, a line amplifier for increasing the amplitude of the camera signal, and the sweep generator used for scanning.

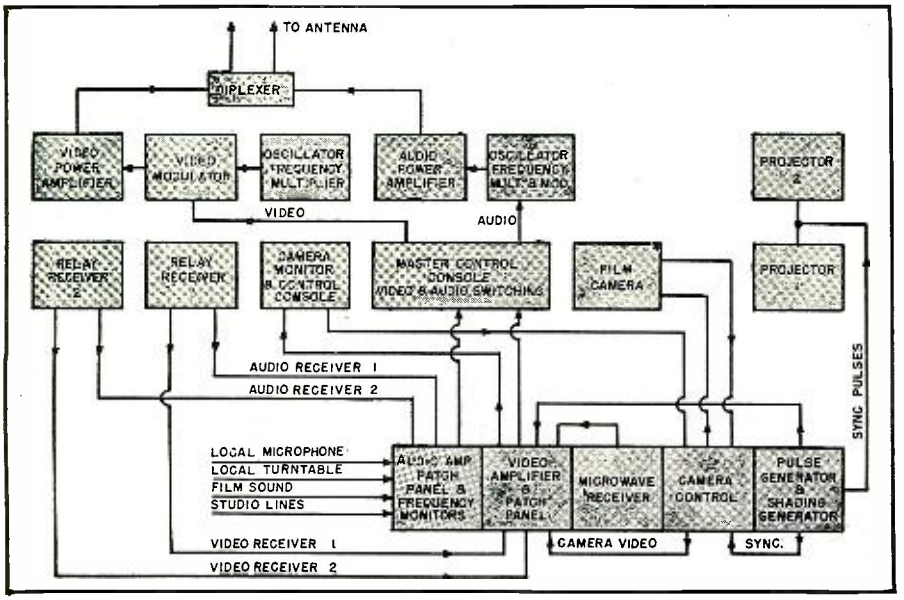
The final auxiliary equipment rack contains a regulated, low voltage power supply feeding the shading generator and the pulse generator unit. The pulse generator supplies all synchronizing signals for the transmitting equipment and also supplies the pulses radiated by the transmitter to synchronize all receivers tuned to the station.

Directly in front of the operator are the video and audio transmitters. The transmitters are housed in fully inclosed compartments with only the front doors showing in the main control room. Near the center front of the main control room is the master operating console. From this point the operator can see most of the important station equipment with the exception of the film room. The film room operator is in touch with the master control desk at all times by means of an intercom system.

The master control console is of considerable interest because it is here that each of the elements to be transmitted are checked for quality and proper relation to each other. The control console at KFMB-TV has been modified so that it functions as the chief control center for all programs except live shows. From two to four programs, taken from as many as three different channels, are relayed nightly, as well as films, and several studio shows. Although video mixing cannot be done on the console most of the functions of a mixer desk are performed at the console with the help of the video patch panel over in the racks. As the operator views the control desk the left half is devoted to control of the incoming video signal, while the right half is audio control. The video side of the console has two cathode-ray tubes which make up the picture monitor. On one tube, a 10FP4, appears a completed picture of the object being televised. Below this kinescope tube is a waveform monitor using a 5 inch cathode-ray tube with a green screen. The waveform monitor shows picture pulses or the waveform equivalent of the object on the screen above. Input to this equipment is controlled by two rows of push-buttons located on the console panel adjacent to the picture monitor. The picture and waveform monitors are independent of each other but both can be used to analyze the same signal whenever desired. The push-buttons allow the operator to make a quick check of the signal from any one of several points as it passes through the transmitter. For instance, either of two incoming video lines can be monitored directly, transmitter input, modulator output, transmitter output or the monitor line from the video patch panel can be instantly checked. The latter position is provided so that video shows can be checked and adjustments made prior to their being put on the air. Video controls on the master control panel in addition to the monitor are; peak power, r.f. gain, sync stretch, picture line attenuator, and a selector switch for either incoming video line. There is also a picture fade control and a peak clipper which is used to prevent overmodulation of the video carrier.

The right half of the master console is devoted to control of the sound transmitted along with the picture. Six audio lines come into the master console and are controlled by three attenuators, that is, two lines are fed into each attenuator. Either of the two lines can be selected by throwing a switch. Output from these three controls can be mixed when desired. After selecting the proper sound level on the incoming lines a master gain control regulates the output of the program amplifier which is used to modulate the FM sound transmitter. A monitor speaker is provided and is controlled with push-buttons in a manner similar to that of the picture monitor. It can be used to monitor any of the incoming lines or the input

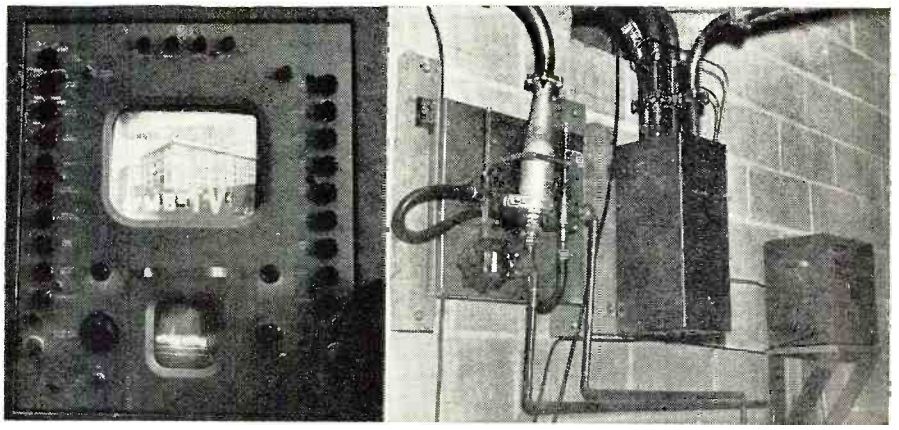
Diagram showing how equipment in transmitter building is interconnected.



or output of the transmitter. It is used, along with the video monitor, for setting up the next program, but is always left in "transmitter output" position to keep a check on the sound going on the air. Meters are used to check percentage of modulation of the FM transmitter and one each to indicate frequency deviation of the FM and video transmitters. A v.u. meter is provided to indicate the level into the program amplifier and a reflectometer meter to indicate a mismatch or the reflected energy on the transmission line. Such faults as moisture in the transmission line would cause an abnormal deflection of the meter. The transmitter is turned on and off by means of push-buttons on the right end of the console. A master switch inside cubicle one, of the transmitter, turns on the air blowers, water cooling system, and the tube filaments. After a short warmup period an automatic time cycle operates a relay which makes the transmitter ready for the air. Push-buttons on the console control the plate voltage and are the final step to putting the transmitter on the air. The control buttons are duplicated on the doors of the transmitters and again in the second cubicle of the visual transmitter. To take the station off the air only two master buttons need to be pushed; these shut off the plate voltages. Then the master switch is thrown turning off the filaments and starting an automatic cycling unit which keeps the blowers and water cooling system going for a cool down period, which lasts about two to three minutes and then everything shuts down automatically. A turntable assembly is provided at the right of the master console for emergency use in case of interrupted programming. At the left end of the master control unit is the camera control console. Part of the saving in personnel at KFMB-TV was accomplished by including this unit and the film room in the transmitter building. When films or slides are being shown the video engineer sits at the desk of the camera control unit and monitors the output of the camera as he watches the output in picture form on a regular television screen and also on a waveform monitor. During the showing of a film the output of the camera is monitored for shading and amplitude. Shading is simply adjustment of the shading generator controls to compensate for dark and light spots or areas in the picture caused by spurious response of the iconoscope. To the video operator's left as he sits at the master control desk are two modified television receivers used to pick up and relay programs originating in the Los Angeles area some 120 airline miles away. Program relay is a regular part of KFMB-TV's telecasting and has been rather highly developed by the station. Channels 4, 5, 7, and 13 are regularly picked up and relayed on Channel 8. Noteworthy is the fact that an adjacent channel, No. 7, is being relayed successfully. This is accomplished by using a specially constructed receiving antenna plus a modified commercial receiver.

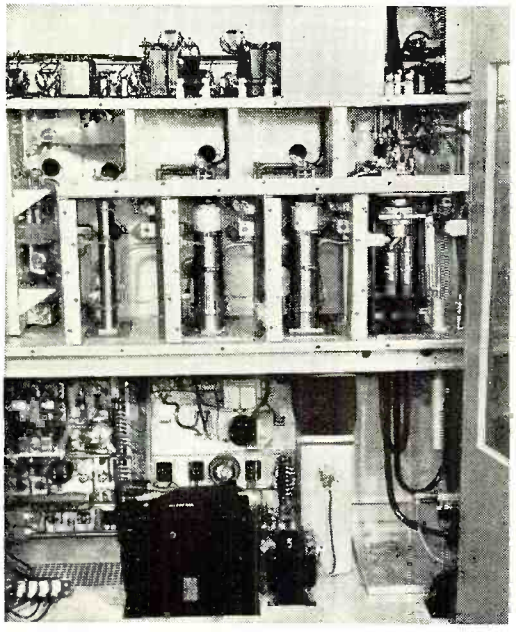
Adjoining the main control room is the film equipment room. One look inside and it can easily be seen that

(*Continued on page* 149)

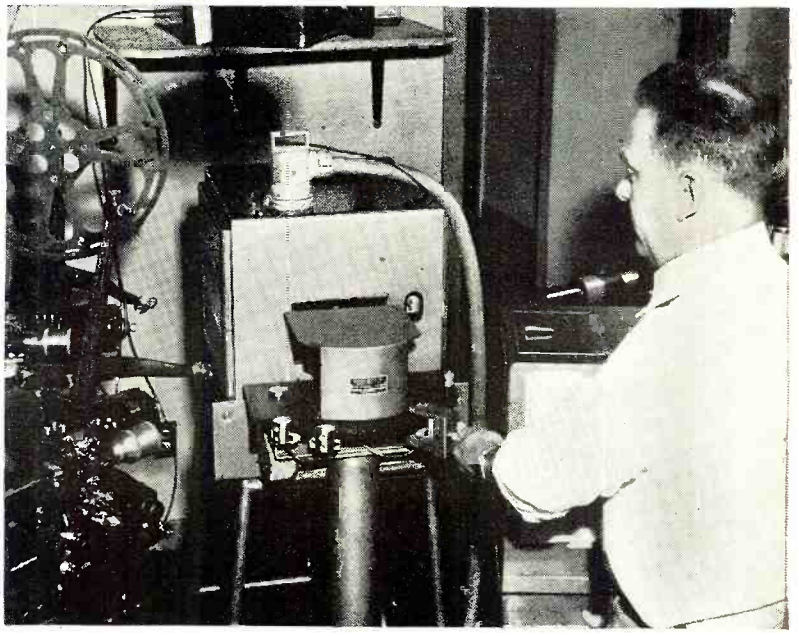


(Left) Output of KFMB-TV as it appears on monitor. Large scope shows picture as it is transmitted, while the waveform monitor below shows composite video signal. Bottom two lines show sync amplitude and above second line is picture signal. (Right) Dummy load appears at left along with water inlet and outlet thermometers. Square box below left thermometer is flow meter. Dummy load checks power output of transmitter. The Diplexer at the center of photo feeds combined video and audio signals to the antenna. Device at right is dryer unit which supplies dry, filtered air to coax line.

Rear view of power output and amplifier section of video transmitter. The 9C24's appear at center right in their water jackets with feeder hose attached. Modulator unit is at lower left. Tube compartment cover plates were removed for photo.



Engineer demonstrates the pivoted mirror which enables any of the film projectors or slide machines to be fed into the camera which is shown in the photograph to the rear of the mirror. The Baloptican unit and a 35 mm. projector are located at the right (partly obscured by the engineer) and the 16 mm. film projectors may be seen in the left foreground of photo.



THE ELECTRONIC SWITCH

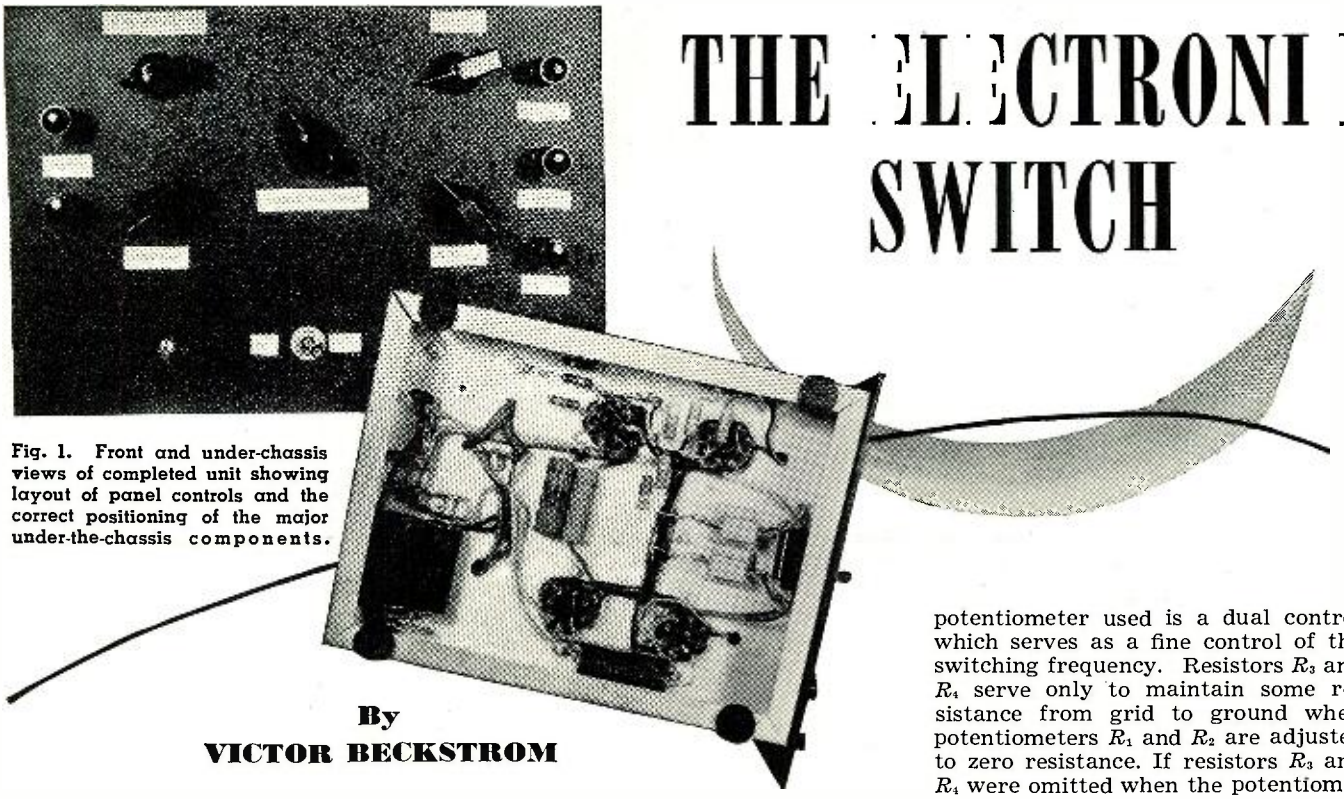


Fig. 1. Front and under-chassis views of completed unit showing layout of panel controls and the correct positioning of the major under-the-chassis components.

By
VICTOR BECKSTROM

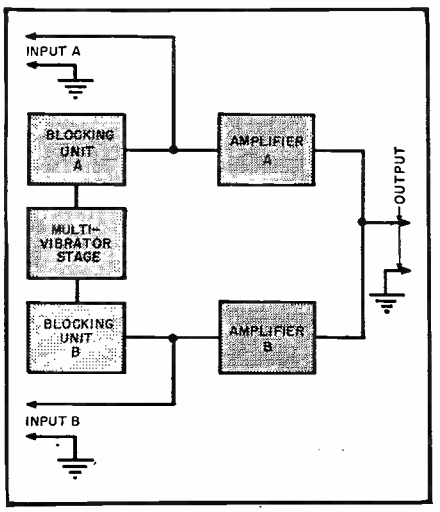
The design, construction, and operation of an economically-built electronic switch test unit.

THE oscilloscope is becoming one of the most important pieces of test equipment used in present day servicing and in the design of electronic equipment. It has become even more important with the advent of television. The oscilloscope's versatility will be increased when used in conjunction with an electronic switch, not only in television and radio servicing, but also in the design of electronic equipment. It also should be remembered that the electronic switch is a source of square-wave frequency over a limited range, and may be used in square-wave testing.

In most cases the literature available to the service technician or experimenter does not contain much information on the electronic switch; therefore it would be well to discuss briefly the theory of an electronic switch so that a better conception of the unit's construction may be had. The electronic switch consists of three units; a multivibrator stage or square-wave generator which may be a gas tube, a blocking stage, and an amplifier stage, as indicated in Fig. 2. Thus when amplifier B is blocked, signal input A appears at the output of the electronic switch. Then the process reverses and amplifier A is blocked and input B appears at the output of the electronic switch. If the square-wave switching frequency is greater than 30 cycles per second, the two waves will appear to be on the screen of the oscilloscope simultaneously due to the persistence of vision.

Referring to Fig. 3, the tube V_{1a}, V_{1b} is the tube used in the multivibrator circuit. Potentiometer R_1, along with condensers C_1, C_2, and C_3, controls half the switching frequency, and potentiometer R_2, with condensers C_4, C_5, and C_6, controls the other half of the switching frequency. To secure a symmetrical wave output from the multivibrator, condenser C_1 must equal condenser C_4, condenser C_2 must equal condenser C_5, and condenser C_3 must equal condenser C_6. Thus two identical condensers are used at one time. By selecting different values of condensers, a coarse control of the multivibrator frequency is obtained. The potentiometer used is a dual control which serves as a fine control of the switching frequency. Resistors R_3 and R_4 serve only to maintain some resistance from grid to ground when potentiometers R_1 and R_2 are adjusted to zero resistance. If resistors R_3 and R_4 were omitted when the potentiometers R_1 and R_2 are adjusted to zero, the time constant of the multivibrator would be zero; therefore there would be no switchboard frequency.

Fig. 2. Block diagram of electronic switch.



The square-wave output is obtained from the plates of the multivibrator tube and fed to the grids of tube V_{2a} and V_{2b}, which is used as the blocking stage. In the blocking stages, each stage is half of the 6SN7 tube and is actually a cathode follower circuit. Condensers C_7 and C_8 are blocking condensers, and resistors R_9 and R_{10} are the bias resistors for the amplifier tubes. Each amplifier tube has a common cathode resistor with the blocking tube. During half of the square-wave voltage, one blocking tube is held positive by the square-wave voltage. The tube will then draw heavy current through the cathode resistor causing a voltage to appear across the cathode resistor that is large enough to bias the amplifier to cut-off. At the same period of time, the current through the cathode resistor resulting from the blocking tube is zero. Therefore the bias on the amplifier is due to the plate current of the amplifier tube only, and the amplifier functions properly. The process then reverses, the other amplifier being blocked.

The input A is fed to the grid of tube V_3 through potentiometer R_{19} and part of potentiometer R_{15}, depending on the setting. Input B is fed to the grid of tube V_4 through potentiometer R_{16} and part of potentiometer R_{15}. The vertical positioning of the wave on the screen of the oscilloscope is obtained by potentiometer R_{15} by feeding a portion of the "B plus" voltage to each side of the potentiometer R_{15} to ground. Theoretically potentiometer R_{15} should have equal resistance

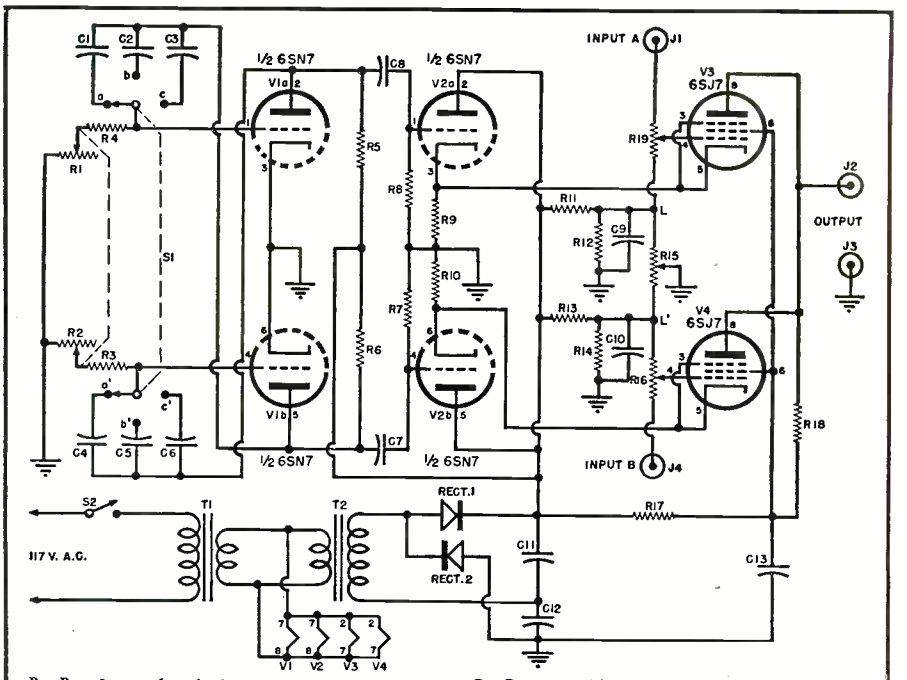
on both sides of the midpoint when both traces are on top of each other as indicated in Fig. 4. When potentiometer R_{15} is set to one side, such as position L in Fig. 3, the traces will separate due to the difference in voltage on the grid of the two amplifier tubes. The result of this is indicated in Fig. 5A. If the potentiometer setting is moved to point L', traces A and B will exchange position from those shown in Fig. 5A.

We have found, up to this point, that the traces may be placed upon each other, as in Fig. 4, or may be separated, as in Fig. 5A, into two separate traces. With this in mind, it would be well to check to see if the amplifiers are functioning properly. With the position control adjusted so that the traces will be that of Fig. 5A (that is, the position control set to one side), then apply a signal to input A and gradually increase the gain control. A 60-cycle test signal may be used for this purpose. The wave will appear on one of the traces, and the other trace will not be affected. If the test signal should be large, the gain of the amplifier will be large enough so that the wave will be too big for the screen of the oscilloscope. Therefore in most cases, the gain required for proper amplification will be small. The results of this test may be seen in Fig. 5B.

With the 60-cycle test signal applied to input A, apply a signal to input B. With this accomplished and if both amplifiers A and B are operating properly, the waveform should be similar to that of Fig. 5C. If a duplicate of the waves shown in Fig. 5C is desired, apply a 60-cycle test signal through a .001 μfd. condenser to input B. The distortion in the waveform is due to the condenser. It should be noted here that the traces and waveforms are solid lines, and not dashed lines. The dashed effect is due to the scale markings on the oscilloscope screen.

In this design the power supply used was a voltage doubler circuit consisting of two selenium rectifiers. A four ampere transformer, T_1, was used to feed from the line. The input was stepped down to 6.3 volts and then stepped up to 117 volts through a 1.2 ampere transformer, T_2, for rectification. By using two transformers as indicated, isolation was obtained. It is the best practice to use an isolation system as the electronic switch is used with other equipment and the possibility of shock between pieces of equipment is avoided. The "B plus" voltage obtained by this method is 250 volts. It may be noted here that, if desired, another power supply system may be used with equal results. This method was used for experimental purposes and yielded excellent results.

The complete electronic switch is small and compact. It was purposely designed with a panel large enough so that sufficient room is available to mount the unit either on a bench



R_1, R_2—2 megohm dual pot.
R_3, R_4, R_5, R_6, R_{17}, R_{18}—33,000 ohm, 1 w. res.
R_7, R_8—1 megohm, 1 w. res.
R_9, R_{10}—1000 ohm, 1 w. res.
R_{11}, R_{13}—68,000 ohm, 1 w. res.
R_{12}, R_{14}—15,000 ohm, 1 w. res.
R_{15}—50,000 ohm pot.
R_{16}, R_{19}—100,000 ohm pot.
C_1, C_4—.006 μfd. mica cond.
C_2, C_5—400 μμfd. mica cond.
C_3, C_6—50 μμfd. mica cond.
C_7, C_8—.1 μfd., 400 v. cond.
C_9, C_{10}—50 μfd., 25 v. elec. cond.
C_{11}, C_{12}, C_{13}—20 μfd., 250 v. elec. cond.
S_1—2-pole, 3-pos. rotary sw.
S_2—S.p.s.t. toggle sw.
T_1—Fil. trans. 117 v. to 6.3 v. @ 4 amps. (Stancor P-4019)
T_2—Fil. trans. 117 v. to 6.3 v. @ 1.2 amps. (Stancor P-6134)
Rect.$_1$, Rect.$_2$—100 ma. selenium rectifier
J_1, J_2, J_3, J_4—Open circuit jack or binding post
V_1, V_2—6SN7 tube
V_3, V_4—6SJ7 tube

Fig. 3. Circuit diagram of electronic switch using selenium type power supply.

panel or in a cabinet by drilling holes along the edge of the panel.

So far we have considered only the operation and construction of the electronic switch. It would be well to become familiar with a few of its many applications.

For example, you might be interested in designing an amplifier. In order to maintain good amplification along with good quality of reproduction of tone, the output wave should be the same as the input wave. If the bias is too high, the tube will be driven beyond cut-off during a portion of the cycle, and the waveform would be as indicated in Fig. 6A. If the grid bias is too low, the grid will be driven positive over a portion of the cycle and the grid driving voltage will drop because of the grid current flow-

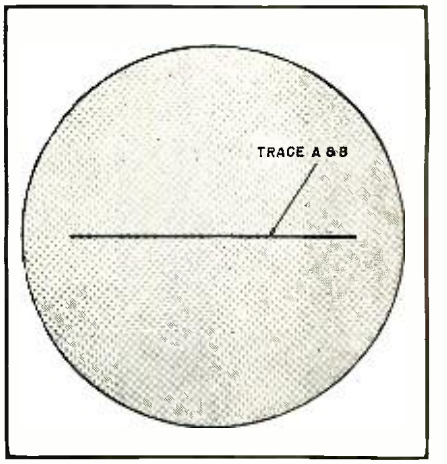
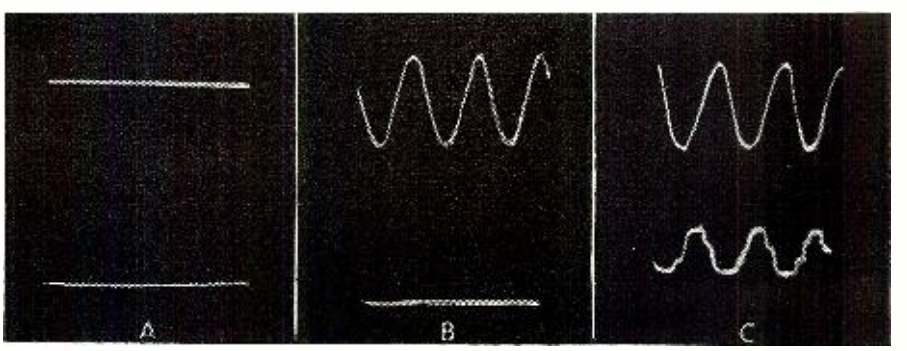


Fig. 4. Two superimposed oscilloscope traces.

Fig. 5. (A) Two traces on oscilloscope obtained from electronic switch. (B) A 60-cycle wave applied to input A, with trace B unaffected. (C) The 60-cycle signal applied to input A, and a distorted wave applied to input B.



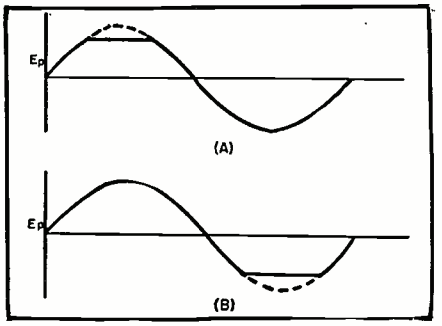


Fig. 6. (A) Clipping due to excessive grid bias. (B) due to insufficient grid bias.

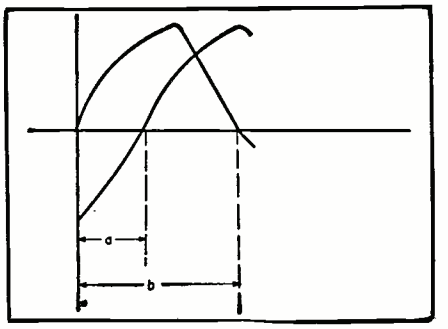


Fig. 7. The a and b distances used in calculating the phase shift of a waveform.

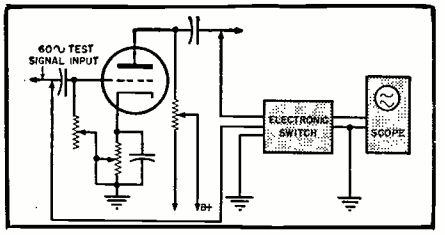


Fig. 8. Test setup used in checking operating condition of audio amplifier stage.

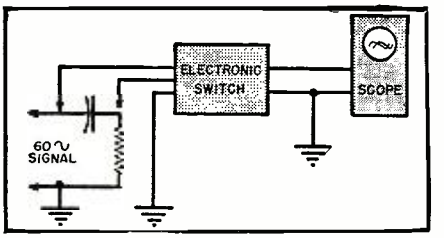


Fig. 9. Diagram of test setup for using the switch to demonstrate phase shift.

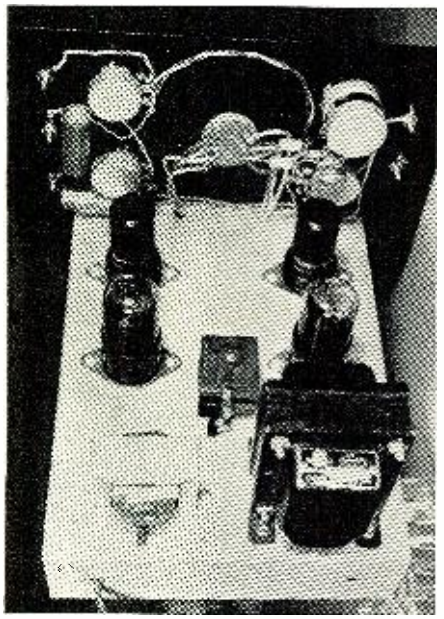


Fig. 10. Top chassis view of unit showing location of back-of-the-panel components.

ing through the impedance of the driving stage. This grid current will result in an output wave as indicated in Fig. 6B. Therefore, it is obvious that if the waveform could be viewed going into the amplifier along with the output waveform, the choice of the proper grid bias could be made. If the bias is correct, a sine wave would be obtained if the input is a sine wave. Thus if the bias is adjusted to this value, the maximum output voltage may be obtained without distortion.

By the use of an electronic switch, the viewing of two waves may be obtained. Variable resistors or potentiometers can be inserted in the cathode, grid, and plate circuits and adjusted while watching the operation of the stage on the oscilloscope. The method used to obtain this proper grid bias is shown in Fig. 8. It may be seen that this method of designing an amplifier, stage-by-stage, may be used to view the wave obtained and to check the amount of distortion in a receiver, stage-by-stage. It may be noted that by this method of designing an amplifier, many mathematical calculations are eliminated.

In order to get a better understanding of this application, refer to Fig. 11A. In this case the electronic switch, oscilloscope, and a cheap four-tube table model radio were connected as in Fig. 8. The top wave is the input 60-cycle sine wave; the bottom wave is the output. In comparing the input and output, the output is highly distorted and shows that an insufficient grid bias exists, as discussed earlier in the article.

Another very important use of the electronic switch is that of finding phase shift. The phase shift may be found in an *LC* circuit or through one or more stages of an amplifier or receiver, or any other type of circuit. For the purpose of illustration of phase shift, we shall use a circuit as in Fig. 9. Before impressing the input signals A and B to the electronic switch, superimpose the traces with the positioning control. Apply the signal to the inputs and bring the waves to equal amplitude with the gain controls. The waveform should be that of Fig. 7 or Fig. 11B. Measure the a and b distance, shown in Fig. 7, with any convenient scale, as long as both a and b distances are measured with the same scale. Most oscilloscopes have a celluloid scale that may be used. If the phase angle is indicated by θ, then:

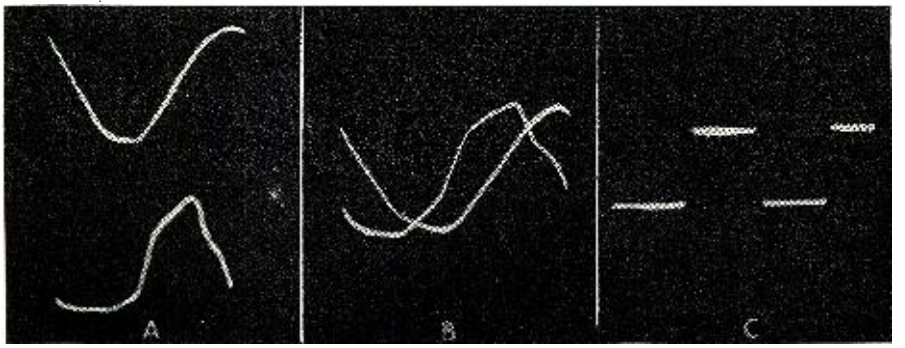
$$\theta = 180\ a/b \text{ degrees.}$$

If $a = 10$ units, and $b = 23$ units, then the phase angle is $\theta = 180\ a/b = 180 \times 10/23$ which is equal to 78.2 degrees. In this case there exists a phase angle along with distortion of the 60-cycle test signal. There are numerous other methods to find phase angle, but the other methods require either higher mathematics or the memorization of numerous configurations. Therefore, it is believed that this method is by far the simplest for all practical purposes.

It has been previously mentioned that the electronic switch is an excellent source of square-wave frequency over a limited range. The useful range of the square-wave frequency of this electronic switch is 80 to 600 cycles per second. The switching rate is 60 to 8000 times per second. The square-wave frequency covers a much larger range that is lower and higher, but at these frequencies the waveform is not a true square wave. The available square-wave frequency is of sufficient quality to be used in square-wave testing. Fig. 11C shows the square wave that may be obtained at mid-frequency. It may be stated here that in some cases at higher frequency, a slight transient effect will be indicated when viewed on an oscilloscope. This transient effect will have no effect upon the square wave.

A number of examples have been used to illustrate the very valuable use of an electronic switch. The complete unit may be constructed for less than 20 dollars. If surplus tubes are used, as in this case, the cost of the completed unit is less. When building the unit, all parts should be mounted first, then all filaments and the power supply should be connected. It was found that if the unit is then wired stage-by-stage, less error in wiring will be encountered. —30—

Fig. 11. (A) Distortion in table model radio illustrated by the difference in two waves. (B) Phase shift as in wave of Fig. 7. (C) Square-wave obtained from electronic switch.



ABC Uses MAGNETIC TAPE For Delayed Broadcasts

By

BYRON H. SPEIRS
AM Recording Supervisor
Central Division, ABC

Wm. Thomas and B. H. Speirs run an equipment check at ABC's tape recording center, Central Div., Chicago.

The exclusive use of magnetic tape in recording programs provides an inexpensive solution to delayed broadcast problem for ABC.

THE seasonal adoption of Daylight Saving Time by the major cities during the summer months creates a problem for the broadcast networks. The portions of the country which do not adopt Daylight Time must be supplied with network programs at their accustomed times to avoid confusion and its attendant loss of listeners.

In the past it was the practice of the major networks to record the programs for the areas remaining on Standard Time on acetate discs. The programs were then fed back to the network at the proper time, and the stations in Standard Time areas took these programs off the line and in turn fed them to their transmitters. The same technique was also used for the stations which operated in the different time zones of the nation.

Obviously, this type of operation required the use of large quantities of discs with their attendant storage problem and high cost. In addition, the recording and playback machines needed frequent service to maintain them in proper operating condition. A bank of recording machines of the disc type also requires a considerable amount of space.

Prior to 1948, the *American Broadcasting Company* did none of their own recording, preferring to have this work done by independent companies equipped to handle this operation. With the advent of high quality tape recorders, several of the problems were automatically solved.

Tape machines have the advantage of requiring little service except routine maintenance, and the tape may be used over and over, with a very low cost per recording, and no storage problem. The fidelity of tape greatly exceeds that obtained with the best disc equipment, and recordings of almost any length may be made with no interruption. A standard sixteen inch disc can only record slightly over 15 minutes of program before it is necessary to change machines. Quite often it is difficult to time the disc to place the end of a recording at a point where the continuity is not disturbed.

Occasionally it is desirable to be able to edit portions of a program to eliminate errors and allow breaks for local spot announcements. Editing is difficult if not impossible with discs, but is a very simple matter when tape is used. The undesired portion is simply cut out and the ends of the tape spliced.

With the use of tape it is also possible to pick out any desired portion of the program, as the tape itself may be readily marked with the content of that portion.

The Chicago studios of *ABC* use a total of ten tape machines. Four units *(Stancil-Hoffman)* are mounted in relay racks. The units mounted in the consoles (as shown on front cover) are *Ampex* machines and are used for the bulk of the recording.

A block diagram showing the basic control and switching system is shown in Fig. 1. By means of this switching system any machine may be selected for either record or playback. All recording and playback is made in duplicate to insure against equipment failure although experience has shown that this feature is seldom needed.

In feeding a program to the network, two machines with duplicate tapes are run in synchronization. The master machine feeds one line while the safety or emergency machine is feeding the second line and is preset to feed the first line in the event of failure, simply by means of pressing an "Operate" button on any control panel. Each machine is equipped with its own control panel and monitor speaker.

The tape equipment was installed in the spring of 1948 and at this time has been in use for approximately 7100 hours. During 1948 the total time lost due to tape breakage was only three minutes. This represents the extremely low figure of .002%. No time whatsoever was lost during 1949.

It has been the experience of the engineers that the tape is constantly being improved in both mechanical and electrical quality. Although accurate records are not kept on the life of the tape, one tape which was checked,

(*Continued on page* 134)

The MINI-RACK MODULATOR

By JOHN F. CLEMENS,
W9ERN

Fig. 1. Front view of modulator unit shown with its companion transmitter, covered last month.

This 50-watt modulator is designed as a companion unit to the "Mini-Rack Transmitter" described in last month's issue. It may, however, be used to modulate any c.w. transmitter of up to 125 watts input. An antenna matching network and a splatter suppressing clipper unit are also included.

A RECENT circuit development by the tube division of *RCA* has opened up new possibilities for the versatile 807 beam tube in audio service. The operating characteristics published for the 807 as a beam tetrode are perhaps the most tempting of any tube for audio powers of up to 120 watts, since such outputs may be obtained with but a fraction of a watt of driving power. Nevertheless, the requirement of a stabilized, low-impedance bias source of about 25 volts has deterred many hams from using the 807 for class AB2 audio applications. Operating conditions for the 807 as a zero-biased high-mu triode are now available and will be hailed by those who dislike C batteries and multiple power supplies as the answer to a ham's prayer.

It will be noticed that the driver transformer drives the 807 *screen grids* with the control grids connected through resistors to their respective screen grids. The value of the series resistance in each control grid, 22,000 ohms, is the "magic number" which has been found to produce a family of plate characteristic curves ideal for class B zero-biased operation. Since the effective value of grid impedance is approximately 7100 ohms, a driver transformer having a 1:1 ratio between primary and one-half of the secondary may be used to couple the modulator to a beam tube such as the 6L6.

In the modulator pictured, a single power supply is used for both modulator and speech amplifier, thereby reducing the cost. Choke input is used to obtain good voltage regulation of the power supply and the speech amplifier acts as a constant load in lieu of a bleeder. For good regulation of the supply output voltage with a filter choke of 8 henrys a bleeder resistor of 8000 ohms would be necessary. This resistor would draw 62 ma. from a 500 volt supply—practically the same amount of current that the speech amplifier consumes. Thus, it is apparent that by eliminating the bleeder and low-voltage power supply we are gaining a considerable amount of over-all efficiency.

A unique virtue of zero-biased class B tubes is the constancy of the load they present to the driver tube. For this reason, in addition to the high value of grid impedance, no special precautions need be taken to obtain good regulation in the driver stage. As a result, distortion-free operation may be obtained with a beam tube rather than the more common low efficiency triode as a driver. By introducing 6 db. of inverse voltage feedback around the driver tube, its effective internal impedance is reduced to the point where distortion does not appear even on audio peaks.

If greater power output is desired, up to 100 watts may be obtained by merely increasing the 807 plate voltage to 750. If the maximum rated power output of 120 watts is required the driving power should be increased. A pair of push-pull 6V6's is suggested for this application. The single 6L6 in the present unit operates at 350 volts on the plate and 200 volts on the screen. The plate voltage for the two speech amplifier stages is obtained from the 200 volt point at the driver screen.

The single power supply uses one of the very common 600 volt, 200 ma. power transformers and supplies, in addition, all filament voltages to the modulator, rectifier, and clipper tube. With choke input, the output voltage is 500 volts with good regulation. The single section filter is quite sufficient since the push-pull connection of the modulator balances out power supply hum and the speech amplifier stages have the additional filtering of the voltage-dropping circuit plus the audio decoupling circuit. The hum level of the power supply itself is approximately 1% or 40 db. down. Plate and filament voltages are turned on together and it is therefore necessary to use a slow heating rectifier tube to avoid a high voltage surge which might damage the audio decoupling condensers. With a 5V4G, the speech amplifier has time to warm up and act as a load on the power supply itself to prevent condenser input conditions occurring.

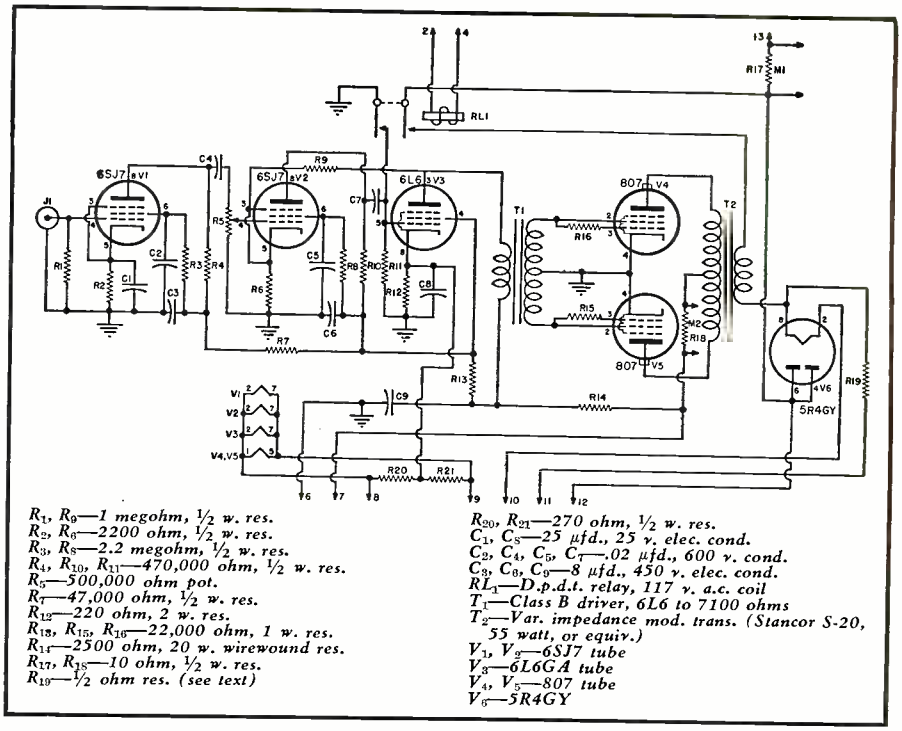
A high resistance bleeder is connected across the power supply as a safety measure to assure discharge of the power supply if it is operated while disconnected from the modulator.

For the speech amplifier, two high-gain, pentode-connected 6SJ7's are used in cascade. The gain is such that full modulation is obtained when speaking a foot or more from the mike pictured, a *Turner* model 33D with an output of −54 db. below one volt. The hum level of the modulator is extremely low due partly to the fact that the heaters are operated at a slight positive potential with respect to the cathodes, as recommended by the tube manufacturers. This positive potential is secured by returning the center-tapped filament resistor to the 6L6 cathode rather than to ground. Both filament leads are above ground so that no 60 cycle current flows in the chassis.

Since the frequency response of amateur-line modulation transformers is limited, the speech amplifier range should be similarly restricted so that distortion will not be produced by driving the transformers outside their distortionless range. To limit the low frequency response, the screen bypass condensers on the two 6SJ7's are made somewhat smaller than usual so that screen grid degeneration will occur at low frequencies. With the specified values of grid and plate load resistors the response will drop off above 5000 and below 150 c.p.s.

The modulators require a plate-to-plate load impedance of about 4000 ohms. A variable transformer is desirable in order to adjust the load to the correct value for least distortion and greatest output power. A measured undistorted output of 54 watts is obtainable from the secondary of the output transformer. For speech work the modulator will modulate transmitters of up to 125 watts input.

A clipper tube has been incorporated in the modulator to prevent splatter due to negative overmodulation. The circuit used is a high-level type clipper which was originated by Howard Johnson, W7MU. This circuit has some advantages over low-level clippers and other types of high-level clippers because it requires no additional filter and there is no arbitrary adjustment necessary. The leakage reactance of the modulation transformer is used in conjunction with the plate bypass condenser to form a low-pass filter which does not pass the distortion frequencies generated by the clipping. The clipping action never occurs until 100% modulation in the downward direction has been exceeded. Excessive upward modulation does not produce splatter and therefore is not objectionable. Since two filament windings are available on the 600 volt power transformer, the extra 6.3 volt winding is used on the clipper tube. The voltage is dropped to the required 5 volts at 2 amps. by the resistance of an 8-inch piece of number 22 soft iron wire used as one of the hookup leads between power supply and modulator chassis. Approximately one-half ohm is required and the exact value may be ascertained by measurement of the voltage on the 5R4GY filament. The filament voltage is not critical and the full 6.3 volts could probably be safely used on the tube filament. Using the 5R4GY with both plates in parallel, the clipper tube is responsible for a voltage drop of 30 volts at 200 ma. With the trapezoid pattern on an oscilloscope



R_1, R_9—1 megohm, ½ w. res.
R_2, R_6—2200 ohm, ½ w. res.
R_3, R_8—2.2 megohm, ½ w. res.
R_4, R_{10}, R_{11}—470,000 ohm, ½ w. res.
R_5—500,000 ohm pot.
R_7—47,000 ohm, ½ w. res.
R_{12}—220 ohm, 2 w. res.
R_{13}, R_{15}, R_{16}—22,000 ohm, 1 w. res.
R_{14}—2500 ohm, 20 w. wirewound res.
R_{17}, R_{18}—10 ohm, ½ w. res.
R_{19}—½ ohm res. (see text)
R_{20}, R_{21}—270 ohm, ½ w. res.
C_1, C_8—25 μfd., 25 v. elec. cond.
C_2, C_4, C_5, C_7—.02 μfd., 600 v. cond.
C_3, C_6, C_9—8 μfd., 450 v. elec. cond.
RL_1—D.p.d.t. relay, 117 v. a.c. coil
T_1—Class B driver, 6L6 to 7100 ohms
T_2—Var. impedance mod. trans. (Stancor S-20, 55 watt, or equiv.)
V_1, V_2—6SJ7 tube
V_3—6L6GA tube
V_4, V_5—807 tube
V_6—5R4GY

Fig. 2. Schematic diagram and parts list for the 50-watt modulator unit.

Fig. 3. Under chassis view of modulator. The bottom cover has been removed to show simplicity of wiring. Ceramic sockets are recommended to prevent leakage and the d.p.d.t. meter switch is of the ceramic wafer type. The lead from the mike connector to the grid of the amplifier must be as short as possible.

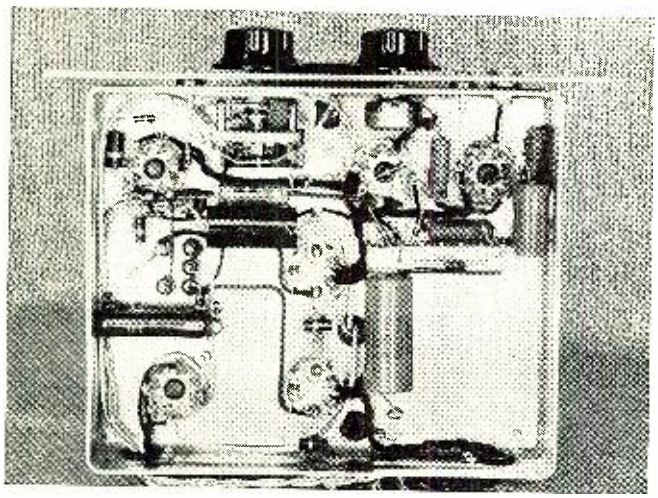
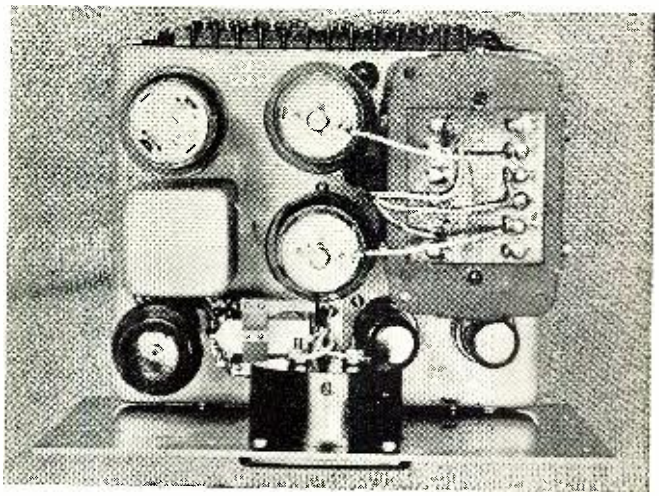
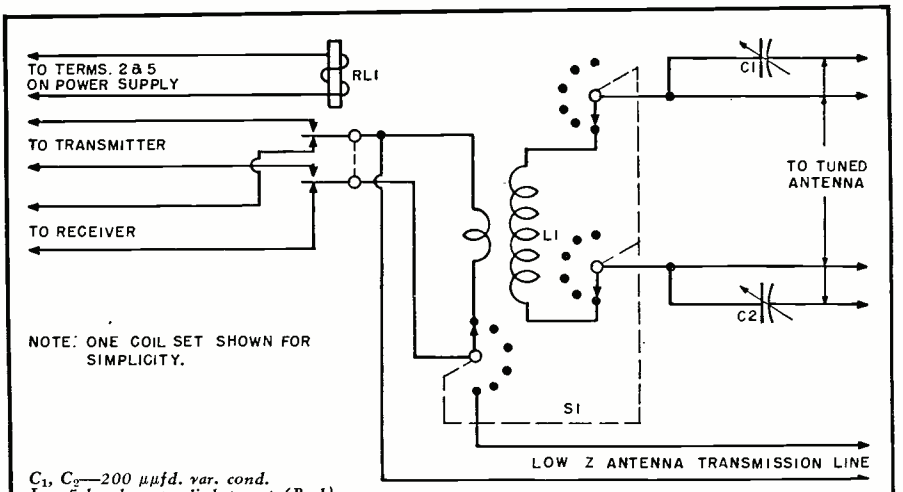


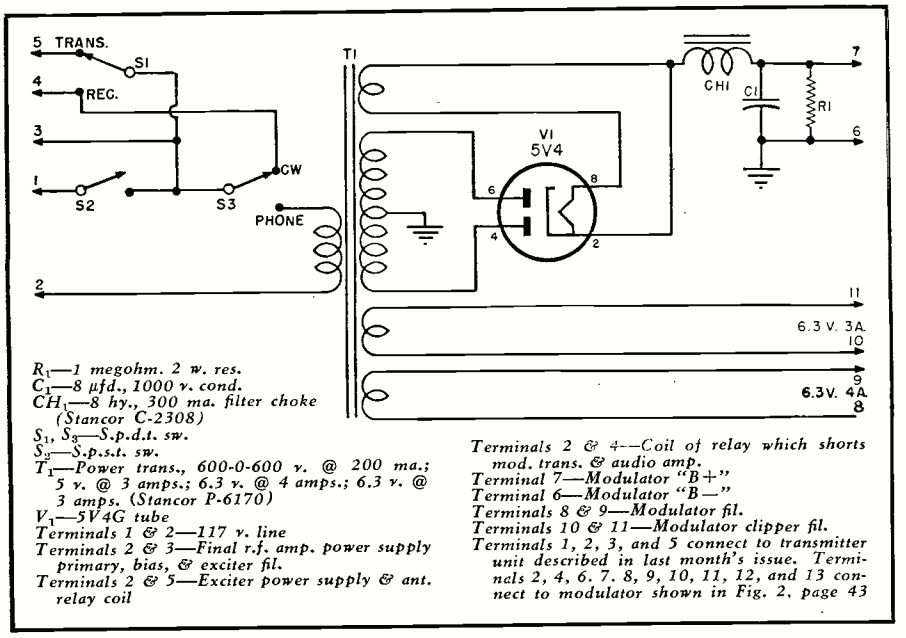
Fig. 4. Top view of the modulator chassis. Directly behind the panel are the two speech amplifier tubes and the audio relay and driver tube in a row. The 5R4GY in one corner of the chassis is the high-level clipper used in this circuit to prevent the overmodulation splatter which is generally encountered.





C_1, C_2—200 μμfd. var. cond.
L_1—5-band center link turret (Bud)
RL_1—D.p.d.t. ceramic insulated ant. relay, 117 v. a.c. coil
Note: Bandswitch, S_1, has 6 positions, the 6th being used to feed low impedance antenna directly through relay to transmitter or receiver.

Fig. 5. Circuit diagram of the 5-band antenna tuner used with the 50-watt modulator.



R_1—1 megohm. 2 w. res.
C_1—8 μfd., 1000 v. cond.
CH_1—8 hy., 300 ma. filter choke (Stancor C-2308)
S_1, S_3—S.p.d.t. sw.
S_2—S.p.s.t. sw.
T_1—Power trans., 600-0-600 v. @ 200 ma.; 5 v. @ 3 amps.; 6.3 v. @ 4 amps.; 6.3 v. @ 3 amps. (Stancor P-6170)
V_1—5V4G tube
Terminals 1 & 2—117 v. line
Terminals 2 & 3—Final r.f. amp. power supply primary, bias, & exciter fil.
Terminals 2 & 5—Exciter power supply & ant. relay coil
Terminals 2 & 4—Coil of relay which shorts mod. trans. & audio amp.
Terminal 7—Modulator "B+"
Terminal 6—Modulator "B—"
Terminals 8 & 9—Modulator fil.
Terminals 10 & 11—Modulator clipper fil.
Terminals 1, 2, 3, and 5 connect to transmitter unit described in last month's issue. Terminals 2, 4, 6. 7. 8, 9, 10, 11, 12, and 13 connect to modulator shown in Fig. 2, page 43

Fig. 6. Circuit diagram and parts list covering the power supply for the modulator.

it is possible to see the improvement due to the clipper by the elimination of the negative "pip."

A 300 ma. meter is installed on the modulator with a switch so that the meter may be used to indicate either class B or the class C plate currents. If the meter is calibrated with an oscilloscope or other modulation indicator it is a very reliable modulation monitor, 100% modulation occurring at about 225 ma. with an input of 100 watts to the modulated stage. The clipper stage may be relied upon to catch the over modulation peaks which invariably occur with speech input and which the meter does not indicate due to its inertia. Switched to the other position the meter reads the sum of the plate and screen currents of the modulated amplifier, but this is not a great disadvantage since it is easy to subtract mentally the 10 to 20 ma. drawn by the screen circuit when computing the plate input. Incidentally, the total plate and screen current should be used in computing the load presented to the modulator.

Three switches on the modulator power supply panel control the entire transmitter. Reference to the circuit diagram will show how the first switch controls the power to the entire transmitter. The second switch selects phone or c.w. operation, while the third is the "transmit-receive" switch. A relay on the modulator chassis shorts the modulation transformer secondary and the clipper tube during standby periods and for c.w. and at the same time shorts the audio signal at the 6L6 driver grid. The modulation transformer should be shorted for c.w. operation since the transient currents caused by abrupt keying of the final plate current may generate sufficient voltage to arc over in the transformer. Shorting the audio signal is to be preferred to switching the plate voltage on the modulator because the audio short circuit is instantaneous in effect and repeated surges and dis-

(Continued on page 95)

Fig. 7. Over-all view of antenna tuner. A 300-ohm twin-lead is used to make the connection from the antenna relay to the receiver terminals as well as the connections between transmitter and tuner. The five coils cover 80, 40, 20, 15, and 10 meters.

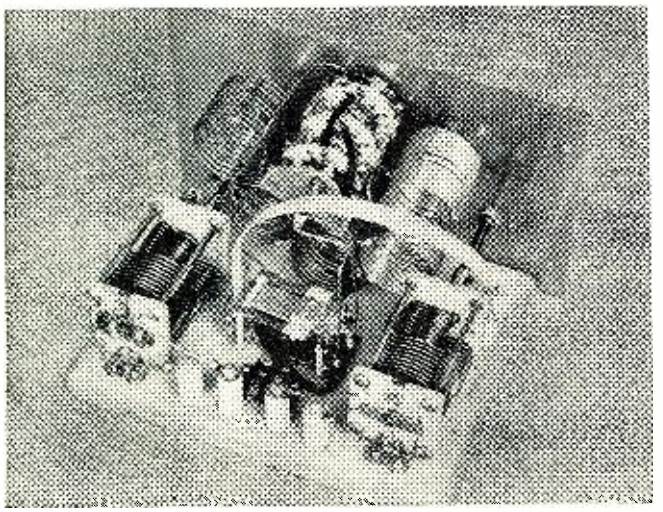
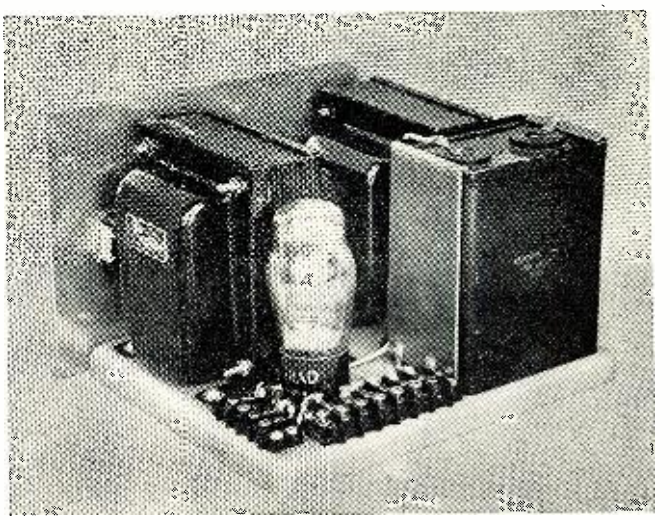
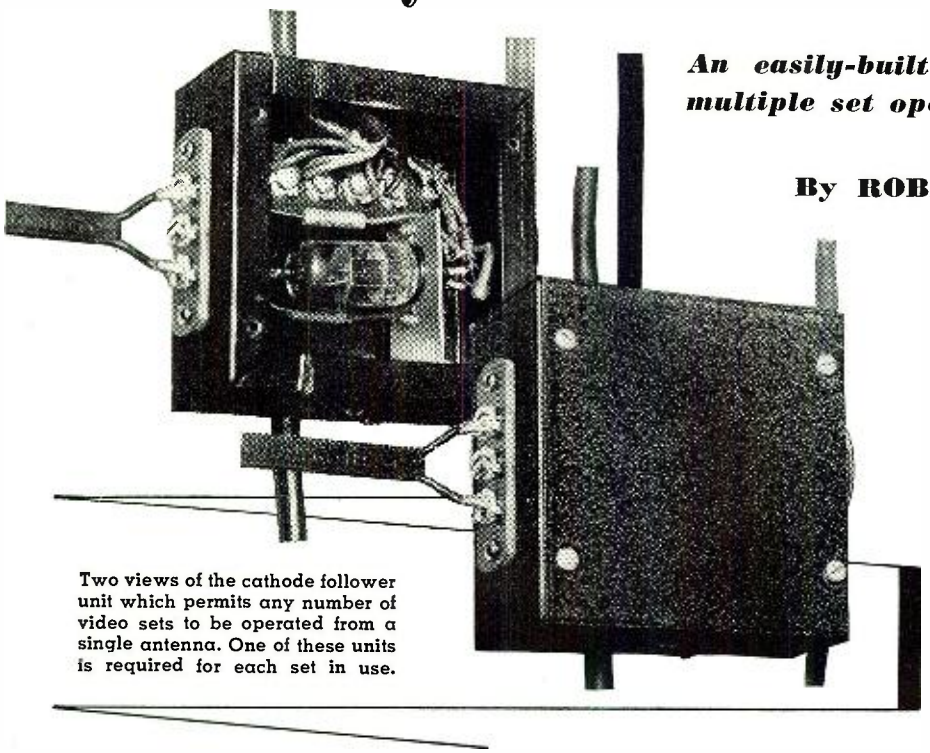


Fig. 8. The modulator power supply. All components are assembled on a ¾" deep chassis to conserve space. All transmitter switching is controlled from the power supply panel through connections to the terminal strip on the rear of the chassis.



MULTIPLEX TV ANTENNA Systems for Stores



Two views of the cathode follower unit which permits any number of video sets to be operated from a single antenna. One of these units is required for each set in use.

An easily-built cathode follower unit for multiple set operation from single antenna.

By ROBERT L. DONALDSON

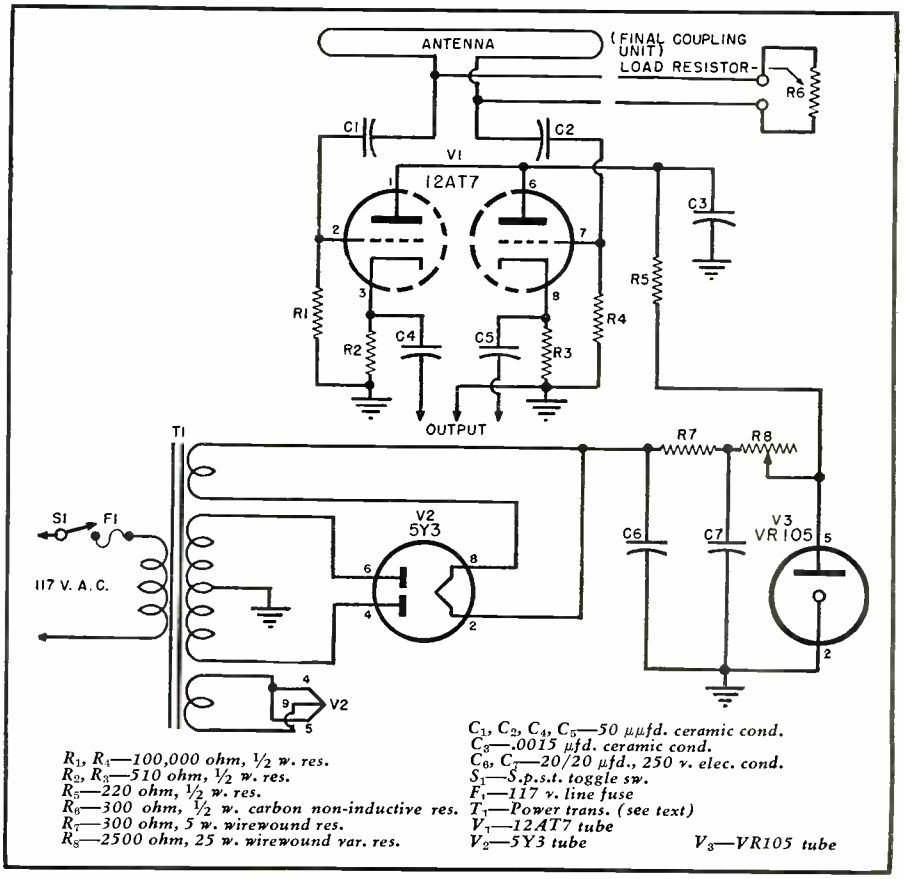
ONE of the problems faced by operators of television receiver showrooms is that of multiple operation of several TV sets from one antenna system. The usual evasion of the problem by installing a switch system that allows but one set at a time to be connected is not satisfactory. The impossibility of showing direct comparisons between sets, and the bother of constantly operating the switch are annoying factors. If two or more sets are connected in parallel across the lead-in the signal power is shared by the sets, and so the signal available to each set gets poorer as more sets are added. The very low load impedance of the combination causes extreme standing wave effects, and reflections result in degeneration of the image on all sets. Resistance pads between the sets and the lead-in help to maintain proper impedance match, but result in even greater attenuation of the signal at the set. In addition, there is usually severe interference between sets, limiting simultaneous operation. What is needed, then, is a simple system that would overcome this general problem.

Such a system is herein described. It operates by employing a number of cathode follower units between the lead-in distribution line and the set inputs. The cathode follower circuit has the desirable characteristics of extremely high input impedance, thus not loading the line, and low output impedance that may be made equal to the input impedance of the set used, thus assuring maximum power transfer. It is also a "one way" device that effectively prevents oscillator energy from a set going back into the line and causing interference with other sets.

The particular arrangement that has proven very effective is where a 300 ohm twin lead is run down from the antenna and is routed around the showroom. At intervals along this line the cathode follower units are placed, attached to the wall, and merely shunted across the line. Any reasonable number of coupling units may be used,

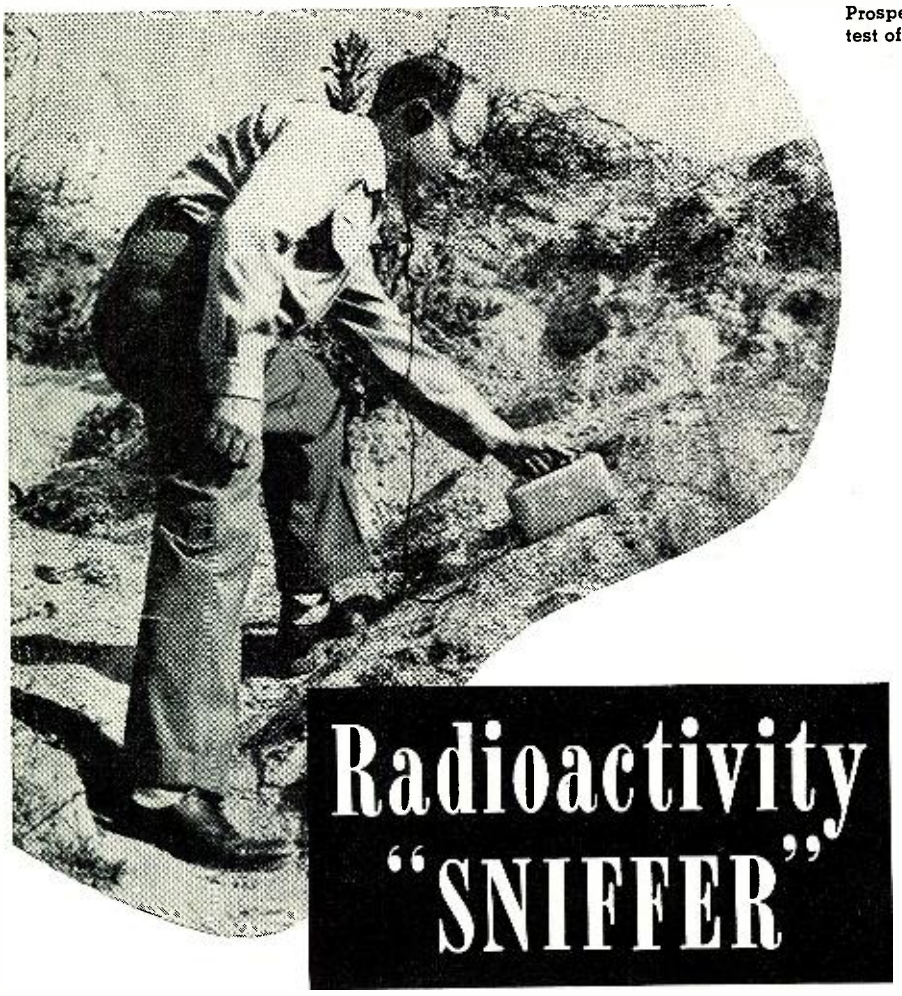
(*Continued on page* 110)

Circuit diagram of the cathode follower unit for multiple receiver operation.



R_1, R_4—100,000 ohm, ½ w. res.
R_2, R_3—510 ohm, ½ w. res.
R_5—220 ohm, ½ w. res.
R_6—300 ohm, ½ w. carbon non-inductive res.
R_7—300 ohm, 5 w. wirewound res.
R_8—2500 ohm, 25 w. wirewound var. res.

C_1, C_2, C_4, C_5—50 μμfd. ceramic cond.
C_3—.0015 μfd. ceramic cond.
C_6, C_7—20/20 μfd., 250 v. elec. cond.
S_1—S.p.s.t. toggle sw.
F_1—117 v. line fuse
T_1—Power trans. (see text)
V_1—12AT7 tube
V_2—5Y3 tube
V_3—VR105 tube



Prospector's portable Geiger counter in a trial test of a sandstone deposit for uranium content.

Radioactivity "SNIFFER"

By ALVIN B. KAUFMAN

Details on the construction and operation of one type of commercial Geiger-Mueller detector unit.

THE construction of a Geiger-Mueller unit for the detection of radioactive ores or waste products has probably been considered by every amateur and professional electronics engineer interested in this field. The inducement to build such a unit for personal use or sale has been spurred on by the U. S. Government, through the Atomic Energy Commission, offering bonuses and subsidization for discovery of any new uranium deposits.

An outline of the inducements offered by the Atomic Energy Commission might not be amiss at this point. A $10,000 bonus is offered for the discovery of any new uranium deposit that yields 20 tons or more of uranium ore or concentrates assaying 20% or higher in uranium oxide. This bonus offer does not apply to carnotite-type or roscoelite-type ores located in the Colorado Plateau area. A guaranteed minimum price of $3.50 a pound for small lots of domestic refined uranium is pledged by the government for a ten year period, for 10% or better uranium oxide concentrates. The same guarantee is made for low grade ores, except the offered price is less refining costs. Lower grade ores containing as little as 0.2% uranium oxide will be purchased by the government. Further details on marketing or securing assay information may be secured by writing to the Atomic Energy Commission, Raw Materials Operation at 70 Columbus Ave., New York, N. Y., or to the Colorado Raw Materials Office at Grand Junction, Colorado.

This article is not concerned solely with the design of a Geiger-Mueller detector, but with the technical problems encountered in searching for and identifying a strike, valuable radioactive minerals, or in determining roughly the contamination of an area. Several articles which the author has read note that valuable ore may be determined as such from the equipment's counting rate. These statements do not take into consideration the mass of the radioactive material, distance to the probe, or possible variations between equipment or Geiger tubes. The number of counts per minute depends on the number of radioactive particles striking the G-M tube. This, in turn, depends upon the tube used and the strength of the radioactivity in its vicinity. Counters of normal sensitivity will register some counts even when there is no radioactive material present. This is the background count. These indications are mainly due to cosmic rays, but can be produced by other weak sources such as the luminous paint on watches. The increase in counts *over* the background count indicates, when properly interpreted, the value of ore or the danger in a contaminated area. In prospecting with Geiger equipment, the most important thing to remember is to allow for the background count. The reading in any specific location, or for any ore sample, is not significant until the background count has been subtracted or noted. In addition, this count will not be the same at all times on the same instrument, as the Geiger tube ages or the batteries become weak. Temporary variations may also occur in the field. Some types of bedrock contain radioactive materials. For example, limestone is usually inert, while granite frequently contains some proportion of radioactive minerals; hence, crossing a limestone-granite contact may increase the background count. A drop in the background count can occur when entering a depression, because the sides of the depression shield the counter from incoming cosmic rays. Relatively large areas of weak radioactivity may raise the background count, causing a response similar to that of a vein of high grade ore. The operation of the counter in the vicinity of an x-ray machine may also give incorrect information. Such changes in the counting rate cannot be controlled, and the prospector must learn to make allowances for them. Samples and specimens should never be carried within the Geiger-Mueller carrying case. The counter otherwise could become contaminated by radioactive dust and dirt entering the case and its background count or operation might be impaired.

The design of a portable G-M radioactive detector brings up problems common to the design of previously designed portable equipment; the use of meters, batteries, carrying case, extensions, and allowable weight. From experience in the field, prospectors, and I've been one, have determined that bulky equipment, regardless of weight distribution, is not desirable. Two or three unit pieces of equipment, where one section is carried on the belt or back, usually indicate excessive weight and clumsiness of use. Meters are not desirable on field equipment as they have high fatality rates and cannot be watched when walking through

rough terrain anyway. Extension cords wherein the detector or G-M tube is placed on the end of a cord to form a probe does have some advantages but generally at the expense of weight and bulkiness.

The most important considerations in the design of an instrument are weight, circuit, and batteries (which go hand in hand) and cost. The high voltage supply is probably the most important section of such a unit. The design of this establishes the weight and cost of the equipment. In present equipment this power supply depends on one of the following systems to supply the 900 volts required by most G-M tubes. Probably the simplest system is to supply the high voltage required by three 300 volt *Eveready* No. 493 batteries in series. These batteries have a long life, but their weight (size of three 67½ volt *Mini-Max*) and wholesale cost of approximately $27-33 was considered excessive. Replacement cost of the batteries alone would be a deterrent to the average prospector. To lower initial and maintenance cost many engineers have designed relaxation oscillator power supplies. These are similar to television receiver high voltage supplies working from the sweep kickback section of the scanning circuit. The only batteries required are a filament and plate voltage battery or two of the miniature portable size. The operation of this circuit is simple. A neon tube (such as the NE-2) is placed in the grid circuit of a tube and arranged to operate as a relaxation or saw-tooth oscillator, in the manner of the simplest cathode-ray tube type of sweep circuit. This action in the grid circuit of the tube will slowly build its plate current up and then sharply cut it off as the neon tube fires. Any large inductance in the plate circuit of this tube will develop a high voltage across itself at the moment the plate current is cut off. This high voltage is rectified by any one of the miniature high voltage rectifiers and filtered for supply to the G-M tube. At the same time this tube's "B" battery may be used with any amplifier tubes. This circuit is very good, costwise, but still possesses excessive weight and its voltage regulation is not too satisfactory. A third method, also popular, is the use of a vibrator-type high voltage supply. The circuit used is similar to the high voltage supply used in car radios. Two power sources have been used commonly with this vibrator circuit, either a 6 volt dry cell battery or a rechargeable 2 volt wet cell.

Considering the over-all situation, the use of a vibrator type high voltage supply seems desirable from the standpoint of simplicity and cost. There was, however, one desirable feature not obtainable with any of these "electronic" power supplies. That was good power supply regulation.

About this time a commercial Geiger-Mueller unit was placed on the market by *Nuclear Instrument & Chemical Corp.* which exceeded by far my requirements as to weight and cost of batteries. A few simple calculations indicated that its method of design if applied to a home constructed unit would give a much cheaper and smaller unit than that previously obtainable by the experimenter. Its low net price makes it optional and up to the individual as to whether purchase or construction is preferable. The commercial unit to be described is tradenamed the "Sniffer." It weighs two pounds and employs a vibrator high voltage power supply using two ordinary flashlight batteries for the power source, and, in conjunction with special regulator tubes, supplies a *regulated* high voltage for the Geiger-Mueller tube.

The components for building a unit similar to the "Sniffer" may be obtained from many companies. *Nuclear Instrument, Raytheon, Technical Associates,* and other companies manufacture Geiger tubes for sale at prices ranging from eight dollars for uncased units to completed probes selling as high as several hundred dollars. Special 900 volt regulator tubes are available from *Raytheon,* and the *Victoreen Company.* Subminiature amplifier tubes are available from a variety of sources.

A commercial "Sniffer" was obtained and examined both electronically and in the field. Its performance and mechanical construction were excellent, and it was found to be adaptable to home construction. Its amplifier gain and sensitivity gave a background count of 20-30 a minute which is good for portable equipment. One word here. Even with this high background count, the individual pulses may at times appear so far apart that the instrument may sound defective. This will not be the case. The cosmic ray background counts will be quite erratic, many times coming close together with large time gaps between groups or single impulses. The only way to be sure of your instrument is to count the total clicks or impulses per minute.

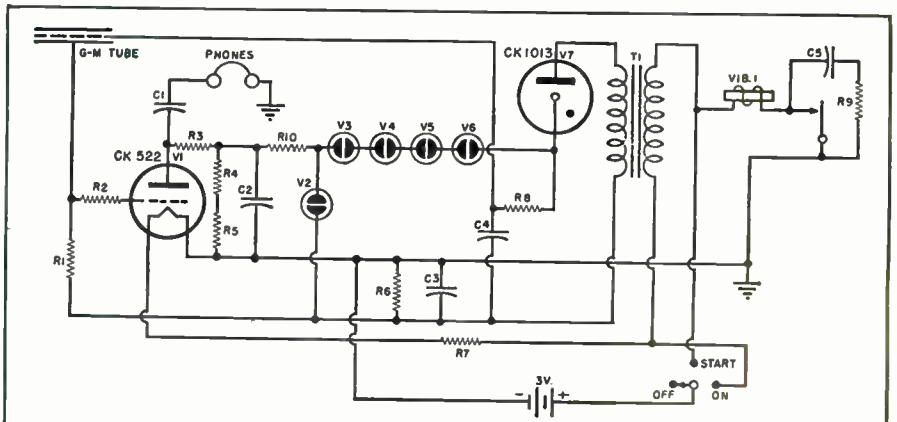
The radiation-sensitive element of the "Sniffer" is a special Geiger-Mueller tube. For the uninitiated, it consists of a thin wire (usually tungsten) centered axially in a metal envelope. The tube is filled with a gas. Effectively it is a gas-filled diode with enough d.c. voltage applied between cathode and anode to bring it almost, but not quite, to the firing point. When the voltage is at this critical point, a single particle striking the tube from a radioactive source causes the gas to ionize. The tube then breaks down or fires and conducts heavily. This current is quite minute, so it is run through a high value resistor which has two functions. The first function is to supply enough voltage to an amplifier tube grid to obtain headphone volume. Secondly, since a gas filled tube will continue to conduct until the voltage across it is lowered, the circuit also quenches the G-M tube by lowering its voltage immediately after each click. Complete fundamentals of G-M tube operation are beyond the scope of this article and have been covered in other articles.*

The Geiger tube impulse current develops a voltage across the 3.9 megohm grid resistor of the subminiature *Raytheon* CK522 triode. The one megohm resistor in series with the tube's grid is to limit any possible grid current from the signal voltage and to possibly give a slight negative bias to the tube from any gas grid current. Tube bias is obtained as outlined in the power supply discussion. As the circuit schematic indicates this single amplifier tube receives its filament current through a 100 ohm dropping resistor from the three volt bat-

(*Continued on page* 136)

* Leslie, Eric; "The Geiger Counter—How Does it Work?", *Radio-Electronics,* September, 1949.

Circuit diagram of Nuclear Instrument & Chemical Corp.'s radioactivity "Sniffer."



R_1, R_6—3.9 megohm, ½ w. res.
R_2, R_8—1 megohm, ½ w. res.
R_3—2.2 megohm, ½ w. res.
R_4, R_5—20 megohm, ½ w. res.
R_7—100 ohm, ½ w. res.
R_9—10 ohm, ½ w. res.
R_{10}—470,000 ohm, ½ w. res.
C_1, C_5—.05 µfd., 200 v. cond.
C_2—.05 µfd., 400 v. cond.
C_3—25 µfd., 25 v. cond.
C_4—.02 µfd., 1000 v. cond.

V_1—CK522 tube
V_2, V_3, V_4, V_5, V_6—Special regulator tubes (Nuclear Instrument & Chemical Corp.)
V_7—CK1013 tube
Vib.$_1$—3 volt vibrator
T_1—Vibrator trans. (Nuclear Instrument & Chemical Corp. #P-2097C)
1—S.p. 3-pos. rotary sw.
1—3 volt battery (two 1½ volt flashlight cells)
1—Headphones (See text)
1—Geiger-Mueller tube

CONSTANT-RESISTANCE Network Inductor Design

By JACK D. GALLAGHER, W5HZB

A useful formula for winding your own constant resistance inductances for dividing networks.

IT IS unfortunate that articles which have been written concerning dividing networks have failed to give the reader an idea of how to wind inductances for these networks. The reader is usually given information about the types of circuits, the values of components used therein, and the fact that the inductance should be wound with heavy wire on non-magnetic forms, but usually no information is given about the size of form needed, the size of wire, and the number of turns of wire required for a given value of inductance.

Various circuits for dividing networks were described in the article "Dividing Networks" which appeared in the December issue of RADIO & TELEVISION NEWS, therefore it is the purpose of this article to present suitable information which can be used to determine the approximate number of turns required for a given value of inductance.

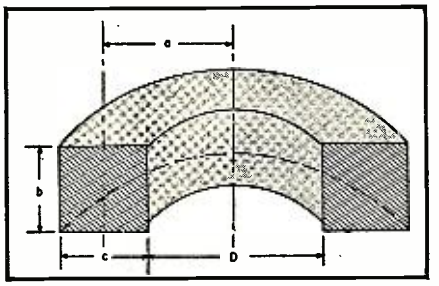


Fig. 1. Cross-section of coil. For maximum inductance c equals b; and c should be .66 of radius a. See text for explanation.

Unfortunately, there has been no exact, simple formula derived whereby it is possible to calculate the number of turns to wind on a form of given dimensions to obtain a desired inductance. However, there are several formulas available which are sufficiently accurate for practical purposes and these can be employed, providing they are used with discretion. Wheeler's simple approximate formula for a multiple-layer inductance of the type shown in Fig. 1 is:

$$L = \frac{0.8(a)^2\ (N)^2}{6a + 9b + 10c} \text{ microhenrys}$$

where dimensions are in inches.

In order to obtain the maximum inductance and the most economical construction, the cross-section of the winding should be a square and the side of the cross-section should be 0.66 times the mean coil radius, *"a"* in Fig. 1. Then L reduces to:

$$L = 0.043(a)(N)^2 \text{ microhenrys}$$

In the parallel constant-resistance type of dividing network, as shown in Fig. 2A, the value of the inductance L is given by the formula:

$$L = \frac{225{,}000\ (R_o)}{f_c} \text{ microhenrys}$$

Equating the two values of L above and noting that the mean coil radius *"a"* is equal to one-half of the inner diameter of the coil plus the depth of the winding *"c"*, then simplifying, the formula for the number of turns of wire to wind on a form of given dimensions for a *parallel* constant-resistance network becomes

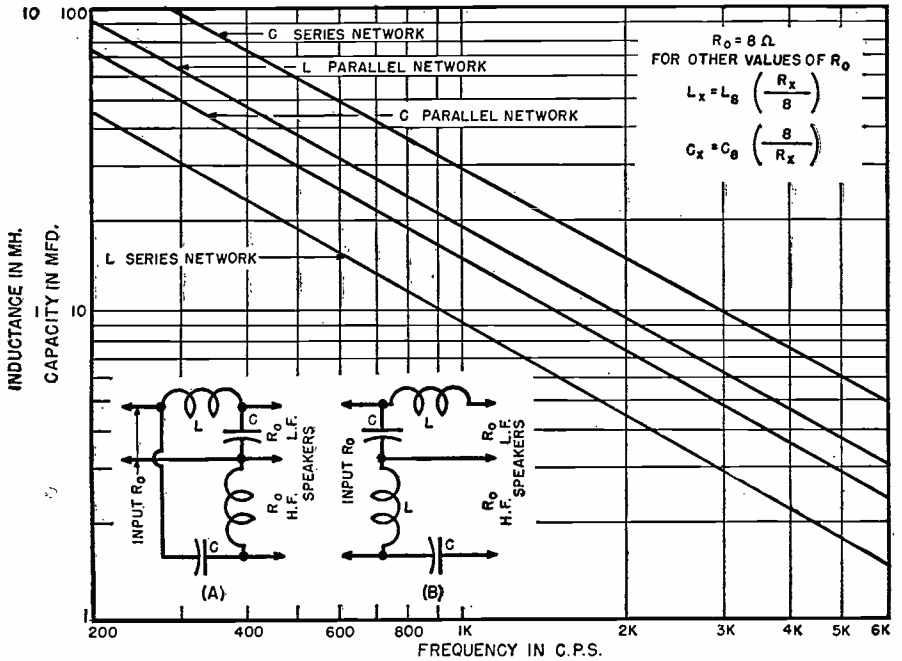
$$N = \frac{2650\ \sqrt{R_o}}{\sqrt{D\ f_c}}$$

where D is the inner diameter of the coil in inches. Since no dimensions other than the inner diameter of the coil exist in the equation above, it may seem to be incomplete. It can be shown that the inner diameter of the coil is approximately twice the winding depth. To obtain the number of turns to wind on a form for the *series* constant-resistance type of network multiply the value of N for the *parallel* circuit by .707.

As an example consider R_o as 8 ohms, the desired crossover frequency as 600 cycles, and the form as 1½ inches in diameter. Substituting in the formula and solving for N we get 250 turns. The diameter of the form is 1½ inches, therefore the depth and width of the winding space

(*Continued on page* 161)

Fig. 2. Inductance and capacitance of parallel (A) and series (B) circuits. Graphs shown are for R_o equal to 8 ohms. L-C equations for other values of R_o are included.



A TV Linearity-Pattern GENERATOR

Fig. 1. Crosshatch pattern on screen permits service technician to demonstrate set's operation to customer.

Hickok's new signal generator provides test pattern at any time for TV alignment and troubleshooting.

By
ROBERT N. VENDELAND*

"LOOK, the wedge on the left hand side of the circle is at least a quarter of an inch bigger than the wedge on the right hand side of the circle. I paid for a year's guarantee on that set and I want it right. Is it a lemon? If it is I'll send it right back to that dealer! I want it right! I want it right!" Before this little scene reaches the mayhem stage let's take a look at one answer to this service technician's problem, a portable crosshatch generator.

This piece of TV test equipment is a customer persuader and looks like an instrument that is capable of speeding up the television service call —especially the nuisance call. We all know that most television service calls, on warranty, are strictly educational calls the salesman of the receiver should have made, but didn't. We also know that some perfectly satisfactory installations have been turned into headaches by some first-hand-cousin that saw a television receiver once and is therefore an expert, so he is perfectly qualified to tell the customer that his linearity is out, or something like that.

Going out on a call of this type puts you, as a service technician, on the defensive right away. You have to say that the picture is good and the customer doesn't believe you!

The linearity pattern generator is an instrument designed to place horizontal and vertical lines on the screen of the cathode-ray tube in the television receiver. It serves as an accurate guide for setting the linearity controls of a receiver when a test pattern is not on the air. However, its chief value lies in its ability to cope with the nuisance call. Let's take one case for an example. The customer isn't satisfied (for no other reason than somebody told him that he shouldn't be getting ignition noise on his receiver—they don't on theirs). You make the call, check the antenna, connect the crosshatch generator to the terminals of the set, disconnect the antenna, and throw a crosshatch on the screen. The customer sees the pattern and sees that the ignition noise has disappeared. While you have the instrument connected you trim up the linearity and record the setting of the output controls. If you were lucky enough to have recorded similar settings at the original installation you can compare the two sets of readings and show the customer that his set hasn't changed—and, therefore, there is nothing to service. The fact that you are using an instrument to check his set, and not just your judgment, carries a great deal more weight. With this method you can definitely show that the noise is external and that the trouble may have developed in the neighborhood after the set was installed. If you explain effectively you may sell him a better antenna installation.

The possibilities of an instrument of this type are unlimited as a customer persuader and also as a service aid. You can readily appreciate the value of a crosshatch generator as a time saver in setting controls when a test pattern is not on the air. As television grows in your community you are going to have less and less test pattern time as morning programs take over.

Before the application of the crosshatch generator as a service instrument in the home and the shop is discussed, perhaps we had better describe exactly how it works.

* The author is Supervisor of the Technical Department of the National Radio School, Cleveland, Ohio, and Vice-President of the Cleveland Television Clinic, Inc.

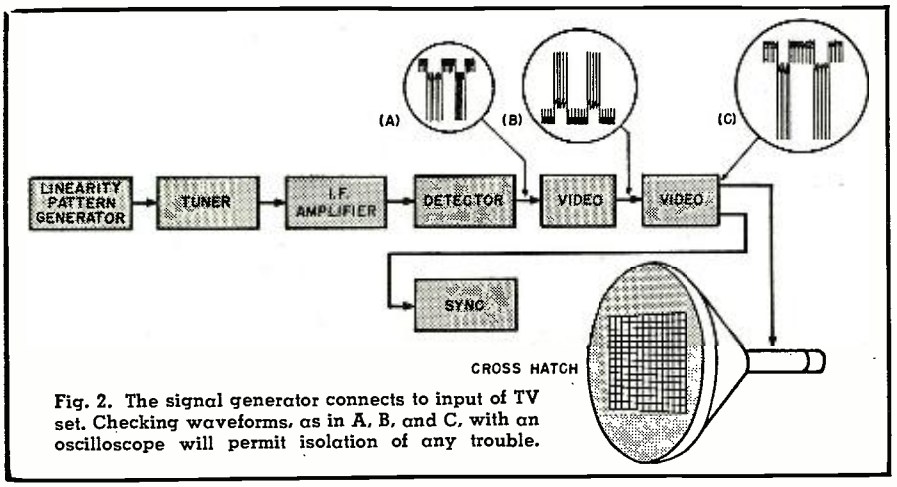


Fig. 2. The signal generator connects to input of TV set. Checking waveforms, as in A, B, and C, with an oscilloscope will permit isolation of any trouble.

The *Hickok* Model 620, Linearity-Pattern Generator (which will be described in this article), connects directly to the antenna terminals of the receiver and has an output that is continuously variable from 50 to 90 mc. Since the output can tune through this range, patterns can be generated in channels 2 through 5. The reason that channel selections are available is to permit use on a channel where no station is operating.

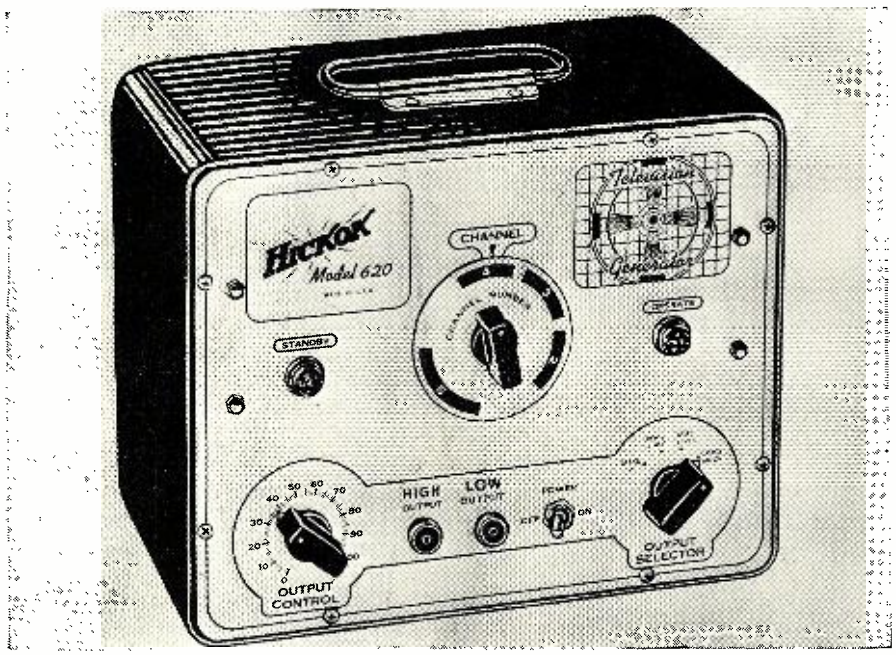
If reference is made to the block diagram, Fig. 5, the following discussion should be easy to follow.

The purpose of the Linearity-Pattern Generator is to modulate the grid of the cathode-ray tube with a signal that places horizontal and vertical lines on the tube. If the hold circuits of the television receiver are working properly, it is a simple matter to adjust the hold controls until the correct number of lines appears on the screen. At this point the linearity controls are adjusted until the lines are equally spaced.

As we already know, the beam sweeps across the screen of the television receiver 15,750 times every second. Since the Linearity-Pattern Generator has its r.f. carrier modulated by the output of a 219.24 kc. crystal, it is easy to see that the beam will be interrupted at regular intervals by the much higher frequency. These interruptions, or blanking of the beam, will occur visually 12 times for each line. So, when the horizontal hold control is set up properly, 12 vertical lines will appear on the screen. It should be easy to see, then, that if the beam is interrupted at regular intervals (by a crystal oscillator, Fig. 5) the lines must have equal spaces. If the linearity of the receiver is not properly set, the lines will not be spaced equally and then adjustment must be made.

Checking the block diagram, Fig. 5, we see that the 219.24 kc. crystal-controlled oscillator feeds directly into the mixer where a frequency of 540 cycles joins it to modulate the r.f. oscillator set at the channel frequency.

Fig. 3. Panel view of Hickok's Model 620 crystal controlled Linearity-Pattern Generator.



The 540 cycles is obtained by stepping down the 219.24 kc. through a series of multivibrators and blocking oscillators so that the two frequencies have a very definite relationship.

Checking the 540 cycles, we see that this, too, is a higher frequency than 60-cycle vertical sweep rate. Therefore, we obtain 9 horizontal lines on the screen where the 540 cycles interrupt the beam as it sweeps down in 1/60 of a second. Vertical linearity can then be adjusted in the same manner as horizontal linearity.

The *Hickok* Linearity-Pattern Generator has a switching arrangement whereby the 540 cycles or 219.24 kc. can be used singly or together. As a result, very accurate settings of the linearity controls can be made.

Since the generator has a variable output from 50 to 5000 microvolts, the sensitivity of receivers can be checked by noting the settings of the output control. When the sensitivity to vertical hold and the sensitivity to horizontal hold is recorded at the installation, you have a definite check on the future operation of the set.

To amplify on this statement, let's say, for example, that an output setting of 30 was recorded for minimum vertical hold of the lines during installation, but an output setting of only 25 was recorded for horizontal hold at the same time. At some future date the customer complains that the set is not holding horizontally. When you check the set you find that the vertical hold still pulls in at 30, but this time the horizontal pulls in at 75. We can then be reasonably sure that the trouble is *not* in the r.f. of the receiver or the i.f., but somewhere after the detector, or some place where the sync splits. But, on the other hand, if the vertical and horizontal both require an output increase from the crosshatch generator we could see that the trouble is common to both circuits. If the lines were dim and did not hold we would suspect the i.f., the front end, or the video amplifier, probably not the sync circuit. But, if the lines were sharp and didn't hold, then it would probably be in the sync circuits of the receiver.

This then, sets up a perfect instrument for quick service calls and tube substitutions in the customer's home. All you have to do is connect your crosshatch to the antenna post, and go ahead with your tube substitution—watching the crosshatch—in exactly the same manner as you do on the station. With this instrument you have the added advantage of being able to vary your output for either horizontal or vertical sync.

In the shop, the generator is as handy as it is in the home. Connecting it to the antenna of the receiver and using a scope you can check almost every circuit in the receiver for operation. A quick discussion of this method (using block diagrams) should help in the application of the Linearity-Pattern Generator to troubleshoot-

ing. In Fig. 2, the Model 620 is connected to the antenna terminals of the television receiver.

The scope is connected to the detector load and the waveform at "A" should appear. To check the contrast control (if it is used as a bias circuit for the i.f. amplifiers) merely turn it clockwise and counter-clockwise. The height of the pattern will vary. To check the operation of the a.g.c., merely increase the output of the Model 620 until the pattern on the scope screen at "A" doesn't increase with further output from the Model 620. This reading is the point where the a.g.c. takes over. From this point on, you can check the video amplifiers and the sync circuits exactly as you would with a station on the air. You should get a reversal of the pattern and an increase in amplitude as the scope is moved back through each video stage ("C"). Calibrating your scope for peak-to-peak readings will give you a very accurate check of the exact gain of the stage and an indication of whether or not the video signal is strong enough to drive the cathode-ray tube.

Some indication can also be obtained as to the frequency response of the video amplifier since you can connect the plates of the scope directly to the output of the last video amplifier and compare the relative heights of the 219.24 kc. pulse with the 540 cycle pulse. The ratio at the output of the last video amplifier should have the same amplitude relationships as the signal at the detector load. If there is a change in ratio, then you have an indication of poor frequency response in the video amplifier.

For accurate checks you must connect the plates of the scope directly to the output of the video stage and check the shape of the pulse. Read any good text on square wave testing of amplifiers for the theory behind this last statement.

The manufacturer's instruction book for the receiver is based on sync waveforms from the transmitter. Of course, the waveforms you see will be slightly different in shape, but a little practice in using the Linearity-Pattern Generator on a set that works will make you familiar with the difference in pulse shapes and frequencies.

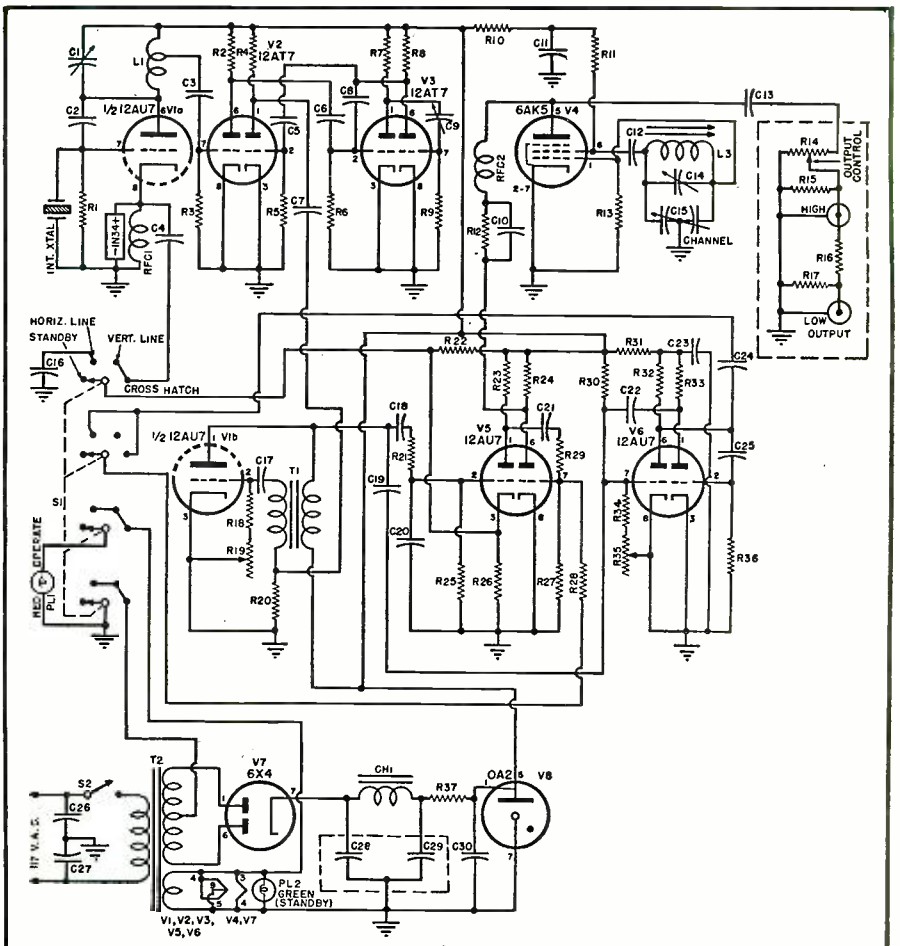
As you use the generator more and more in service you should find countless applications not mentioned in this article.

Circuit Analysis

Since the instrument must be extremely stable in order that proper adjustments of the television receiver can be made, the operation of the circuits in the Model 620 is dependent on an internal crystal oscillator operating at 219.24 kc. To further increase the stability, all "B plus" voltages are supplied from a voltage regulated power supply.

Referring to Fig. 4, we see that the

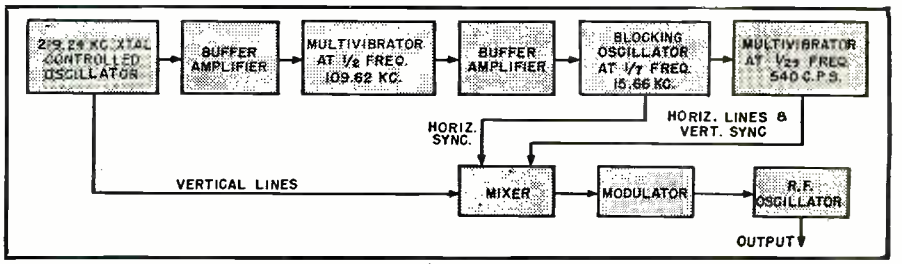
(*Continued on page* 117)



R_1*—3.3 megohm, ½ w. res.
R_2, R_3, R_4, R_5—56,000 ohm, ½ w. res.
R_6, R_{29}—47,000 ohm, ½ w. res.
R_7, R_8, R_{32}—27,000 ohm, ½ w. res.
R_9, R_{12}, R_{13}—100,000 ohm, ½ w. res.
R_{10}—2700 ohm, ½ w. res.
R_{11}—22,000 ohm, ½ w. res.
R_{14}—200 ohm, linear-taper carbon pot (output control)
R_{15}—75 ohm, ½ w. res.
R_{16}—680 ohm, ½ w. res.
R_{17}—75 ohm, ½ w. res.
R_{18}, R_{34}—270,000 ohm, ½ w. res.
R_{19}—100,000 ohm, linear-taper pot (linear control)
R_{20}, R_{26}—4700 ohm, ½ w. res.
R_{21}—33,000 ohm, ½ w. res.
R_{22}*—56,000 ohm, 1 w. res. ±5%
R_{23}, R_{27}—10,000 ohm, ½ w. res.
R_{24}—27,000 ohm, 1 w. res.
R_{25}, R_{28}*—1.8 megohm, ½ w. res.
R_{30}*—2.2 megohm, ½ w. res. ±5%
R_{31}—10,000 ohm, 1 w. res.
R_{33}—27,000 ohm, 2 w. res.
R_{35}—250,000 ohm, linear-taper pot (slotted shaft)
R_{36}—100,000 ohm, ½ w. res. ± 5%
R_{37}—700 ohm, 5 w. wirewound res.
All resistors to be ± 10% tolerance unless otherwise specified
C_1—18-180 μμfd. mica trimmer
C_2, C_{13}—5 μμfd. ceramic cond.
C_3—50 μμfd. zero temp. coeff. ceramic cond.
C_4—2200 μμfd. mica cond. ±10%
C_5, C_{12}—15 μμfd. ceramic cond. ±10%
C_6, C_{19}—10 μμfd. mica cond. ±10%
C_7, C_8, C_{29}—47 μμfd. mica cond. ±10%
C_9—10-100 μμfd. trimmer cond.
C_{10}—.25 μfd., 400 v. cond.
C_{11}—10 μfd., 350 v. elec. cond.
C_{14}—3-12 μμfd. ceramic trimmer cond.
C_{15}—Dual var. cond. (Hickok #3120-16)
C_{16}, C_{26}—.05 μfd., 400 v. cond.
C_{17}—470 μμfd. mica cond. ±10%
C_{18}, C_{25}—1000 μμfd. mica cond. ±10%
C_{21}, C_{22}, C_{24}—.01 μfd., 400 v. cond.
C_{23}—10 μfd., 350 v. elec. cond.
C_{28}, C_{29}, C_{30}—30/10/20 μfd., 350/350/250 v. elec. cond.
L_1—Line osc. coil (Hickok #3320-59)
L_3—Osc. coil (Hickok #3320-60)
RFC_1—.53 mh. r.f. coil
RFC_2—R.f. choke (Hickok #3250-10)
CH_1—16 hy., 50 ma. filter choke
PL_1—60 ma., 2 v. pilot lamp
PL_2—6.3 v. pilot lamp (#40 Mazda)
T_1—Hor. blocking osc. trans. (Hickok #20800-94)
T_2—Power trans. (Hickok #20800-95)
S_1—4-pole, 4-pos., two-deck rotary sw.
S_2—S.p.s.t. toggle sw.
1—1N34 crystal rectifier
1—219.24 kc. crystal
V_1, V_5, V_6—12AU7 tube
V_2, V_3—12AT7 tube
V_4—6AK5 tube
V_7—6X4 tube
V_8—OA2 tube
* Approximate value. Exact value to be determined in construction.

Fig. 4. Complete schematic diagram and parts list for Linearity-Pattern Generator.

Fig. 5. Block diagram shows functional operation of the new Hickok Model 620 unit.



Design Considerations For High-Quality Reproducing Systems

By HERB MATTHEWS

Part 1. Points to remember when designing your own audio systems. Final part will appear next month.

THE "audio philosophy factor" is all too often overlooked in amplifier design. Lack of serious consideration of this factor frequently leads to disappointment with the final result.

There is a good deal more to consider than control function, physical layout, and type of chassis construction. The good designer must also consider which factors may be compromised with cost, what are the over-all requirements of the system, and what is the actual purpose behind his construction of the unit. If the builder is interested in learning more about audio, or if he seeks the joy of creating, then his goal is clearly marked. If his sole purpose is to obtain a reproducing system of the highest quality, he may actually find it more economical to obtain one of the better laboratory-engineered units now on the market.

Before an audio system can be designed, many factors must be taken into consideration. The average experimenter usually begins with only the rough notion that he is going to build a "high fidelity" amplifier and proceeds to assemble assorted components into one of several basic designs.

A consideration of the several fundamental factors may help the reader crystalize his own audio philosophy.

High Fidelity: What is it? High fidelity has always been broadly interpreted to mean faithful reproduction of the original sound. When the term was first foisted on the public it was taken to mean any wide range system with better than 50 to 10,000 c.p.s. response and less than 5% distortion. High fidelity amplifiers have been sold for many years without any real thought being given to their behavior with various types of loudspeaker systems or their transient response to a complex audio wave. As long as the amplifier was flat ±3 db. and it faithfully reproduced sine waves in the desired frequency range, the system had "high fidelity." As a result of this fallacious reasoning, the public has been educated to believe that a radio could not approach realistic reproduction, that it must "sound like a radio." Until fairly recently the "best" engineers were insisting that the public did not want 20 to 20,000 c.p.s. reproduction. They had proven, by "actual listening tests," a preference for 5000 c.p.s. cut-off.

Present audio men shy away from the term "high fidelity" because of its past connotation and we now find terms like wide range, high quality, presence, etc., used in literature.

Obviously a minimum of 50 to 10,000 c.p.s. response with low distortion is a basic requirement. It should be apparent that there are certain "negative factors" which must be eliminated from a reproducing system if high quality is to be achieved.

The most objectionable of these is noise. Because most noise is considerably reduced in a 5000 c.p.s. system, the layman has shown a preference for the limited range. With the increasing popularity of FM and with the advent of new, improved suppressor circuits, particularly those of the vertical gate type, wide range, noiseless reproduction is a practical reality.

The second most important negative is distortion. With good, conservative design, distortion can usually be held to a negligible factor.

Hangover is the third important negative. Hangover produces an unpleasant, muddy quality which is often described as the lack of "presence." In an otherwise perfect system, hangover adds the one sour note which marks mechanical reproduction as decidedly different from original performance. Hangover is the tendency of a system to continue vibrating after the exciting signal has ceased. This effect may be compared to the tendency of timpani to sound, once struck, until the musician places his hand on the drumheads to stop them, or, perhaps more familiarly, to a piano string which continues sounding until the action of the damper pads it out.

Good damping, therefore, is another important *must* in a reproducing system. Damping may be present in an amplifier (expressed in terms of low internal generator resistance), or it may be present in the speaker system (expressed in terms of high field flux density and stiffness of the vibrating system). Ideally, both the loudspeaker system and the amplifier should be well damped at all working frequencies. Generally speaking, a well damped system exhibits a smooth peak-free frequency response characteristic. Distortion and noise are not emphasized in a well damped system because the tendency to overshoot on transient peaks is reduced.

Frequency Response Considerations: Ideally, an amplifier should be flat from 20 to 20,000 c.p.s. It should have good response from 10 c.p.s. to 40,000 c.p.s. The practical designer, who must consider cost as a factor, may decide to compromise his ideals and limit his equipment to a range of 8 or 10 kc. In this event it should be remembered that to preserve good upper and lower balance, the product of the upper and lower cut-off frequencies should be about 400,000 or 500,000. This would indicate a range

of 40 to 10,000 c.p.s. or 50 to 8000 c.p.s. with an over-all flat system utilizing sharp cut-off at both ends of the spectrum (Figs. 1A and 1B).

It should be remembered, however, that most practical systems do not cut off sharply at both ends of the spectrum, but generally taper off, particularly at the upper end (see Fig. 1C). For this reason some discretion must be exercised in selecting an optimum characteristic; although these figures are a very useful guide, it is far better to let the ear be the final judge. It should also be pointed out that a sharp cut-off characteristic is undesirable because it produces a peculiarly harsh kind of frequency distortion. Fig. 2A illustrates a 5000 c.p.s. waveform with a complex harmonic structure. If this wave is reproduced by a system with the response of Fig. 1C it will look something like Fig. 2B, not badly distorted. If it is reproduced in a system with the response of Fig. 1A it will resemble a sine wave (Fig. 2C), considerably distorted from its original form. These examples should help explain the difference between horizontal and vertical high frequency attenuation and also explain the superiority of the newer vertical gate suppressor circuits recently introduced.

A very common fallacy which has been allowed to continue without contradiction is the premise that, when an amplifier with flat response is utilized, the entire system will yield flat reproduction. This statement is only partially true in the rare case of some of the better high priced speakers mounted in well-designed enclosures. To obtain a reasonably accurate picture of amplifier performance, a frequency run should be made with the output meter connected across the voice coil of the speaker and with the speaker mounted in the final baffle in which it is to be used. Even when this precaution is taken it must be remembered that the actual transient response of most systems may be somewhat different from the steady state response as measured with slowly varied sine waves. This disparity is particularly noticeable in a poorly damped system.

It has been this writer's experience that a U-shaped curve with boost at both ends of the spectrum may be required, particularly with speakers in the $10 to $20 price range. Figs. 1D and 1E show typical curves using the boost. Note that as much as 25 db. boost at 60 c.p.s. may be required and that the response may not start rising until about 300 c.p.s. This is a typical requirement where undersized or inefficient baffling or perhaps poor speaker performance cause low frequency loss below 200 or 300 c.p.s. Note, too, that the upper boost may occur from 2000 c.p.s. up, depending on where the highs begin to fall off. High frequency droop may occur in

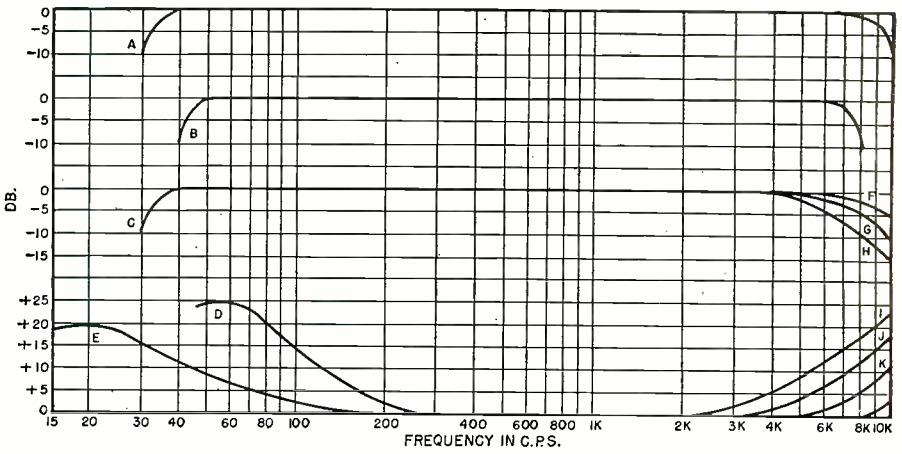


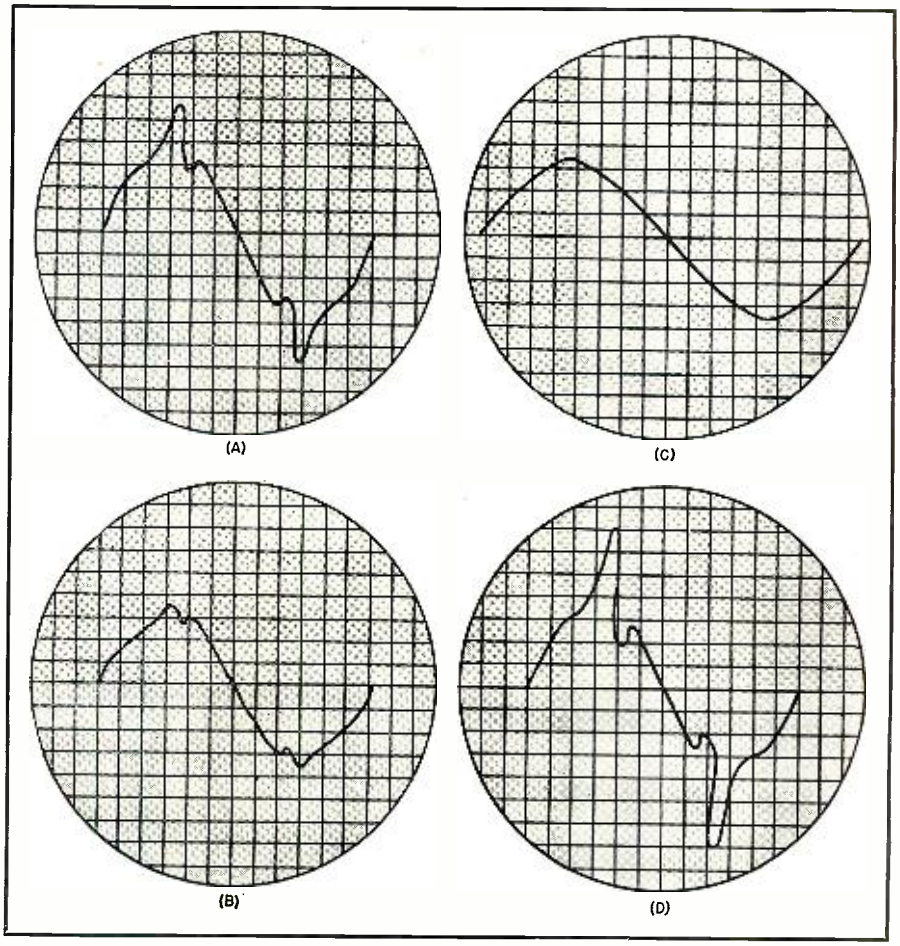
Fig. 1.

a system even though a tweeter is used. Again, here is a case where the ear is the most reliable available judge of a system's quality. Listening tests should be made over some extended period of time on live local programs known to have good quality. It is difficult to form any accurate opinion of the worth of a reproducing system in one sitting. The ear and the brain are both subject to day-to-day variations which make subjective analysis a difficult, though worthwhile, method.

If an audio oscillator is available it should be used as a guide to system performance. Frequency runs should be made at normal volume levels with the speaker system placed in its normal position in the room and as many pairs of trained ears as are available should be used as volume level indicators. Moving around in the room will show up standing wave conditions. Experience has shown that if a system sounds reasonably flat when tested by this means, the balance will be reasonably good at normal levels. The effect of changes in volume level on tonal balance, as reported by Fletcher & Munson in

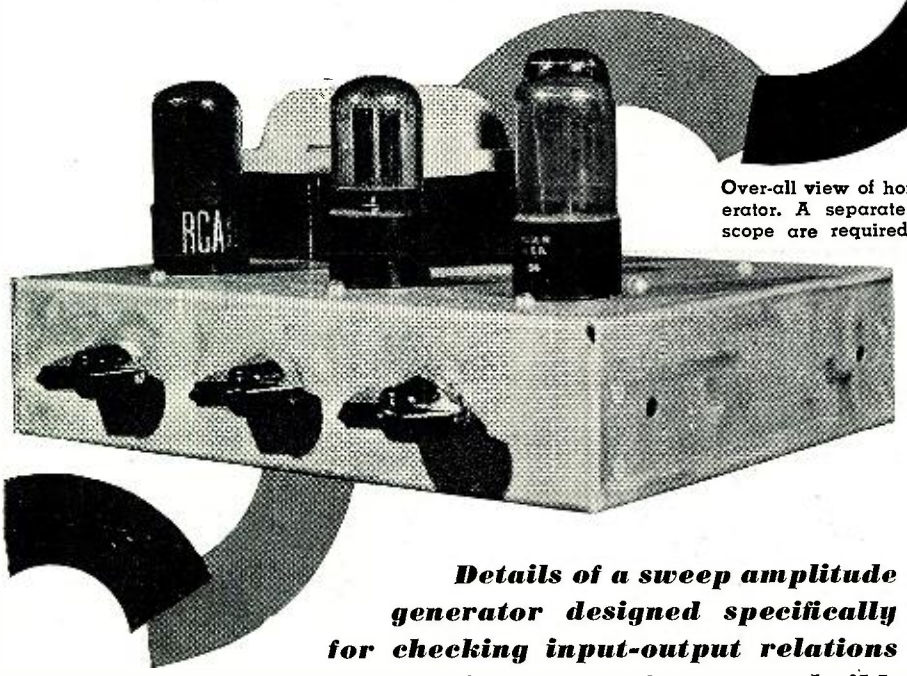
(*Continued on page* 120)

Fig. 2.



Linea ity I istortion In Audio Equipment

By
GLEN SOUTHWORTH



Over-all view of home-built sweep amplitude generator. A separate audio oscillator and oscilloscope are required to check linearity distortion.

Details of a sweep amplitude generator designed specifically for checking input-output relations of audio equipment. It is easy to build.

THE relative importance of various distortions is often dependent upon the state of the audio art. As a result, present day means of reproducing wide dynamic ranges, such as FM broadcasting and new recording developments, indicate the importance of achieving linear input-output relations in audio equipment.

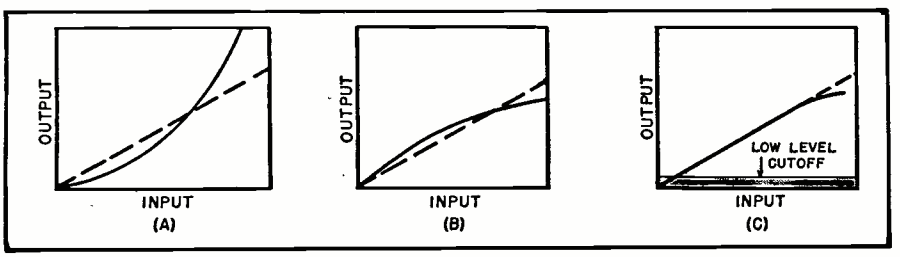
Although the reader may be more familiar with the problems involved in noise levels and volume compression or expansion, nonlinearity gives rise to another serious problem which is seldom mentioned. Many important components of speech and music may have a level thirty decibels or so below the average level. If a reproducing system exhibits a definite amplitude cut-off at low levels, these components may be partially or wholly suppressed. An extreme example of this is in a system in which an amplifier grid is driven positive by a defective coupling condenser. Although excessive harmonic distortion results, which should mean an increase, in high frequency output, the opposite is often the case and a loss of high frequencies, accompanied by excessive "mushiness," is the result. The reason for this is that relatively low-level, high-frequency components do not have sufficient amplitude to reach beyond the nonlinear portion of the tube curve, while the peaks of the higher level low frequencies may have sufficient amplitude to be reproduced. Although by present standards one per-cent harmonic or intermodulation distortion is considered low, one per-cent of this type of amplitude distortion may produce noticeable changes in reproduction quality and is probably an important contributing factor to "listening fatigue."

An examination of hearing sensitivity curves will show that the average listener may have a sensitivity for frequencies in the two- to three-thousand cycle region that is one hundred times as great as for frequencies below one hundred cycles at the threshold of hearing. As a result, even though two different frequencies may have the same apparent loudness, their actual intensity may be widely different and nonlinearity in the reproducing equipment may produce decided dynamic frequency response variation. For example, a system with greater gain at low levels than at high levels may tend to emphasize low-amplitude, high-frequency components. Two fairly common cases of this nature are the speech clipper and the volume compressor. The opposite case, a system in which gain is greater at high levels than at low, will tend to produce the reverse and low-level highs will tend to be suppressed. Several types of noise suppressors make use of this principle.

Audio amplifiers represent a particular case in nonlinearity, as in complex waveforms the high frequency component will be operating over varying portions of the characteristic curve, often resulting in periodic variations in gain, known as intermodulation distortion. As a result, in systems in which the gain decreases with increasing input, high frequencies may suffer considerable compression when accompanied by high-amplitude, low-frequency waveforms. Likewise, other effects derived from different departures from linearity may be noticed.

In amplifiers it may be generally assumed that nonlinearity will mean modulation rather than constant attenuation where complex waves are concerned. In some instances, notably electromechanical devices, this does not appear to hold entirely true and low level components may be attenuated regardless of whether occurring alone or in combination. One example of this is in the record manufacturing

Simple forms of nonlinearity. The characteristic in (A) may be obtained by overbiasing push-pull amplifiers while that of (B) often occurs in beam power amplifiers. (C) Illustrating the result of a sharp, low-level amplitude cut-off. Signals below a certain level are not reproduced, while many other low-level signals may suffer serious attenuation.

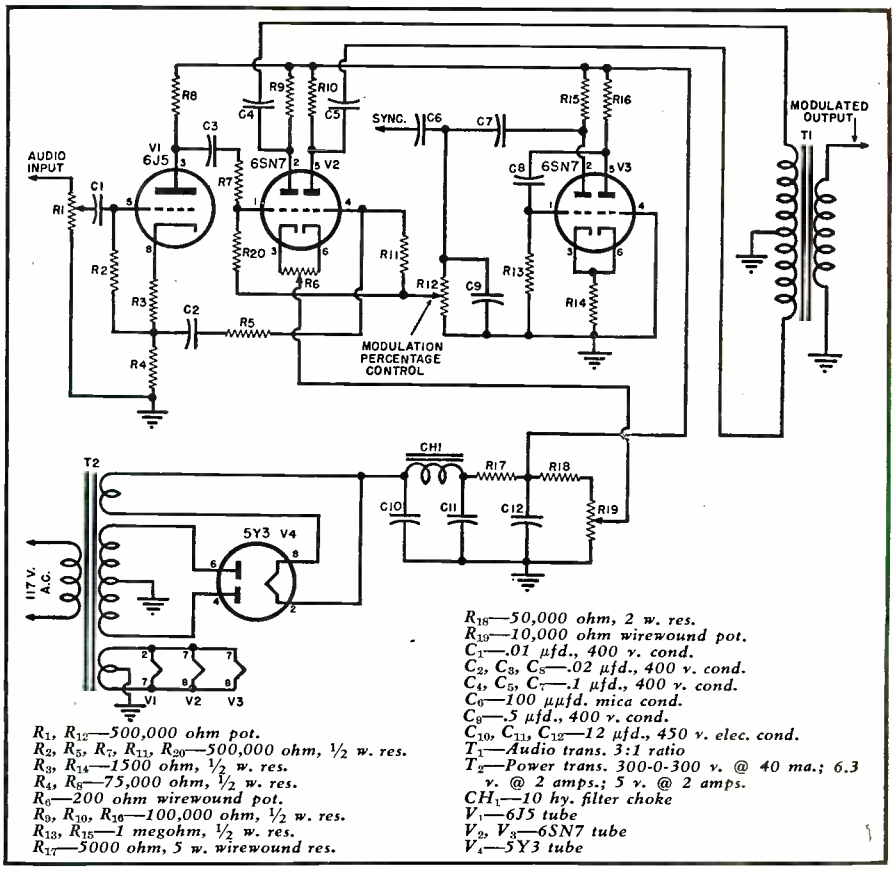


process wherein a slight discontinuity in pressing may have a decided effect on low level components though producing negligible distortion of high amplitudes. Similarly, record wear will tend to obliterate weak passages sooner than high level ones. The effect in both of these instances is similar to a factor having a subtractive coefficient of one such as illustrated in the graph. This will produce a negligible effect on high amplitude waveforms but results in complete attenuation of waveforms having an amplitude of unity or less.

It is fairly well known that certain types of electroacoustic equipment, such as microphones and loudspeakers, do not perform well at low input levels. The nonlinear characteristic thus indicated may produce several undesirable effects. In one instance the nonlinearity may result in the attenuation or suppression of important low level harmonics with resultant "colorless" reproduction. In another case the system may have a nonlinear characteristic in respect to frequency, such as shown in the scope photos, and give undesirable emphasis to certain harmonic components. Likewise, a sharp upward bend in the amplitude curve may generate an unpleasing effect.

Microphone technique may be considerably simplified by use of equipment with improved sensitivity and linearity. With poor equipment it is usually necessary to use a "close up" microphone technique in order to provide adequate input to operate the microphone over a fairly linear portion of its range, likewise wall reflections may tend to suppress the direct sound and introduce an unnatural reverberation decay period due to nonlinearity in the microphone, thus making controlled acoustics desirable. On the other hand, when superior equipment is used, a single microphone placed at some distance from the orchestra is often sufficient, and room acoustics need not be so carefully controlled due to the more natural reproduction of the decay characteristics. In fact, in some instances it is possible to secure clearer reproduction than that the listener would hear if seated next to the microphone.

Linearity distortions may give rise to effects similar to those produced by transient distortions and in several respects the two phenomena may be related, as both studies are concerned with the ability of a system to reproduce sounds of varying amplitude. In connection with this it is interesting to note that seldom is the ability of electroaudio equipment to handle modulated waves mentioned. As many musical instruments represent shock excited resonant systems which emit waveforms of a pulsating nature, this is a problem of some interest in discussions of high fidelity. A casual study of loudspeaker characteristics indicates that the ability to reproduce modulated waves is related to the speaker resonance frequency. Small speakers with high resonance points



R_1, R_{12}—500,000 ohm pot.
R_2, R_5, R_7, R_{11}, R_{20}—500,000 ohm, ½ w. res.
R_3, R_{14}—1500 ohm, ½ w. res.
R_4, R_8—75,000 ohm, ½ w. res.
R_6—200 ohm wirewound pot.
R_9, R_{10}, R_{16}—100,000 ohm, ½ w. res.
R_{13}, R_{15}—1 megohm, ½ w. res.
R_{17}—5000 ohm, 5 w. wirewound res.
R_{18}—50,000 ohm, 2 w. res.
R_{19}—10,000 ohm wirewound pot.
C_1—.01 μfd., 400 v. cond.
C_2, C_3, C_8—.02 μfd., 400 v. cond.
C_4, C_5, C_7—.1 μfd., 400 v. cond.
C_6—100 μμfd. mica cond.
C_9—.5 μfd., 400 v. cond.
C_{10}, C_{11}, C_{12}—12 μfd., 450 v. elec. cond.
T_1—Audio trans. 3:1 ratio
T_2—Power trans. 300-0-300 v. @ 40 ma.; 6.3 v. @ 2 amps.; 5 v. @ 2 amps.
CH_1—10 hy. filter choke
V_1—6J5 tube
V_2, V_3—6SN7 tube
V_4—5Y3 tube

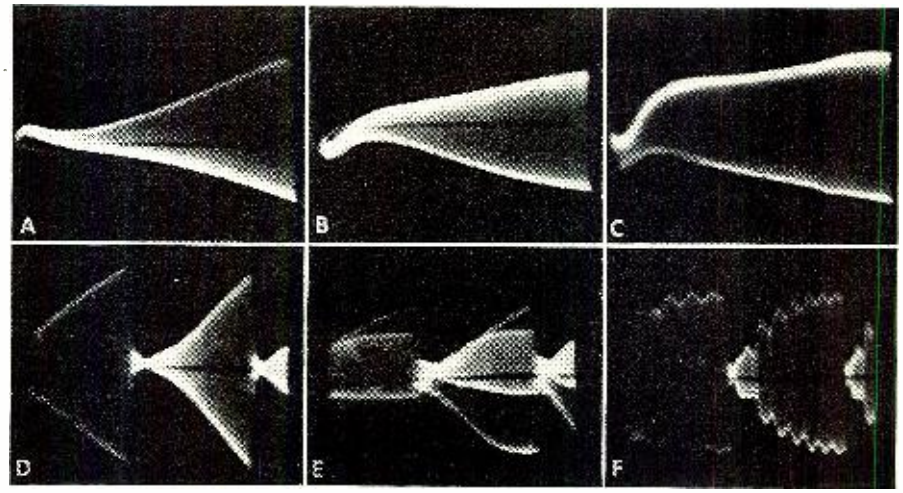
Schematic diagram and parts list covering the sweep amplitude generator.

appear to be superior in this respect to larger diameter speakers with heavier cones. A simple and interesting test is to use loudspeakers in place of microphones. Tolerable quality may be maintained by the small three- or four-inch speaker, providing the primary resonance is not too objectionable, while in large diameter speakers the quality may be greatly degraded and exhibit the characteristic "mushiness" of poor linearity.

Although data on linearity is seldom published, transmission measuring sets capable of a high degree of accuracy have been available for some time. Unfortunately, conventional procedure is a tedious and time consuming process requiring point-by-point checks

(*Continued on page* 128)

Oscilloscope patterns resulting from tests made using the sweep amplitude method of linearity measurement. (A) Pattern of 30-watt beam power amplifier at low levels into a resistive load without feedback. (B) Pattern of same amplifier at medium power levels. (C) Pattern of same amplifier with square top distortion just occurring at maximum amplitude. (D) Six-inch loudspeaker reproducing a 4000 cycle note at medium peak power levels. (E) Same speaker at same level but with a 6000 cycle signal. Both harmonic distortion and amplitude distortion are present but in varying ratios. (F) Same speaker overloaded with 7000 cycle note. While excessive nonlinearity and modulation introduced by transient vibrations are present, little harmonic distortion appears.



Mac's RADIO SERVICE SHOP

By JOHN T. FRYE

PORTABLE PATTER

"HOLY cow! Wha' hoppen?" Barney asked as he stood in the open door of the service shop and surveyed the sea of portable receivers that almost completely engulfed Miss Perkins' desk.

"That's the first day's answer to our special 'check-your-portable-for-only-a-dollar' offer, and don't overlook that TV portable that one joker ran in on us," the office girl told him. "And let me warn you that your story about being sick Saturday had better be good. Mac half suspects you of playing an April Fool joke on him."

The apprentice service technician walked over to the service department and cautiously tossed his battered felt hat through the door.

"Come on in here, you red-headed Irishman!" Mac's voice instantly boomed forth. "Let me get a good look at you. If you look healthy, you won't long. Of all the days I ever needed you, Saturday was it, and—Hm-m-m-m," he broke off as he caught sight of Barney's pale but grinning countenance, "your freckles *do* look a little more three-dimensional than usual. I'm not surprised, though. I knew that sooner or later that billy-goat appetite of yours would cause you to founder yourself."

"The trouble," Barney announced loftily—"and I quote—'was an attack of migraine, probably induced by intense cerebration.'"

"I'll buy the migraine part of it," Mac conceded, "but I've got to see a sample of that cerebration; and come to think of it, where could you find a better place to demonstrate than on these portables? Before you start, though, perhaps we had better have us a little chalk talk:

"Naturally, we shall check all of the tubes; but tube-checking in portable sets can fool you, especially on some kinds of emission checkers. As you know (I hope), the emission of a filament type of tube depends pretty closely on the temperature of the filament; but watch the filament of the 1A7 in the checker when I push this *'Test'* button."

Barney, with his chin hooked over Mac's shoulder, saw the dull red thread of the tube filament glow noticeably brighter as the button was depressed and then return to its former appearance as the button was released.

"The plate current," Mac explained, "flows through that portion of the filament that lies between the 'B-minus' end and the point where the electrons take off for the plate. In many tube checkers, this emission current during test is quite heavy, being a husky percentage of the fifty-milliampere current that is normally supposed to flow through the filament; and when this emission current is added to the filament current, it raises the temperature of the filament considerably above normal. The result is that one of these 50-ma. tubes will frequently show 'Good' in the emission tester when its emission at the normal filament current is well below what it should be."

"What do you do about it?"

"If there is any doubt in your mind, try substituting a new tube in the set. If this makes a marked improvement, a new tube is needed, no matter what the tube-tester says. With experience you will learn to detect a certain sluggishness or hesitation in the swing of the meter pointer on one of these low-emission tubes; but for now, just remember that a playing set and a substitute set of tubes constitute the practical serviceman's Tester of Final Decision.

"And now let us take up the case of those radios which their owners say are too hard on batteries. Most of these complaints, while made in all sincerity, are not deserved. Some people have a most optimistic idea of how long batteries *should* last; others simply forget when the batteries were purchased or how many hours the set has been used since; and finally, never overlook the battery salesman's best friends: small children who just love to turn on these sets and let them run when Mama and Papa are not around.

"We cannot, though, dismiss all complaints as being unfounded; so here is what I want done with every one of these portables that has a reputation of being a battery-eater:

"Open up the positive filament and plate leads and insert current meters in each. Then turn the set on and check the currents drawn. Compare these values with what the set *should* draw, getting this information either from the service manuals or by computing it from tube manual data. Then, with the meters still in place, turn the set off and make sure the currents drop to zero. Finally, in the event the radio is a three-way portable, see if the currents remain at zero when the set is playing on a.c.

"If any of these tests reveal anything funny, find out *why*. If not, when you give the set back to the customer, remind him that batteries are like human beings in that they last much longer if they are given time to rest and recuperate between periods of activity than they do if they are kept going steadily. If the set is a three-way portable, strongly suggest that it be used on batteries only when an a.c. outlet is not available. As a clincher, remind him always to be sure and get *fresh* batteries, like the kind he always gets at Mac's Radio Service Shop!"

"Gotcha!" Barney grinned. "Tell me more!"

"Well, one thing you want to watch is to see that the chassis and batteries are in place in the cabinet when you align the r.f. trimmer that is across the loop; otherwise the loop will be seriously detuned when these items are placed inside its field. This is especially true where the loop is wound on the inside of the cabinet. If the loop is fastened to the back of the cabinet, this should be in its normal position before adjusting the trimmer.

"In most sets, provision is made for doing this; but there are a few that offer no porthole for reaching this trimmer with the chassis and back in their normal operating positions. When the cabinet is of wood covered with airplane cloth, I usually drill a small hole in the cabinet that allows me to adjust the trimmer and then I close this opening with a snap button hole plug."

"And if the cabinet is made of a plastic material?"

"Sometimes there is room to use a

(*Continued on page* 118)

MODERN Television RECEIVERS

Part 24. Concluding article of the series—a review of recent developments in TV receivers.

Fig. 1. A 16RP4 video tube. It provides a useful screen area of 139 sq. inches and is 18¾ inches long. The deflection angle is 70°.

By
MILTON S. KIVER

IT HAS been almost two years since the first article of this series was written and during that period television has become a dominating factor in the radio manufacturing and the home entertainment fields. In April, 1948, there was slightly under a million television sets in use. Today, we are rapidly approaching the five million mark.

As is true of every new development, numerous changes are being made continually, with the major emphasis in the television receiver being directed toward a simplification in set construction, a reduction in set cost, and an improvement in image detail. In the preceding twenty-three articles every effort was made to keep the reader abreast of the latest developments. However, new changes in design are appearing even while this article is being written and it might prove of interest to stop and note just what some of these are.

Cathode-Ray Tubes

Perhaps the greatest change that is taking place within the television receiver is occurring at the cathode-ray tube. Present tubes with their 50° deflection angle are gradually being replaced by shorter, stubbier tubes utilizing a 70° deflection angle. As an illustration of the space saving achieved by the use of a wider deflection angle, the new 19AP4 with its 70° deflection angle has an over-all length of 21½ inches while the 20BP4 with a 50° angle, has an over-all length of 28½ inches. To swing the electron beam through the wider angle, more efficient horizontal output transformers have been designed, such as the new *General Electric* ceramic core transformer requiring only a single driving amplifier. Changes are taking place, too, in the shape of the tube. It has long been evident that a cathode-ray tube using a circular screen is wasteful not only of screen area, but of cabinet space as well. The obvious solution was a rectangular-shaped screen, designed in the standardized 4 to 3 aspect ratio of the transmitted image. Manufacturing difficulties have prevented the introduction of this tube in any appreciable quantity until recently, when the glass industry announced that it can supply rectangular tubes in quantity. As an indication of the space saving feature of these tubes, the 16RP4, shown in Fig. 1, will fit any cabinet now housing a circular 12-inch tube and provide a useful screen area of 139 square inches. Its over-all length is but 18¾ inches, with a deflection angle near 70°.

Additional modifications, besides size and shape, have also been made in the cathode-ray tube. Of these, the most important from the standpoint of the viewer has been the increase in image contrast. It was found, after television receivers had been in use for some time, that many observers reported eyestrain after viewing the screen continuously for more than an hour. Investigation revealed that this was due primarily to the poor contrast of the reproduced image. The viewer, being dissatisfied with this poor contrast in which the difference in shading between the white and black portions of the image was limited, usually turned the contrast control up. This caused the white portions of the image to receive excessive illumination, and produced the illusion that the blacks became blacker. Actually, the blacks did not become blacker by this procedure, but the illusion was created because of eye fatigue produced by the greater intensity of the whiter portions of the image.

Two methods for improving the contrast of the image have been advanced and are in use at this time. One method employs a special type of filter glass (known commercially as *Teleglas*) for the face of the tube. This glass acts as a filter by absorbing more of the light passing through it than an ordinary glass does. This has two effects. First, light from the room striking the face of the image tube is absorbed to a greater extent than it is with clear glass, reducing the ability of this light to destroy the contrast between various sections of the image. Second, there is a reduction in the amount of scattered light present between the inner and outer surfaces of the glass face. In ordinary tubes, these reflections cause light from a bright point to scatter over a relatively large surrounding area, reaching areas that should be dark and causing a decrease in detail contrast. The use of a light absorbing glass reduces the extent of this scattering.

The second method, employed to date only by *American Television* in Chicago, incorporates a special binder with the fluorescent crystals which restricts the light at any one point from going in any direction other than forward. The result, again, is a reduction in light scattering.

Finally, cathode-ray tubes not employing ion traps, such as the 12JP4 and 15AP4 have been replaced by the 12RP4 and the 15DP4, which do require traps. The newer tubes contain

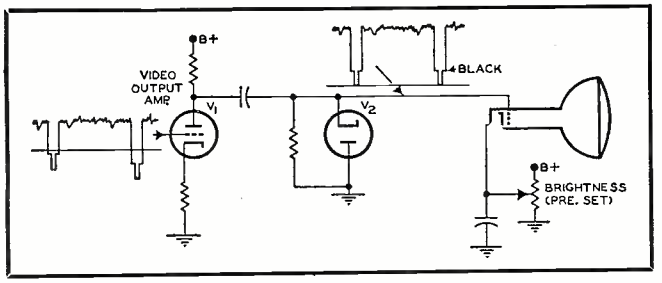


Fig. 2. One typical and widely-used d.c. restorer circuit.

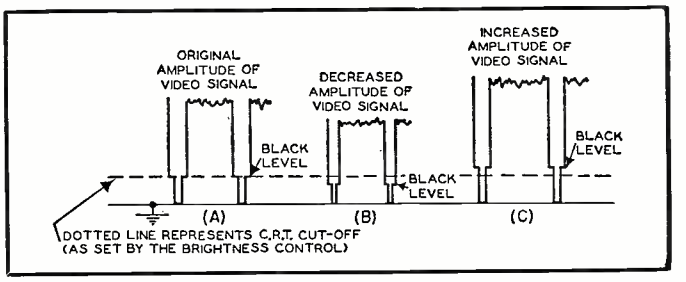


Fig. 3. Effect of contrast control setting on video signal.

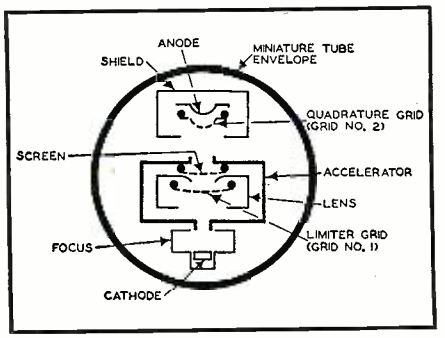


Fig. 4. The internal construction of the 6BN6 beam-gated tube used by Zenith.

a bent gun which, in conjunction with an external ion trap, removes the ions from the scanning beam. It is these ions, it will be recalled, which produced blemishes on the face of the tube. Other image tubes which employ the diagonal-cut gun and an external ion trap are still used.

I.F. System

The r.f. systems, on the whole, have retained the circuits reviewed in previous articles of this series. The i.f. frequencies, however, have risen until now they reach as high as 45.75 mc. The use of such high i.f. values has, as its immediate purpose, a reduction in the number of spurious responses to which all television circuits are subject. Why a higher i.f. will reduce the interference present in television sets can be seen from the following brief analysis.

1. *Direct I.F. Interference.* One of the major sources of interference to a television receiver is direct i.f. pickup of the interfering signals. To solve this problm, a band of i.f. frequencies should be chosen in which no other commercial or industrial services are present, or if present, are permitted to employ only small amounts of power. A further limitation of the choice of a suitable i.f. is that it should be below the lowest television channel, in this instance channel 2, 54 to 60 mc. Examination of existing FCC allocations between 20 and 50 mc. reveals that the band of frequencies extending from 41 to 45 mc. is better suited for this purpose than the 21 to 26 mc. frequencies originally recommended by the FCC.

2. *Oscillator Radiation.* It is a common experience with present television receivers to have the oscillator voltage radiation from one set cause interference to another set tuned to some other channel. Thus consider two television receivers located within the same building, one tuned to channel 2, the other to channel 5. With a video i.f. value of 25.75 mc., the local oscillator in the set tuned for channel 2 will be at 55.25 mc. plus 25.75 mc., or 81 mc. Channel 5 extends from 76 to 82 mc. Hence, any signal emanating from the channel 2 receiver will cause a narrow bar pattern to appear on the receiver tuned to channel 5. Similar disturbances can occur, in various degrees, on other channels.

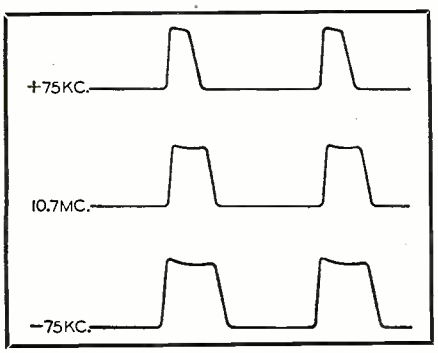
By raising the i.f. value, we also raise the operating frequency of the local oscillator and by choosing an i.f. value between 40 and 50 mc., the resulting oscillator frequencies fall outside the present v.h.f. television band.

A similar analysis with other types of spurious responses will reveal that as the i.f. value rises, the effects of the spurious responses decrease.

Now, this desirability of high i.f. frequencies has long been known but has only become economically practical recently due to advances made in fabricating miniature components and high gain pentodes.

There is still another reason for desiring the high i.f. values, and this stems from the fact that within a relatively short period of time, use will be made of the ultra-high frequencies for the transmission and reception of television broadcasts. Since r.f. amplification of u.h.f. signals yields less gain than a similar amplification of v.h.f. signals, conversion to a lower i.f. frequency will be made as soon as the signal is received. The choice of a high i.f. is advantageous at u.h.f. for the same reasons that it is at the lower v.h.f. frequencies. In addition, in the u.h.f. band (between 475 and 920 mc.), the local oscillator will, in all probability, be placed below the incoming signal frequency rather than above, as it is at the present frequencies. In this respect, use of a high i.f. is also desirable, since the higher the i.f. value, the lower the oscillator frequency.

Fig. 5. The variation in the length of current pulses passing through the 6BN6 when an FM signal is being received at the set.



A.G.C. Systems

The trend in recent television receivers has been toward a.g.c. systems wherein the a.g.c. tube is permitted to conduct only when the horizontal synchronizing pulse appears in the received signal. Throughout the remainder of the video signal, the a.g.c. tube is completely inactive since a pulse from the horizontal output transformer is required for the tube to conduct. This pulse is developed at approximately the same time that the horizontal sync pulse appears in the received signal.

The advantage of keyed a.g.c. systems lies in the fact that they are active only 5% of the time, thereby eliminating the effects of any strong noise pulses that might arrive during the remaining 95% of the time. Furthermore, with a keyed a.g.c. system, short time-constant filters can be used in the a.g.c. distribution network. These are extremely helpful in eliminating certain types of interference, especially airplane flutter. Full information concerning the actual circuits used in such a.g.c. systems can be obtained from an article on the subject appearing in the December, 1949 issue of RADIO & TELEVISION NEWS.*

Automatic Brightness Control

It is common experience that whenever the contrast control setting of a receiver is changed, the brightness control must likewise be readjusted. A circuit designed to eliminate the need for this continual resetting of the brightness control has been devised by *Sparton* television engineers and is known as an automatic black level system.

In most television receivers, the video signal at the output of the final video amplifier is applied to a d.c. restorer where sufficient variable bias is developed to restore all sync pulse tips to the same level. See Fig. 2. In essence, what the d.c. restorer does is to develop a positive voltage which, when added in proper amount to the video signal, raises all sync pulse tips to a common level. The brightness control

* Buchsbaum, W. H.: "Need For Fast Acting A.G.C. Systems"

is then adjusted until the image tube electron beam is cut off at the black level of the video signal.

Consider what happens, now, as the contrast control is varied. When the control is turned counterclockwise, the amplitude of the signal decreases, as shown in Fig. 3B. This change in amplitude also affects the position of the black level of the signal. On the other hand, when the contrast control is turned clockwise, the amplitude of the signal increases, again changing the position of the black level. (In this instance the vertical retrace lines become visible). For both conditions, adjustment of the brightness control would be necessary in order to have the electron beam cut off at the black level of the signal.

The interaction between contrast and brightness controls can be eliminated if the d.c. restorer circuit is made to operate at the black level of the video sync pulses rather than at the sync pulse tips themselves. Since it is the black level that, when combined with the proper image tube bias, sets the point at which the beam is cut off, maintaining this black level constant irrespective of the contrast control setting, will remove the need for continual readjustment of the brightness control.

At the same time, d.c. restoration will be achieved since the relationship between the black level and the sync pulse tips is fixed and establishing a fixed level for one will automatically fix the level of the other.

The circuit for the automatic black level system is shown in Fig. 8. Its basic action is similar to that of any diode d.c. restorer with the exception that the circuit in the receiver is so arranged that negative sync pulses of greater amplitude than the sync pulses of the video signal (appearing at the cathode of V_2, Fig. 8) are applied to the plate of the diode, as shown. These negative sync pulses effectively cut off the d.c. restorer during the period when the sync pulses of the video signal appear at its cathode. The d.c. restorer then conducts only on the most negative portions of the remaining signal, that is, on the front and back porches of the blanking pulse which represent the true black level of any picture. Operating in this manner the d.c. restorer sets the black level of the video signal directly at a definite reference level at the image-tube grid instead of setting the sync pulse peaks at the reference level and letting the black level fall where it may, depending on video signal amplitude.

Beam-Gated Tubes

The most recent *Zenith* television receivers contain a 6BN6 beam-gated tube which represents a new approach to a combined limiter-discriminator circuit. This tube, designed by Dr. Robert Adler of the *Zenith Radio Corporation,* possesses a characteristic such that, when the grid voltage changes from negative to positive values, the plate current rises rapidly from zero to a sharply defined maximum level. This same maximum value of plate current remains, no matter how positive the grid voltage is made. Current cut-off is achieved just as abruptly when the grid voltage goes about two volts negative.

The reason for this particular behavior of the tube stems from its construction. See Fig. 4. The focus electrode, together with the first accelerator slot, form an electron gun which projects a thin sheet electron stream upon grid No. 1; the curved screen grid, together with the grounded lens slot and aided by the slight curvature of grid No. 1, refocuses the beam and projects it through the second accelerator slot upon the second control grid. This grid and the anode which follows are enclosed in a shield box. Internally, the focus, lens, and shield electrodes are connected to the cathode. The accelerator and the screen grid receive the same positive voltage because both are connected internally.

The foregoing design is such that the electrons approaching the first grid do so head-on. Hence, when grid No. 1 is at zero potential or slightly positive, all approaching electrons pass through the grid. Making the grid more positive can not, therefore, increase the plate current further. When, on the other hand grid No. 1 is made negative, those electrons that are stopped and repelled back toward the cathode do so along the same path followed in their approach to the grid. Due to the narrowness of the electron beam and its path of travel, electrons repelled by the grid form a sufficiently large space charge directly in the path of other approaching electrons to cause an immediate cessation of current flow throughout the tube. In conventionally-constructed tubes, the spread of the electron beam traveling from cathode to grid is so wide that those electrons repelled by the grid return to the cathode without exerting much influence on other electrons which might possess greater energy and therefore be able to overcome the negative grid voltage. It is only when the control grid voltage is made so negative that no emitted electrons possess sufficient energy to overcome it that

(*Continued on page* 138)

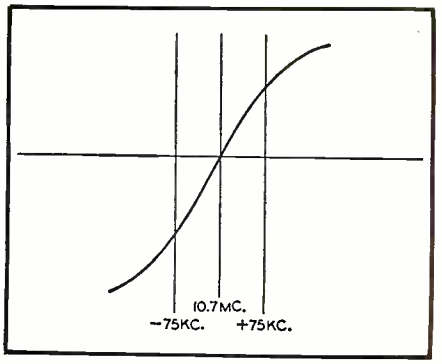


Fig. 6. The discriminator response of circuit shown in the diagram of Fig. 9.

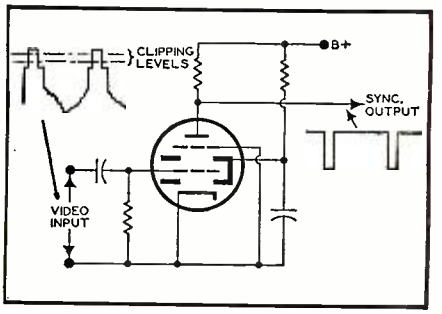


Fig. 7. A 6BN6 connected as sync separator.

Fig. 9. A limiter-discriminator circuit using the 6BN6.

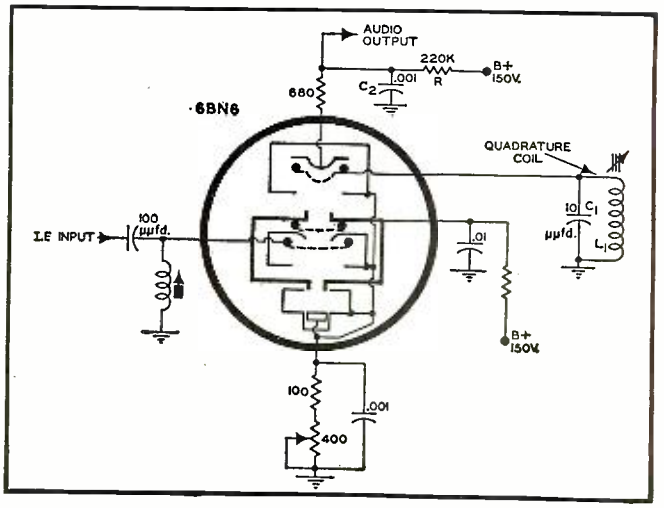


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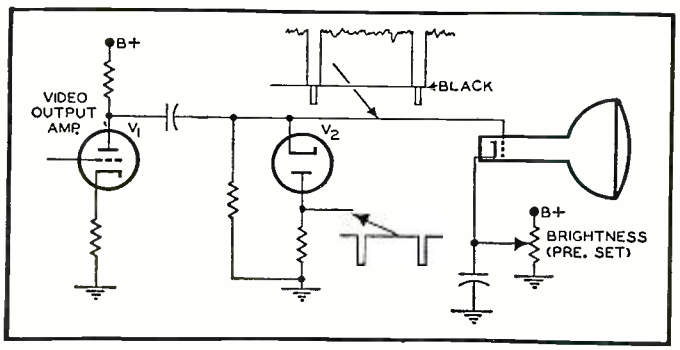
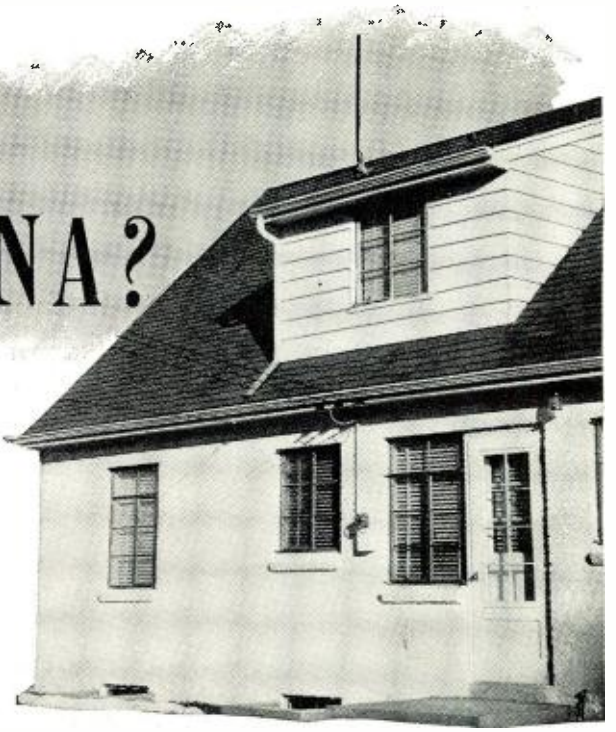
Fig. 8. The basic circuit of the d.c. restorer as used in the automatic black level system described herein.



NO SPACE FOR AN ANTENNA?



By STAN JOHNSON, W8LBV

Two solutions to the problem of getting on the air without the necessity for erecting a bulky and often forbidden antenna array.

MANY a ham, or would-be ham, would be on the air were it not for an uncooperative landlord, belligerent neighbors, or an XYL with a will of iron—who doesn't want the landscape cluttered up with a transmitting antenna. To these luckless hams this article is dedicated, for it describes two practical antennas, both tested in months of operation, which should enable almost anybody to go on the air.

Both antennas to be described are for the 10 meter band. This band is the logical choice for the ham with space problems, since it is the highest frequency band consistently useful for both "ground wave" and "DX" work. And, of course, the higher the frequency the shorter the antenna—and the better the chance of finding a spot for it.

The antennas are of two types, one a non-directional low-angle radiator, and the other a two-element beam.

First, the beam, which is a natural for those whose best chance for an antenna is to park it in the attic where only mice, and perhaps an inquisitive woodpecker, will ever see it.

Choosing a beam for an attic is no cinch, since unless you live in a mansion (in which case you probably own the place and have neither landlord nor neighbor problems) you are not apt to find enough space to rotate the beam. True, there are "bent" and "folded" beams—but the writer has tried this approach and takes a dim view of the results.

Since we are stuck with a non-rotating beam, the best bet is to make it bi-directional, so that we have two chances to work stations instead of one. The logical choice is an "end-fire array," or as the old-timers know them, an "8JK." This antenna, once top favorite for 10 meters, is still a good one. It gives a gain of over 4 db. in two directions, in theory, and in practice seems to do considerably better than that.

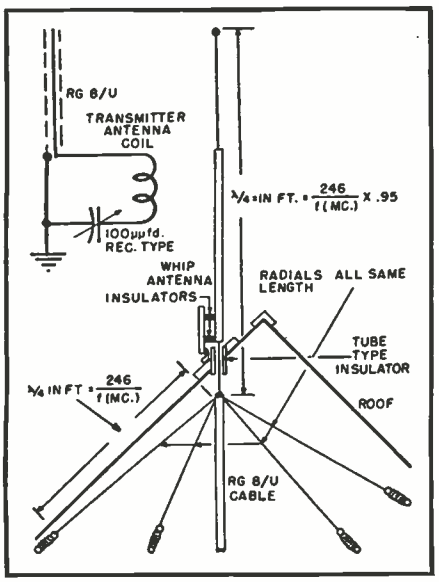
The 8JK can be made up in many different ways but the easiest way at the moment is to utilize the various "ribbon" lines which are on the market today. Essentially, the antenna consists of two folded dipoles, spaced a quarter-wave apart and fed 180 degrees out-of-phase. The dipoles are made up of standard 300 ohm ribbon, as shown on page 61, and both dipoles are fed with lengths of 150 ohm line. This line is used on the assumption that the quarter-wave spacing of the two radiators lowers the radiation resistance of each of the dipoles to approximately one-half of that usually found at the center of a folded dipole in free space. The two lengths of 150 ohm line can be any *equal* length over 9 feet. As shown in the drawing, *one* of these lengths of 150 ohm line should be twisted one-half turn, to allow feeding the dipoles out-of-phase. At the juncture point of the two 150 ohm feeders a 72 ohm transmitting type twin-lead is attached and run to the transmitter.

Dimensions should be calculated for the most-used frequency, following the formula given in the diagram. The 72 ohm line should be made somewhat longer than needed to reach the transmitter, and then carefully pruned a couple of feet at a time to find the length which gives best antenna loading. The fact that the line needs pruning proves that there are standing waves present but they do not seem to be high. After the feeder has been pruned, the antenna will take power over a surprisingly wide range of frequencies.

The photograph (page 61) shows one practical way to mount the antenna in an attic. Of course, the antenna is directional at right angles to the length of the dipoles, and it should be oriented with this in mind. Running the antenna north and south is recommended, for example, if you are located in the middle of the U.S.A. and want to work both coasts.

The luck you will have with the antenna will depend upon a lot of things, including, the writer found, upon whether the antenna is installed above or below the insulation! Mounting the antenna above the insulation in the attic gave noticeably better results than when the antenna was mounted directly below it—apparently even rock wool will soak up radio waves. The

Construction details on "Inside-Outside" ground plane unit for 10 meter operation.

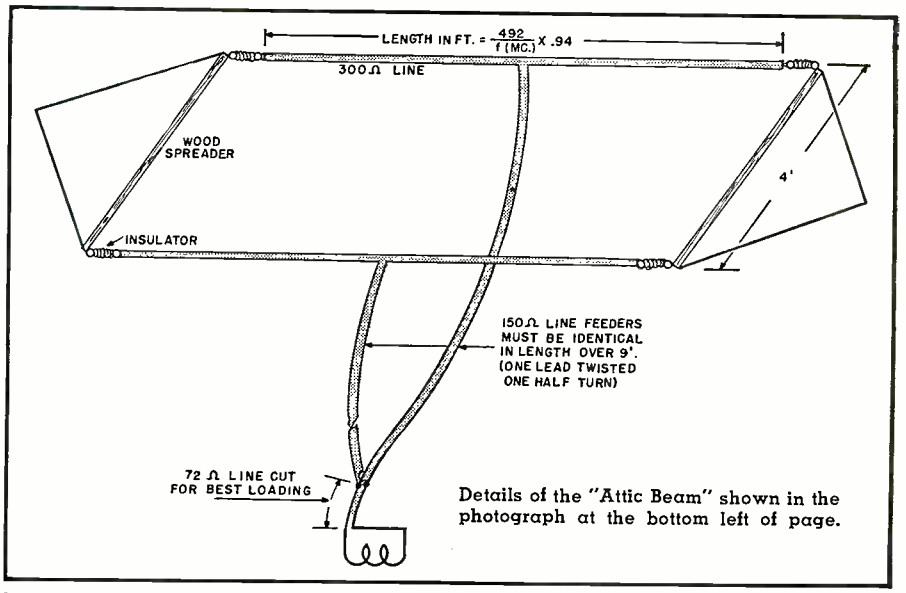


material used for roofing will undoubtedly have some effect, as will the proximity of water pipes, etc.

As explained previously, the 8JK is quite directional in each of its two directions. So if you want to work in all directions, at the sacrifice of gain, or if your house is oriented in such a way that the 8JK would dump its signal into regions inhabited largely by fish and polar bears—you will need another way out. A variation of the "drooping ground plane," popularized by W6FFF, is a nice solution.

This antenna consists of a radiating portion, which is made from an ordinary "whip" antenna, with four radials at the base. The use of the radials leading off at an angle (not critical) results in an antenna which is a fairly good match for a standard 52 ohm cable such as RG8/U. The whip can be mounted on the roof of the house, since it is neat by nature, and the rather messy radials hidden beneath the roof, where even the nosiest neighbor won't know they are there.

One large manufacturer of whip antennas makes a telescoping 12 foot antenna, complete with mounting bracket and insulators, which sells for less than five dollars, which is ideal for this type of installation. Notice that the *inside* of the coaxial cable connects to the bottom end of the whip, and the braid connects to the four radials. For purposes of measurement the "antenna" consists of everything from the point at which the coax braid ends (and the radials are attached) to the top end of the whip. The whip is mounted on a block of wood, which is screwed to the roof, using the angles furnished with the antenna. This antenna does require drilling a small hole through the roof, but if you plug it with a piece of caulking compound after dark the night you move out, the landlord will never know what happened. Incidentally, the same caulking compound is recommended for plugging the space around the wire which is pulled through the tube insulator at the base of the antenna. The writer used a piece of coax with the braid stripped off, as this lead-in, taking advantage of the extra insulating material which remained on the coax.



Details of the "Attic Beam" shown in the photograph at the bottom left of page.

The drooping ground plane is reputed to be equally good in all directions, and experience with it seems to bear this out. Of course, it will not lay down a signal like a beam, but it does concentrate your power at low angles, which helps. It will receive DX stations surprisingly well—along, alas, with auto QRM, if there happens to be some nearby. The best "DX" which the writer has worked with the antenna shown in the photograph is Guam, which, while nothing to shout about, is quite a long haul with a 50 watt phone rig.

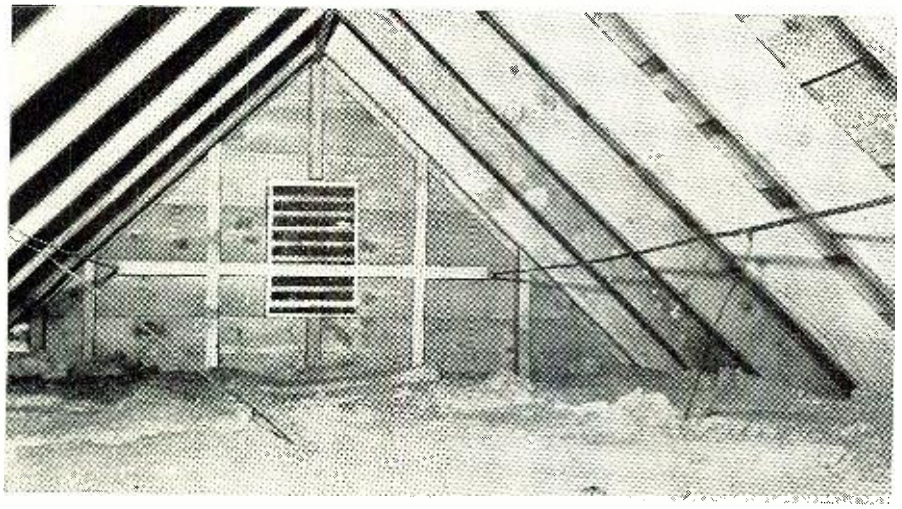
You will notice that the diagram shows a tuning condenser connected to the pick-up coil at the transmitter. This makes it possible to tune out the reactance, which means simply that the antenna will load up with looser antenna coupling. The little condenser (voltage is low so an ordinary receiving type condenser will do) is simply adjusted to the point which makes the transmitter load up the best. The ground plane antenna really soaks up r.f., and apparently is not too critical as to frequency.

After using the two antennas shown, the writer still has one more antenna to try before pulling out all stops and doing a selling job on the XYL to convince her that a wide spaced four element beam would blend well with Colonial architecture. The antenna to try would utilize *two* 8JK's as radiators. According to the book, if these antennas are spaced along in a line a full wavelength apart (as measured from center-to-center) it is possible to get either a cloverleaf or a bi-directional pattern, simply by feeding the two antennas in—or out—of-phase. The gain is supposed to be about 7 db., which would be quite an "assist" for the 50 watter.

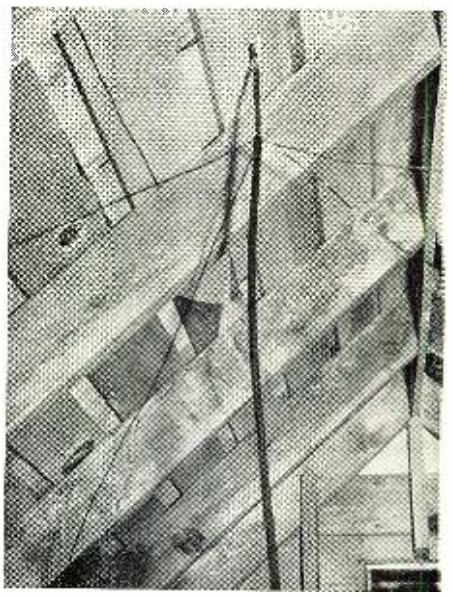
And perhaps if the power were hiked to a couple of hundred watts, the r.f. would melt snow off the roof.

Not that it matters. The writer has talked to Miami, Florida, right *through* 8 inches of snow on the shingles! —30—

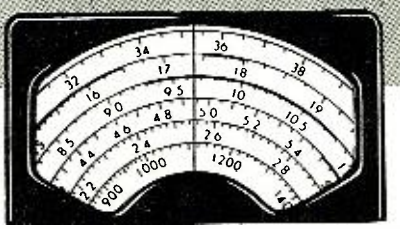
This two-element end-fire array (8JK) is easy to install in attic where it will turn in better performance than standard folded dipole under same conditions.



The "Inside" portion of the antenna shown in the photo on opposite page. The radials at the base of the antenna are in attic, neat "whip" is only element outside.



International SHORT-WAVE



***Compiled by* KENNETH R. BOORD**

EDGAR W. PARMENTER, General Manager of the International Monitoring Service, informs me that IMS wishes to expand its services to short-wave broadcasters. Says Mr. Parmenter:

"The International Monitoring Service—which is in the business of publishing and cataloging short-wave broadcasting information and technical data—wishes to expand its *free* foreign broadcast monitoring service.

"For many years, the IMS has given freely of its time, effort, and experience to foreign broadcasting stations which operate in the short-wave bands, in the interest of good will and understanding between nations through the medium of short-wave broadcasts. It has been the sincere belief of the directors that there was a need for a reliable method of getting reception data without cost to the individual broadcasters. With this thought in mind, IMS surveyed its position and found that the necessary equipment and manpower was available. So it was, after the end of World War II, and as liberated and free broadcasting stations returned to the air, that IMS-1 station, San Carlos, California, was put into operation. Since then, IMS-1 has voluntarily served broadcasting stations on all continents and in every corner of the globe.

"The time has now come when we must attempt to expand these listening posts to every strategic location in the United States and its possessions. Once this is done, coordinated checks on reception over a large area of North America will be available to broadcasters.

"IMS is asking SWL's who would be interested in serving as a monitor, to write to The International Monitoring Service, P.O. Box 485, San Carlos, California. A descriptive folder and questionnaire will then be mailed, outlining the requirements and many benefits obtainable by the volunteer. We would like to stress that IMS does not and will not change or cause to be changed any of the services it or its affiliates and associates render to the broadcasters."

Our best wishes go to IMS in this worth-while effort!

* * *

Radio Tibet

According to press dispatches from India, at long last Tibet has gone on the air. A few days before this was written, it was reported from India that "a thin, wavering voice calling from a station that announced itself as 'Radio Tibet'" had been heard in the 41-meter band on a frequency of approximately 7.200. The broadcast stated that the Government of the Dalai Lama was "shocked" by the threat of a Chinese Communist invasion and an appeal was made to all neighboring countries for aid in fighting possible aggression.

A dispatch from Kalimpong, in northern Bengal near the Tibetan frontier, said that "Radio Tibet" would start regular broadcasts the following day in *English,* Chinese, and Tibetan.

A report from New Delhi said it was believed that "Radio Tibet" had been set up in behalf of the Tibetan Government by Reginald Fox, a British citizen who has lived in Lhasa, the capital of Tibet, for many years and who is married to a Tibetan.

Any further information regarding "Radio Tibet" will be welcomed.

* * *

"A Little About DX-ing"

Of interest is this comment by Sidney Pearce, England, a valuable monthly contributor to this Department, as it appeared in a recent issue of *NATTUGGLAN* (Night Owl), house organ of the Scandinavian DX Club, Sweden:

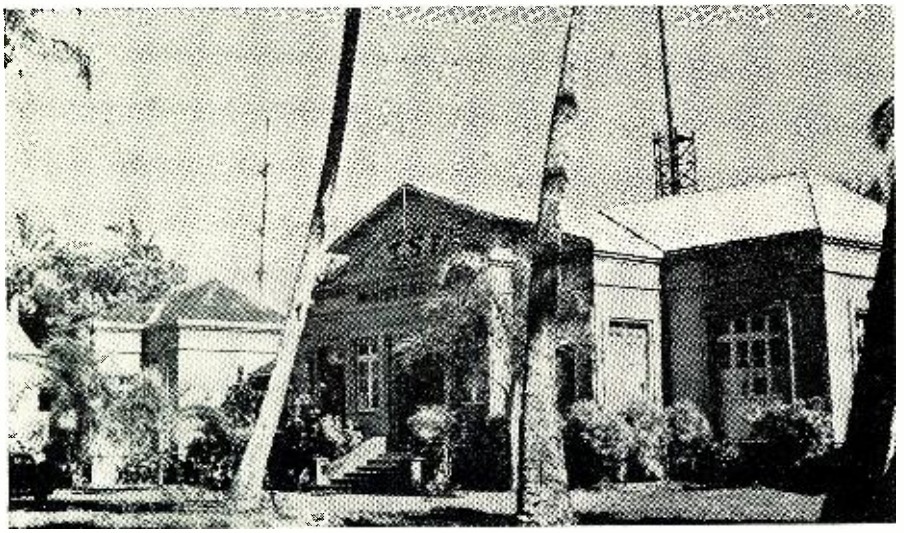
"I actually started being a short-wave fan in December 1935, when I used a home-built OV. Z battery band-spread receiver. I got quite a thrill when I heard my first DX-station, Boundbrook, New Jersey, in the 16-meter band. But I think my biggest thrill in those days was one February afternoon when I logged the old VK2ME in Sydney, Australia, and in due course received its QSL card. In some ways, I got more thrill in those days using a small receiver than with my present communications receiver, although most stations were low-powered. I think we had more chance of logging some of the stations at that time than today, because there were not so many stations on the bands and especially no very high-powered local transmitters as today which 'swamp' many weaker signals on adjoining frequencies.

"To be successful in short-wave listening, I think you need up-to-date news of stations on the air, schedules, et cetera, and a good station list. . . . You also should have a fair knowledge of geography. Another tip is, although most of the weaker signals are the ones worth investigation for DX, never turn down a strong signal un-

(*Continued on page* 102)

(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.

General view of Radio Tahiti at Papeete, Tahiti. The station is on the air daily, mostly in the French language, from 2315-2400 EST on 6.982 and 12.080 megacycles.



R. F. Power OUTPUT METER for V.H.F. and U.H.F.

This unit has a useful frequency range of between 3 and 300 mc. which covers most amateur and many commercial bands.

Front and rear views of the compact, home-built r.f. power output meter. The unit is housed in a standard black crinkle metal utility cabinet.

By
J. A. HOUSER,† W2VCM

BY THE application of established theory and practice it is a comparatively simple matter to measure the power output of low-powered AM or FM carriers without elaborate or expensive equipment such as concentric slotted lines and the like.

The meter to be described is low in cost, simple to build, and easy to calibrate. It has a maximum standing wave ratio of 1.3 at 150 megacycles. Compared to some of the most expensive power output meters which guarantee their standing wave ratio to 1.1 or 1.15, but taking into consideration the difference in cost, this 0.2 increase in standing wave ratio is negligible.[1]

As far as the writer has been able to determine, the discrimination over an extremely wide frequency range is also negligible. The useful frequency range seems to be approximately 3 to 300 megacycles, which includes most of the amateur bands and many commercial services.

The writer has found this instrument especially useful for checking taxi, truck, and police transmitters operating in the 35 to 45 and 152 to 162 megacycle bands, where it is literally worth its weight in gold. (It weighs only a couple of pounds and is completely self-powered, self-contained, and extremely portable and convenient to use).

The entire unit is housed within a Bud CU-728 metal utility cabinet of black crinkle, measuring 3" deep x 5" wide x 4" high. This cabinet has two removable side plates which makes it most convenient for making all connections. The switch selected must have sufficient positions for the various ranges the constructor wishes to calibrate. The numerical limits of the power ranges will be governed by the number of switch positions. The power ranges themselves will be discussed later in connection with the metering circuit.

The photographs show the construction very well. The switch S_1 is a single-pole, double-throw type. The low position is for 10 watts full scale, readable to 1 watt with accuracy, and the high position is for 100 watts. These power ranges are wholly and completely at the discretion of the constructor within the limits of the calibrations he wishes to make and the light bulbs available. A 0-1 ma. meter was used, but this proved to be superfluously sensitive. Anything up to the limit of the rectifier may be used.

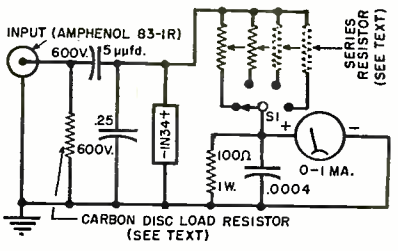
The input is through an 83-1R type chassis receptacle mounted with four 6/32 brass, nickel-plated machine screws, although it is necessary to drill out the holes in the 83-1R to take these standard screws. Brass nuts were used. The usual scraping procedure for good ground, and fastening of a heavy ground lug through one of the screws on the rear was followed.

The heart of the meter, the resistance element, is composed of carbon discs which were purchased as war surplus. They are copper plated and

(*Continued on page* 114)

Complete schematic diagram of the r.f. power output meter.

1—100 ohm, 1 w. res.
1—10,000 ohm, 1 w. res. (see text)*
1—100,00 ohm, 1 w. res. (see text)*
1—5 μμfd. mica cond.
1—.25 μfd., 600 v. cond.
1—400 μμfd. mica cond.
20—2.5 ohm carbon discs
1—1.25 ohm carbon disc
1—S.p.d.t. toggle sw. (see text)
1—1N34 crystal
1—0-1 ma. meter, 2½"
2—lengths 10/32 brass, threaded rod, 6" long
2—10/32 x ¼" RH brass, nickel-plated machine screws
2—1" long x ¾" diam. poly insulators, tapped both ends 10/32 for ⅜" depth
2—6" pieces of spaghetti to fit tightly over 10/32 rod but within ¼" diam. holes in carbon discs

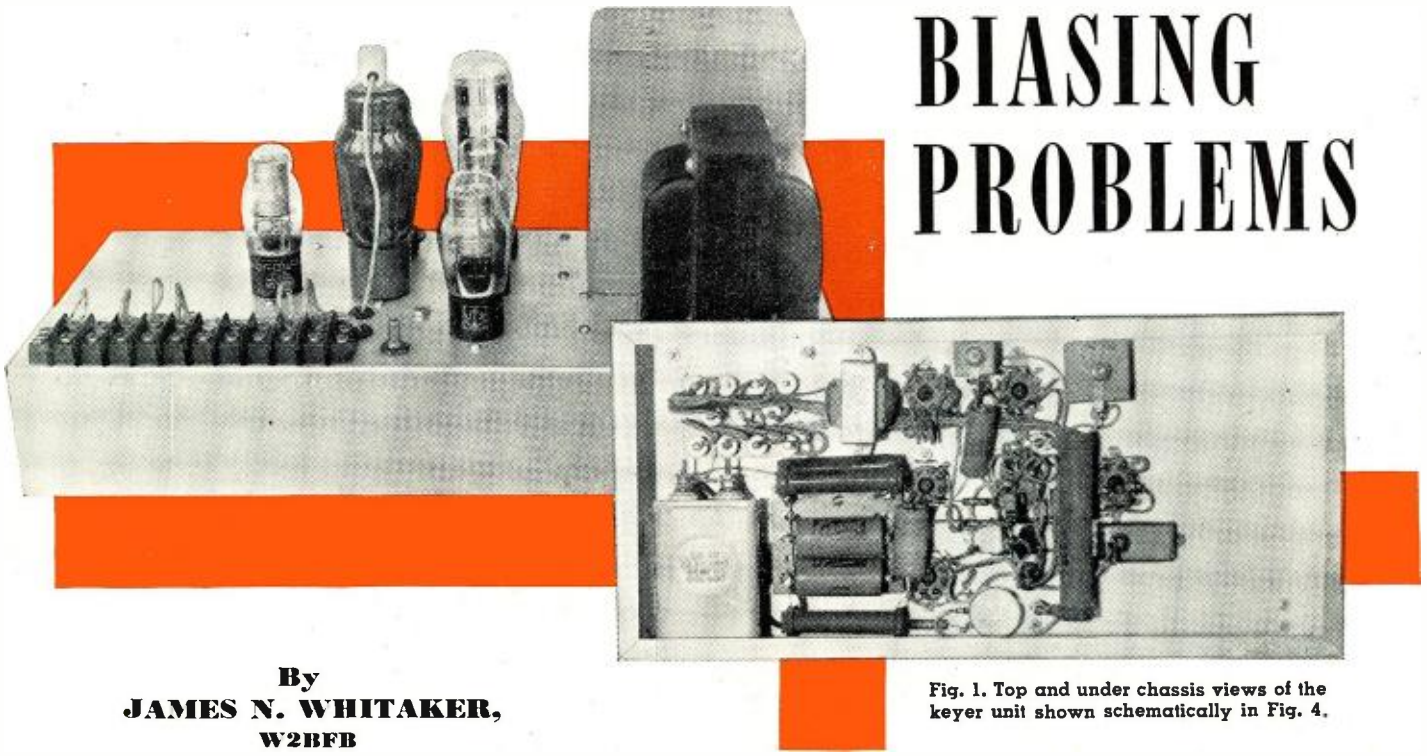


** Other series res. to suit ranges selected (see text)*

† 23 Washington St., Rensselaer, N. Y.

[1] Graham, R. C.; "Developments in Solid Dielectric R.F. Transmission Lines," RADIO NEWS, Oct., 1946, page 46.

TRANSMITTER KEYING AND BIASING PROBLEMS



By
JAMES N. WHITAKER,
W2BFB

Fig. 1. Top and under chassis views of the keyer unit shown schematically in Fig. 4.

Analysis of some causes of keying transients, and a means of eliminating interaction between stages due to the use of a common biasing supply. Specifications and a description of a unit combining a vacuum tube keyer and biasing system, which is applicable to an existing phone transmitter, are also given.

THE present trend toward telephony and new modulation systems appears to have captured the amateur's fancy to the extent that c.w. telegraphy is considered old art, with all problems nicely solved and adequately described. A few minutes expended in critically listening over the c.w. portions of the amateur bands will quickly dispel this idea. There are still plenty of chirps and an abundance of key clicks.

Clickless keying is not always easily obtained, nor are the causes of key clicks always understood. The transients produced by sharp keying waveforms are the types most generally treated in popular texts. This type of keying transient is usually eliminated by a simple *RC* filter network in the keying circuit. This does not always eliminate the click or thump, although theoretically shaping the keying waveform.

If the power supply regulation is poor, the radiated power may be considerably higher at the start of the keying pulse, dropping sharply to the normal level as shown in Fig. 3A. This output wave shape will cause a bad "thump," but may not necessarily cause a "click." It is caused by the increase in power supply voltage under no-load conditions. In some instances, this increase may be as much as 50%, even in power supplies normally considered adequately designed. Excessive power supply filtering of the "brute force" type is a common cause of poor regulation under keying conditions.

A secondary result of poor regulation may be spurious oscillations at the start of each keying pulse. The power amplifier (or, in fact, all keyed stages) although stable for all practical purposes at the normal plate potentials, may break into violent self oscillation with an appreciable increase in plate potential. This spurious oscillation may disappear as soon as the plate potential approaches normal, and therefore may not be recognized as anything other than "key clicks." This is the type of "key click" that appears to spread out over a very wide band, the bandwidth depending upon the spurious frequencies generated. The presence of these spurious frequencies is easily detected by examining the keyed transmitter output with an oscilloscope. The keyed stages should be free from spurious oscillations even with more than twice the normal applied plate potential. If spurious oscillations are present, they must be eliminated before clean, clickless keying can be obtained.

The high amplitude at the beginning of the keying pulse, described above and in Fig. 3A, is due to the rise in power supply potential between keying characters. The load is removed when the key is up, permitting the voltage to rise appreciably. A power supply that is quite satisfactory for telephony may be entirely unsatisfactory for c.w. operation. The regulation is more important than the a.c. ripple, although the ripple should not exceed 10% under full load conditions. A single section filter using choke input is usually adequate, and will provide better regulation than the conventional two section filter.

With a power supply having inherently good regulation, and with complete freedom from spurious oscillations, the keying waveform may be shaped as desired using conventional methods. The method will depend upon the type of keying used. In setting up any keying system, the r.f. envelope should be observed in an oscilloscope while the wave shaping network is being adjusted. The wave shaping network may be adjusted to compensate for a reasonable amount of power supply regulation.

The perfect keying waveform is very difficult to obtain. The waveform shown in Fig. 3B will provide a clear, crisp sounding signal with no "tailing." Fig. 3C illustrates a wave front which is much too steep, and which will produce objectionable keying clicks. Fig. 3D illustrates over-compensation, which will produce a "ringing" type of signal.

The owner of a phone rig will usually find he is faced with at least three problems when converting to phone/c.w. First, the power supply was probably designed to operate with a constant load, and may have poor regulation in keyed service. Some modifications may be required to prevent a dangerous rise in voltage under no-load conditions. Secondly, it will be necessary to effectively remove the secondary winding of the modulation transformer from the PA plate supply circuit when keying. This is very important. If the modulation transformer is left in the circuit and the PA is keyed, the peak transient voltage resulting from the sudden change in current through the modulation transformer winding can easily reach seven to ten times the applied d.c. voltage, depending upon the "Q" of the transformer winding, keying waveform, etc. Such peak potentials can be very destructive indeed.

It is generally much easier to short circuit the secondary winding of the modulation transformer than to disconnect it from the circuit. A high voltage switch will be required for this purpose. It is not at all difficult to obtain a high voltage switch with several contacts. These other contacts may be used to change the power supply filter connections for c.w. or phone operation. The exact connections will depend upon the power supply, but as an example, the modification of the transmitter at W2BFB is shown in Fig. 2A. Note that this arrangement takes care of problems one and two. (For a complete schematic diagram and other details, see RADIO NEWS, April and May 1947 issues.)

The third problem will be the installation of a keying system. This is frequently not one problem, but a series of problems. Low level or oscillator keying may be the easiest to apply, but leads to other difficulties. First, a system must be devised which will be free from frequency shift or "chirps" when the key is closed. Secondly, a phone rig probably will use grid resistor biasing systems in the multiplier and amplifier stages. This system is very satisfactory providing grid excitation is applied at all times. If grid excitation fails or is removed, the overload relays will operate, or the tubes will dissipate destructive amounts of power because of the loss of grid bias. It therefore becomes necessary to supply at least a protective bias to all stages normally designed for grid resistor bias only. This bias need not be the normal operating bias, but must be of such a value as to bias the tubes sufficiently to prevent excessive plate dissipation. For economical reasons, the bias should reduce the plate current to substantially zero.

If a common bias supply is to be used in a multiple stage transmitter, the regulation must be good or serious reaction between stages may occur due to grid current, which tends to increase the biasing potential.

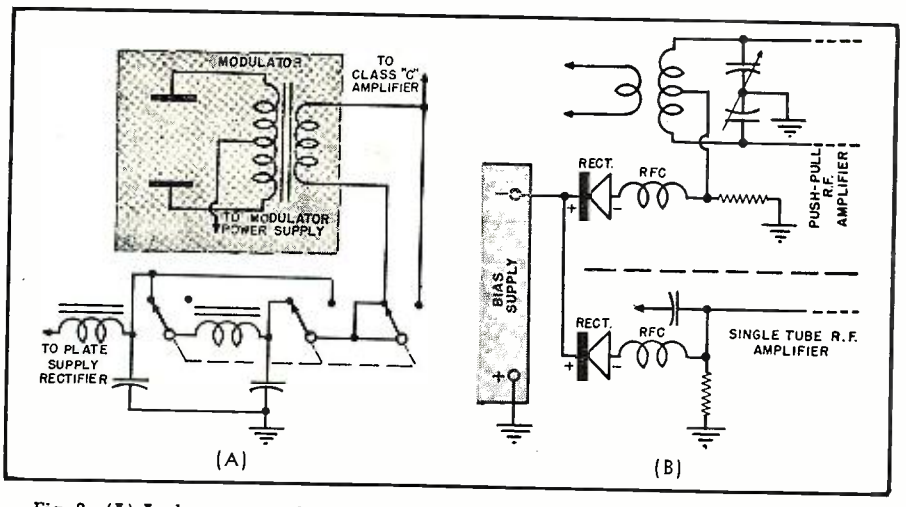


Fig. 2. (A) A phone-c.w. switching system, and (B) a grid bias supply isolating system.

One method of preventing interaction between stages is shown in Fig. 2B. In this system, a rectifier is used as a valve between each grid resistor and the bias supply. Current will flow through the rectifier and grid resistor from the bias supply, as long as the voltage appearing across the grid resistor from any source is less than that produced by the bias supply. When excitation is applied to the tube, grid current will also flow through the grid resistor. When the grid current produces an *IR* drop across the grid resistor which equals or exceeds the potential of the bias supply, the grid resistor will be effectively isolated from the bias supply by the rectifier which will not conduct any appreciable current in the reverse direction.

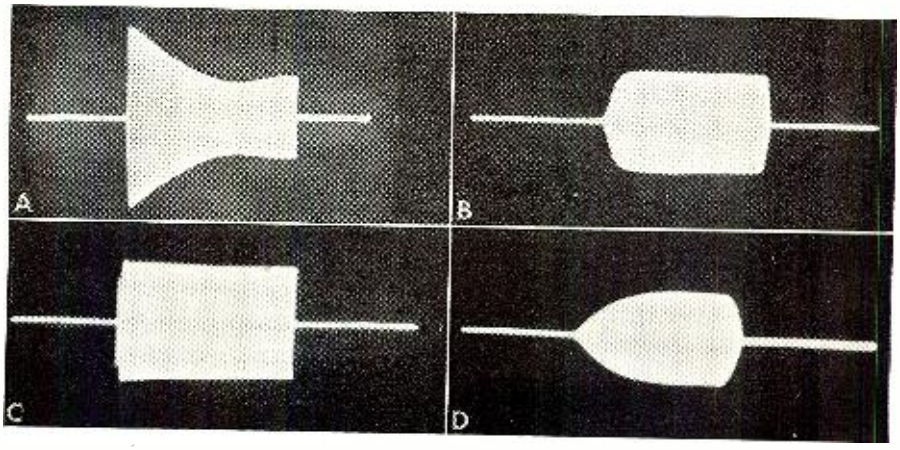
The power delivered by the bias supply need only be sufficient to provide a cut-off bias across the various grid resistors. This bias will seldom exceed 150 volts, and the current is relatively small, enabling a VR150 tube to be used for stabilizing the power supply voltage. If large triodes are used and the current required from the bias supply exceeds the capabilities of a VR150 regulator, a simple vacuum tube voltage regulator using a 6L6 will suffice.

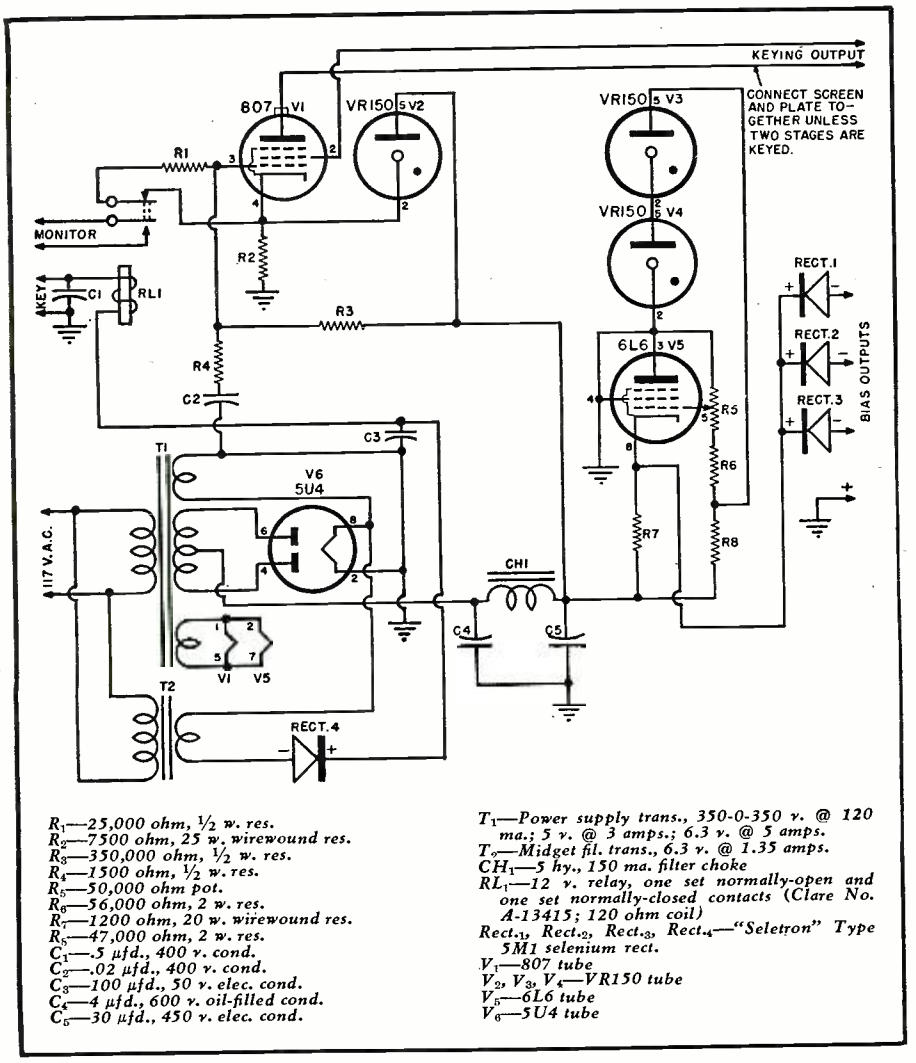
It is often desirable to key the transmitter at some point beyond the oscillator for "chirpless" keying, or other reasons. The keying should be applied at least one stage ahead of the PA, if possible, unless the driving stage if of very low power, to guard against "key up" radiation.

In most modern transmitters, at least the driver stage is a "beam" type of tube. Often the lower stages and the PA are also "beam" tubes. These tubes lend themselves very nicely to vacuum tube keyers of various types.

Several vacuum tube keying systems have been described elsewhere in recent literature. The system to be described in the following paragraphs is particularly applicable to beam pentode or tetrode keying, and is a part of a bias supply system designed to apply grid bias to a transmitter nor-

Fig. 3. (A) High amplitude at the start of the pulse indicates poor power supply regulation. This waveform produces "thumps" because of greatly increased power at start of the keying pulse. Note that the keying waveforms are at a rather high keying speed (75 w.p.m.) to accentuate the slopes for easier observation. (B) Ideal keying waveform. Well rounded start of pulse assures clickless keying. (C) Insufficient time-constant circuit with steep wave front. Relay contact bounce produces spike at the beginning of the pulse. This waveform will produce loud clicks that spread out over a wide range of frequencies. (D) Keying waveform showing excessive time-constant. This results in a "ringing" signal which will be difficult to copy. However, this waveform combined with poor power supply regulation, as in A, will produce good keying, as shown in B.





R_1—25,000 ohm, ½ w. res.
R_2—7500 ohm, 25 w. wirewound res.
R_3—350,000 ohm, ½ w. res.
R_4—1500 ohm, ½ w. res.
R_5—50,000 ohm pot.
R_6—56,000 ohm, 2 w. res.
R_7—1200 ohm, 20 w. wirewound res.
R_8—47,000 ohm, 2 w. res.
C_1—.5 μfd., 400 v. cond.
C_2—.02 μfd., 400 v. cond.
C_3—100 μfd., 50 v. elec. cond.
C_4—4 μfd., 600 v. oil-filled cond.
C_5—30 μfd., 450 v. elec. cond.

T_1—Power supply trans., 350-0-350 v. @ 120 ma.; 5 v. @ 3 amps.; 6.3 v. @ 5 amps.
T_2—Midget fil. trans., 6.3 v. @ 1.35 amps.
CH_1—5 hy., 150 ma. filter choke
RL_1—12 v. relay, one set normally-open and one set normally-closed contacts (Clare No. A-13415; 120 ohm coil)
$Rect._1$, $Rect._2$, $Rect._3$, $Rect._4$—"Seletron" Type 5M1 selenium rect.
V_1—807 tube
V_2, V_3, V_4—VR150 tube
V_5—6L6 tube
V_6—5U4 tube

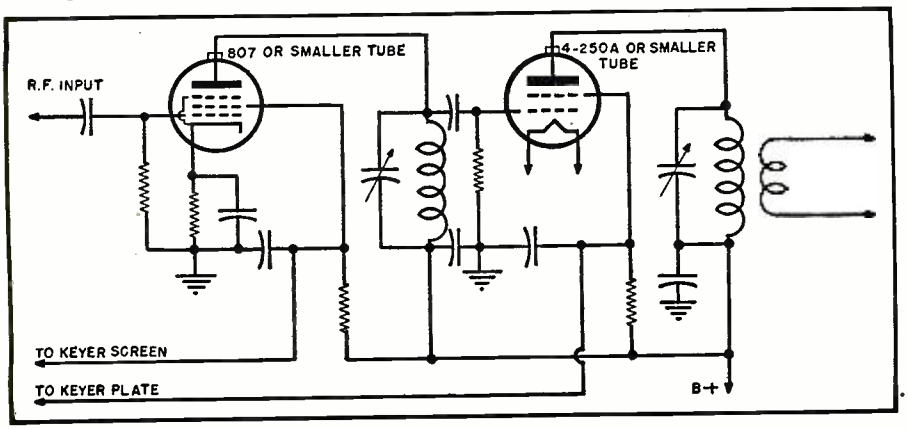
Fig. 4. Schematic diagram showing circuit details of a vacuum tube keyer and bias supply.

mally provided with grid resistor biasing only.

The circuit is shown schematically in Fig. 4. The bias supply system includes a 6L6 voltage regulator, capable of holding the power supply output voltage constant within 5%, from no load to full load. The vacuum tube keyer circuit includes an 807 keyer tube, in a circuit which is designed to change the screen grid of an 813, HK257B, 4-125A, 4-250A, or any smaller tube from its normal positive value to a negative value when the key is up. It is necessary that the screen potential for the keyed stage be obtained from the plate supply through a series dropping resistor when using this system.

The voltage regulator provides a constant load for the power supply. It is somewhat less complicated and less susceptible to oscillations than some of the other forms of regulators, and is entirely adequate for the purpose intended.

Fig. 5. Schematic of a circuit which permits the simultaneous keying of two stages.



The keying relay is arranged with two sets of contacts. The normally-closed contacts connect the grid of the keyer tube to its cathode through resistor R_1 in the "key up" position. The voltage drop across the tube is less than 10 volts. The anode of the tube is, therefore, approximately 100 volts negative with respect to ground, and the screen grid of the keyed tube is also held correspondingly negative with respect to ground.

When the key is "down" and the relay coil is energized, a negative cut-off bias is applied to the keyer tube, preventing the flow of screen and plate current, and the screen of the keyed tube receives its normal positive potential.

If it is desired to key two stages simultaneously, the screen grid of the keyer tube may be connected to the screen of a preceding stage in the transmitter as shown in Fig. 5. This system will operate satisfactorily providing the stage keyed by the screen of the keyer tube is an 807 or smaller pentode or tetrode type, and further, providing the screen grid potential for this stage is also obtained from the plate supply through a series dropping resistor.

The keying wave shape is determined by R_1, R_3, R_4, and C_2 The values indicated produce the keying wave shown in Fig. 3B, which leaves little to be desired. The values of R_3 and C_2 may be changed to compensate for poor power supply regulation. The values of R_3 and C_2 will largely determine the shape of the start of the keying pulse, while the values of C_2 and R_1 will determine the shape of the end of the keying pulse.

The keying relay is equipped with two normally-open and two normally-closed contacts. The normally-closed contacts are used for transmitter keying, and the two normally-open contacts are used for keying an audio oscillator for monitoring purposes.

The keying relay is supplied with rectified a.c. from the 5 volt filament supply of the rectifier tube plus 6.3 volts a.c. from the midget filament transformer, T_2. The 11.3 v. a.c. is rectified by a selenium rectifier, filtered roughly by C_3, and applied to the relay coil through the telegraph key. The telegraph key is bypassed by condenser C_1 to absorb the inductive surges from the relay coil. If C_1 is omitted, slight but unpleasant shocks may be felt at the telegraph key. The use of low voltage plus C_1 precludes the possibility of shock to the operator of the telegraph key.

When the proper constants for correct keying have been determined, they will be essentially correct for any of the keying speeds normally used.

Your neighboring hams will never know you are on the air unless they tune across your signal. And the stability resulting from the changes will go far in reducing TVI caused by parasitic oscillations.

—30—

An L-C-Q METER

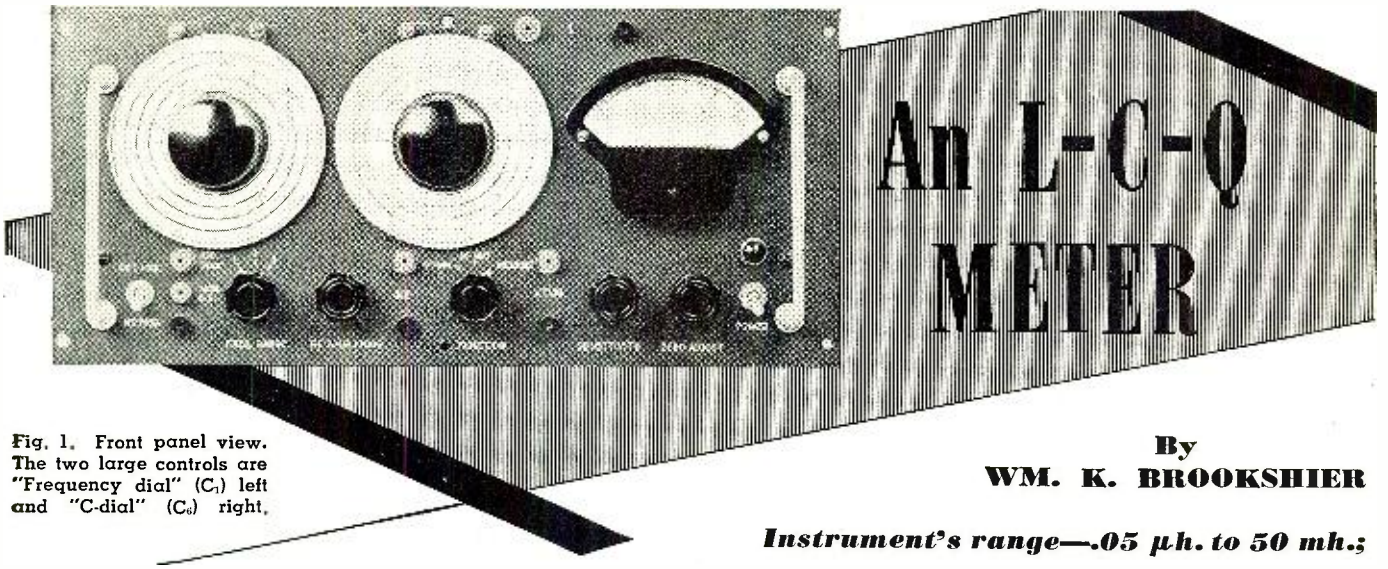


Fig. 1. Front panel view. The two large controls are "Frequency dial" (C_1) left and "C-dial" (C_6) right.

By
WM. K. BROOKSHIER

Instrument's range—.05 μh. to 50 mh.; 1 μμfd. to .01 μfd.; and "Q" of 10 to 200. Can also be used as an r.f. signal generator.

THIS instrument was originally designed for the purpose of measuring inductance over a useful part of the r.f. spectrum. Its resultant capabilities, however, proved to be numerous, and can best be presented by giving some specifications.

Inductance from .05 μh. to 50 mh. can be measured. If the value of inductance lies between 1 μh., and 16 mh., it can be read directly from a calibrated scale. The accuracy of these measurements depends upon many factors—primarily the accuracy of calibration. A reasonable figure would be 1 to 3 per-cent.

Values of capacity from 1 μμfd. to .01 μfd. can be measured by means to be described later. Again a reasonable figure for the accuracy of these measurements is 1 to 3 per-cent. Under some conditions the accuracy may be better—under others, much poorer.

The "Q" of inductances may be measured by the 70.7% method, which is further described under "Operation." A range of about 10 to 200 can be covered with an accuracy that depends almost entirely upon the exact methods employed.

The instrument may be used as an r.f. signal generator covering a frequency range from 125 kc. to 12 mc. in three ranges: (1) 125 to 570 kc. (2) 570 kc. to 2.65 mc. (3) 2.65 mc. to 12.4 mc. The r.f. voltage available at 125 kc. is about 40 volts, decreasing to about 3 volts at 12 mc. Provisions are made for external amplitude modulation.

This instrument may be used as an uncalibrated vacuum-tube voltmeter. Five ranges, with full scale a.c. deflection voltages of .43, 1.53, 4.7, 14.5, and 46, were obtained in the original instrument. The input impedance at the front panel of the instrument is approximately 1.7 megohms shunted by 10 μμfd. The frequency range of the voltmeter extends from about 200 cycles to 100 mc. However, due to the absence of a probe, its usefulness above 10 mc. would be limited.

The functional diagram of the instrument as used to measure inductance and capacity is shown in Fig. 2. The oscillator is represented by a variable-frequency voltage in series with the output impedance Z_G of the oscillator, which is quite low compared with the value of the resistor R_6. Parallel resonance is used, with the unknown inductance and the capacity of the calibrated condenser forming the tuned circuit. The vacuum-tube voltmeter circuit measures the r.f. voltage appearing across the tuned circuit. In measuring inductance, either the C-dial or the Frequency dial is set at a convenient value, and the other dial is tuned to give a peak reading on the meter. If the "Q" of the inductance coil is 10 or greater, which is almost always the case, the error involved in assuming that the reactance of the condenser equals the reactance of the coil will be 1 per-cent or less. Thus, to a high degree of approximation, we may assume that:

$$2\pi fL = \frac{1}{2\pi fC}$$

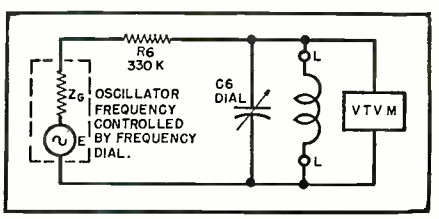
and the inductance may be calculated by:

$$L = \frac{1}{4\pi^2 f^2 C}$$

when the frequency and capacity are known.

The complete circuit diagram is shown in Fig. 3. The oscillator employs a 6SK7 in a conventional Hartley-type circuit. An unusually high value of tuning capacity, obtained by paralleling both sections of a two-gang condenser, was used to obtain somewhat greater frequency coverage than could be had in three bands if only a single gang were used.

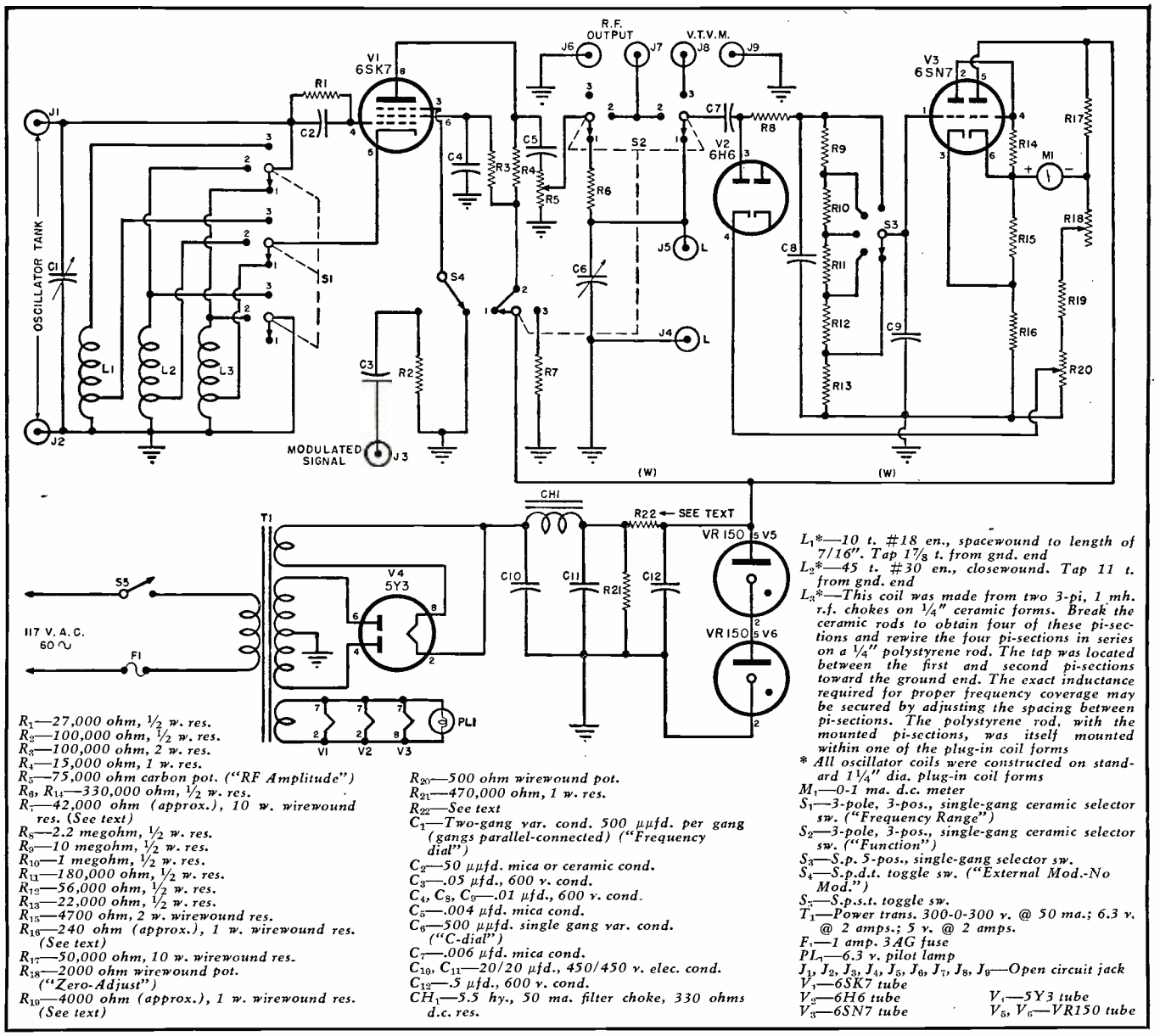
Fig. 2. Fundamental diagram of unit as used to measure inductance and capacity.



The lower section of the bandswitch S_1 (Fig. 3) is used to short across L_3 when the switch is on band 2, and to short across L_2 when the switch is on band 3. This was found to be necessary. The self-resonant frequency of L_3 fell within band 2, and, due to the close coupling between coils caused by their physical placement, the calibration of the frequency dial on band 2 was seriously distorted at the resonant frequency of L_3. A similar effect was noted on band 3 due to the self-resonant frequency of L_2. Shorting of the coils in the manner shown completely eliminates this trouble.

The potentiometer R_5, marked "*RF Amplitude*" on the front panel, controls the voltage applied to the measuring circuit when S_2 is in position 1, and controls the amplitude of the r.f. voltage appearing at the "*RF Output*" jacks when S_2 is in position 2. When S_2 is in position 1, which is the position used for measuring inductance, the vacuum-tube voltmeter circuit is connected across the tuned circuit. When S_2 is in position 2, marked "*RF Output*," the voltmeter circuit monitors the r.f. voltage appearing at the "*RF Output*" jacks. When S_2 is in position 3, the vacuum-tube voltmeter circuit alone may be used externally. One section of S_2 then disconnects plate and screen voltages to the oscillator to prevent any stray coupling to the meter circuit causing an initial reading.

The vacuum-tube voltmeter circuit contains a conventional shunt-diode rectifier circuit, with its d.c. output voltage being applied to the grid of the first half of the 6SN7. This half acts as a d.c. amplifier. The correct grid bias for this triode is had by the proper choice of the value for R_{16}. It



R_1—27,000 ohm, ½ w. res.
R_2—100,000 ohm, ½ w. res.
R_3—100,000 ohm, 2 w. res.
R_4—15,000 ohm, 1 w. res.
R_5—75,000 ohm carbon pot. ("RF Amplitude")
R_6, R_{14}—330,000 ohm, ½ w. res.
R_7—42,000 ohm (approx.), 10 w. wirewound res. (See text)
R_8—2.2 megohm, ½ w. res.
R_9—10 megohm, ½ w. res.
R_{10}—1 megohm, ½ w. res.
R_{11}—180,000 ohm, ½ w. res.
R_{12}—56,000 ohm, ½ w. res.
R_{13}—22,000 ohm, ½ w. res.
R_{15}—4700 ohm, 2 w. wirewound res.
R_{16}—240 ohm (approx.), 1 w. wirewound res. (See text)
R_{17}—50,000 ohm, 10 w. wirewound res.
R_{18}—2000 ohm wirewound pot. ("Zero-Adjust")
R_{19}—4000 ohm (approx.), 1 w. wirewound res. (See text)
R_{20}—500 ohm wirewound pot.
R_{21}—470,000 ohm, 1 w. res.
R_{22}—See text
C_1—Two-gang var. cond. 500 μμfd. per gang (gangs parallel-connected) ("Frequency dial")
C_2—50 μμfd. mica or ceramic cond.
C_3—.05 μfd., 600 v. cond.
C_4, C_8, C_9—.01 μfd., 600 v. cond.
C_5—.004 μfd. mica cond.
C_6—500 μμfd. single gang var. cond. ("C-dial")
C_7—.006 μfd. mica cond.
C_{10}, C_{11}—20/20 μfd., 450/450 v. elec. cond.
C_{12}—.5 μfd., 600 v. cond.
CH_1—5.5 hy., 50 ma. filter choke, 330 ohms d.c. res.

L_1*—10 t. #18 en., spacewound to length of 7/16". Tap 1⅞ t. from gnd. end
L_2*—45 t. #30 en., closewound. Tap 11 t. from gnd. end
L_3*—This coil was made from two 3-pi, 1 mh. r.f. chokes on ¼" ceramic forms. Break the ceramic rods to obtain four of these pi-sections and rewire the four pi-sections in series on a ¼" polystyrene rod. The tap was located between the first and second pi-sections toward the ground end. The exact inductance required for proper frequency coverage may be secured by adjusting the spacing between pi-sections. The polystyrene rod, with the mounted pi-sections, was itself mounted within one of the plug-in coil forms
* All oscillator coils were constructed on standard 1¼" dia. plug-in coil forms
M_1—0-1 ma. d.c. meter
S_1—3-pole, 3-pos., single-gang ceramic selector sw. ("Frequency Range")
S_2—3-pole, 3-pos., single-gang ceramic selector sw. ("Function")
S_3—S.p. 5-pos., single-gang selector sw.
S_4—S.p.d.t. toggle sw. ("External Mod.-No Mod.")
S_5—S.p.s.t. toggle sw.
T_1—Power trans. 300-0-300 v. @ 50 ma.; 6.3 v. @ 2 amps.; 5 v. @ 2 amps.
F_1—1 amp. 3AG fuse
PL_1—6.3 v. pilot lamp
J_1, J_2, J_3, J_4, J_5, J_6, J_7, J_8, J_9—Open circuit jack
V_1—6SK7 tube
V_2—6H6 tube
V_3—6SN7 tube
V_4—5Y3 tube
V_5, V_6—VR150 tube

Fig. 3. Schematic diagram of meter. Position 1 of S_1 is low frequency band, position 2 is middle frequency band, position 3 is high frequency band. For switch S_2, position 1 is "Measure," position 2 is "RF Output," and position 3 is "VTVM."

was found that the value of this resistor was relatively critical, as far as affecting the sensitivity of the voltmeter circuit is concerned. For this reason several values of resistance near 240 ohms should be tried until maximum sensitivity is obtained from the voltmeter circuit. A sensitivity of between .3 and .5 volts r.m.s. (required for full-scale deflection of the milliammeter) should be obtained with S_3 in position 1.

The second half of the 6SN7 forms one of the elements in a Wheatstone bridge circuit. The change in voltage across R_{14} causes the unbalance resulting in current flow through the milliammeter. R_{18} is the zero-adjust for the voltmeter circuit. Resistor R_{19} determines the range of operation for the zero adjust and should be chosen so as to cause the voltmeter to adjust to zero when R_{18} is near its mid-position. R_{20} controls the amplitude of a positive voltage applied to the cathode of the 6H6 for the purpose of balancing out the contact potential developed by it. With the pointer on R_{20} turned all the way toward the ground end, a d.c. vacuum-tube voltmeter connected to the top of R_9 will read the negative contact potential voltage, which may be between .5 and 1 volt. As the pointer on R_{20} is turned up, this negative voltage will decrease toward zero. The proper adjustment for R_{20} is at a point where the voltage measured has not quite reached zero. If it is attempted to counteract the contact potential completely, an extreme loss of sensitivity will result. The author adjusted R_{20} for a voltage of about .03 volt, as measured on a 3-volt scale, at the top of R_9. The resulting variation in zero-signal current through the meter was about .1 ma. as the range switch S_3 was changed from position 1 to position 5.

A certain amount of instability is to be expected in a voltmeter circuit such as this. However, since the voltmeter is not intended to measure voltage magnitudes, but merely to indicate peaks of voltage, the basic requirement is to establish a degree of stability that is not too annoying. To accomplish this, it is necessary to use resistor R_7. This resistor acts as a substitute load, replacing the load of the oscillator tube when S_2 is in position 3. Without it the "regulated" 300 volts developed across the voltage regulator tubes may increase by as much as 5 to 10 volts when the load of the oscillator is removed. The value for R_7 should be determined by experiment after the instrument has been completed. The author used three resistors in series for R_7, which can be seen in the middle of the chassis in Fig. 5.

Since the sensitivity of this vacuum-tube voltmeter circuit would be affected greatly by the changing of tubes, aging of components, and other

factors, it is definitely inadvisable to attempt permanent calibration. However, if the builder should desire a calibrated voltmeter, any other circuit meeting a few basic requirements may be substituted. These requirements are: (1) Reasonably high input resistance—1.5 megohms or higher (2) Reasonably low input capacity of 10 to 12 $\mu\mu$fd. or lower (3) Fairly high sensitivity. A full scale sensitivity of 3 volts, r.m.s. value, would be usable, although 1 volt would be much more satisfactory. This sensitivity is required in order to make small inductance measurements.

The power supply circuit is conventional, except for the lack of a dropping resistor in series with the voltage regulator tubes. It may be necessary, depending upon the particular power transformer and filter choke used, to add such a dropping resistor (R_{22}) in the circuit. It should be chosen or adjusted to provide a current of about 30 to 35 ma. through the voltage regulator tubes when the wires "*W*" are disconnected.

In order to secure reliable performance, it is highly recommended that quality components be used throughout. All carbon resistors should be of the metallized type. Resistors R_{15} through R_{20} should be wirewound. It is not necessary to use any precision resistors.

Mechanical Construction

The original instrument was built on a homemade chassis 15¼"x6¼"x 2½". The front panel was made of ⅛" aluminum by cutting down a standard 8¾"x19" rack panel to dimensions of 16½"x7⅞" to fit the case from a BC-375 tuning unit.

Two *National* Velvet-Vernier dial mechanisms, one of which may be found in each BC-375 tuning unit, were used for the Frequency dial and C-dial. The 4½" dial plates were cut from .040" sheet aluminum. These plates were then faced with white production enamel paper, obtainable from most office supply stores, and the lettering was done with black drawing ink. *Sanford's* rubber cement was used to fasten the paper to the dial plates. The dial indicator glasses were cut from *Plexiglas*, the hairline being inscribed with a sharp knife and filled with black drawing ink. The front panel lettering was accomplished with straight pen and white drawing ink, and given a coat of clear lacquer.

The layout of parts is not too critical. However, the same general placement of parts as indicated in Figs. 1, 4, and 5 would seem advisable. In order to secure short leads in the oscillator circuit wiring, the oscillator bandswitch was mounted behind the front panel, with the shaft coming out through a panel bearing. Most of the wiring in the r.f. circuits was done with No. 12 bus bar.

Pin jacks were used for the front panel terminals. The non-grounded *"RF Output," "VTVM," "Osc. Tank,"* and *"L"* pin jacks were mounted in polystyrene inserts cut from ½" polystyrene rod.

Calibration

Since methods of frequency measurement are relatively well-known, little will be said about the calibration of the Frequency dial. The Frequency dial should be calibrated before the C-dial.

There are several possible methods that might be used in the calibration of the C-dial. Perhaps the simplest requires a coil with known inductance and distributed capacity, with the value of inductance lying between 100 and 500 μh. Specifications for the construction of a 100 μh. coil are as follows: Wind 100¼ turns of No. 30 enameled wire on ¾ inch form. This should be closewound. The winding should be about 1.11 inches long. If these specifications are followed closely, an accuracy of 1% may be expected. The distributed capacity of this coil is about 1.3 $\mu\mu$fd. A figure of 1 $\mu\mu$fd. should be sufficiently accurate for calculations. For illustration, let us assume that a coil with an inductance of 100 μh. and a distributed capacity of 1 $\mu\mu$fd. is used. To determine the point at which to mark "300 $\mu\mu$fd." on the C-dial, first calculate the frequency at which 100 μh. resonates with 300 plus 1 $\mu\mu$fd. This frequency, in megacycles, is given by:

$$f = \frac{159.2}{\sqrt{LC}}$$

Calibration point on C-dial in $\mu\mu$fd.	Frequency in mc.
30	2.86
40	2.49
50	2.23
60	2.04
70	1.89
80	1.77
90	1.67
100	1.58
150	1.295
200	1.12
250	1.005
300	.918
350	.850
400	.794
450	.750
500	.711

Table 1. Data for the calibration of the "C-dial" (C_6) using a 100 μh. coil with a distributed capacity of around 1 $\mu\mu$fd.

with L in μh. and C in $\mu\mu$fd. In this case:

$$f = \frac{159.2}{\sqrt{100 \times 301}} = .918 \text{ mc.}$$

Set this frequency up on the Frequency dial, and, with the *"Function"* switch on *"Measure,"* tune the C-dial for a peak reading on the meter. This is the point at which 300 $\mu\mu$fd. is to be marked on the dial. A similar process must be followed to obtain as many calibration points as are desired. A suggested list of calibration points is: Every 10 $\mu\mu$fd. from 30 through 100, and every 50 $\mu\mu$fd. thereafter. Linear interpolation between these calibration points will generally be quite satisfactory. The necessary calculations, based upon the use of a 100 μh. coil with a distributed capacity of 1 $\mu\mu$fd., are given in Table 1. One word of caution. Since a peak reading will be obtained every time the tuned circuit is tuned to a harmonic of the oscillator's fundamental frequency, it will generally be necessary to determine the nature of the indicated peak. This task is a simple one, though, and the methods involved should become readily apparent to the user.

After the capacity scale on the C-dial has been calibrated, the calibration points for the inductance scale may be determined entirely by calculation. At any single frequency, for every value of capacity on the C-dial the value of inductance required to resonate to the given frequency is uniquely determined. Thus, if the frequency dial is fixed at some particular

Fig. 4. Top chassis view of the completed L-C-Q Meter.

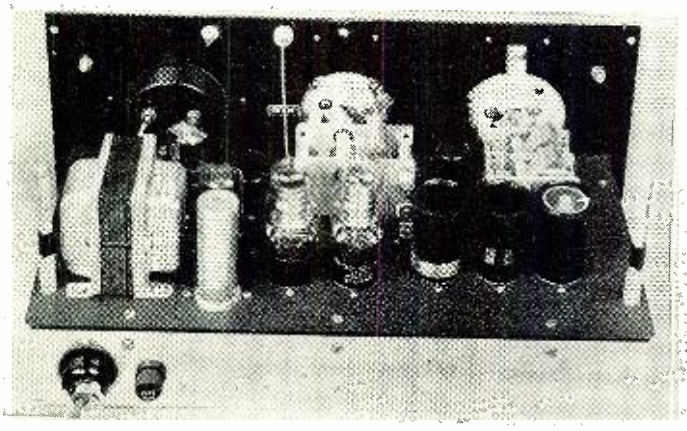
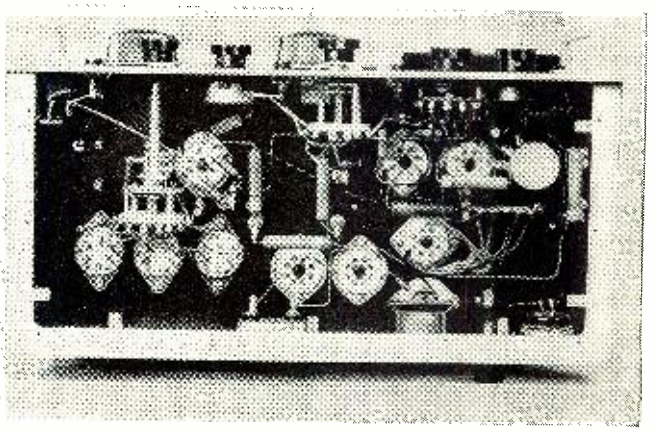


Fig. 5. Under chassis of meter showing construction.



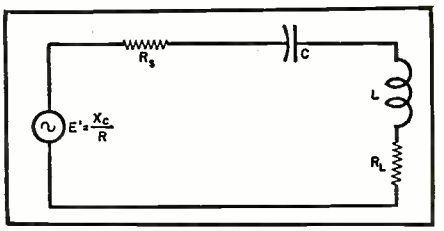


Fig. 6. The approximate equivalent series circuit of the L-C-Q measuring instrument.

Freq.	Multiplying Factor
7.13 mc.	1
2.25 mc.	10
.713 mc.	100
.225 mc.	1000 (read scale in mh.)

Data for Inductance Scale

L in μh.	C in μμfd.	L in μh.	C in μμfd.
1.0	500	4	125
1.1	455	5	100
1.2	417	6	83.3
1.3	385	7	71.5
1.4	357	8	62.5
1.5	333	9	55.5
1.6	313	10	50.0
1.7	294	11	45.5
1.8	278	12	41.7
1.9	263	13	38.5
2.0	250	14	35.7
2.5	200	15	33.3
3.0	167	16	31.3
3.5	143		

Table 2. Calculations for inductance scale.

frequency, an inductance scale may be laid out on the C-dial, with each value of inductance being that value required to resonate with the corresponding C-dial capacity at the fixed frequency. For example, suppose that the fixed frequency is 7.13 mc. The value of inductance required to resonate with 500 μμfd. at 7.13 mc. is found by the expression:

$$L = \frac{25{,}400}{f^2 C}$$

with L in μh., C in μμfd., and f in mc. In this case:

$$L = \frac{25{,}400}{(7.13)^2\,(500)} = 1\ \mu\text{h.}$$

which is the value of inductance that should appear in line with 500 μμfd. on the C-dial. To determine the calibration point for a given value of inductance, simply solve for C in the last equation, obtaining:

$$C = \frac{25{,}400}{f^2 L}$$

The calibration point for $L = 1.1$ μh. would be

$$C = \frac{25{,}400}{(7.13)^2(1.1)} = 455\ \mu\mu\text{fd.}$$

Although, as may be noted in Fig. 1, the original instrument was calibrated with three separate inductance scales, it is only necessary to calibrate a single scale if the operating frequencies are chosen so that multiplying factors of 1, 10, 100, etc., may be used. The recommended frequencies are 7.13 mc., 2.25 mc., .713 mc., and .225 mc., which will provide inductance scales of 1 to 16 μh., 10 to 160 μh., 100 μh. to 1.6 mh., and 1 to 16 mh., respectively. Calculations for an inductance scale using these frequencies are given in Table 2.

The measurement of inductance with this instrument should be fairly straightforward. In using the calibrated scales, it is only necessary to set the frequency dial at one of the calibration frequencies, and apply the correct multiplying factor.

When it is desired to measure values of inductance below about 5 μh., the differential method is to be preferred. Connect a pair of test leads to the *"L"* terminals, short them, and measure their inductance. Add the unknown inductance in series, and measure the new value of inductance. The difference between the two readings is the value of the unknown inductance. The position of the test leads should remain fixed during this process.

To measure values of capacity below 470 μμfd., first connect some inductance coil across the *"L"* terminals. Its value need not be known or measured. Set the C-dial on some even value of capacity—to illustrate, say 100 μμfd. Then tune the frequency dial for resonance. Connect the unknown condenser in parallel with the inductance coil, and retune to resonance by decreasing the capacity of the C-dial. If the final C-dial reading were 60 μμfd., the value of the unknown would be 40 μμfd. This method is useful in measuring the small values of tube interelectrode capacitances, stray wiring capacity, etc., since useful accuracy down to 1 μμfd. may be had.

Suppose that it is desired to measure a value of capacity that is greater than 470 μμfd., say a value near .01 μfd., or 10,000 μμfd. Set the C-dial on some even value of capacity—for illustration, say 200 μμfd.—and connect a known value of inductance (previously measured) across the *"L"* terminals. Tune the Frequency dial for resonance. If the value of the inductance were 100 μh., and the resonant frequency were 159 kc., the value of the total capacity paralleling the inductance would be:

$$C = \frac{25{,}400}{(.159)^2(100)} = 10{,}000\ \mu\mu\text{fd.}$$

Since this value includes the capacity of the C-dial, subtraction of 200 μμfd. gives the answer of 9800 μμfd. for the capacity of the unknown.

In order to make "Q" measurements, it is necessary to determine the point on the scale of the voltmeter that represents 70.7% of full-scale voltage. This should be done for one or more of the 5 ranges, preferably all, by the use of another calibrated r.f. vacuum-tube voltmeter connected to the *"RF Output"* jacks. Since the meter would have an extremely nonlinear scale if calibrated for a.c., the .707 mark will not be too close to the linear scale reading of .707 ma.

There are two ways of making a "Q" measurement, one involving frequency variation and the other capacity variation. For the first, connect the coil whose "Q" is to be measured to the *"L"* terminals as usual. Set the C-dial at a relatively large value of capacity—above 400 μμfd.—and tune the Frequency dial for the resonant peak. Note the resonant frequency f_o. Check the zero adjustment on the voltmeter with the *"RF Amplitude"* control turned down, and then adjust the *"RF Amplitude"* control until the amplitude of the peak is exactly full-scale for whatever range is being used on the voltmeter. Vary the frequency dial until the voltmeter reading drops off to the previously determined .707 mark, and note the frequency. In a similar manner determine the frequency on the other side of the peak at which the voltage has dropped off to the .707 mark. The "Q" may be determined by the expression:

$$Q = \frac{f_o}{\Delta f}$$

where Δf is the difference between the two frequencies on either side of the resonant frequency f_o.

The capacity variation method is very similar. The frequency dial is left fixed at the resonant frequency, and the C-dial is varied to obtain 70.7% deflection. The "Q" may then be determined by the expression:

$$Q = \frac{2C_o}{\Delta C}$$

where C_o is the value of capacity at resonance, and ΔC is the difference between the two C-dial readings on either side of resonance.

Fig. 6 shows a series circuit that is equivalent, within close approximation, to the actual circuit shown in the functional diagram of Fig. 2. The value of the capacity C is that of the C-dial, the value of the inductance L is that of the coil connected to the L terminals, R_L is the r.f. resistance of the inductance, and the resistance R_s has a value equal to:

$$\frac{X^2_c}{R} \text{ or } \frac{L}{RC}$$

where R is 330,000 ohms, the value of resistor R_s in the circuit diagram. In order to minimize error in measuring the "Q" of a coil, it is highly desirable to keep R_s small, since the "Q" that is measured is:

$$\frac{X_L}{R_L + R_s}$$

This is the reason for setting the C-dial at 400 μμfd. or more when making the "Q" measurements described. With a small value of inductance, this may not be necessary. If the L to C ratio, with L in μh. and C in μμfd., is kept smaller than one-third, the value of R_s will be 1 ohm or less. If it is kept smaller than one-sixth, the value of R_s will be .5 ohms or less. In order to obtain a small L to C ratio when L is large, additional capacity may be connected in parallel with the coil. If the frequency variation method is used, the value of this capacity need not be known accurately.

The difficulty in determining either ΔC or Δf accurately by reading directly from the dials of the instrument is perhaps the greatest factor tending

(*Continued on page* 153)

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- All the convenient ranges 10–30–300–1,000–5,000 Volts.
- Large quality 3" built-in meter.

The instrument for all—the ranges you need—beauty you'll enjoy for years and you can assemble it in a matter of minutes—an instrument for everyone. The handiest quality voltohmeter of all. Small enough to put in your pocket yet a full 3" meter. Easy pictorial wiring diagrams eliminate all assembly problems. Uses only 1% precision ceramic divider resistors and wire wound shunts. Twelve different ranges. AC and DC ranges of 10–30–300–1,000–5,000 Volts. Ohms ranges of 0–3,000 ohms and 0–300,000 ohms. Milliampere ranges of 10MA and 100MA. Hearing aid type ohms adjust control fits conveniently under thumb for one hand adjustment. Banana type jacks for positive low resistance connections. Quality test leads included. The high quality Bradley instrument rectifier was especially chosen for linear scales on AC.
The modern case was styled by Harrah Engineering for this instrument. The 400 microampere meter movement comes already mounted in the case protected from dust during assembly. An ideal classroom assembly instrument useful for a lifetime. Perfect for radio service calls, electricians, garage mechanics, students, amateurs and beginners in radio. The only quality voltohmeter under $20.00. An hour of assembly saves you one-half the cost and quality parts give you a better instrument. Order today. Shipping weight 2 lbs.

$13.50

Note HANDY OHMS ADJUST.

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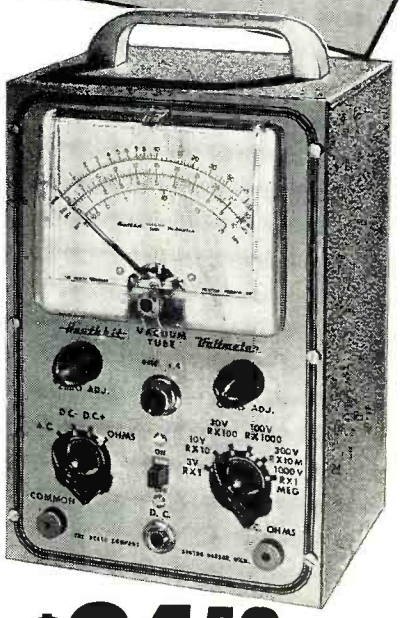
. . . BENTON HARBOR 15, MICHIGAN

MORE QUALITY in 1950 Heathkits

The NEW V-4 Heathkit VACUUM TUBE VOLTMETER KIT

Features

- Meter scale 17% longer than average 4½" meter.
- Modern streamline 200 ua meter.
- New modern streamline styling.
- Burn-out proof meter circuit.
- 24 Complete ranges.
- Isolated probe for dynamic testing.
- Most beautiful VTVM in America.
- Accessory probes (extra) extend ranges to 10,000 Volts and 100 Megacycles.
- Uses 1% precision ceramic divider resistors.
- Modern push-pull electronic voltmeter circuit.
- Electronic AC circuit. No current drawing rectifiers.
- Shatterproof plastic meter face.



The new Heathkit Model V-4 Vacuum Tube Voltmeter has dozens of improvements. A new modern streamlined 200 microampere meter has Alnico V magnet for fast, accurate readings. The new electronic AC voltmeter circuit incorporates an entire new balance control which eliminates contact potential and provides greater accuracy. New simplified switches for quicker assembly. New snap-in battery mounting is on the chassis for easy replacement.

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.

The DC probe is isolated for dynamic measurements. Has db scale for making gain and other audio measurements.

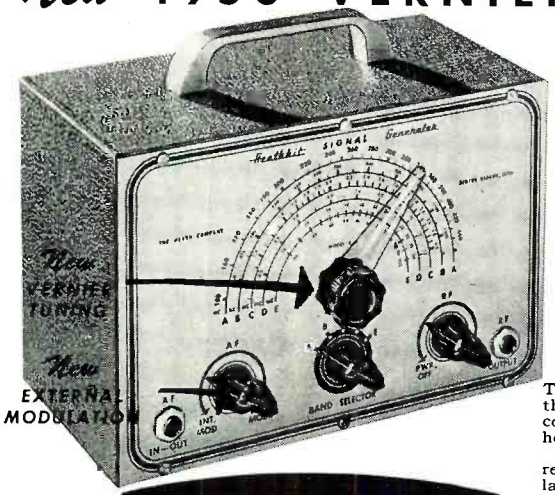
The new instruction manual features pictorial diagrams and step-by-step instructions for easy assembly. The Heathkit VTVM is complete with every part — 110V transformer operated with test leads, tubes, light aluminum cabinet for portability, giant 4½" 200 microamp meter and complete instruction manual.

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.

$24.50

New 1950 VERNIER TUNING R.F. Heathkit SIGNAL GENERATOR KIT



$19.50

Features

- New 5 to 1 ratio vernier tuning for ease and accuracy.
- New external modulation switch—use it for fidelity testing.
- New precision coils for greater output.
- Cathode follower output for greatest stability.
- 400 cycle audio available for audio testing.
- Most modern type R.F. oscillator.
- Covers 150Kc. to 34Mc. on fundamentals and calibrated strong harmonics to 102 Mc.

The most popular signal generator kit has been vastly improved—the experience of thousands combined to give you the best. Check the features in this fine generator and consider the low price $19.50. A best buy for any shop, yet inexpensive enough for hobbyists. Everyone can have an accurate controlled source of R.F. signal voltage.

The new features double the value—think of being able to make fidelity checks on receivers by inserting a variable audio signal. Internal 400 cycle saw-tooth audio oscillator modulates R.F. signal and is available externally for audio testing. The new 5 to 1 ratio vernier drive gives hairline tuning for maximum accuracy in scale settings. The coils are already precision wound and calibrated. Uses turret type coil and switch assembly for ease of construction. The generator is 110 V. 60 cycle transformer operated and comes complete in every detail—cabinet—tubes—coils—beautiful two color calibrated panel and all small parts—new step-by-step pictorial diagrams and complete instruction manual make assembly a cinch even for novices. Why try to get along without a signal generator when you can have the best for less than a twenty dollar bill. Better order it now. Shipping weight 7 lbs. **$19.50**

CONVERSION KIT FOR G-1 GENERATORS

Conversion kit for G-1 generators for vernier tuning and external modulation includes new high band coil for greater output. Gives all the features of new G-5 listed above. Order G-5 Conversion Kit No. 316. ..... **$4.50**

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Beauty · Quality · Economy

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New Heathkit

IMPEDANCE BRIDGE KIT

A LABORATORY INSTRUMENT NOW WITHIN THE PRICE RANGE OF ALL

Measures Inductance from 10 microhenries to 100 henries capacitance from .00001 MFD to 1000 MFD. Resistance from .01 ohms to 10 megohms. Dissipation factor from .001 to 1. "Q" from 1 to 1000.

Ideal for schools, laboratories, service shops, serious experimentors.

An impedance bridge for everyone — the most useful instrument of all, which heretofore has been out of the price range of serious experimentors and service shops. Now at the lowest price possible. All highest quality parts. General Radio main calibrated control. General Radio 1000 cycle hummer. Mallory ceramic switches with 60 degree indexing — 200 micro-amp zero center galvanometer — ½ of 1% ceramic non-inductive decade resistors. Professional type binding posts with standard ¾" centers. Beautiful birch cabinet. Directly calibrated "Q" and dissipation factor scales. Ready calibrated capacity and inductance standards of *Silver* Mica, accurate to ½ of 1% and with dissipation factors of less than 30 parts in one million. Provisions on panel for external generator and detector. Measure all your unknowns the way laboratories do — with a bridge for accuracy and speed.

Internal 6 volt battery for resistance and hummer operation. Circuit utilizes Wheatstone, Hay and Maxwell circuits for different measurements. Supplied complete with every quality part — all calibrations completed and instruction manual for assembly and use. Deliveries are limited. Shipping weight, approximately 15 lbs.

Heathkit

CONDENSER CHECKER KIT

$9.50

Features

- Power factor scale
- Measures resistance
- Measures leakage
- Checks paper-mica-electrolytics
- Bridge type circuit
- Magic eye indicator
- 110V. transformer operated
- All scales on panel

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.

New Heathkit

TELEVISION ALIGNMENT GENERATOR KIT

Nothing ELSE TO BUY

Everything you want in a television alignment generator. A wide band sweep generator covering all TV frequencies 0 - 46 54 to 100 — 174 to 220 Megacycles, a marker indicator covering 19 to 42 Megacycles, AM modulation for RF alignment — variable calibrated sweep width 0 - 30 Mc. — mechanical driven inductive sweep. Husky 110V. 60 cycle power transformer operated — step type output attenuator with 10,000 to 1 range — high output on all ranges — band switching for each range — vernier driven main calibrated dial with over 45 inches of calibration — vernier driven calibrated indicator marker tuning. Large grey crackle cabinet 16⅛" x 10⅜" x 7-3/16". Phase control for single trace adjustment. Uses three high frequency triodes plus 5Y3 rectifier — split stator tuning condensers for greater efficiency and accuracy at high frequencies — this Heathkit is complete and adequate for every alignment need and is supplied with every part — cabinet — calibrated panel — all coils and condensers wound, calibrated and adjusted. Tubes, transformer, test leads — every part with instruction manual for assembly and use. Actually three instruments in one — TV sweep generator — TV AM generator and TV marker indicator.

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Heathkit
TUBE CHECKER KIT

Features

1. Measures each element individually
2. Has gear driven roller chart
3. Has lever switching for speed
4. Complete range of filament voltages
5. Checks every tube element
6. Uses latest type lever switches
7. Uses beautiful shatterproof full view meter
8. Large size 11" x 14" x 4" complete
9. Checks new 9 pin piniatures

Check the features and you will realize that this Heathkit has all the features you want. Speed — simplicity — beauty — protection against obsolescence. The most modern type of tester — measures each element — beautiful Bad-Good scale, high quality meter — the best of parts — rugged oversize 110V. 60 cycle power transformer — finest of Mallory switches — Centralab controls — quality wood cabinet — complete set of sockets for all type tubes including blank spare for future types — fast action gear driven roller chart uses brass gears to quickly locate and set up any type tube. Simplified switching cuts necessary time to minimum and saves valuable service time. Short and open element check. No matter what arrangement of tube elements, the Heathkit flexible switching arrangement easily handles it. Order your Heathkit Tube Checker today. See for yourself that Heath again saves you ⅔ and yet retains all the quality — this tube checker will pay for itself in a few weeks — better build it now.

Complete with detail instructions — all parts — cabinet — roller chart — ready to wire up and operate. Shipping Wt., 15 lbs.

Only $29.50

Nothing ELSE TO BUY

Heathkit
SINE AND SQUARE WAVE AUDIO GENERATOR KIT

Nothing ELSE TO BUY

$34.50

Experimenters and servicemen working with a square wave for the first time invariably wonder why it was not introduced before. The characteristics of an amplifier can be determined in seconds compared to several hours of tedious plotting using older methods. Stage by stage, amplifier testing is as easy as signal tracing. The low distortion (less than 1%) and linear output (± one db.) make this Heathkit equal or superior to factory built equipment selling for three or four times its price. The circuit is the popular RC tuning circuit using a four gang variable condenser. Three ranges 20-200, 200-2,000, 2,000-20,000 cycles are provided by selector switch. Either sine or square waves instantly available at slide switch. All components are of highest quality, cased 110V. 60 cycle power transformer. Mallory F.P. filter condensers, 5 tubes, calibrated 2 color panel, grey crackle aluminum cabinet. The detailed instructions make assembly an interesting and instructive few hours. Shipping Wt., 13 lbs.

New Heathkit
BATTERY ELIMINATOR KIT

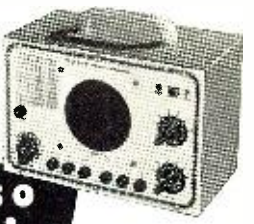
Nothing ELSE TO BUY

$22.50

Now a bench 6 Volt power supply kit for all auto radio testing. Supplies 5 - 7½ Volts at 10 Amperes continuous or 15 Amperes intermittent. A well filtered rugged power supply uses heavy duty selenium rectifier, choke input filter with 4,000 MFD of electrolytic filter. 0 - 15 Volt meter indicates output. Output variable in eight steps. Excellent for demonstrating auto radios. Ideal for servicing — can be lowered to find sticky vibrators or stepped up to equivalent of generator overload — easily constructed in less than two hours. Complete in every respect. Shipping Wt., 18 lbs.

NEW Heathkit
SIGNAL TRACER AND UNIVERSAL TEST SPEAKER KIT

Nothing ELSE TO BUY



$19.50

The popular Heathkit signal tracer has now been combined with a universal test speaker at no increase in price. The same high quality tracer follows signal from antenna to speaker —locates intermittents—defective parts quicker—saves valuable service time—gives greater income per service hour. Works equally well on broadcast — FM or TV receivers. The test speaker has assortment of switching ranges to match push pull or single output impedance. Also test microphones, pickups — PA systems — comes complete — cabinet — 110V. 60 cycle power transformer — tubes, test probe, all parts and detailed instructions for assembly and use. Shipping Wt., 8 lbs.

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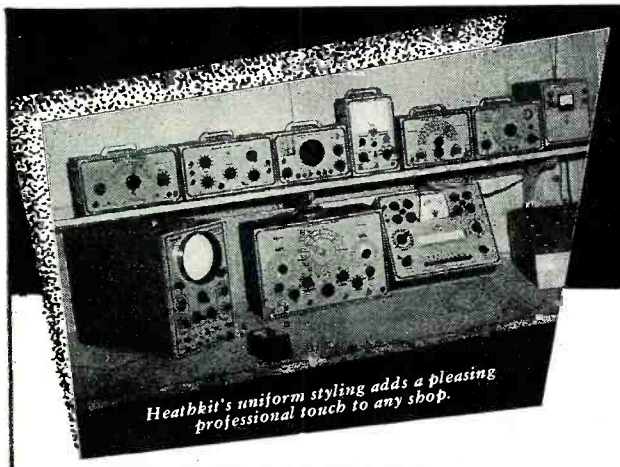
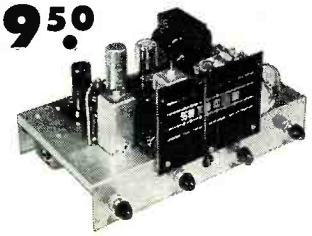


Heathkits PROVIDE PROFESSIONAL LABORATORY APPEARANCE

New Heathkit
BROADCAST AND 3 BAND SUPERHETERODYNE RECEIVER KIT

BROADCAST MODEL BR-1
550 to 1600 Kc.

$19.50



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 output stage, 5Y3 rectifier. Excellent sensitivity for distant reception with selectivity which effectively separates adjacent stations.

The husky 110 V. cased power transformer is conservatively rated for long life.

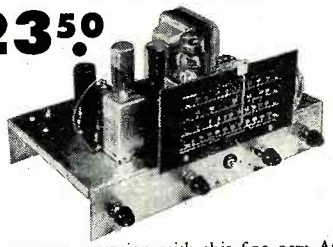
The illuminated six inch slide rule dial is accurately calibrated for DX reception. Enjoy the pleasure of assembling your own fine home receiver. Has tone, volume, tuning and phono-radio controls. Chassis size 2¼" x 7" x 12½" Comes complete with all parts including quality output transformer to 3.4 ohm voice coil, tubes, instruction manual, etc. (less speaker). Shipping Wt., 10 lbs. No. BR-1 Receiver $19.50.

No. 335 Communications Type Table Model Metal Cabinet..... **$4.50**
No. 320 High Quality 5" PM Speaker for above..... **2.75**

Two new Heathkit Superheterodynes featuring the best of design and material. Beautiful six inch slide rule dials — 110 V. 60 cy. AC power transformer operated—metal cased filters—quality output transformers, dual iron core metal can IF transformers — two gang tuning condenser. The chassis is provided with phono-radio switch—110 V. outlet for changer motor and phono pickup jack. Each kit is complete with all parts and detailed instruction booklet. Pictorial diagrams and step-by-step instructions make assembly quick and easy.

3 BAND MODEL AR-1
550 Kc. to 20 Mc.

$23.50

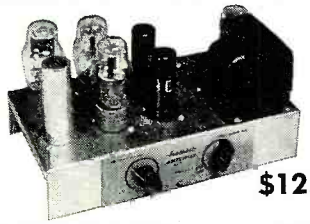


Enjoy the thrill of world wide short wave reception with this fine new AC operated Heathkit 3 band superheterodyne — amazing sensitivity 15 microvolt or better on all bands. Continuous coverage 550 Kc. to over 20 Mc. Easy to build with complete step-by-step instructions and pictorial diagram. Attractive accurately calibrated six inch slide rule dial for easy tuning. Six tubes with one dual purpose tube gives seven tube performance. Beam power ourput 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 instructions (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 preamplifier 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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BENTON HARBOR
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MARS Station of the Month

MARS AND NAVY SPONSOR DOUBLE-HEADER PROGRAM MAY 20TH

MARS and the Navy will co-sponsor a double-header program for amateurs on Armed Forces Day, May 20, 1950. The two-fold program will consist of receiving competition, similar to the old Navy-Day Copying Contest, and a QSO and message relay contest which will emphasize the handling of traffic.

The Honorable Louis A. Johnson, Secretary of Defense, will issue a special message to the amateurs. This message will be broadcast on 13 military frequencies at 25 w.p.m. as follows: May 20, 1950 at 2100 EST and at 2300 EST. NSS, Washington, D. C., will transmit on 122 kc., 4390 kc., 9425 kc., 12,630 kc. and 17,000 kc. WAR, Washington, D. C., will transmit on 3497.5 kc., 6997.5 kc., 14,405 kc., 20,994 kc., and 27,994 kc. May 20, 1950 at 2000 PST. NPG, San Francisco, will transmit on 115 kc., 9255 kc., and 12,540 kc.

Anyone who can receive and transcribe the message without error may send his transcribed copy to Headquarters MARS, Room 5 B 519, The Pentagon, Washington 25, D. C., where it will be checked for accuracy. All who submit a perfect copy will receive a special Certificate of Merit attesting to their code copying proficiency.

The QSO and message relay contest will last 12 hours and will have for its main purpose the demonstration on a national scale of the effectiveness of point-to-point or person-to-person communication by amateur radio as a back-up system for normal communications systems which might be knocked out by flood, fire, storm, ice, or sabotage. The contest will begin at 1700 GCT (1200 EST, 1100 CST, 1000 MST, and 0900 PST). Any radio amateur licensed by the FCC or by the Armed Forces of the United States is eligible to compete in the contest. All amateur bands, either fone or c.w. may be used. Single or multi-operator stations will be considered separately for purposes of scoring the contest. Contest log forms (or additional information on the Armed Forces Day program) may be obtained by writing the Headquarters MARS, Room 5 B 519, The Pentagon, Washington 25, D. C.

A3PGO/W3PGO, club station at the Baltimore Signal Depot, has been named MARS Station-of-the-month by Captain E. L. Nielsen, Chief of MARS—Army. Lt. Louis Aclin, A3KIZ, is the station trustee and technical advisor to the club.

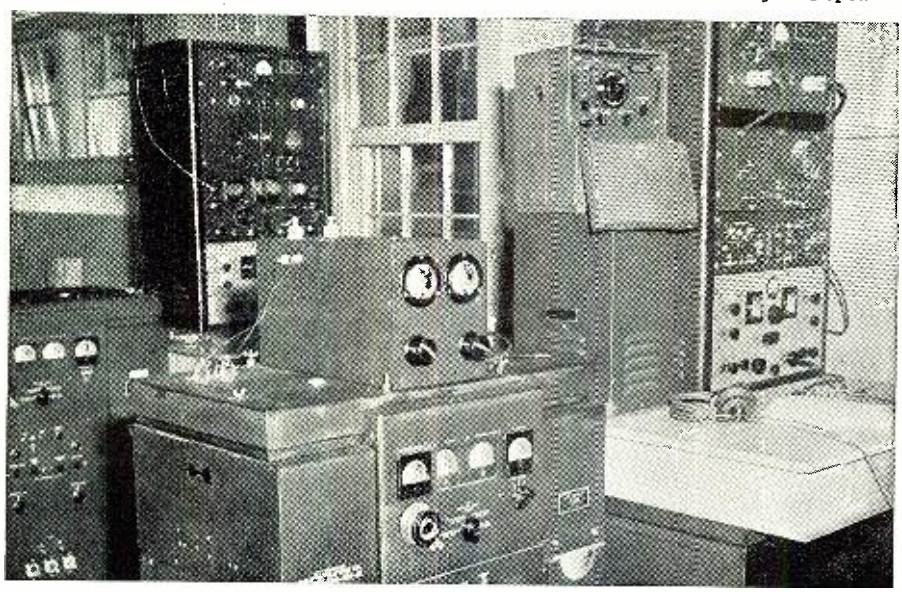
The Baltimore Depot ham club was organized in January, 1949. Members donated spare time, evenings, and weekends repairing a Depot building and in March, 1949, the club moved into its new quarters. The clubhouse now houses two BC-610 transmitters and operating consoles. A third transmitter is set up for two-meter operation.

W3PGO became a MARS member station in September, 1949, and was assigned the call A3PGO. On January 9, 1950, Colonel Harry E. Storms, Commanding Officer of the Depot, formally dedicated the station and Colonel Arthur Pulsifer, Signal Officer, Second Army, was on hand to welcome the Radio Club into the MARS.

Bernard Custodero, W3NYB, was the station's first ham operator. B. Harris, J. Finlayson, A. Gnacyk and J. Davis conduct regular classes in radio theory and code practice at the clubhouse. The club publishes its own newspaper with Irene Nowicki as editor.

The MARS Club has set itself a lofty goal—to encourage all employees of the Baltimore Signal Depot to learn the fundamentals of radio theory and operation and thus to be prepared to assist in emergency radio networks whenever they might be needed. —30—

The 80 meter position at A3PGO/W3PGO, club station at the Baltimore Signal Depot.



MOTOROLA-8 TUBE MODEL 708-T6 AUTO RADIO AT McGEE $44.95 for

AUTO AERIAL REGULAR $6.95

McGEE'S SCOOP LIST PRICE $2.95

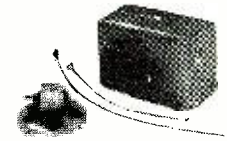
Top cowl or fender mounting auto aerial, 3 section. You will know the famous antenna maker when you see the antenna. A regular **$6.95** list. Stock DC-F3T, made for Tucker. Shipping weight 2 lbs. McGee's scoop price **$2.95.** Offered either for your replacement stock or buy one with a Motorola auto set.

BRAND NEW MODEL 708-T6 MOTOROLAS

FITS MOST CARS AND TRUCKS
8-WATTS HIGH FIDELITY AUDIO
$44.95

MOTOROLA SETS SOLD TO TUCKER, BUT ARE CONVENTIONAL SETS THAT MAY BE PUT IN MOST CARS

Brand new and in the original factory cartons. These 8 Tube Motorola auto sets, Model 708-T6, 8 tube superhet with tuned RF stage for best long distance reception. Push pull 6V6 audio (8 watts). Wide range audio, tone control. Compact size (9⅞x5¾x6⅝") fits most all cars and trucks. 6" PM speaker for dash mounting. Price does not include remote control, but does include cables and mounting hardware. You can buy any custom remote control head from a Motorola jobber. Or for $1.95 extra, we have a universal underdash control. A limited number of custom controls are available at $1.95 each for the following cars: 40 Ford-Mercury, 42-46-Packard, 40-42-46 Lincoln Zephyr, 42-46 Cadillac. Motorola auto set No. 708-T6, Shipping weight 17 lbs. Net price **$44.95.** Underdash control kit, **$1.95** extra.

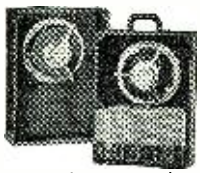


Pushbutton underdash Motorola remote control for use in all cars and trucks. Stock No. 2A1. **$1.95,** when purchased with the Motorola radio.

Buy a "WEBSTER" $187.00 LIST AMPLIFIER AT McGEE FOR $ 2.95

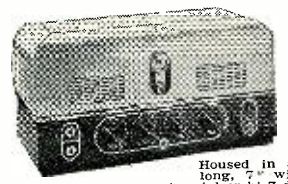
★ McGEE DOES IT AGAIN ★ CARLOAD OF BRAND NEW AMPLIFIERS ★ DISTRESS PRICES
★ FINEST QUALITY WEBSTER ELECTRIC BRANDED ★ WHY PAY MORE
"EVERY AMPLIFIER GUARANTEED" ★ A FEW JENSEN P.M.'s—AT RIDICULOUS PRICES

SAVE ON A WEBSTER P.A.



WEBSTER MODEL 12-TN COMPLETE 12-WATT PORTABLE PUBLIC ADDRESS SYSTEM
SALE PRICE $59.95

Complete portable public address system. Webster Racine Model 12TN-1 consists of one Model 41-12 amplifier, one carrying case, two S6025 heavy duty PM speakers and 50 feet of rubber cord with plug. All equipment is contained in the split type amplifier case. A small American crystal mike and desk stand is included. This PA system is conservatively rated at 12 watts. Input for one mike and one phono player. Ship. weight 41 lbs. Less than 50 of these portable PA systems are available at the ridiculous price of **$59.95.**

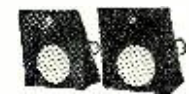


20 WATT $187.00 List Webster Model 16A20 McGee's SALE PRICE $42.95

Webster Electric Model 16A20, conservatively rated at 20 watts. Original retail price was $187.00. Housed in a heavy metal case, 16" long, 7" wide and 9" high. Two inputs for microphones (crystal or hi Z dynamic), 1 phono input for crystal pickup. .1 volt required for rated amplifier output. Two mike volume or fader controls. One phono control and one dual type tone control. Wide range frequency response, plus or minus 1 db. from 50 to 10,000 CPS. Output transformer taps, 2-4-8-250 and 500 ohms. Electron-ray eye tube indicates rated power output when eye is closed, in order to prevent overload distortion. Complete with tubes: 2—6J7, 6N7, 6SN7, 2—6L6, 5V4, 6H6 and 6E5. Shipping weight 33 lbs. This is one of the finest public address amplifiers that we have ever seen. We have only 250 to sell, at the ridiculous price of only **$42.95.** Remember this amplifier's original retail list was $187.00. Amplifiers are new and in factory cartons. Better order now.

WEBSTER PORTABLE SPEAKERS

WAS $156.00 LIST McGEE'S SALE PRICE $44.95



Model DS12-50HN comprises 2—12" A12PM—$4...00 list heavy duty Jensen PM speakers, housed in a split leatherette carrying case. The original retail list on these speakers and case was $156.00. McGee's scoop price, **$44.95.** Shipping weight 49 lbs. Only 50 pieces.

Webster-Jensen $41.00 List A12-PM $13.95

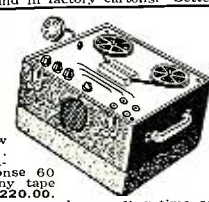
12" Jensen PM speaker, Model A12-PM, 8 ohm voice coil. Webster Racine Stock No. S-4626. Original list price was $41.00. Ship. wt. 19 lbs. McGee offers them to you, while stock lasts, **$13.95** each.

10" 9 watt permanent magnet speaker, Webster Racine Stock No. S6026, 6 ohm voice coil. Oxford. Net price, each **$3.95**

12" Jensen PM speaker Model PM-12C, 6 ohm voice coil. Webster Racine Stock No. S-4482. The original retail list on this speaker was $22.95. Net **$7.95.**

NEW 1950 MODEL PORTABLE TAPE RECORDER

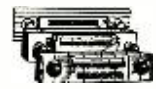
McGEE SALE PRICE $99.50
RESPONSE 60 TO 8000 CPS



Our brand new 1950 model portable tape recorder. A new and smaller size, leatherette covered case, size 10x13x14". Full 6" speaker. A complete self-contained unit, for recording and playback of standard magnetic tape. Top response 60 to 8,000 cps. Makes a more natural recording than any tape recorder in its class. Comparable to units selling up to **$220.00.** Tape speed 7½ feet per second. Twin track type. Twice as much recording time as older model recorders. You make a 30 minute recording on 7" reel, then turn reel over to finish out one hour time. A new type mechanism is incorporated for wow-less reproduction. Inputs for crystal mike, phono pickup or radio tuner. External speaker jack. AC transformer amplifier. Hinged lid covers mechanism. Furnished with mike and 30 minute spool of tape. Model PLT-3. Shipping weight 29 lbs. McGee's price **$99.50.**

5" reel of recording tape **$1.50** each, 10 for **$13.95.**
7" reel of tape (one hour) **$2.70** each, 10 for **$24.95.**

10 CONTROL HEADS



$14.95 ALL MOTOROLAS

10 assorted genuine Motorola remote control heads. New factory cartoned. We assort them from our stock, 5 each push-button and manual types. Yours will come from this selection. Automatics: D-522. D-920, 7PDA. D-512, D-520, 7HNA, 6CCA. D-923. D-730, D-717, D-524, D-528. D-6HNA, D-530 and 6LDA. Manuals: D-829. D-820, 7HNM, D-430, D-823. 6PDM. 6LNM, D-429, 6CCM, D-420, D-628 and 2A1. If you want to pick any particular numbers listed, Price **$1.95** each. 10 assorted, our choice, no more than one of each type, 10 for **$14.95.**

15 INCH CAPEHART COAXIAL SALE PRICE $29.95

15" Capehart Coaxial Permanent Magnet Speaker. Made by Jensen. Response from 50 to above 15,000 cps. Capehart No. JAP-60 C4690. This is a coaxial speaker of the finest quality, with a super heavy duty speaker for a woofer and a coaxially suspended 5" tweeter. Each speaker has a 16 ohm voice coil. Each speaker has connections. You supply your own crossover network. Shipping wt. 25 lbs. Stock No. JAP-60 C4690. Net Price **$29.95.**

6-TUBE—3 BAND RADIO

ANOTHER McGEE SCOOP ONLY $15.95

LIGHTED SLIDE RULE DIAL BEAUTIFUL PLASTIC CABINET FULL 2-GANG SUPERHET

Another red hot McGee special. We made a lucky purchase of 250 6 tube 3 band ac dc 3 band radios. Attractive ivory plastic cabinet with lighted slide rule dial. Receives standard broadcast, foreign short wave and police. A full 6 tube 2 gang superhet with AVC. Made by a well known radio factory. Stock No. FR-63. Ship. weight 10 lbs. Sale price, **$15.95,** two for **$30.00.**

6-TUBE BROADCAST SET $11.95

A few hundred of these ivory plastic 6 tube broadcast radios available at the scoop price of **$11.95.** Full 6 tube 2 gang supers with loop and lighted slide rule dial. Ship. weight 9 lbs. Stock No. FR-S7. Sale price **$11.95.**

CABINETS FOR S-56 HALLICRAFTERS OR WITH BLANK PANEL

Armchair radio - phono combination cabinet, ready-cut to house the S-56 Hallicrafters. 24" high x 27 x 16½". Hinged lid covers record changer compartment. Will accommodate up to a 12" speaker and space for a record changer up to 14" square. Changer board is blank, you cut to fit your changer. Dial knob and mounting holes cut for S-56 Hallicrafters. Cabinet is of top quality and has furniture type finish. Shipping weight 40 lbs. Available in walnut, mahogany or blond.

Walnut armchair cabinet, cut for S-56. Net **$28.95**
Mahogany armchair cabinet, cut for S-56. Net **$29.95**
Blond armchair cabinet, cut for S-56. Net **$34.95**

Any of the above may also be had with blank radio panel. (Specify blank radio panel when ordering.)

AUTOMATIC RADIO PHONO $24.95

MODEL JA-70 RECORD PLAYER RADIO $14.95

Radio-Phono Combination ON SALE AT McGEE $14.95

ONLY 300 TO SELL RED HOT CLOSEOUT SPECIAL

McGee's red hot value of the month. For the children's or recreation room. You can have a radio-phonograph combination for less than the price of just a record player. Here is what you get for only **$14.95:** A full 2 gang, 5 tube superhet broadcast chassis, with loop antenna, wired in the Farnsworth factory, a Ballentine 78 RPM phono motor, a crystal pickup for standard 78 RPM records and a walnut finish cabinet. Uses tubes 12SA7, 12SK7, 12SQ7, 50L6 and 35Z5. When you receive your radio-phono combination all that is necessary is about an hour's work, drilling six small round holes and mounting the wired radio chassis, phono motor and pickup in the cabinet. Off-on switch and phono switch mount on top of the cabinet. This is the nicest deal we have been able to offer for your children's radio and record player combination. Shipping weight 15 lbs. Stock No. JA-70. Net price, **$14.95.**

Automatic radio-phono combination. The same as JA-70 described above, only furnished with a 78 RPM G. I. automatic record changer. The same Farnsworth wired 5 tube broadcast chassis and walnut cabinet. Stock No. AUT-JO. Net. **$24.95**

S-56 HALLICRAFTERS

11-TUBE FM-AM CUSTOM CHASSIS. A $110.00 VALUE AT McGEE FOR ONLY..... $59.95

● WIDE RANGE ● AUTOMATIC FREQUENCY CONTROL ON F.M.

Receives 88 to 108 MC F.M. and Broadcast 550 to 1650 K.C.

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 for 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. Pick your combination from the prices listed below and save.

S-56 chassis with our **$62.50** list 15" coaxial (P15-8) PM speaker, on sale for **$77.95.**

S-56 chassis with our **$32.50** list 12" coaxial (CU-13X) PM speaker, both for **$69.50.**

S-56 chassis with our new 12" curvilinear cone (1202-X) PM speaker, both for **$67.95.**

VM-406 Tri-O-Matic, 3 speed changer **$33.21.**

VM-406GE, 3 speed changer with new GE RPX-050 V.R. cartridge **$36.01.**

Pre-amplifier for S-56 $3.95

Dual purpose preamplifier for either S-56 or S-66. Only 4 wires to connect (instructions furnished). With this you can convert set to operate either a G.E. variable reluctance pick-up or a crystal or dynamic mike, making your S-56 a home P.A. system. Preamp Model SS-69, Size 3½x4x3". Shipping weight 2 lbs. Net price, **$3.95.**

Crystal mike and desk stand, **$4.95** extra.

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

5000-$32.50 IST 2" COAXIAL P.M. SPEAKERS AT McGEE FOR ONLY $9.95 each

MODEL CU-13X
12-INCH "COAXIAL"
WIDE RANGE SPEAKER
★ NEW 1950 MODEL
★ Regular $32.50 List
On Sale at McGee's for **$9.95**

McGee announces its new 1950 Model 12" coaxial PM speaker. A regular $32.50 list speaker, but mass production enables a new low price of $9.95. Made especially for McGee by a famous speaker manufacturer, to our own specifications. It's a new 1950 model. The sale of 10,000 coaxial speakers assures you that this speaker is a smart choice. The speaker consists of a 12" Alnico V PM with coaxially suspended 3" hard cone tweeter. The 12" portion has a 6.8 oz. Alnico V magnet with 1" voice coil and heavy one piece ribbed cone. This responds to the lower register of the audio spectrum. The tweeter has its own separate 2.15 oz. Alnico V magnet. A high pass filter is concealed under the pot cover. This prevents low frequency from reaching the tweeter. The 3" tweeter has a very stiff cone and responds only to the upper register of the audio spectrum. With all this the speaker is still just as simple to connect as any ordinary PM. Only two wires to connect. Input 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 P15-8
15-INCH "COAXIAL"
WIDE RANGE SPEAKER
★ NEW 1950 MODEL
★ Regular $62.50 List
On Sale at McGee's for **$19.95**
"IT WOOFS AS IT TWEETS"

This 15", 35 watt peak coaxial PM speaker is not surplus. It is manufactured by a leading speaker company, to our own specifications. We buy them by the hundreds in order to offer them to you at this low $19.95 price. They are comparable to any $62.50 list speaker on the market. The 15" woofer will reproduce down to 20 cycles. It has a 22 oz. Alnico V magnet and molded cone with 1½" voice coil. The high frequency tweeter is coaxially built in, with a special cone that will produce notes up to 17,500 cycles. The input impedance of both reproducers combined, is 8 ohms. Matching network is concealed under the pot cover. Just hook this up like any other 8 ohm speaker and hear the difference. Shipping Wt. 16 lbs. Stock No. P15-8. Sale price **$19.95. Two for** **$38.00**

15" 40 WATT P.M.

20-12500 CPS KING JUKE MODEL 15-LS **$15.95**

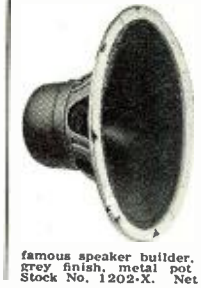
A regular $45.00 list 15", molded cone Alnico V PM speaker. 21½ oz. Alnico V magnet, with molded cone and 1¼", 8 ohm voice coil. Truly a super heavy duty speaker that will take 35 watts with ease, up to a 50 watt peak. The King Juke PM. Response down to 20 cps and up to 12,000 cps. Shipping weight 14 lbs. Model 15-LS. Net price **$15.95, 2 for** **$30.00**

Model 15-KR, standard juke box PM. 15" with 8 ohm voice coil and 12 oz. Alnico V magnet. Shipping weight 10 lbs. Net price **$9.95. 2 for** **$19.00**

12" 40 WATT P.M.
A Rugged Duty SPEAKER **$13.95**
McGee Sale Price
MODEL A-50

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. But, by our large purchase, we are able to offer it to you for only ..... **$13.95** Do not confuse this speaker with surplus merchandise. This is the latest production. Model A-50. Shipping wt. 7 lbs.

12" WIDE RANGE P.M.



35 to 12500 CPS AT McGEE FOR..... **$9.95**
MODEL 1202X
A-1950 MODEL

Why pay more? McGee's new 1950 model 1202-X Music Lovers Reproducer. A full heavy duty 14½ oz. Alnico V magnet PM speaker. Full 1¼", 8 ohm voice coil. One piece molded curvelinlar cone forms a trumpet for the high note distribution. An ideal speaker for high fidelity music system and P.A. work. The rugged construction of this speaker enables handling of low notes down to 35 cps; organ lows, etc. Highs up to 12,500 cps. Made for us by a famous speaker builder, to our own specifications. Lustre-grey finish, metal pot cover. Shipping weight 7 lbs. Stock No. 1202-X. Net price **$9.95, 2 for** **$19.00**

McGEE'S SUPER High Fidelity OUTPUT TRANS. 20-20,000 CPS. $6.95
Best Value in U.S.A.

A-403—6600 ohms. Plate to Plate. Why pay $20.00 or $30.00 for an output? Supreme quality and high fidelity output transformer. Designed to match push-pull plates (2—6L6, 2—6V6, or 2—6AQ5) class AB, to 4-8-15-250 and 500 ohm; with 10% feed-back winding. Housed in a compound filled case: 3⅞x4½x3". Actual net weight, 6 lbs. If you want the best quality from your audio system, order this transformer. Response essentially flat from 20 to 20,000 cycles. We have tried several high fidelity outputs in our lab and find this to be the best value. Even though your amplifier only puts out 10 or 15 watts, this 34 watt job is what you should have. Connecting instructions are furnished. Stock No. A-403, shipping weight 8 lbs. Net price **$6.95**

40-WATT CAPEHART High Fidelity $7.95
Output Worth $20.00

Specially built for Capehart for this finest combination. 40 watt capacity all windings interwound to increase high frequency response and decrease capacity losses. High inductance in coils makes for best efficiency at low audio frequency. This high fidelity output transformer is fully shielded and has a net weight of 6 lbs. Made to match push-pull 6L6 tubes 5,000 ohm plate to plate. Has tertiary winding for 10% feed back and voice coil windings of 4 and 8 ohms. Frequency response plus or minus 2 BD from 30 to 15,000 cycles. Down 6DB below 20 cycles and above 20,000 cycles. Furnished with connecting instructions. Size: 3½x4x4¾" tall. Shipping weight 8 lbs.
Stock No. SX-55, net **$7.95**
Stock No. SX-44. Same as SX-55 only 25 watt capacity. Same winding. Shipping weight 5 lbs., net **$4.95**

30 WATT COMMERCIAL QUALITY PUBLIC ADDRESS AMP. KIT $19.95

- TWO MIKE INPUTS
- READY PUNCHED CHASSIS
- UNIVERSAL OUTPUT TRANS.
- SCHEMATIC DIAGRAM AND PHOTOS

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 5½ x 12". 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.

12" PM Speaker and Wall Baffle $7.95

Combination deal, 12" 12 watt Alnico V PM speaker and 12" plastic front baffle, both for **$7.95**
Combination deal (pictured) 8", 7 oz. Alnico V PM speaker; super heavy duty and plastic front baffle, both for **$4.79**
8", 7 oz. Alnico V PM, made especially for juke boxes. 8 ohm voice coil. Stock No. SE-8X speaker **only $2.95 each, 10 for** **$27.50**

34-WATT MUSIC LOVERS AMP. KIT
- 20-20000 CPS WIDE RANGE RESPONSE
- ELECTRONIC BASE AND TREBLE BOOST

MATCHED PARTS— COMPLETE KIT **$29.95**

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 diagrams 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.

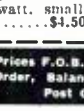
ALUMINUM VOICE COIL
REPLACEMENT SPEAKERS—FACTORY PRICES

McGee's Aluminum Voice Coil Double X Line. McGee offers you our Double X line of replacement P.M. Speakers. Made by a pioneer of the aluminum voice coil speakers. All of the Double X speakers have Alnico V magnets. All aluminum voice coils with RMA standard 3.2 ohm impedance. Why pay twice as much for a replacement speaker? McGee buys them by the carload and sells them for half price. Every speaker is unconditionally guaranteed.

Double X Aluminum Voice Coil, Alnico V Magnet, RMA 3.2 ohm V.C.

Stock No.					
4XX	4" square	1 Oz. Mag.	$1.09 ea.,	10 for	$10.00
5XX	5" round	1 Oz. Mag.	1.09 ea.,	10 for	10.00
6XX	6" pincushion	1.47 Oz. Mag.	1.69 ea.,	10 for	14.95
6XX2	6" pincushion	2.15 Oz. Mag.	1.95 ea.,	10 for	17.95
46XX	4x6"	1 Oz. Mag.	1.49 ea.,	10 for	13.95
57XX	5x7" oval	1.47 Oz. Mag.	1.95 ea.,	10 for	17.95
7XX	7" pincushion (Auto set)	3.15 Oz. Mag.	2.79 ea.,	10 for	24.95
8XX	8" pincushion	3.16 Oz. Mag.	2.95 ea.,	10 for	27.95
69XX	6x9" oval	3.16 Oz. Mag.	2.95 ea.,	10 for	27.95

Universal replacement output transformers for any push-pull or single plate 2500 to 13,000 ohms from 2 to 16 ohm voice coil. Standard size, strap mounting with long leads and lugs for voice coil connections.



U-5	5 watt universal output	$ .79 each, 10 for $ 7.50
U-8	8 watt universal output	.99 each, 10 for 9.50
U-15	15 watt universal output	1.19 each, 10 for 11.00
U-20	20 watt universal output	1.49 each, 10 for 13.95

JJ-4 Single universal output. Any plate to 3.2 ohm voice coil. 4 watt, small size. 49c each, 10 for **$1.50**

A. Crystal mike New recording type. Small size, for all of our amplifiers. Stock No. CS-50. Net price ..... $4.95 Same as "A," only new dynamic type. Stock No. CS-51D. Net price ... $5.95

B. Crystal mike and desk stand. Latest production. Stock No. AA-49. Net price **$4.95**

C. New hidden mike, crystal unit, only 1¼" in diameter. High fidelity response, 60 to 8,000 cps. No cable furnished. For concealed use or experimentors. Stock No. T-001. Net price **$3.95**

12-WATT AMP. KIT INPUT FOR G. E. PICK UP $9.95

Kit Model TM-12. 12 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. 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-12. Weight 10 lbs Net **$9.95**
AA-49 crystal utility mike and desk stand **$4.95 extra.***

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.

12 watt Musical, P.A. and Paging amplifier kit. A complete AC type amp kit. Portable case, 8" PM speaker. 2—12AX7, 2—6AQ5, plus rectifier. Two inputs for use with mike, instrument pickup or phono pickup. Kit complete with instructions and diagram. Model MM-12RC. Weight 18 lbs. Net price **$12.95**

8" Jensen P.M.

9 watt 8 inch 6.8 oz. alnico V magnet pm speaker, made by Jensen. A red hot value. Stock No. S-8R, net **$2.95**

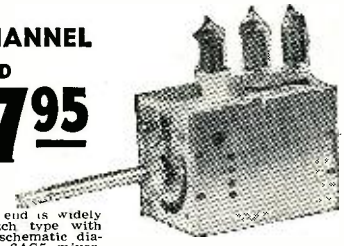
12" Aluminum V.C. P. M.

18 Watt 12 inch aluminum voice coil pm speaker with 6.8 oz. alnico V magnet and 8 ohm voice coil. Stock No. 12-XX, net **$5.95**

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

McGEE HAS
SARKES-TARZAIN 13 CHANNEL
TELEVISION FRONT END
WITH TUBES AND DIAGRAM A SCOOP AT ONLY $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 oas, 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 intercarrier 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

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

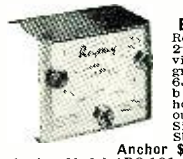
B. Deflection Yoke 201D1 for 12 or 10 inch picture tube. Net price **$2.95** ea.

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



REGENCY T.V. BOOSTER $17.61

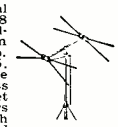
Regency Model DB-213 all channel Television Booster. Tuned grid, tuned plate with 6J6 triodes. Two boosters can be hooked in series without circuit instability. Size 5¼ x 3¼ x 4". Shipping wt. 3 lbs.

Anchor $22.05

Anchor Model ARC-101-50 Television Booster. Research organizations accept this as a number one booster. Tuned plate, tuned grid circuit A11 channel. Size 8¼ x 5 x 4". Shipping wt. 6 lbs. Net **$22.05.**

Astatic $29.10

Astatic Model AT-1, "Channel Chief" Television Booster. Two tuned circuits and two broad circuits on all channels. Higher gain, equivalent to two ordinary boosters. Dual controls tune sound and picture independently. Size 8½ x 6½ x 7¼". Shipping wt. 6 lbs. Net price **$29.10.**



Television all band conical antenna, as pictured with 8 foot mast and mounting hardware. You furnish your own 300 ohm lead. Stock No. RT-44LL. Net price $6.75. Conical elements only, same as above antenna, but less mast. Stock No. SK-22. Net price $4.69. Stacking bars 90c per pair. Order one each of the above for a stacked conical TV antenna. Stock No. RB-T1 Rabbit Ear or V antenn for the top of your TV set. Has heavy weighted base. Best quality. Net price. **$2.29.**

Regular $25.00 Television Magnifier
SALE PRICE $7.95

Stock No. HA-22
FOR 7-10-12 INCH TUBES

Stock No. HA-22 12 x 17 in. television magnifier. Made of crystal-clear plastic and oil-filled. Magnifies your present 7-, 10-, or 12-inch television picture up to four times. We offer you these new factory cartoned magnifiers, you provide your own means of mounting to your set. Edge of magnifier may be drilled and hung on your set with cord. This lens is a $25.00 value, but McGee offers them to you for only **$7.95.** Shipped by express only. Ship. wt. 22 lbs.

DETROLA—SCOOP COILS, GANG, DIAL, PAN $2.95

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. It is not a complete kit. You supply your own tubes, speaker, resistors, condensers, etc. Stock No. DET-1. Shipping weight 9 lbs. Net **$2.95.**

RECORD PLAYER KIT $9.95

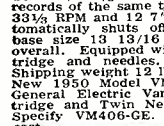
Complete record player kit, for 78 RPM records. All parts, tubes and diagram for building a 70L7 type amplifier. Attractive ready cut walnut base (speaker cut-out on top). Ballentine phono motor and Astatic pickup with permanent needle. Shipping weight 10 lbs. Model No. MD-78. Net price **$9.95.**
Three-speed model No. D-3378, same as above only has 2 speed motor and Webster flip-over pickup and twin needles. Net price **$14.95.**

3-SPEED AUTOMATIC PLAYER KIT $39.95

Walnut cabinet, automatic 3 speed record player kit. Attractive cabinet with hinged lid. Two tube amplifier kit of parts including diagram, tubes and Alnico V PM speaker. Latest 3 speed automatic record changer that intermixes records of the same speed. 33⅓, 78 and 45 RPM changer Model VM-406, with twin needles. A complete easy to assemble kit with instructions. Shipping weight 20 lbs. Stock No. LL-374. Net price **$39.95.**
Model LB-23 same as above only with 78 RPM changer, **$24.95.**
We have a few walnut record player cabinets only, to offer by themselves, for the builders. Changer area is 12½ x 16 x 5½", cut for 5" speaker. Stock No. BJC-1, weight 10 lbs. Net price **$6.95.**

PHONO MOTORS

Heavy duty 78 RPM phono motor with weighted recording type turntable. Stock No. RM-4. Scoop price, **$5.95.**
Ballentine 78 RPM best quality phono motor with turntable. Net price, **$2.95** each. 3 speed phono motor with turntable. Net price, **$5.49.**



VM-406 Tri-O-Matic 3-Speed Changer $33.21

The new VM model 406 Tri-O-Matic automatically plays all records, all sizes and all speeds now on the market. Protective features: records are lowered, not dropped, no wobbling down the spindle, no slip or scrape, no possibility of the tiny microgrooves on the new type records being damaged. Plays 12 10", 33⅓ or 78 RPM, 10 12", 33⅓ or 78 RPM, any 10 or 12" records of the same type intermixed, 12 7" 33⅓ RPM and 12 7" 45 RPM records. Automatically shuts off on the last record. base size 13 13/16 x 12¼", 7¼" high overall. Equipped with flipover crystal cartridge and needles. Stock No. VM-406. Shipping weight 12 lbs. Net price **$33.21.**
New 1950 Model VM-406 with All-in-one General Electric Variable Reluctance Cartridge and Twin Needles. Model 406GE. Specify VM406-GE. Add **$2.85** to above cost.

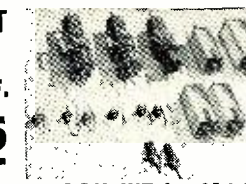
PHONO NEEDLES

DUOTONE 99 Sapphires, 59c ea.; 10/**$4.95**
DUOTONE Ruby with Record Brush....**99c**
DUOTONE NYLON, very popular....**$1.25**
DECCA-CHEEP BRASS NEEDLES. 50 for **19c**

Capehart Automatic Record Changer SCOOP $6.95

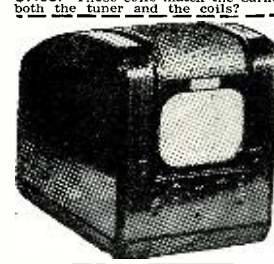
While our stock lasts we offer these Capehart changers for only $6.95 each. Plays 10-12" or 12-10" records automatically. These changers are in good condition, but have been removed from sets to make way for 3 speed changers. They need adjusting, however, you service men with a little ingenuity can put them to profitable use. These changers are equipped with True Timber Variable Resistance Cartridge with permanent needle. (Requires same gain as G.E. Variable Reluctance.) Connecting instructions furnished. Base size 14¼x 14¼". Shipping weight 23 lbs. Extra pick up arm with standard Crystal Cartridge $1.00 extra. Stock No. 71-WL. Net **$6.95** each. 2 for **$12.95.**

TELEVISION VIDEO COIL KIT
20 MATCHED COILS FOR SEPARATE PICTURE & SOUND I.F.
A RED HOT SCOOP AT STOCK #205-XX $7.95



★ BUY SARKES-TARZAIN FRONT END and COIL KIT for $14.95

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 converter 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 at left. Why not order both the tuner and the coils?



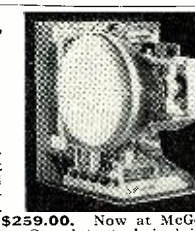
10" T.V. CABINET $5.95

Buy this 10" streamlined mahogany television cabinet at less than the manufacturers 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.

15-INCH NATIONALLY ADV. T.V. CHASSIS $149.95
COMPLETE WITH PICTURE TUBE
FULL DESCRIPTION ON REQUEST



A complete television receiver chassis made by a manufacturer whose name you will recognize. Not a kit, but a 15" TV set with all tubes, 8" speaker and 15DP4 picture tube. Has 19 tubes, plus three rectifiers. Supplied with wood frame for wall or cabinet mounting. Size 19½ x 23" wide and 21¼" deep. Price was **$259.00.** Now at McGee for **$149.95.** Stock No. 520E. Shipping weight 80 lbs. Complete technical information and manufacturers name furnished on request.

TOP QUALITY RADIO KITS COST LESS AT McGEE
RED HOT VALUES IN COMPLETE RADIO KITS

MODEL 6-ACX5
2 BAND CHASSIS KIT

6 TUBE AC SUPERHET KIT BROADCAST AND SHORTWAVE MATCHED PARTS $9.95

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-ACX5. Net price **$9.95.**
10" Heavy duty PM speaker, **$3.95** extra.
8" Heavy duty PM speaker, **$2.95** extra.
12" Heavy duty PM speaker, **4.95** extra.

GAROD PERSONAL PORTABLE KIT

Complete Garod personal portable kit Model X-45. Made from genuine Garod factory-matched parts. A complete kit to build a broadcast battery-operated 4-tube receiver. Small in size, 6½x3¼x4½". Weight 3½ lbs. 2-gang superhet circuit. Set comes on when lid opens. Rugged metal case with colored plastic front and back. Loop antenna in lid. Furnished with diagram, photos and tubes. 67½ volt B battery and flashlight cell, **$1.65** extra. Will go together like a factory-built radio. Shipping weight 6 lbs. Model X-45. Net price, **$9.95.**
Model X-45WT portable radio is X-45 wired ready to operate. Net, **$14.95.**

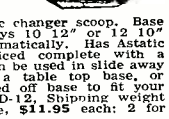
NEW 1950 MODEL 5-TUBE SUPERHET RADIO KIT MODEL NS-5 $9.95

McGee's new 1950 Model 5 tube AC-DC superheterodyne radio kit. Has loop antenna and 2 gang condenser, with lighted slide rule dial and attractive plastic cabinet. Receives broadcast, 550 to 1650 kc. Full size dynamic speaker, matched 456 I.F.'s, automatic volume control. This is a complete radio kit. Everything furnished, including diagram, photos and tubes: 12BE6, 12BA6, 12AT6. 50B5 and 35W4. Shipping weight 7 lbs. Stock No. NS-5. Net price, **$9.95.**

BUILD YOUR OWN MINIATURE RADIO STATION KIT MODEL DE-6X $6.95

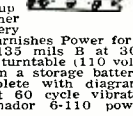
Kit Model DE-6X. With this simple kit you can build your own radio station in miniature. Has 4 tubes. Broadcast on frequency from 800 to 1500 KC, from either a crystal microphone or phonograph record. (This transmitter will transmit about 170 feet, with the short antenna lead furnished.) One control fades from mike to record. Price includes parts, diagram, instructions, photo and tubes. Everyone will enjoy your miniature broadcast station. Kit Model DE-6X. Shipping weight 4 lbs. Net price, **$6.95.**
Model DE-6XWT, miniature transmitter, wired and tested. Net price, **$8.95.**
Crystal mike and desk stand, pictured with transmitter, **$4.95** extra.
Dynamic mike, small palm-of-your-hand type. **$5.95** extra.
Stock No. T-001 small aluminum cased crystal mike, response 40 to 9000 CPS. About the size of an overcoat button. Furnished less cable. Just solder on connections for concealed use, **$3.95** extra.

Our Leader Changer Scoop $11.95, 2 for $22.95



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, **$11.95** each: 2 for **$22.95.**

6-110V. POWER SUPPLY KIT $14.95



New utility power supply kit, works on either a 6 volt storage battery or 110 volts AC. Furnishes Power for a 25 watt amplifier (135 mils B at 300 volts) and will run a turntable (110 volts AC at 25 watts) from a storage battery. Kit 6-110 KR complete with diagram, **$14.95.** 6-110 volt 60 cycle vibrator only **$1.98.** Thermador 6-110 power transformer, **$5.95.**

What's New in Radio

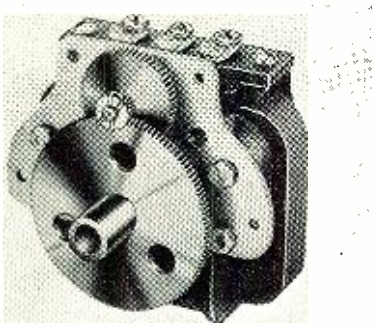
For additional information on any of the items described herein, readers are asked to write direct to the manufacturer. By mentioning RADIO & TELEVISION NEWS, the page, and the issue number, delay will be avoided.

YAZ MOTOR

Barber-Colman Company of Rockford, Illinois, is currently offering a reversible geared head motor with a high starting torque and electrodynamic braking for rapid stopping for antenna positioning and remote tuning in the amateur as well as commercial fields.

The "Barcol YAZ" has a shaded-pole induction-type motor without brushes. Vibration is minimized by an accurately balanced rotor mounted on a finely ground stainless steel shaft. Backlash and noise are minimized by speed reductions through hardened machine cut gears.

For applications requiring high output, capacitors or high impedance



shading coils can be controlled by electronic circuits.

The company's open-type geared head motors are available with speed reductions from 20:1 to 360:1. Closed types can be supplied with reductions from 7.2:1 to 1,333,800:1.

NEEDLE CLIP

The Mueller Electric Co., 1583 East 31st Street, Cleveland, Ohio, is currently introducing a new, solid bronze needle clip for making quick electric contact by piercing the insulation of wires.

The new clip is particularly useful in electrical and radio test work because the sharp needle in one jaw will make quick contact through the insulation, thus eliminating the necessity for disconnecting the wire to make a test.

The clip is made of non-corrosive bronze and is equipped with brass screw connection.

MAGNETIC RECORDER

A high-fidelity magnetic tape recorder, designed for custom installation in studios, schools, homes, and industrial plants, has been announced by *Berlant Associates*, 9215 Venice Blvd., Los Angeles 34, California.

Designated the "Concertone," the new unit features instantaneous monitoring from the tape while recording; separate heads for high frequency erase, record, and playback; forward and reverse high speed rewind; three dynamically balanced motors; record level indicator; instantaneous choice of 7½ or 15 inches per second tape speed; independent azimuth adjustment for each head; and operation with either 7 inch or NAB 10½ inch reels.

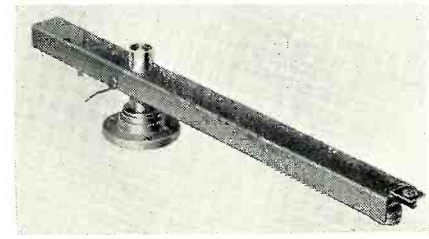
The Basic Recorder No. 401 can be easily converted for either console or portable use.

NEW PICKUP ARM

Pickering & Company of Oceanside, New York, has announced a new pickup arm, the Model 190, which has been designed to overcome the disadvantages inherent in conventional arms and permit a high quality cartridge to meet the stringent require-

ments for playing LP records without distortion.

Features of this new arm include a low vertical-to-lateral moment of inertia, a minimized vertical mass in



order to track any record without imposing extra vertical load on grooves, absence of spurious arm resonance at any frequency, lower than 3 gram centimeters pivot friction, static balancing about the vertical axis to eliminate tendency to jump grooves when subjected to bumping or jarring, an offset head to reduce tracking error to less than ± 2½ degrees, and protection of the stylus point against contact with anything but the record grooves.

PORTABLE SCOPE

Another portable model oscilloscope has been added to the *Waterman Products Company, Inc.,* line of test equipment.

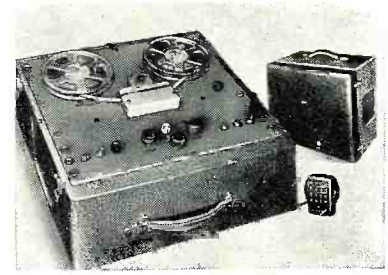
The new Model S-14-A Pocketscope is especially engineered to meet the requirements of the electronic designer. Weighing only 12½ pounds, its 12" x 5¾" x 7" dimensions permit easy handling for bench work as well as portable needs.

Characteristics include identical vertical and horizontal channels with 10 mv./in. sensitivity, response from 0 to 200 kc. within ±2 db., non-frequency discriminating attenuators and gain controls, internal calibration of trace amplitude, linear time base oscillators with ± sync for either repetitive or trigger sweeps, for ½ cycle to 50 kc., trace expansion, filter screen, and a Mumetal shield.

KNIGHT RECORDER

A new low-priced magnetic tape recorder has been released by *Allied Radio Corporation* of 833 W. Jackson Blvd., Chicago, under the "Knight" tradename.

Light and compact, the new unit in-



corporates the latest engineering features for ease of operation, including simplified tape threading which eliminates fumbling, and only one control for the tape transport mechanism.

(*Continued on page* 130)

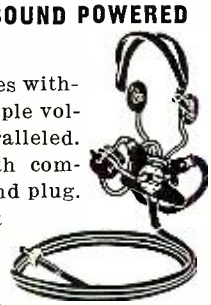
WE'RE BE NG SWAMPED!

*Dealer Inquiries Invited

WITH ORDERS FOR THE NEW NIAGARA HI-PASS FILTER KIT. You don't have to be plagued with TV Interference. We guarantee positive protection against amateur, diathermy, industrial and all other R.F. interference. No loss in brightness or clarity. Money back if it does not work. Designed for 300 ohm antenna feedline.

***Cat. No. N-281**—We can supply every one at the fabulously low price of..... **$1.95** plus 15c shpg. in U. S. A.

BARGAINS IN SOUND POWERED PHONES



Talk up to 10 miles without batteries. Ample volume. May be paralleled. Two types — both complete with cord and plug. Type "O" Chest set mike with headset phones. RCA #MI-2475. Our Cat. No. N-299. Special ..... **$4.95** each

Type "Q" Headset with "Swing-Away" Mike attached. RCA #2454. Our Cat. No. N-300. Special ... **$9.95** each

T-24 CARBON HAND MIKE

A rugged mike with push-to-talk switch, ideally suited for mobile or marine use. Features—7 ft. flexible rubber cord, PL-106, anti-noise choke and JK-38 jack into which two other mikes may be plugged, making a 3-way parallel talking circuit.
Cat. No. N-278
Very special ..... **$1.00** ea.
Postpaid in U.S.A.

BT CUT 1000 KC. CRYSTAL

Fine precision crystal originally used in frequency standard. Low drift, moisture sealed, BT cut. Brand new in ¾" pin spaced holders.
Cat. No. N-189.
YOUR COST **$4.95**

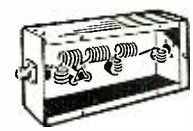
MORE BARGAINS IN SURPLUS EQUIPMENT

1—2 or 3 of each • Check every line!

Wilcox CW-3-110V Superhet Rcvr. New	$ 75.00
Antenna Rotating Motor—RL—42A Reel Exc.	2.95
W.E. XMTR. MOD. Comp. w/controls spares—New	225.00
MN 26C Radio Compass—New	32.00
MN26C Radio Compass—Used	26.95
73-D Localized Receiver Exc.	6.95
AN-APN-1 Altimeter—L.N.	18.95
274N Modulator BC456A w/tubes Exc.	2.65
274N Modulator BC456A Fair less tubes	1.49
SCR522 XMTR-BC625 Exc. less tubes	11.95
BC 1000A Transceiver New	300.00
BC 645 Transceiver, Contr. Box, Dyn, Instruction book, New	17.95
T-17 Handmike 200 Ohm Imp. Exc. 69c, 3 for	1.95
PE 94 24V. DYN. for SCR522 Used L.N.	2.95
Surplus Radio Conv. Manual Vol. 1 or 2	2.50
BC 654 80 Meter XMTR & RCVR w/tubes & XTAL—L. N.	24.95
ASD Radar Set Complete—New (Price on Request)	
ASD Parabolic Antenna—Rotable—L.N. (Price on Request)	
2601A Parabolic Rot. Ant.—L.N. (Price on Request)	
R784 APS 15A Electronic Camera (Price on Request)	
BC221 Freq. Mtr. w/XTAL & Calib. Book L.N.	$75.00
LM Freq. Mtr. w/XTAL. Book. Mod., Exc.	90.00
TBY, Navy 6 & 10 Mtr. Bat. Transceiver	34.95
RME69 RCVR, w/SPKR—GD.	59.00
BC-375 Tuning Units New—cased	4.95
BC-375 Tuning Units New—cased	3.95
GE 25 Watt Phone XMTR Model GF4A Pow. Sup. Exc.	29.95
ATD 50 Watt XMTR New	49.95
JQ Navy 6V. Port. Audio Ampl. w/V1B. Sup. VY. GD.	9.95
BC 614 Speech Amplifier For BC610 L.N.	55.00
W1252 Electronic Wavemeter 22-30 Mcs. Exc.	44.95
BC 939 Ant. Tuner for BC610 L.N.	59.90
BC 342 Navy Comm. RCVR. Exc.	69.95
McMurdo Silver, RCVR. Mod. 801 G-80 Mtrs. w/tubes L.N.	29.95
Gon-Set 50-54 Mc. Conv. L.N.	24.95
Beach 80 Meter VFO New	19.95
Handy 28.5-29.7 Mc. Conv. New	24.95
BC-347C Interphone Amplif. L.N.	2.95
Dynamotor SA 5088 Inp. 18V./Out P. 450V	4.95
GP7 Tuning Units—New—cased. Range A-D	4.95
GP7 Tuning Units—Used—cased. Range A-D	3.95
GP7 Tuning Units—Used—no case. Range A-D	2.95
BC-610 plug in tuning unit. new. TU47-TU54	3.50

HAMS—

DON'T BE BLAMED FOR TVI!



Tests have proven that Niagara's New LOW PASS FILTER KIT attenuates frequencies above 40 MCS. Passes all frequencies below 40 MCS. Less than 1/60 of 1 DB insertion loss. Fits any 72-50 ohm line. Will take up to a full KW. Directions included.

*Cat. No. N-279 **$4.95** plus 25c shipping in U. S.

ATTENTION MOBILE HAMS!

Noise suppression Kit coming next month.

TERRIFIC PRICE SLASH!

BRAND NEW TUBES

TRANSMITTING		RECEIVING	
E1148	$ .34	1H5GT	$ .50
2C26	.28	3A4	.27
5BP1	1.70	3B7	.29
10Y	.28	3D6	.29
211	.28	6C4	.20
803	3.63	6AR5	.54
805	3.63	6D6	.42
813	6.90	6K7GT	.43
815	1.37	6SH7	.27
843	.38	6SS7	.53
954	.18	7C4	.28
955	.18	12A6	.15
957	.18	12H6	.22
958A	.18	12K7GT	.49
1619	.18	12SH7	.29
1625	.18	12SR7	.29
1626	.18	28D7	.29
7193	.47	35L6GT	.49
9004	.18	50B5	.49
9006	.18	50L6GT	.48

ALL QUANTITIES LIMITED

SEND FOR COMPLETE NEW TUBE LISTING "N"

MEET THE WINNER!

of last month's TALL TALES CONTEST

James M. Bowden (W2LD) of Boonton, New Jersey, walked off with this month's $5 prize since he bowled our judges over with this whopper—"Recently, while adjusting the element on my ten meter beam I lost my balance and dropped sixty feet to the ground. Was I hurt? Naw. You see I had on my light fall coat!"

You may be $5 richer next month. Send your entry in—today.

IMPORTANT NOTICE: Please include 20% deposit with C.O.D. orders, unless rated. Orders received without postage will be shipped railway express collect. Send us your inquiries today. We correspond in English, Spanish, French, Italian, Polish, Rumanian, Hebrew, German, Portuguese, etc. Prices subject to change without notice. All stock subject to prior sale. All merchandise f.o.b. N. Y. C. **MINIMUM ORDER $2.00.**

Niagara Radio Supply Corp.

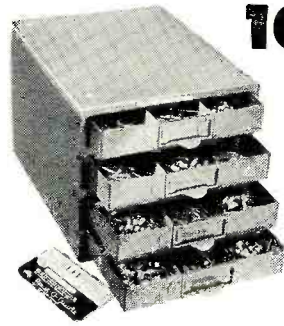
Phone Digby 9-1132-3-4

DEPT. N40 — 160 Greenwich Street, New York 6, N. Y.

OLSON AKRAD

Olson Radio Warehouse, Inc.

73 E. Mill St. • Akron 8, Ohio



1000 RESISTOR KIT

A famous resistor manufacturer (you know who it is, too) called to tell us they had a terrific quantity of INSULATED resistors, all brand new, clean, fresh stock. We grabbed the whole works and Olson is passing the slashed price on to you.

Every resistor is color coded and insulated. Guaranteed by the manufacturer and Olson. Included are ¼- and ½-watt values from 100 ohms to 10 megohms in popular ranges.

Packed in a handsome steel 4-drawer chest with 48 compartments. Size 8½x7½x10½".

Here's your chance to get a full thousand Insulated Resistors at less than distributor's cost. Your cost is only about 1½c per resistor. Regular price is 9c each or $90.00. Shpg. wt. 12 lbs.

Limit: positively only ONE DEAL to a customer. None sold to Jobbers.

Stock No. AS-29 SPECIAL EACH $15.95

Color Code Guide Included

STOCK No. AS-29.....$15.95

GENUINE ASTATIC MICROPHONE

with ON-OFF Switch!

Universal high output crystal for public address, home recording and communications. Equipped with handle which plugs into desk base. 7-ft. shielded cable. Switch in handle. A beauty, too, for this price. Shpg. wt. 3 lbs.

M-66. Special from OLSON, each.....**$5.95**

Same as above but less switch.

M-67.....**$4.95**

MUSICAL INSTRUMENT MIKE

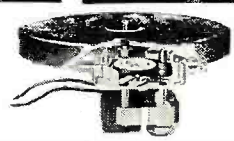
Nationally-famous quality! Regularly sells for about twice our sale price. Easily attached. Delivers brilliant tone from string instruments. Equipped with 4' shielded cable.

M-61. With Volume Control.....**$5.95**

RECORD CHANGER MOTORS

Genuine and exact replacement motors for VM, Detrola, Erwood, Crescent, Westinghouse, GE, Emerson, Belmont, Milwaukee, RCA and many other popular record changers. 115 volts AC. Shpg. wt. 3 lbs.

Reg. $4.95
X-151.....**$1.79**



RIM DRIVE PHONO MOTORS

Famous Makes! Real bargains at these low prices. Self-starting; complete with turntable. All parts included. Shpg. wt. 4 lbs.

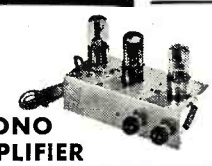
M-52. 78 rpm for 115 volts AC.....**$2.75**

M-63. 3-speed, 33⅓, 45 and 78 rpm.....**4.95**

GENUINE ASTATIC PICKUP ARM

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

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



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"x3¼"x2" chassis. Shpg. wt. 2 lbs.

RA-19.....**$2.98**
AS-22. Tubes for above **1.87**

ASTATIC 3-SPEED TONE ARM

Latest model crystal tone arm. Plays all records, 33⅓, 45 and 78 rpm. Includes precious tip needle.

M-68
Only at Olson's, ea...**$3.95**

TV TRANSFORMER

Vertical oscillator blocking transformer, same as RCA type 208T2. Shpg. wt. 1 lb.

T-81
Special, each.....**98c**

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**

HOOK-UP WIRE KIT

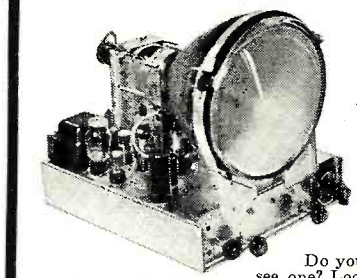
How can we give you so much high grade wire for so little? Olson bought bought all the wire in sight and is passing the bargain on to you. Kit contains 5 rolls, each 100 ft. . . . total 500 ft. Various colors, push back, plastic and rubber insulation; solid and stranded copper. Shpg. wt. 3 lbs.

AS19. 500 feet.....**$2.50**

COIL FORMS

Low-loss plastic. Size ⅜" dia., 1¼" long. Terminal lugs included. Perfect for coils, chokes, stand-offs, etc. Our price isn't much more than ½ cent each.

X-202. Only at OLSON'S, per 100.....**69c**



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.

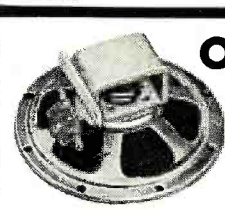
RA-33
Olson's great TV bargain, ONLY.....**$129.95**

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**

FREE SEND FOR OUR LATEST RADIO AND TELEVISION BARGAIN CATALOG



OLSON AKRAD PM SPEAKERS

These are the PM speakers that have made the Olson Akrad brand famous. Brand new, clean, fresh stock. Not surplus. Every speaker individually boxed and labeled. Alnico V magnets. Standard 3.2 ohm voice coils on all speakers up to 10" size. 6-8 ohm voice coil on 12" size. Every speaker guaranteed.

Stock No.	Size	Single Each	Lots of 10 Each
S-4	4"	$1.29	$1.19
S-5	5"	1.29	1.19
S-98	5¼"	1.79	1.69
S-7	6"	1.79	1.69
S-114	6x9"	2.59	2.39
S-96	7"	2.59	2.39
S-86	8"	2.49	2.39
S-97	10"	3.25	2.95
S-111	12"	3.95	3.95

SPEAKERS MAY BE ASSORTED FOR 10 LOT PRICE

JENSEN PM SPEAKERS

Genuine Jensen Concert Series Extended Range PM speakers for PA or radio use. Cone and coil assembly permanently aligned. Heavy Alnico V magnets. Order early. Stock limited.

Stock No.	Watts	Diam.	Sh.Wt.	Net
S-121	9	8"	5 lbs.	$3.49
S-12	12	12"	7 lbs.	6.95

PANEL LAMPS

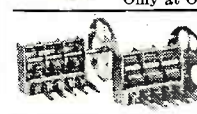
Westinghouse, GE, and Tung-Sol bayonet panel lamps. Brand new, fresh stock. Packed 100 of a type to the box. Sorry, we can't split boxes at this low price.

Stock No.	Type No.	Price per 100
X-161	47	$4.90
X-174	44	

TV FOCUS COIL

Same as RCA Part No. 202D1. Perfect for all RCA 630-type or similar TV sets. Regular list price is $6.50. Shpg. wt. 2 lbs.

T-80.
Only at OLSON'S, Each...**$1.49**



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.....**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"x7½"x10½". Shpg. wt. 11 lbs.

AS-20. Only.....**$14.95**

42 "AKRAD" BY-PASS CONDENSERS!

Qty.	Cap.	V.	List Each	Total
2	.001	600	$.25	$.50
2	.002	600	.25	.50
2	.005	600	.25	.50
5	.01	600	.30	1.50
5	.02	600	.30	1.50
10	.05	600	.40	4.00
10	.1	600	.45	4.50
2	.005	1600	.55	1.10
2	.008	1600	.55	1.10
2	.01	1600	.60	1.20

ALSO 27 "AKRAD" ELECTROLYTIC CONDENSERS

Qty.	Cap.	V.	List Each	Total
2	10	25	$.75	$1.50
2	25	25	.85	1.70
5	20	150	.95	4.75
5	40	150	1.10	5.50
4	20-20	150	1.30	5.20
5	8	450	.95	4.75
4	16	450	1.35	5.40
69	Total List Value			$45.20

Plus the Steel 4-drawer chest FREE

3-SPEED RECORD PLAY R

PLAYS ALL RECORDS

You couldn't buy the parts alone for this price, but Olson gave a contract to a manufacturer who specializes in record players. Look at these features:

- Attractive sturdy portable case
- Alliance 3-speed motor for 33⅓, 45 and 78 rpm
- Astatic Tone Arm with precious tip needle
- Built-in amplifier with PM speaker
- Operates on 115 volts AC
  Shpg. wt. 10 lbs.

RA-34
Order Now From Olson **$19.95**

OLSON AKRAD

THE HOUSE OF RADIO AND TELEVISION BARGAINS

RCA, GE, SYLVANIA Tubes

NATIONALLY ADVERTISED RADIO TUBES IN HANDY OLSON KITS AT PRICES THAT SAVE YOU MONEY!

Matched kits that contain popular tube types. All tubes are brand new, fresh and genuine GE, Kenrad, Sylvania and RCA . . . attractively packed in handy shelf boxes. Every tube 100% guaranteed!

"ALL AMERICAN"—Kit of 5 tubes.
AS-11. Each **$2.96½**
Contains one each of following:
12SA7—12SK7—12SQ7
35Z5—50L6

"LOCTAL"—Kit of 5 tubes. **$2.96½**
AS-15. Each .....
Contains one each of following:
14A7—14B6—14Q7
50A5—35Y4

"MINIATURE"—Kit of 4 tubes. **$2.74½**
AS-23. Each .....
Contains one each of following:
12BA6—12BE6—50B5—35W4

ASTATIC CRYSTAL CARTRIDGES

Genuine Astatic crystal cartridges. Brand new fresh stock, individually boxed.

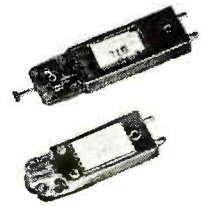
ASTATIC MODEL L-70 OR L-82

Standard replacement for 90% of all pickups. Equipped with push-on terminals. Regular list price is $5.55.
XC-37. Single.
Each $1.99
Order in lots of 10 and pay only, each. **$1.79**

ASTATIC MODEL QT3-M

One of the newest types to come from the world famous Astatic laboratories. 1-oz. needle pressure. Has built-in, replaceable, precious metal needle. Regular list price is $8.40.
XC-32. Single. Each $2.79
Order in lots of 10 and pay only, each **$2.49**

NEW—OLSON CRYSTAL CARTRIDGE—3-volt output, wide range response, push-on terminals, standard ½" mtg. ctrs.
Stock No. XC-50. Each $1.79.
LOTS OF 10. Each **$1.59**



CARTRIDGES MAY BE ASSORTED FOR SPECIAL 10 LOT PRICE

BIG BARGAIN! AC LAMP CORD

New! Tough! Fine for lamps, radios, appliances, etc. 2 conductor copper stranded. Well insulated. Shpg. wt. 6 lbs.
W-53—
250 ft. **$3.49**

SPRING-ACTION AC PLUGS

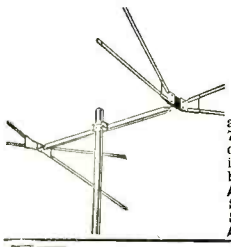
Choice of 2 types: Y-49 Flat Bakelite or Y-50 Round Rubber.
Box of 10 ..... **79c**

4-DRAWER ALL-STEEL CHEST

Just the item you need for small parts, etc. Knob on each drawer; various size compartments. Each drawer 1¼" deep. Size: 6¼" H, 5¾" W, 8⅛" D. Shpg. wt. 5 lbs.
X-199—Each. **$1.98**

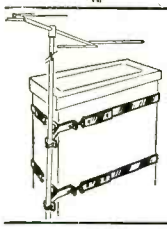
HOW TO ORDER

Order directly from this ad. For convenience use this order blank. Fill in columns below with quantity desired, stock number, description and price. You may send remittance with order (include enough for postage or parcel post shipment), or if you prefer SEND NO MONEY. Olson will ship C.O.D. and you may pay mail or expressman for merchandise and postage.



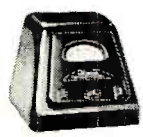
TV-FM ANTENNAS and ACCESSORIES
OLSON'S FINEST QUALITY TELEVISION-FM ANTENNAS

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.
AU-61 ..... **$11.99**
Same antenna with single bay and 5-ft. mast. Shpg. wt. 10 lbs.
AU-60 ..... **$5.99**



ADJUSTABLE CHIMNEY ANTENNA MOUNT

Worth twice our price. Strongly made of heavily plated steel. It's easy to attach any antenna mast from ¾" to 1½" diameter to any chimney. Comes complete with strapping and all hardware. U. S. Patent 2482575. The best. Shpg. wt. 5 lbs.
Stock No. X-207.
Special, each $1.59.
Lots of 10, each **$1.39**



Alliance ANTENNA ROTATOR with DIRECTION INDICATOR

New! Remote control . . . turns antenna full 360° at 1 rpm. Starts, stops, reverses. Position of antenna is always shown. Weatherproof. 110-volt AC. Shpg. wt. 10 lbs. **$29.17**
AU-12 (DIR)—Complete with direction box .....
ALLIANCE TENNA-ROTOR WITH CONTROL BOX—which shows end of 360° rotation but not direction of antenna. Shpg. wt. 9 lbs. **$23.49**
AU-15 (ATR) .....
4-Conductor Cable for above rotators. **$3.30**
100 ft. .....

PLEASE— MINIMUM ORDER $3

QUANTITY	STOCK NUMBER	DESCRIPTION	PRICE EACH	TOTAL
			TOTAL	
			ADD: POSTAGE	
			TOTAL AMOUNT	

NAME _____

ADDRESS _____

CITY _____ ZONE ___ STATE _____

450

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.

Cut Out and Mail to: **OLSON RADIO WAREHOUSE, INC.**
73 E. MILL ST. • AKRON 8, OHIO

LETTERS *from our readers*

'MODEL T' TELEVISION

"CONGRATULATIONS on your editorial in the January issue ('Is Television Going Model T?'). It was an interesting article and will really make some of these radio-minded persons 'wake up and smell the coffee.'

"I have built two 12" television sets from *Transvision* kits using the *Mallory* Inductuner (*Du Mont* Inputuner). That was over two years ago. The parts I used then are as good as new and even the resistors have their original color codes. I'll give the manufacturers credit for putting quality in those sets two years ago. Now the sets are coming through with parts under-rated because of the price factor.

"Your article was 100 per-cent as far as I'm concerned!"

Bernard Deckelmann
Chicago, Ill.

* * *

"WE READ your editorial in the January issue and found it interesting—but you only skimmed the surface.

"So much TV junk is being manufactured and advertised as the last word in picture clarity and stability that I wonder where the industry is going.

"We have had to repair almost every set that we sell, some sets are continuously in and out of the repair shop from the time they are sold—all of this within the warranty period. In some brands, replacement parts warranties are a farce. And who started this 12 channel TV business? Four or five higher definition 800-1000 line TV channels would have been superior service. Many customers with only one station in their service areas will never use the other channels in their sets."

John Martich
Johnstown, Pa.

* * *

A HANDY SCOPE

"AS a service technician working on my own, I service special equipment, *i.e.,* movie sound projectors, p.a. systems, flash guns, timers, cameras, etc. I have found your magazine invaluable. The material is particularly well balanced. I have constructed many of your special devices and they are all doing yeoman work in my servicing and installation business.

"In particular, I would like to comment on the television oscilloscope by L. H. Van Arsdale, Jr. in the April and May 1948 issues. Until one has built it, used it, and compared it with others, he cannot appreciate its features and performance. Due to the design, it is more stable and outperforms some of the $500.00 instruments on the market. This instrument is far ahead of its time."

Edwin C. Libhart
Stockton, Cal.

* * *

THE CODE

"JUST a few lines from a fellow who still hopes 'to get' the code and then a ham ticket. Your recent pro and con letters should consider such items as: If you don't require code training below 100 mc. where DX is good at times or constant, how could a ham stop operation or render assistance in case of an SOS or similar distress signal? He'd never know. This procedure is part of the FCC and International Radio Law. Next, ham radio, like 'Freedom' and 'Liberty,' must have some rules and requirements for the game. Then, why does the younger generation (only a few at least) feel too sophisticated to do the 'lowly' job of studying code? After all, they do require certain skills to drive a car! Besides look at all the retired folks, young kids, and women that get the code—anyone can do it if he is willing to study and practice religiously.

"Finally, some talk has been around that above 300 mc. code may be optional, but I wonder how many 'no code' boys would have the real stuff to gadgeteer home-built gear stations of advancing quality above this region? I suspect 90 per-cent wouldn't do anything. The 'Law of Probability' comes into the picture with the other 10 per-cent who are scientists at heart and would do a wonderful job—at least until the other 90 per-cent were waiting for 'store-boughten' and plug-it-in-and-it-works equipment to be offered for sale—complete with built-in antenna!"

Frank E. Brooks
Colonial Beach, Va.

* * *

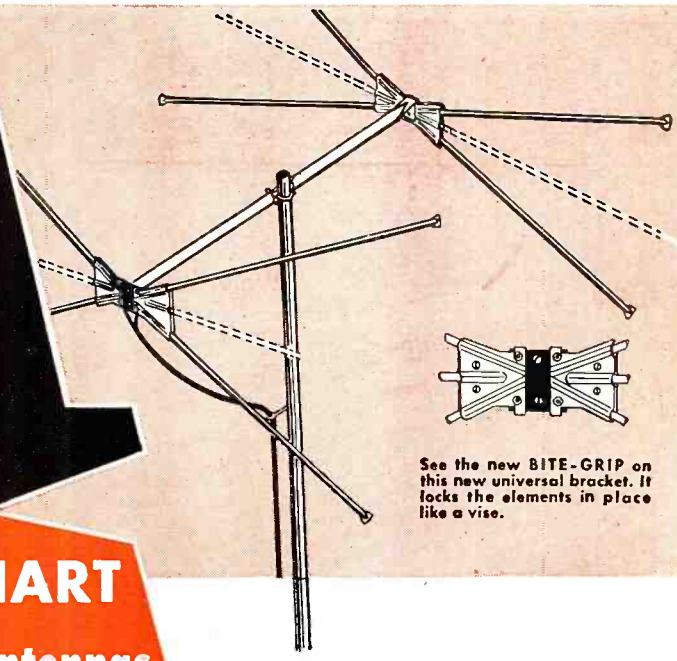
SECOND THE MOTION

"AND many hearty 'me-too's' on F. R. Redwine's letter in the January issue. To hit the nail more solidly on the head would be impossible. Mr. R. does a fine job of exposing how really little regard business propagandists have for the American people. We are expected to swallow any brand of hot air pumped out—with no questions asked—and there seems to be no defense against it!"

Daniel Lazare
Metuchen, N. J.

—30—

THE COMPLETE QUALITY LINE at Budget Prices



See the new BITE-GRIP on this new universal bracket. It locks the elements in place like a vise.

RADIART TELE-ROTOR

POWER To Rotate TV Antennas Under Even The Most Adverse Conditions

RADIART TV Antennas

THERE IS A RADIART ANTENNA . . . for EVERY Condition . . . all of the highest quality . . . at the lowest possible prices!

RADIART was among the first to build quality TV and FM antennas and has pioneered many advance ideas that have improved TV reception! Recognizing that there is a SPECIFIC TYPE that works best under certain conditions . . . RADIART has a COMPLETE line . . . all at popular prices! Jobbers recognize . . . and SERVICEMEN know . . . that what they need is RADIART . . . to do the job best . . . because RADIART has everything!

- ★ Streamlined WEATHER-PROOF Housing! Keeps Out Water, Snow and Ice.
- ★ Powerful heavy duty Motor that Reverses Instantly! Handles 150 pound loads Easily!
- ★ Heavy Duty Precision STEEL Gears For Years and Years of Wear!
- ★ Twelve Heavy Duty Ball Bearings in Two 6½-in. diameter Races for Smooth, Easy Rotation.

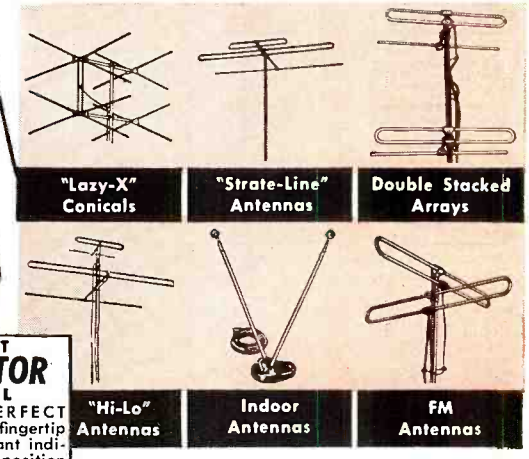
RADIART TELE-ROTOR CONTROL . . . with the PERFECT PATTERN dial . . . fingertip control with instant indication of antenna position shown on the illuminated two-tone face.

Available in These Models:

TR-1 . . . Rototor and control unit with end of rotation light (uses 4 wire cable) $39.95

TR-2 . . . Compass Control Rototor with illuminated "Perfect Pattern" dial (uses 8 wire cable) $44.95

Radiart Has a Complete Variety of Models Within These Basic Classifications:



IT'S RIGHT WHEN IT'S RADIART

THE RADIART CORPORATION
CLEVELAND 2, OHIO

Subsidiary of Cornell-Dubilier Electric Corp.

• ROTATORS • VIBRATORS • TV ANTENNAS • AUTO AERIALS • POWER SUPPLIES

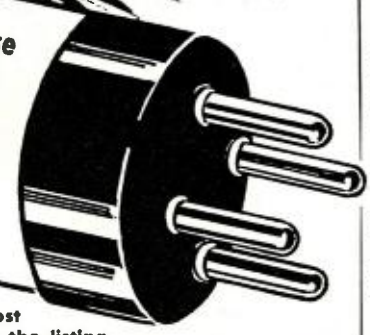
* *You Can't Beat a RADIART ANTENNA on a TELE-ROTOR . . . It's TOPS!*

first time in RHS history!
Special Purchase SALE!

while quantities last!

Transmitting—Cathode Ray—Special Purpose TUBES

Brand New! Standard Brands! No Seconds!



We made a once-in-a-lifetime purchase—and now you can benefit by the terrific savings! No need to tell you these are the most sensational values in our history! Just look at the listing below . . . compare the prices . . . you'll know what we mean when we say that you may never again come across a real savings opportunity like this!

DIODE GAS RECTIFIERS

4B26 $3.49	866A $1.05	RX21 $2.39
249C 1.49	866JR .98	RX120 8.95
575A 11.95	869B 26.50	
816 .99	872A 1.12	

PENTODES

307A/RK75 $3.69	803 52.95	1619 $ .15
713A .79	804 7.95	1851 .69
717A .49	807 1.09	EF50 .39
802 4.19	837 1.19	HY115/145 .59
RK25 4.19	1613 .49	

UHF TRIODES

2C40 $2.95	703A/368AS $1.89	
2C43 7.95	708A 3.59	
2C44 .98	826 .39	
2C46 6.95	8012 .89	
3C24/24G .35	GL434A 2.69	
388A .47	HY615 .19	
527 5.95	VT127A/100TS 1.95	

THYRATRONS

2D21 $ .89	2051 $ .39	
3C23 2.19	C6J 3.65	
3C31/C1B 1.69	FG17 2.69	
3C45 12.95	FG27A 6.95	
884 1.19	FG81A 3.29	
885 1.19	FG105 8.95	
2050 1.19	FG172 13.95	

VOLTAGE REGULATORS

OA3/VR75 $ .93	OC3/VR105 $ .69
OB3/VR90 .65	OD3/VR150 .49
874 $ .39	

ACORNS

954 $ .16	957 $ .22	9004 $ .24
955 .25	958 .22	9005 1.39
956 .25	959 .35	

MINIATURES

9001 $ .32	9003 $ .33
9002 .25	9006 .15

TRIODES

2C22/7193 $ .15	710A $ .25	845 $3.85
2C26A .15	800 1.49	851 12.95
3C22 39.50	801A .19	1626 .25
6J4 4.49	805 3.65	8005 4.75
10Y .19	808 .99	8011/WL538 .25
30 spec. .19	809/3C30 1.89	8014 22.50
45 spec. .19	810 7.95	8025 3.69
75TL 3.89	811 1.98	F123A 7.95
100TH 10.49	812 2.45	F127A 15.95
211 .25	814 1.98	F128A 69.50
250TH 18.75	833A 33.95	F862A 397.50
304TH 3.49	838 1.98	HYE1148 .29
304TL 1.29	841 .29	ML101/
316A .29	843 .29	GL605 49.50
450TH 16.95		WL530 12.95

DIODE VACUUM RECTIFIERS

3B24 $1.49	371B $ .49	VU111 $ .49
3B26 1.49	705A .69	WL531 4.75
15R .49	1616 .49	WL816 37.50
100R/8020 .89	8013 1.39	KC4 37.50
GL451 .89	F660/WL562 49.50	ML100 37.50
250R 5.95	RK72 .59	F606 37.50
371A .39	RK73 .59	

CATHODE RAY TUBES

2AP1 53.89	5AP1 $2.95	5JP1 $29.95
3AP1 4.59	5AP4 2.95	5JP2 8.95
3BP1 2.39	5BP1 1.85	5LP1 12.95
3CP1 1.39	5BP4 2.39	7DP7 3.49
3DP1 1.79	5CP1 1.29	9LP7 1.98
3DP1-S2A 2.79	5CP7 2.95	902 3.39
3FP7 .97	5FP7 1.19	905 2.49
3GP1 5.95	5GP1 2.98	908/3AP1 4.95
4AP10 2.95		

CRYSTAL RECTIFIERS

1N21 $ .49	1N23 $ .59	1N27 $ .89
1N21A .89	1N23A .79	1N34 .82
1N21B .89	1N23B 1.89	

KLYSTRONS

2K25/	417A $ 8.95	726A $ 6.75
723AB $22.50	707B 14.95	726B 29.50
2K28 24.95	723A/B 12.95	726C 49.50

TWIN PENTODES

3E29 $8.95	829 UHF $7.45
815 HF 1.59	832A 4.89

TETRODES

3D21A $ .98	RK65/5D23 $24.50	813 $ 6.85
4-65A 14.21	5D21 24.45	860 14.95
4-125A 26.05	350B 1.39	861 9.49
4-250A 36.25	715A 5.49	865 .79
4E27 12.45	715B 6.59	1614 1.35
257B 12.45	715C 19.95	

GAS SWITCHING TUBES

1B24 TR $4.59	1B23 $8.75	
1B26 TR 2.79	1B32/WL532A 1.89	
1B27 TR 7.95	1B36 anti TR 3.95	
1B29 .79	721A anti TR 1.98	
1B21 2.69	724B anti TR 2.49	
1B22 2.87	1960/S836 diode .89	

PHOTOTUBES

1P23 $2.98	930 $ .98
1P24 .59	931A 2.39
1P36 2.98	

TWIN TRIODES

2C51 $5.95	2C34/RK34 $ .22
2C21/RK33 .24	RK59 1.69
1642 .24	

MAGNETRONS

2J21A $ 7.95	2J31 $ 8.49	5J29 $11.95	
2J22 7.95	2J32 12.95	5J30 47.50	
2J26 6.95	2J48 12.75	714AY 3.59	
2J27 12.75	2J54B 22.50	725A 6.45	

DUO-DIODE GAS RECTIFIERS

3B22/EL1C $1.98	CK1005 $ .09
4B24/EL3C 1.98	CK1006 .85

SPECIALS

4D22 $9.95	1624 beam amp. $.67		
4D32 9.95	1625 beam amp. .19		
23D4 ballast .29	1629 tuning eye .19		
28D7 beam amp. .29	1631 beam amp. .98		
559 UHF diode .98	1636 beam amp. .98		
876 ballast .29	REL21 spark gap .98		
1630 orbital beam hexode $ .49			
RK60/1641 duodiode vac rect. .42			

RECEIVING TUBES

0A2	$1.29	6B8G	$ .69	12AT6	$ .44
0A4G	.89	6BA6	.55	12AT7	.79
0B2	1.67	6BE6	.52	12AU6	.57
0Z4	.57	6BF6	.57	12AU7	.67
1A	.39	6BG6G	1.47	12AV6	.54
1A3	.44	6BH6	.59	12BA6	.55
1A4	1.09	6BJ6	.57	12BE6	.49
1A4P	.97	6C4	.19	12C8	.34
1A5GT	.49	6C5	.47	12F5GT	.58
1A6	.79	6C6	.57	12H6	.27
1A7GT	.67	6C8G	.69	12J5GT	.34
1AB5	.59	6D6	.44	12J7GT	.67
1B3/8016	1.15	6D8G	.79	12K7GT	.52
1B4	1.19	6E5	.69	12K8	.59
1B5/25S	.89	6F5	.47	12Q7	.49
1C5GT	.59	6F6	.57	12S[illegible]	.57
1C6	.89	6F6GT	.57	12SC7	.54
1C7G	.89	6F7	.69	12SF5	.59
1D5GP	.97	6F8G	.87	12SF7	.54
1D7G	.89	6G6G	.69	12SG7	.52
1D8GT	.95	6H6	.39	12SH7	.35
1F4	.75	6H6GT	.37	12SJ7	.47
1F5G	.75	6J5	.47	12SK7	.57
1G4GT	.69	6J5GT	.39	12SL7	.59
1G6GT	.65	6J6	.77	12SN7	.52
1E7G	1.15	6J7	.67	12SQ7	.49
1N4G	.55	6J7GT	.65	12SR7	.49
1H5GT	.54	6K5GT	.79	12Z3	.69
1H6GT	.87	6K6GT	.44	14A4	.79
1J6G	.75	6K7	.49	14A7	.52
1L4	.48	6K8	.79	14B6	.67
1LA4	.79	6L5GT	.79	14F7	.69
1LA6	.89	6L6	1.05	14F8	.79
1LB4	.89	6L6G	.99	14H7	.59
1LC5	.69	6L6GA	.85	14J7	.87
1LC6	.79	6L7	.79	14N7	.85
1LD5	.79	6L7G	.87	14Q7	.53
1LE3	.69	6N7	.75	14R7	.67
1L5	.79	6Q7	.64	19	.69
1LH4	.79	6R7	.79	24A	.49
1LN5	.67	6S7G	.79	25L6GT	.53
1N5GT	.59	6S8GT	.77	25Z5	.44
1P5GT	.67	6SA7	.44	25Z6GT	.43
1Q5GT	.67	6SC7	.59	26	.49
1R4	.59	6SD7GT	.44	27	.42
1R5	.69	6SF5	.49	28D7	.35
1S4	.59	6SF7	.59	30	.37
1S5	.49	6SG7	.59	31	.59
1T4	.53	6SH7	.37	32	.85
1T5GT	.69	6SJ7	.47	32L7GT	.89
1U4	.59	6SK7GT	.44	33	.69
1V	.57	6SL7GT	.59	34	.37
2A3	.87	6SN6GT	.97	35/51	.57
2A4G	1.07	6SN7GT	.54	35A5	.63
2A5	.69	6SQ7	.45	35B5	.55
2A6	.79	6SR7GT	.52	35C5	.59
2A7	.79	6SS7	.49	35L6	.52
2V3G	.69	6ST7	.72	35W4	.39
2X2	.37	6SU7GTY	1.25	35Y4	.49
2X2A	.65	6SV7	.79	35Z3	.57
3A4	.34	6T7G	.89	35Z4	.44
3A5	.79	6U5G	.65	35Z5	.39
3A8	1.59	6U6GT	.63	36	.67
3B7/1291	.29	6U7G	.49	37	.35
3D6/1299	.29	6V6	.89	38	.37
3LF4	.79	6V6GT	.57	39/44	.27
3Q4	.47	6W4	.63	41	.49
3Q5GT	.67	6W7G	.77	42	.49
3S4	.57	6X4	.57	43	.49
3V4	.67	6X5GT	.47	45	.52
5R4GY	1.09	6Y6G	.67	45Z3	.57
5T4	.87	6C7G	.98	45Z5	.55
5U4G	.49	6ZY5G	.59	46	.62
5V4G	.87	7A4/XXL	.49	47	.69
5W4	.67	7A6	.59	49	.85
5X4G	.57	7A7	.53	50	1.39
5Y3GT	.39	7AG7	.72	50A5	.69
5Y4G	.49	7B4	.53	50B5	.53
5Z3	.52	7B5	.67	50L6GT	.52
5Z4	.77	7B6	.56	50Y6	.57
6A3	.92	7B7	.59	53	.87
6A4LA	1.09	7C4	.34	56	.45
6A6	.79	7C5	.48	57	.45
6A7	.69	7C7	.59	58	.49
6A8	.75	7E5	.67	59	.89
6AB7	.79	7E6	.54	70L7	.94
6AC7	.74	7E7	.62	71A	.59
6AD7G	1.09	7F7	.59	75	.53
6AF6G	.79	7H7	.59	76	.44
6AG5	.69	7K7	.89	77	.43
6AG7	.98	7L7	.69	78	.44
6AH6	1.29	7N7	.67	80	.37
6AJ5	.79	7Q7	.59	81	1.25
6AK5	.85	7R7	.69	82	.84
6AK6	.79	7V7	.87	83	.75
6AL5	.59	7W7	.79	83V	.89
6AQ5	.49	7X7	.79	84/6Z4	.56
6AQ6	.59	7Y4	.47	85	.69
6AR5	.52	7Z4	.57	89Y	.35
6AT6	.44	12A	.57	117L7/M7	1.19
6AU6	.59	12A6	.17	117N7	1.19
6AV6	.47	12A7	.89	117P7	1.19
6B4G	.89	12A8GT	.49	117Z3	.49
6B6G	.79	12AH7GT	.80	117Z6	.65
6B7	.87				

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OIL CONDENSERS—DC RATINGS

3x.1	mfd 600v	$ .49	.1	mfd 2500v	$1.09
.25	mfd 600v	.25	.25	mfd 2500v	1.19
.5	mfd 600v	.25	.5	mfd 2500v	1.29
1	mfd 600v	.28	2	mfd 2500v	1.98
2	mfd 600v	.28	.01	mfd 3000v	1.07
2x2	mfd 600v	.57	.05	mfd 3000v	1.19
4	mfd 600v	.57	.1	mfd 3000v	1.39
6	mfd 600v	.97	.25	mfd 3000v	1.49
8	mfd 600v	1.05	.5	mfd 3000v	1.69
10	mfd 600v	1.15	1	mfd 3000v	2.19
3x.1	mfd 1000v	.59	2	mfd 3000v	3.47
.25	mfd 1000v	.29	4	mfd 3000v	4.45
.5	mfd 1000v	.39	1	mfd 3600v	2.39
1	mfd 1000v	.49	.25	mfd 4000v	1.98
2	mfd 1000v	.69	.5	mfd 4000v	2.49
4	mfd 1000v	1.29	1	mfd 4000v	2.79
8	mfd 1000v	1.89	2	mfd 4000v	3.10
10	mfd 1000v	2.07	3	mfd 4000v	4.95
20	mfd 1000v	3.29	.1	mfd 5000v	1.98
.5	mfd 1500v	.77	.25	mfd 5000v	2.29
1	mfd 1500v	.97	1	mfd 5000v	2.98
2	mfd 1500v	1.19	.1	mfd 7000v	1.49
4	mfd 1500v	1.98	.01	mfd 7500v	1.79
24	mfd 1500v	4.98	.02	mfd 7500v	1.79
.1	mfd 2000v	.69	.03	mfd 7500v	1.79
.25	mfd 2000v	.89	.05	mfd 7500v	1.79
.5	mfd 2000v	.97	.1	mfd 7500v	1.79
1	mfd 2000v	1.29	2x.1	mfd 7500v	4.95
2	mfd 2000v	1.98	.02	mfd 12000v	9.95
4	mfd 2000v	3.89			
8	mfd 2000v	4.95			

HIGH CAPACITY CONDENSERS

2x3500	mfd 25v	$3.47	200	mfd 35v	$ .57
2500	mfd 3v	.35	100	mfd 50v	.45
3000	mfd 25v	2.45	4000	mfd 18v	1.95
650	mfd 80v	1.29	4000	mfd 30v	3.25
1000	mfd 15v	.98	2350	mfd 24v	2.25
			10000	mfd 25v	4.57

1000KC crystal BT cut	$3.95
3" scope shield	1.29
2 speed dial drive for ¼" shaft ratios 5 to 1 1 to 1	.49

SOCKETS

Angle octal	$ .19	Ceramic for 5D21, 705A	$ .89
Magnal	.59	Ceramic for 832, 826, 829	.69
Diheptal	.59	Mycalex for VT127A	.59
Safety recessed for 2X2	.39	Ceramic acorn	.29
Mycalex for 813	.59	Ceramic for 866A	.59

TRANSFORMERS—115v 60 cyc

HS—Herm. sealed OF—Open frame FS—Full shell FE—Fully enclosed

	Secondaries	Wgt.	Ht.	W.	D.	Price
HS	6350v @ .025 arms (16kv ins)	33½	8	7¾	6	$11.95
OF	6250v or 3850v or 2600v @ .056 arms	37	12	8	5¾	13.95
HS	2500v @ 15 ma	13¼	5½	4¾	4½	3.49
FS	2700v @ 2ma; 6.3v @ .6A; 2.5v @ 2A	3	3	3	2¾	4.95
HS	1600v @ 4 ma; 350-0-350v @ 150 ma; 6.3v @ 9A	9¾	5½	4	3¾	4.45
HS	1540v @ 5 ma; 340-0-340v @ 300 ma	16	5¼	5½	4¾	4.35
FS	1120-0-1120v @ 500 ma; 12v CT @ 14A; 2.5v @ 10A; 17v @ 2.5A; 32 v @ 25 ma 115/230 pri	45	7¼	10	7¼	27.00
HS	925v @ 10 ma; 525-0-525v @ 60 ma; 2x5v @ 3A; 6.3v CT @ 3.6A; 6.3v @ 2A; 6.3v @ 1A	14¾	5½	4¾	4½	5.55
FE	700-0-700v @ 300 ma	34	5½	11½	4¼	7.55
FE	500-0-500v @ 175 ma	16½	5½	5¾	4¼	4.55
FS	430-0-430v @ 340 ma; 6.3v CT @ 6.3A; 5v @ 6A	14	5½	4¾	4¼	4.85
HS	425-0-425v @ 75 ma; 6.3v @ 1.5A; 5v @ 3A	8½	5¼	3¾	3¼	3.65
FE	415-0-415v @ 60 ma; 5v CT @ 2A 115/230 dual pri	7½	5	5	3¾	4.97
FS	405-0-405v @ 150 ma; 6.3v CT @ 2½A; 5v @ 3A; 2.5v CT @ 5A	7½	4¾	3¾	3¾	4.35
HS	400-315-0-100-315v @ 200 ma; 2x6 .3v @ 9A; 5v @ 3A; 2.5v @ 2A	12¾	5¼	4¾	4¼	5.35
HS	500-385-0-385v @ 200 ma; 3x6 .3v @ .6A; 5v @ 3A; 2.5v @ 2A	18	6¾	4½	4¼	4.75
FE	325-0-325v @ 12 ma; 255-0-255v @ 240 ma	15½	5¾	4½	3¾	4.25
HS	300-0-300v @ 65 ma; 6.3v @ 2.5A; 6.3v @ 1A; 2x5v @ 2A	6¾	3½	3¾	3¾	3.25
HS	120-0-120v @ 50 ma	3¼	4¼	2½	2½	.95
HS	80-0-80v @ 225 ma; 5v @ 2A; 5v @ 4A	6½	4¼	3½	3¼	2.97
FE	0-17.4/21.6/25.8v @ 400 ma; 6.4v @ .5A; 2.6v CT @ 2.5A pri 115/230	7	5	5	3¾	3.85

	Secondaries	Wgt.	Ht.	W.	D.	Price
OF	18 or 36v @ 15A	16	6½	6	3¾	$8.75
FS	13.5v CT @ 3.25A	5½	4¼	3½	3	2.17
FS	12.6v CT @ 10A; 11v CT @ 6.5A	12½	6¼	5½	3¾	6.35
FE	3x10.3v CT @ 7A	17½	4½	7	5¾	6.95
HS	6.5v @ 12A; 6.3v @ 2A; 115v @ .1A	9¾	5¼	4½	3½	3.50
HS	6.4v @ 10A; 6.3v @ .6A	7¼	5¼	4½	2¼	2.77
OF	6.5v @ 8A; 6.5v @ 6A; 2.5v @ 1.75A	9	4¾	4¼	3¾	4.17

	Secondaries	Wgt.	Ht.	W.	D.	Price
HS	6.3v @ 1A; 2.5v @ 2A	8	5½	4¼	3½	$2.29
OF	6.3v @ 1A	½	1¼	2	1½	.77
FE	6.3v CT @ 3.5A; 2x2.5v CT @ 3A	7	3¾	3½	3	2.97
FE	5v CT @ 20A; 10 KV ins.	22	7½	7½	4¼	8.95
HS	4-0-4v @ 1A	1½	2¾	2½	2	.87
HS	.6v @ 15A rms	3½	3¾	3¾	2¼	1.47

TRANSFORMERS—220v 60 cyc

FE	512.5-0-512.5 @ 427 ma	24½	6¾	6½	4½	5.35
FE	3x5v @ 6A; 4v @ .25A	10	5¼	4	4	2.95
FE	3x6.3v CT @ 3A; 6.3v CT @ 1.6A	9½	5¼	4	3¼	2.95
FE	10v CT @ 6.5A; 6.3v CT @ 2.5A; 6.3v CT @ 1.8A 220/440 pri	13	5½	5¼	4½	3.95

	Secondaries					Price
FE	Step up/down 110/220 500 watt	25	6	11	5	10.95
FE	Step up/down 110/220. 220/440 600 watt	39	5½	7¼	7	14.95

FILTER CHOKES—HI V INS

HS	600 hy @ 1 ma/500 ohms	1	2¾	2	dia.	3.15
HS	325 hy @ 2 ma/4500 ohms	1	2¼	2½	1¾	3.37
HS	200 hy @ 10 ma/5260 ohms	1½	3¼	2½	dia.	3.37
FE	30 hy @ 60 ma/240 ohms	6	4	4¼	3	1.57
HS	30 hy @ 25 ma/870 ohms	1½	2¾	2	2	.97
HS	15 hy @ 70 ma/500 ohms	3	3¼	2¾	2¼	1.15
FS	10 hy @ 200 ma/85 ohms	3½	3¾	3	8	2.17
FS	3/30 hy @ 250 ma/70 ohms	6½	4½	3¾	dia.	3.65
FS	10/20 hy @ 85 ma/2000 ohms	2½	3	2½	2½	1.55
FE	14/3.5 hy @ 40/400 ma	17	4½	6¼	6¼	6.95
FE	3 hy @ 50 ma/300 ohms	½	1½	1½	dia.	.33
HS	2 hy @ 175 ma/60 ohms	1½	2½	1¾	1¾	1.49
FE	5 hy @ 70 ma/100 ohms; .2 hy @ 350 ma/6 ohms dual	5	3¾	4½	3	2.39
HS	.1 hy @ 5A	12	6¼	4½	3½	6.97
FE	.065 hy @ 2.5A	9	4	4¾	3¼	2.49
HS	.05 hy @ 15A	11	6	4¾	3¼	7.97

SELENIUM RECTIFIERS—FULL WAVE BRIDGE TYPE

Input: 0-18v AC			Output: 0-14.5v DC		
Type	Max. DC Current	Price	Type	Max. DC Current	Price
18D1	1.2	$ 2.59	18K2	26.0	$17.95
18E1	2.4	3.49	18K3	39.0	24.95
18F1	6.4	4.95	18K4	52.0	29.95
18K1	13.0	8.95	18K5	65.0	35.95
18J1	17.5	11.95			

Input: 0-40v AC			Output: 0-34v DC		
Type	Current	Price	Type	Current	Price
40D1	0.6	$ 2.95	40K2	12.0	$18.95
40E1	1.2	3.89	40J2	18.0	22.45
40F1	3.2	5.79	40K4	24.0	32.50
40K1	6.0	9.95	40K5	30.0	37.95
40J1	9.0	12.95	40J4	36.0	42.50

Input: 0-120v AC			Output: 0-100v DC		
Type	Max. DC Current	Price	Type	Max. DC Current	Price
40D1	.6	$ 7.85	40K1	6.0	$27.47
40E1	1.2	10.76	40J1	9.0	34.35
40F1	3.2	16.65			

SINGLE PHASE FULL WAVE CENTER TAPPED

Input: 10-0-10v AC			Output: 8v DC		
Type	Max. DC Current	Price	Type	Max. DC Current	Price
20D1	1.2	$ 1.89	20K4	48.0	$17.95
20E1	2.4	2.25	20K5	60.0	22.49
20F1	6.4	3.87	20K6	72.0	25.57
20K1	12.0	4.95	20K7	84.0	27.95
20J1	16.0	7.95	20J6	96.0	32.50
20K2	24.0	11.95	20K10	120.0	36.50
20K3	36.0	14.95			

THREE PHASE FULL WAVE—BRIDGE RECTIFIERS

Input: 120v AC			Output: 150v DC		
Type	Max. DC Current	Price	Type	Max. DC Current	Price
40D31	.9	$16.52	40K31	9.0	$32.50
40E31	1.8	19.87	40J31	12.0	54.69
40F31	4.75	27.95			

Input: 240v DC			Output: 0-300v DC		
Type	Max. DC Current	Price	Type	Max. DC Current	Price
40D61	.9	$27.45	40K61	9.0	$92.76
40E61	1.8	33.65	40J61	12.0	98.75
40F61	4.75	49.95			

Current ratings can be increased 2 to 2½ times by fan cooling.

COMPONENTS

50 mmfd ceramic condensers	$ .59
50 mmfd button condensers	.07
55 mmfd ceramicon feed thru	.08
4-30 mmfd ceramicon trimmers	.29
25, 50 mmfd air trimmers screwdriver	.29
100, 140 mmfd air trimmers screwdriver	.39
50 mmfd 5KV GE vacuum condenser	1.49
1 mfd 600v donut condenser (152 in box) per box	1.98
TMC-300 National variable 300 mmf	1.29
Single gang variable 33-435 mmf	.69
Five gang variable 11.5-30 mmf per section	.98
Three megacycle IF coil double slug	.29
Thirty megacycle IF coil	.19
80 meter osc. coil for ARC5	.29
80 meter PA final coil for ARC5	.29
0-1 ma meter Weston 506	2.95
—10+5 decibel meter Weston 301	9.95
2v, 6v, 12v vibrators	.98
Circuit breaker 15 amp	.98
J37 key	.69
200 watt power supply kit, complete	17.95
400 watt modulation xformer 803, 813, 100TH	19.95
Output xformer UTC pri: 8500 ohms, sec: 0-8-125-500	.69
500 watt 12.5 ohm rheostat	3.49
Driver unit WE 35 watt	4.95
Horn throat for above	.39
Rotary switch GE mycalex, 2 deck SP3T	.49
Plate caps ceramic, 2X2, 807, etc.	.19
Plate caps ceramic, 866A, 813, etc.	.19
Couplings ceramic ¼" to ¼"	.29
Couplings ceramic ¼" to ⅜"	.29
Couplings ceramic ⅜" to ⅜"	.29
Crystal socket ceramic 2 prong ⅝"	.14

EQUIPMENT

APN-1 altimeter transceiver	New	$ 7.95
ATR inverter 12v DC in 110v AC 100w out	New	16.95
AN/CRW-2 UHF receiver	New	5.95
BC 1016 tape recorder	New	139.50
BC 950A-121 xmitter 100-156 mc, modulated	New	49.50
BC 778 Gibson Girl	Shelfworn	3.95
BC375E xmitter, 7 tuning units, dynamotor	Like new	69.50
BC-AL229 receiver	Used	2.95
BC 733 receiver	New	6.95
BC 433 receiver	Used	24.95
BC 456 modulator	New	1.98
BC 434A control box/SCR269	Used	2.45
BC 996T1 interphone amplifier	Like new	6.95
BC 602A control box/SCR522	Used	.49
BK-22 relay for SCR269	New	2.95
BK-22 relay for SCR269	Used	1.95
CFI Navy unit w/200 KC crystal	New	14.95
Constant voltage transformer, Sola 190/260-60c in 115v-1.7A out	New	16.95
DM19 dynamotor 12v DC in 500v 200 ma cont out	Good	5.95
EE8 foundation unit	Good	4.95
KS12013 wire recorder GE, complete	Good	97.50
LM7 or 10 frequency meter	Good	37.50
MN26C compass receiver	Good	24.95
M110 dynamic chest mike	New	4.95
PE94 dynamotor/SCR52	Good	1.98
PE97A vibrator power supply	New	4.95
R89/ARN5 receiver	New	7.95
SCR518 altimeter, complete	New	29.95
T17B carbon mike	Good	.98
T21B field microphone radiosonde	Good	19.95
TU25 tuning unit/BC223	New	1.79

RADIO HAM SHACK Inc.
189 GREENWICH STREET . NEW YORK, N. Y.

PHONE DIGBY 9-0347

WRITE FOR QUANTITY PRICES
Prices Subject to Change Without Notice
All Merchandise Guaranteed
F.O.B. N. Y. C. Minimum Order $10.
20% Deposit Required

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.

INSTRUMENT TRANSFORMERS

Westinghouse Electric Corporation, P. O. Box 2099, Pittsburgh 30, Pa., has recently issued a 12-page booklet which describes the construction features of the company's complete line of instrument transformers.

Methods of insulating current and potential transformers using oil, plastic, or dry-type construction are explained for all voltage classes. Types of cores are shown and reasons why high-permeability Hipersil core material saves weight and reduces size are given. Illustrations show how instrument transformer impulse levels are coordinated and built up to provide a high degree of protection against surges.

A 2-page table with illustrations shows typical shapes, construction, and applications of the *Westinghouse* line of instrument transformers. In requesting this catalogue please specify booklet B-4319.

WELDING CHART

A two-color wall chart which contains valuable welding information is being offered by *Eutectic Welding Alloys Corporation* of 40 Worth Street, New York 13, New York.

This illustrated chart, measuring nearly 2 feet by 3 feet, lists over one hundred "EutecRods" and "EutecTrodes" with their standard sizes, giving for each rod such technical data as type of joint for which suitable, metal on which used, bonding temperature, tensile strength, Brinnell hardness, degree of color match, electrical conductivity, resistance to corrosion, flame adjustment, etc.

Requests for copies of the chart must be made on your company letterhead.

AUDAK FOLDER

A 4-page folder, covering the company's new polyphase reproducer system, is currently available from *Audak Company,* 500 Fifth Avenue, New York 18, New York.

The pamphlet carries a description of the unit and performance data. A listing of the various components in the system, along with their prices, is also included.

TV COMPONENTS

Philco Corporation has announced publication of the "Television Components Handbook," a companion volume to the company's "Radio Components Handbook."

The new handbook covers the application of component parts in television receivers together with general component and television data. The volume is cloth bound, contains 160 pages, measures 6 x 9 inches, and carries an index. The price is $2.50 and the book is available from *Philco* distributors or direct from the Accessory Division of *Philco Corporation,* Philadelphia, Pa.

RECORDING DATA

Magnecord, Inc., has announced a new monthly publication "Magnecord INK" which will be devoted to the latest news and developments in the field of magnetic tape recording.

Written by authorities in the field and staff experts, the magazine is available free of charge to persons interested in tape recording. To get your name on the mailing list, address your request to Dept. H, *Magnecord, Inc.,* 360 N. Michigan Avenue, Chicago 1, Illinois.

BEARING CATALOGUE

The newly released Technical Bulletin No. 50, covering the company's "Micro" Ball Bearings, is currently available from *New Hampshire Ball Bearings, Inc.,* Peterborough 1, N. H.

The 12-page catalogue describes a full line of standard and special ball bearings including Conrad radial, full race radial, extra light radial, angular contact, self-aligning and pivot, in ⅛" to ⅜" o.d. of alloy steel, stainless steel, and beryllium copper, with data on tolerances, loads, speeds, life, lubrication, mounting, fits, etc.

OXFORD SPEAKERS

A new catalogue which provides a complete listing of *Oxford* speakers has just been released by *Oxford Electric Corporation,* 3911 S. Michigan Avenue, Chicago, Illinois.

This 4-page, multi-colored catalogue tabulates all the pertinent data on the company's PM, electro-dynamic, television, p.a., auto, intercom, and weatherproof speakers. Six of the speakers are illustrated.

PRECISION RESISTORS

Cinema Engineering Company of 1510 West Verdugo Avenue, Burbank, California, has announced publication of its Catalogue No. 11Ax, covering precision resistors, resistive devices, and sound equipment.

The 36-page catalogue includes mixer attenuation curves, mixer circuits, data on loss calculations of mixer circuits, voltage ratio table, pad formulas, and dimensions at attenuator frames. Equipment listed includes amplifiers, attenuators, db. meters, decade boxes, equalizers, faders, gain

SCR-522 VHF XMTR-RCVR

10-tube, xtal controlled rcvr, 7-tube xmtr. Makes ideal 2-meter, 2-way mobile rig. 100-156 mc. w/ tubes. Price **$34.95**

MINE DETECTOR MI

Detects all types of metal, metallic rocks, or anything that has a metallic substance. Less Batteries.....**$49.00**

SCR610 Mobile FM TRANSCEIVER — Includes 10 meter band. Excellent condition with tubes.....**$15.95**

PE-120 Power Supply with tubes—Less Vibrator and Cond.....**$5.50**

Combination BC-620 and PE-120. Both for **$20.95**

GIBSON GIRL

The Emergency Radio Transmitter. Sends S O S signals automatically on 500KC. 150-mile range. No batteries required. Has hand-driven generator, Frequency coverage 2000 KC. to 5250 KC. by use of three plug-in coils. Five tube operation. 801 oscillator, 801 power amplifier two 46 modulators, and one 46 special amplifier. Price with Tuning Unit. 3—4.5MC or 3.5—5.2MC **$22.95**

BC 223 XMITR

30 Watt Transmitter with crystal oscillator control on four pre-selected channels—also master oscillator. Frequency coverage 2000 KC. to 5250 KC. by use of three plug-in coils. Five tube operation. 801 oscillator, 801 power amplifier two 46 modulators, and one 46 special amplifier. Price with Tuning Unit. 3—4.5MC or 3.5—5.2MC **$22.95**

ARR2 Homing Receiver w/Dyn. 334-358MC .....**$6.50 ea.**

Remote Control CABLES

2MC215	MC124
34"	65"
190"	52"
260"	29"
186"	13"
77"	103"
183"	63"

Many Others

METERS

0-5MA Sq. 2" Metal Case **98c**

0-500MA Sq. 3" Bake Case ..**$2.95**

TELEV. TRANS.

2300V 4MA.
2.5/2A ..**$5.79**
1080VCT 55MA, 6.3 / 1.2, 6.3 / 1.2 .....**$4.49**

UNDERRATED CHOKES

Dual
10HY 250MA **3.25**
20HY 300MA **6.49**
6HY 150MA **.99**
25HY 75MA **1.25**
8.5HY 125MA **1.29**
Many Others

TRANSFORMERS 115V/60CY

6861—2100VCT 175MA, 7.5VCT/4A, 2.5V/10A	$ 7.29
8825—360VCT 340MA, 6.3VCT/3.6, 6.3VCT/3A	3.95
721—550VCT/80MA, 6.3/.5, 2.5VCT/1.75	2.25
848—600VCT/160MA, 6.3VCT/5, 5VCT/3	3.95
367—580VCT/80MA, 5VCT/3	2.95
160—1120VCT/770, 590VCT/100	12.49
375—1120VCT/700, 2x5VCT/6-2, 6.3VCT/3, 6.3/3	14.79

Many Others. Write for Choke and Transformer Lists.

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**

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**

EE89A Telephone Repeater

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**

Ceramicons

Mmf.	
1	25
3	27
3.1	35
4	30
5	47
6	50
7	57
8.5	58
11	60
15	62
20	67
24	70
79	220
115	240
125	250
150	350
180	1000
200	
100 for	$6.50

Silver

Button	Feed Thru
40 100	50
180 200	500
115 500	470
185	
100 for	$8.50

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	2ST	.25
.1	2TT	.19
.5	1TT	.19
1	2ST	.23
2	2ST	.26
	600VDC	
.1	2ST	.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

MICA CONDSRS

1000VDC TEST	
.0015	$0.36
.0175	.45
.00005	.59
.00137	.98
1200VDC TEST	
.000075	.59
.00027	.59
2000VDC TEST	
.00003	.98
.01	1.64
2500VDC TEST	
.00025	.36
.006	1.38
.005	1.00
.000047	.39
.005	.79
.00051	.39
.0005	.54
3000VDC TEST	
.00007	1.59
.0004	1.25
.002	1.60
5000VDC TEST	
.0035	.98
.006	1.65
.0001	2.70
.0043	.98
.0002	2.70
.0008	2.70
.0004	2.70
.0075	2.70
.005	2.50

SEND YOUR REQ.

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

AUDIO XFRMRS

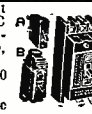
UTC 80707 ouncer Pl. to Mult. Gds. **$1.29**
5119—Ouncer Pl. to line.... .49
901—Pl. to V. coil..... .75
6282—Pl. to Hdst or line... .69
5640—Mike or Line to Grid. 1.29
T202—6V6 Pl to 811 Gds.. 1.45
765—Line to Grd..... .98
25—Pl. to Line..... .98
837—1:1-1:2 Ratio ..... .75
622—1:2.28 Ratio ..... .75

Many Others—Write

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**

Heineman Ckt Bkrs. For AC-DC Operation. Amperes .5, 3, 12, 50, 80, 100, 150, 180. Ea. $1.10



Klixon 25A, 50A ..... .98c

Electric Motor

115V 60Cy 3500 RPM 3¼x2x1⅝ ¾" L Shaft

$1.95 Each

SOUND POWERED PHONES

Complete. No batteries req. brand new. Leather case. Waterproof w/ ringing CK; operation more than 12 miles, 2 as Fig. Above **$37.50**

VFO CAPACITOR

High Grade Unit. Consists of 3 Gang Capacitor. 20 mmf per sect. Ceramic ins. Low drift w/Worm Gear (reduction) 120:1 w/ext. Shaft and Veeder 4 digit Counter **$3.95**

ROTARY BEAM COUPLER

RF Coupler 360° rotation 1 turn coupling link. Easily adpt 200 to 300 Mc. Plastic case mount on side. **Price**.....**$2.95**

UNIVERSAL OUTPUT TRANSFORMER

Amertran Silcor. PRI: 20,000/16,000 / 5000 / 4000 ohms. Sect. 500/15/7.5/5/3.75/1.25 ohms. 30 db. contin. Flat to 17-00 CY. w/Diag. & Inst. for 6 watt amplifier ...**$4.75**

VEEDER COUNTER

Counts to 9999 and repeats. Many uses. ¼" shaft front mtg. 1" x 1¼". **Price 98c.**

Soldering Iron 200W

121-130V iron ⅝" removable copper tip. Heats in a minute. Complete with cord & plug. New with stand **$3.95**

T.V. Transformer, for 9" scope, 3000v / 5 MA, 720 vct / 200 MA, 6.4 / 8.7A, 6.4 / .6A, 5/3A, 1.25 / .3A. New. Pr. **$3.95**

UHF ANTENNA

12" / 30cm. AT5 / ARR1 Convertible Citizens' Band Threaded Coax Term Insulated Silv Pl Cont w/waterproof gask flange & hardware for MOBILE mtg BRAND NEW 39c; 4/$1.00.

PL259 for Above **29c**

ANT AN130B Spring Swiveled Whip. 33" lg. SPECIAL **79c**

SUPER PRO EQUIPT.

1st and 2nd RF 10-20 MC Coil FT-SA111. — RF ANT OTPT 2.5-5 MC Coil SA-116.—ANT INPT 200-400 KC Coil SA-81.—ANT INPT 200-400 KC SA 48.—HI FREQ OSC 2.5-5MC Coil SA118.—ANT OTPT 10-20 MC Coil SA110. **Price Each... 65c**

M.O. COIL

1800-2250KC P/o Collins 32RA Plug in .....59c MANY OTHERS

VARIABLE CERAMIC COND.

MMF	Price
25-220	.20c
400-520	.20c
10-160	.20c
5-50	.20c
20-160	.20c
200-350	.20c
Set of 6	$1.00

SELSYN MOTORS

115 V.A.C. 60 cycle No. C-78248. Can be used to turn small antennas or as indicators. Size 3¼" x 5⅛". **Price per pair**.....**$6.49**

LAMPS

#1488—14V	10/60c
#623—24-28V	10/60c
#1251—24-28V	10/60c
LM37 13V Red 10W 60V	10/60c
Auto 6-8V	10c ea.

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
800	15	.98
1000	15	.85
500	50	.95
6000	12	1.35
9000	12	2.00

Write for Flyer of 100,000 New Electrolytics in Stock.

A62 — Phantom Ant. For pretuning rigs for single wire doublet or coax. Fed. Ant. consists of 2 coils, 2 resis, var cond, ind. 1 lamp, enclosed in can. Pr. **$1.49** ea.

MOSSMAN Switch. 4PST N.O. and N.C. ... **$1.10**

Birtcher Tube Clamps

926C	926C-24
926—16	926—C15
926—B1	926—C13
926—B2	926B
926—B8	11c ea.
926B—16	100 for
926A—14	$10.50
926C—19	1000 for
926A	10c ea.
926—C1	
926—A11	

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

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
4-5 Mc w/4495 Ks XTAL	2.95

Many Others

TUNING UNIT FOR BC 223

TU 18A 3-4.5 MC. Price **$2.50**
TU 25 3.5-5.2 MC. Price **$2.50**

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 88/ARC5 Junction Box
FT 141 6⅜x4⅜
MT 80/ARC5 Junction Box
FT 282A P/o SCR 518A
FT 308A P/o PE119A
MT 167/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

VARIABLE TRIMMER CONDENSERS

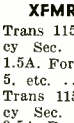
C714	3.2-42Mmf..	19c ea.
C713	2.8-27Mmf..	
C717	2.8-35Mmf..	
A289	3-25Mmf..	
1741	3.9-50Mmf..	

Write for Other Values

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

932 PHOTO TUBE



Gas Phototube having Si response, particularly sensitive to Red and Near Infrared Radiation. Can be used with incandescent light source. Send for Data. Price **75c**

1619—1619—1619 Octal Base Pentog Aversatile High Perveance Tube. **21c**

5 for....New $1.00

LINE FILTERS

LINE FILTER. GE 100 Amp Filter w/2x 5Mfd 50V oil cond. Operates on 110VAC DC.. **$1.98**

1KW LINE FILTER, clean up BCI & TVI. With 4-.002Mfd Cond. Easy to Mount..... **$3.95**

Noise Filt. Jx51E. 10 Amp **98c**

Noise Filt. Jx55D. 4 Amp **35c**

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 $8.95

BASIC 15 WATT AMPLIFIER 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 $7.49

BASIC 50 WATT AMPLIFIER KIT

Pwr. Supply contains Trans. 820VCT / 200 MA, Dual 10HY 200 MA Choke, 2 — 7MFD 600V, 5T4 Tube, Socket. Price..$9.49

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

Telephone Ringer

1250 ohms MC 131 AC/DC. Each....30c

Loading Coil

C114 same as WE No. 632. In waterproof case w/C/ASP to counterbalance capacity in line used w/ w110 wire....85c ea.

Meter Cabinet

For BC221 Freq. Meter. Brand New Wood. 14½H x 10½W x 10D. Value $20.00. Only $2.95

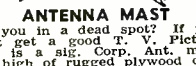
T-24-G Mike w/PL-106, JK38; like new, only **$1.95**

HS30 Headphones. New 85c

Transformer for above 35c

Combination— Both **$1.10**

ANTENNA MAST



Are you in a dead spot? If you can't get a good T. V. Picture here is a sig. Corp. Ant. mast 30' high of rugged plywood construction to solve your problem. It telescopes into 3 ten ft. sect. for easy stowage. Easy to Mnt. Comp. with stakes & rods. **Each** **$19.95**

MS49 and MS50 Dipole Antenna, 74" long. Both for.....49c

TOM THUMB CONDENSERS

Mfd	Price
200V	
1	$0.15
400V	
.5	.18
2	.20
4	.30
600V	
.1	.12
.25	.20
.5	.20
1	.25
2	.28
4	.45
1000V	
.1	.20
.25	.28
.5	.30
1	.39
2	.50

XMTR COILS AIR WOUND

80 MTR Bar Prong 100 w **$1.19**
40 MTR. 5 Prong 50w plug in socket.....$1.19
160 MTR 5 Prong 50w plug in socket.....$1.19
40 MTR 3 Prong Bar 100w **$1.19**
#C538 2-3.5 MC. 300w Fix. Link **$1.19**
#1735 2-3.5 MC. 300w Var. Link **$1.49**
#C390 5-7 MC. 300w Fix. Link **$1.19**
160 MTR Bar Type 100w **$1.19**

SENSATIONAL KIT BUYS

Silver & Mica Cndsrs...	30/$1.50
Controls, 500ohm-2Megs.	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&B.....	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
ToggleSlideSwitches.	10/ .95
Ferrule Resistors	10/ .95
Trimmer Cond	100/ 2.95
Asst. Popular Bath Tubs.	10/ .95

MICROWAVE

WRITE FOR FLYERS OF DEMORNAY BUDD PLUMBING. WE PURCHASED 80% OF THE N. Y. INVENTORY TO BE SOLD AT SURPLUS PRICES.

sets, pads, resistors, speaker controls, transmission measuring sets, and volume indicator panels and boxes.

Various accessories for different types of sound equipment are also listed and described. Complete specifications are tabulated on the company's line of resistors, attenuators, and potentiometers.

ELECTRIC PLANTS

An 8-page, 2-color booklet covering the complete line of gasoline-driven electric plants manufactured by the company has been issued by *D. W. Onan & Sons, Inc.*, of Minneapolis 5, Minnesota.

Included are units ranging from 260 watts to 35,000 watts in all standard voltages, frequencies, and phases. Direct current models in standard voltages are described in ranges from 750 to 15,000 watts. Battery-charging electric plants in 6, 12, and 32 volts, 400 to 2000 watts are also listed.

When requesting copies of this catalogue, please specify *Onan* Line Folder A-168.

SELENIUM RECTIFIERS

Seletron Division of *Radio Receptor Co., Inc.*, 251 West 19th Street, New York 11, New York, is currently offering a 4-page pamphlet on the design, application, and servicing of selenium rectifiers.

Besides including a complete description and tabulation of test and repair procedures, the pamphlet supplies information on troubleshooting methods for half-wave circuits. Rectifier repair and replacement techniques are also described fully.

TV REPLACEMENTS

Merit Transformer Corp., 4425 N. Clark Street, Chicago 40, Illinois, has issued a 1950 TV "Repl" Guide which lists approximately 400 popular television receivers, made by 60 manufacturers, and then lists the appropriate replacement parts for each receiver.

Designed to cut bench time, this complete and up-to-date listing is to be revised periodically. At the same time the company has introduced ten new flyback focus coils and deflection yokes and twelve new TV transformers to round out its line of television replacement components.

"LABORATORY STANDARDS"

A comprehensive catalogue which lists its line of standard signal generators, television signal generators, pulse generators, square-wave generators, megacycle meter, v.t.v.m. and other laboratory-type equipment has just been issued by *Measurements Corporation* of Boonton, New Jersey.

This 44-page Catalogue C provides a general description of each unit, special features of the instrument, and application data. A block diagram of the unit and a concise listing of specifications is also included.

The company also announces publication of the first issue of "Measurement Notes," a 4-page illustrated brochure describing the use of the Model 59 megacycle meter in the design and construction of traps and filters for the elimination of television interference.

DATA SHEETS

Rotron Manufacturing Co., Inc., of 7-9 Schoonmaker Lane, Woodstock, New York, has recently made available a series of new catalogue sheets describing its Models "B" and "C" exhaust fans.

These fans have been designed for continuous duty operation in high ambient temperatures. Because of their small size, these new units are particularly well adapted for use inside enclosures such as radio transmitters and instrument cabinets where quiet, trouble-free operation is required.

The catalogue sheets cover mechanical specifications and performance curves for the two models. A data sheet on the use of dust filters is also included.

GENERATOR BULLETIN

General Electric Company, Schenectady 5, New York, is currently offering a new 8-page, 2-color bulletin covering its line of Tri-Clad high-speed synchronous generators.

The bulletin, GEA5415, deals with generators for standby, portable, and prime source power in various fields of applications. Construction features,

SELENIUM RECTIFIERS — and — ELECTRONIC COMPONENTS

THREE PHASE FULL WAVE BRIDGE RECTIFIERS

Input 0-234VAC Type No.	Current	Output 0-250 VDC Price
3B13-1	1 AMP.	$ 22.00
3B13-2	2 AMP.	32.00
3B13-4	4 AMP.	56.00
3B13-6	6 AMP.	81.50
3B13-10	10 AMP.	105.00
3B13-15	15 AMP.	120.00

CENTER TAPPED RECTIFIERS SINGLE PHASE FULL WAVE

Input 10-0-10VAC Type No.	Current	Output 0-8 VDC Price
C1-10	10 AMP.	$ 6.95
C1-20	20 AMP.	10.95
C1-30	30 AMP.	14.95
C1-40	40 AMP.	17.95
C1-50	50 AMP.	20.95

RECTIFIER MOUNTING BRACKETS

For Types B1 through B6, and Type C1 ..... $ .35 per set
For Types B13 ..... .70 per set
For Types 3B ..... 1.05 per set

SINGLE PHASE FULL WAVE BRIDGE RECTIFIERS

Input 0-18VAC Type No.	Current	Output 0-12 VDC Price
B1-250	250 MA.	$0.98
B1-1	1 AMP.	2.49
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
B6-250	250 MA.	$2.95
B6-600	600 MA.	5.95
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

CUSTOM DC POWER SUPPLIES
Built to your specifications
We will be pleased to quote on your requirements. Kindly send for our specification form.

RECTIFIER CAPACITORS

CF-14	3000 MFD	12VDC	$1.69
CF-15	6000 MFD	12VDC	2.95
CF-1	1000 MFD	15VDC	.98
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-5	1500 MFD	30VDC	2.49
CF-6	4000 MFD	30VDC	3.25
CF-7	3000 MFD	35VDC	3.25
CF-8	100 MFD	50VDC	.98
CF-19	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-10	500 MFD	200VDC	3.25
CF-12	125 MFD	350VDC	2.49

Mounting clamps for above capacitors . . 15c ea.

RECTIFIER TRANSFORMERS

All Primaries 115VAC 50/60 Cycles

Type No.	Volts	Amps.	Shpg. Wt.	Price
XF15-12	15	12	7 lbs.	$ 3.95
TXF36-2	36	2	6 lbs.	3.95
TXF36-5	36	5	8 lbs.	4.95
TXF36-10	36	10	12 lbs.	7.95
TXF36-15	36	15	20 lbs.	11.95
TXF36-20	36	20	30 lbs.	17.95
XFC18-14	18VCT	14	10 lbs.	5.95

All TXF Types are Tapped to Deliver 32, 34, 36 Volts. XFC Type is Tapped to Deliver 16, 17, 18 Volts Center Tapped.

RECTIFIER CHOKES

Type No.	Hy.	Amps.	Dc Res.	Price
HY5	.02	5	.25	$3.25
HY5A	.028	5	.20	3.95
HY10	.02	10	.30	9.95
HY10A	.014	10	.04	7.95
HY15	.015	15	.30	13.95
HY20A	.007	20	.02	12.95

Type "A" low resistance chokes are specially suited to circuits requiring excellent voltage regulation.

ADDITIONAL SELENIUM RECTIFIER TYPES AND GENERAL INFORMATION MAY BE FOUND IN OUR CATALOG No. 719

VACUUM CAPACITORS

Standard Brands

12 Mmfd. 20 Kv **$4.95**
50 Mmfd. 32 Kv **5.95**
Overall length 6½", diameter 2¾". terminal diameter ¾", shpg. wt. 2 lbs

EDISON THERMO TIME DELAY RELAY

Heater voltage 115 V. Norm. open SPST contacts. 15-30 sec. delay. Contact rating 115 V 3A., 440 V. 2A. Size 3¾"x1⅛" diam. Standard 4-prong tube base ..... Ea. **98c**

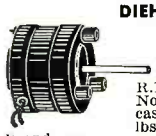
WHILE THEY LAST METER SPECIALS

0-300 VDC, Basic 0-1 ma. 2" rd. Bakelite case.
Shpg. wt. 2 lbs.
Bargain price **$2.25**

KLIXON 40 SECOND DELAY SWITCH

Heater operates on 115 VAC or DC. Contacts SPST rated at 30 A., 115 V. or 20 A., 220 V. Auxiliary contacts for lighter loads. Each **$2.49**

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

SILVER CERAMIC TRIMMERS

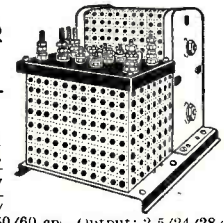
820-Z 5-20 Mmfd. Zero Temp. 24c
822-N 5-20 Mmfd. Neg. 300 ..... 24c
822-AZ 4.5-25 Mmfd. Zero Temp. 24c
823-AN 20-125 Mmfd. Neg. 650 ..... 33c

ATTENTION!!!

Bulletin No. 713, listing various government and commercial surplus items, is now available upon request.

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**

FILTER KITS FOR No. 612-10

1 section choke input 10% ripple **$9.64**
2 section choke input, 2% ripple **19.28**

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.

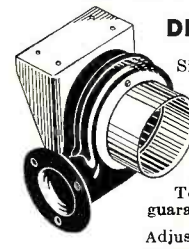
All prices subject to change without notice. Prices and delivery F.O.B. our NYC Warehouse.

All merchandise subject to prior sale.

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 2¾", overall size 7½" long, 6" diam. Moisture and fungus resistant. With capacitor. Shpg. wt. 15 lbs. Quantity limited **$13.95**

DIEHL BLOWER



Sirocco type, displaces 100 C.F.M. 115 VAC, 60 cps. Moisture and fungus resistant. Flange diameter 4". Overall size 7½"x6½". Removed from equipment. Shpg. wt. 10 lbs. Tested and guaranteed. **$9.95**

Adjustable right angle aluminum extension tube to fit flange **98c**

WESTINGHOUSE AIRCRAFT MOTOR

Brand new—24 VDC or AC. 2 AMPS., reversible on both. 1/50 H.P. 4800 RPM continuous duty Length of leads 18". Dimensions 3½"x2¼", shaft ¼" diam. by ⅝" long. Price **$2.95**
Reversing switch with "off" position. Each 79c

OPAD-GREEN COMPANY
71-3 Warren St.
New York 7, N. Y.
Phone: BEekman 3 7385-6

mechanical modifications, and performance data are provided on the line which includes units rated from 12½ to 1250 kva. and speeds from 1800 r.p.m. to 514 r.p.m.

SURPLUS MANUAL

The Office of Technical Services of the U.S. Department of Commerce has just issued a second simplified manual to guide users of the more common types of electronic equipment purchased from government surplus stocks.

The new volume, entitled "A.M. Receivers and Transmitters," provides purchasers with the basic circuit diagrams, parts, values, and voltages of the equipment listed.

These assemblies include AN/TRC-2, BC-453 receiver, BC-454 receiver, BC-455 receiver, BC-456 modulator, BC-457 transmitter, BC-458 transmitter, BC-459 transmitter, BC-696-A transmitter, BC-946-B receiver, DM-40-A dynamotor, DM-41-A dynamotor, DM-42-A dynamotor, DM-43-A dynamotor, GN-44-A generator, SCR-284-A receiver and transmitter, SCR-288 receiver and transmitter, SCR-506 receiver and transmitter, and SCR-694 receiver and transmitter.

Copies of Volume 2, publication PB 99539, are available from the Office of Technical Services, U.S. Department of Commerce, Washington 25, D.C. Orders must be accompanied by a check or money order for $1.00 payable to the Treasurer of the United States.

Copies of the first volume are also available from the same source at the same price. Ask for publication PB 98487.

AUDIO EQUIPMENT

A pocket manual, entitled "1950 Audio Equipment," has just been published by *Sun Radio & Electronics Co., Inc.*, of 122-124 Duane Street, New York 7, New York.

Written by Irving Greene, manager of the company's audio engineering department, the booklet covers radio AM and FM tuners, phonograph pickups, records, amplifiers, and speakers in addition to data on the installation.

The manual also includes a condensed listing of a variety of such equipment for ready reference. Copies are free of charge on request. —30—

TV OUTPUT UP

ACCORDING to the most recent report received from Radio Manufacturers Association, television set production by member-companies continues at a record level.

Contrary to expectations, January production of telcvision receivers reached 335,588 for the four-week period. The January output topped all 1949 months except November which had five weeks.

Radio output remained substantially the same with 660,195 sets being produced. FM and FM-AM receivers totaled 89,136 with an additional 34,087 TV sets equipped with FM. —30—

Mini-Rack Modulator

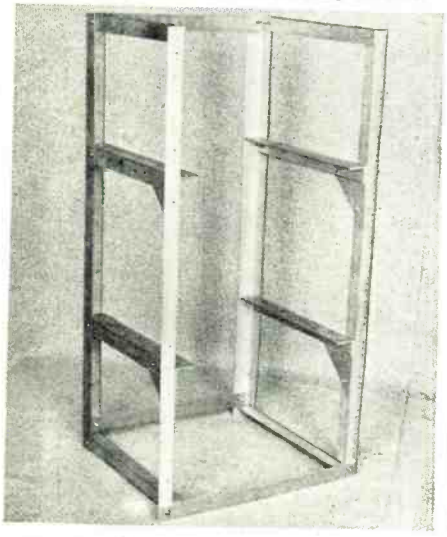
(*Continued from page 44*)

charges of the filter condensers would impose an extra strain on the components.

An antenna tuning network is included to complete the transmitter. The circuit utilizes an all-band turret and a pair of variable condensers in a versatile arrangement which allows setting up the following tuning methods: (1) series tuning with either one or two condensers, (2) parallel tuning with one or two condensers, (3) combination series-parallel tuning in an unbalanced circuit, (4) pi-network for tuning random lengths of antenna. These combinations take care of virtually all antenna circuit possibilities in conjunction with the swinging link output of the transmitter for low-impedance loads. The *Bud* turret has a six position bandswitch although only 5 positions are used for coil connections. The sixth switch point is, therefore, available to connect the antenna relay directly to a pair of terminals for low-impedance loads such as folded dipoles, etc., which require no antenna tuning network. The other tuning arrangements are set up by means of jumpers across the appropriate standoff insulators along the rear of the antenna tuner chassis. The antenna relay switches the low-impedance link of the antenna tuner to the receiver during the stand-by period. This method of antenna switching puts the relay in the low voltage part of the circuit where relay insulation is a relatively unimportant factor and allows the use of the tuning network to match the antenna to the low-impedance input found in most communications receivers.

The power supply, modulator, and antenna tuner are constructed in miniature relay rack style to match the

Fig. 9. The rack framework is assembled from 5/8" aluminum (24ST) angle stock. Small triangles in the corners prevent hinging of the various parts and make the whole assembly rigid. All pieces are fastened by means of self-tapping screws.



transmitter. The panel space is 10x19 inches and the rack is 8 inches deep. The modulator is built on a readily available surplus drawn aluminum chassis with a bottom cover for complete shielding while the power supply and antenna tuner are each constructed on one of the ¾ inch deep covers. Aluminum angle stock fastened together with sheet metal screws completes the assembly. The use of the bottom shielded modulator chassis is no doubt an aid in obtaining freedom from r.f. and audio feedback and the stability is such that the modulator may be run at full gain without hum or feedback.

The aluminum panels were first cleaned with naphtha and then sprayed with gray wrinkle finish enamel with a paint spray attachment and a household vacuum cleaner. An electric heat lamp was then waved slowly over the panels until the wrinkling began and covered the entire surface. Needless to say, the panels should be laid on a flat surface during the painting to avoid runs in the paint. Once the paint has wrinkled, the panels may be allowed to dry in the air. At least 24 hours should be allowed for complete drying.

To adapt the original Mini-Rack transmitter to phone/c.w. operation the following minor modifications were made: (1) The 117 volt input to the bias supply was rewired in parallel with the final r.f. amplifier power supply so that bias for the r.f. tubes appears immediately when the line switch is closed; (2) Screen and plate bypass condensers on the modulated push-pull 807 stage were reduced to .002 each; (3) All the original parasitic-suppressing resistors in the grid, plate, and cathode leads were removed and the parasitic-suppression system of Don Mix, W1TS, was installed. This consists of an r.f. choke of 8 turns of number 14 wire, wound on a 5/16 inch form in each plate lead and a choke of 15 turns of number 22 wire close-wound on a ¼ inch form in each grid lead. The screens are bypassed directly to ground without any resistors or chokes. This method has resulted in a perfectly stable modulated amplifier on all bands.

This economically constructed modulator has brought many favorable comments on its excellent quality. The no-signal resting plate current of the zero-biased 807's is 6 ma. so that even though the plate current on speech peaks is in excess of the rating of the power transformer, the average current is well below the rated 200 ma. This circuit seems to be ideal to fill the gap between 6L6's and 811's in audio work. —30—

USE YOUR MULTIMETER AS A CONDENSER LEAKAGE TESTER

By

EDWIN W. HILL, Chief Eng., WDHL

A VOLT-ohm-milliammeter, when used with one of its high voltage ranges, makes a handy and very sensitive condenser leakage tester. The writer has used his meter for this purpose so often that he has come to depend on it and to prefer it to the exclusion of other condenser tests. It is particularly effective in locating leaky coupling condensers in audio amplifiers.

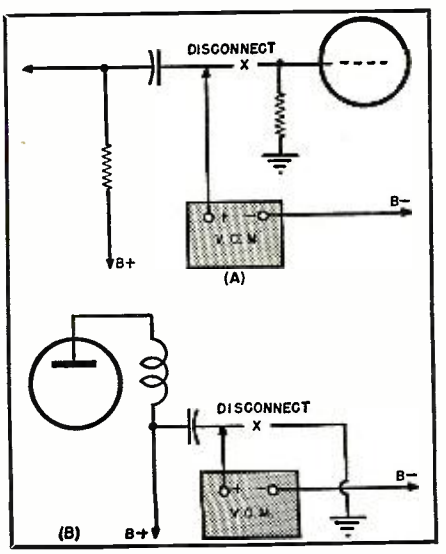
The low side of the condenser to be tested is disconnected, leaving the other end of the condenser undisturbed in the circuit. The low side of a condenser is that end which is grounded or which has no voltage on it. The positive test lead of the v.o.m. is then attached to the disconnected condenser lead, and the negative test lead to the negative of the power supply of the receiver or amplifier. Use the 500- or 1000-volt range of the multimeter.

The receiver or amplifier is then switched on. If the condenser being tested is a good one, the meter will first indicate some reading and then fall back to zero. If it does not go back to zero there is some leakage in the condenser, the amount being in proportion to the meter reading. If the leakage is intermittent, the meter reading will go back to zero and then suddenly and erratically jump as the condenser leaks. Sometimes this condition does not show up until some r.f. or audio is applied across it, so that it is a good idea to tune the receiver to some station, or to play a record through the amplifier, while the test is being made.

In effect, the multimeter is being used as a high-resistance milliammeter, and, consequently, it is quite sensitive to the smallest currents passing through it. This condenser testing method will not work, of course, unless there is some d.c. voltage across the condenser.

—30—

Setup (A) for testing coupling condensers and (B) for testing bypass condensers.



FOR OUR 4th ANNIVERSARY CELEBRATION

NIAGARA SLASHES TUBE PRICES 50% to 90%

ALL BRAND NEW—STANDARD BRANDS

Type	Price
1B22	$ 3.45
1B23	8.45
1B24	4.49
1B25A	4.95
1B26	4.45
1B27	4.95
1B29	.89
1B32	1.95
1B38	34.50
1B10	4.95
1B59	12.95
1B60	4.95
1N21	.89
1N23	.69
1P23	1.95
2AP1	3.59
2C4	1.18
2C21	.25
2C22	.28
2C26A	.18
2C34	.25
2C40	2.98
2C43	9.50
2C44	1.75
2C46	7.50
2C51	6.50
2D21	1.16
2E22	1.29
2E24	4.95
2E25A	4.25
2E26	3.95
2E30	2.39
2J21A	10.75
2J26	6.95
2J27	13.95
2J30	19.95
2J31	8.95
2J32	11.95
2J33	19.95
2J36	75.00
2J37	12.95
2J38	12.95
2J48	24.50
2J49	19.50
2JB51	4.95
2J54B	24.95
2JG1	24.50
2K23	24.95
2K25	24.95
2K28	24.95
3AP1	4.75
3B22	2.50
3B23	4.95
3B24	1.98
3B24W	2.95
3B26	1.50
3B28	5.95
3BP1	2.50
3C23	2.25
3C24	.35
3C30	.30
3C31	3.50
3CP1	1.40
3DP1-A	3.95
3EP1	2.50
3E29	4.95
3FP7	1.75
3GP1	4.95
3JP7	7.95
4-65A	14.50
4-125A	27.50
4-250A	37.50
4A1	.98
4AP10	4.50
4C35	19.45
4E27	12.50
4J26	110.00
5AP1	1.85
5AP4	1.85
5BP1	1.75
5BP4	2.50
5C22	49.50
5CP1	1.50
5CP1A	9.95
5D21	29.95
5FP7	1.25
5GP1	5.50
5HP4	9.95
5J23	100.00
5J29	12.50
5JP2	9.50
5LP1	11.95
5MP1	4.95
5NP1	1.98
6AF6G	.88
6C21	24.95
6F4	5.95
6J4	4.95
7BP1	4.95
7BP7	4.50
7C23	75.00
7C24	80.00
7C25	90.00
7DP4	17.95
9C23	250.00
9GP7	15.00
9JP1	6.50
9LP7	15.00
9NP1	7.95
10Y	.39
10SPEC	.69
10BP4	22.45
10CP4	29.50
12DP7	12.50
12DP8	14.95
12FP7	14.95
12GP7	12.95
12HP7	12.95
12KP4	49.50
12LP4	49.50
15E	1.25
15R	.50
23D4	.49
24G	.35
35T	4.95
45SPEC	.25
53A	24.95
75TL	3.50
100TH	11.00
100TS	2.00
101F	4.95
114A	.69
114B	1.25
120	5.95
121A	2.65
203A	16.95
205B	4.50
205F	4.50
211	.40
215A	.50
218	12.50
221A	1.75
231D	1.20
249C	1.75
250R	7.50
250TH	19.50
252A	4.95
259A	4.95
262A/B	3.50
274B	1.00
275A	7.95
282A/B	9.95
283A	10.95
286A	10.95
290A	4.95
291A	4.95
294A	4.50
300A	3.95
301A	6.95
304B	5.95
304TH	3.50
304TL	1.30
307A	4.95
310A	7.95
315A	6.95
316A	.50
327A	2.50
338A	3.75
348A	5.95
350A/B	2.75
354C/D	19.95
357B	49.50
368AS	4.93
371A/B	.50
374A	2.50
393A	3.50
394A	3.50
399A	2.50
400A	3.25
401A	1.95
403A/B	1.75
417A	9.50
434A	2.75
446A	1.00
446B	1.95
450TH	24.95
450TL	35.00
464A	9.50
527	6.50
531	4.95
532A	4.95
631P1	4.95
700B/D	19.00
701A	2.50
703A	3.50
705A	1.00
706AY	18.50
706CY	18.50
706GY	49.50
707A/B	14.00
708A	3.75
710A	2.95
713A	1.00
714AY	4.75
715A/B	6.75
715C	22.50
717A	.58
720DY	34.95
721A/B	2.60
723AB	7.95
724A/B	2.75
725A	6.75
726A/B/C	13.50
728GY	24.95
730A	9.75
750TL	49.50
800	1.75
801A	.28
802	4.25
803	3.45
804	8.50
805	3.50
807	1.10
808	1.35
809	2.50
810	7.75
811	2.00
812	2.50
812H	6.90
813	6.75
814	2.40
815	1.25
816	1.19
826	.35
829A/B	7.25
830	2.95
830B	3.25
832/A	4.95
833A	34.25
834	5.50
836	.90
837	1.50
838	2.25
841	.30
843	.25
845/W	4.00
849A/H	69.50
851	25.00
860	5.75
861	35.00
864	.35
865	1.95
866A	.99
866JR	1.19
872A	1.30
874	.35
876	.28
878	1.75
884	1.49
885	.98
889R	140.00
891	110.00
892	115.00
902P1	3.50
905	2.75
907	11.95
913	4.95
917	1.50
918	1.50
922	1.00
923	.75
925	1.40
930	.80
931A	2.60
934GT	1.50
949A	69.50
950	.98
954	.30
955	.35
956	.35
957	.19
958A	.18
959	.35
966A	.99
972A	2.95
975A	14.95
991	.23
1613	.45
1614	1.35
1616	.50
1619	.15
1620	4.95
1621	.98
1622	1.75
1624	1.05
1625	.35
1626	.25
1628	4.95
1629	.19
1631	1.35
1633	.75
1634	.79
1636	3.50
1638	.75
1641	.45
1642	.25
1644	1.49
1645	1.98
1649	1.25
1665	1.05
1851	.95
1852	1.06
1853	1.06
1960	.85
2050	.95
2051	.40
5514	4.95
5516	5.95
5562	10.00
7193	.18
8005	4.60
8011	2.00
8012A	1.25
8013A	1.25
8014A	24.95
8016	1.10
8020	1.25
8025A	7.95
8026	12.95
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BH	4.95
CIA	4.95
CIB	4.95
C5B	12.95
C6A	7.50
C6J	3.75
CEQ72	1.95
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CK1006	.69
CK1090	2.75
EF50	.35
EL1C	4.95
EL3C	4.95
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F128A	70.00
F660	110.00
FG17	2.75
FG27A	8.95
FG32	5.95
FG33	8.95
FG81A	3.75
FG95	9.95
FG105	9.50
FG172A	13.75
FG235	59.50
FG238B	160.00
GL146	9.75
GL473	65.00
GL502A	1.98
GL530	49.50
GL559	5.35
GL673	11.50
GL697	65.00
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HF200	17.95
HF210	17.95
HF300	17.50
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HV18	12.95
HY615	.20
HYE1148	.35
KU23	15.00
KU610	9.50
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MX408U	.49
PJ23	1.35
R100	3.75
R200	7.95
R1130	12.95
REL36	.55
RK20A	7.50
RK22	4.95
RK23	4.75
RK31	2.50
RK33	.25
RK34	.25
RK39	1.75
RK51	3.95
RK52	4.50
RK59	1.75
RK60	.79
RK62	1.98
RK63	12.95
RK65	24.95
RK72	.65
RK73	.65
RX21	3.10
RX120	8.75
T20	1.50
T21	1.75
T55	3.95
T200	10.95
TZ20	1.50
TZ40	2.95
UH50	5.95
UX200	.75
V70D	6.95
VR75	.98
VR78	.25
VR90	.65
VR91	1.49
VR105	.75
VR150	.50
VT127A	2.00
VU111	.50
WL460	14.95
WL468	6.75
WL532A	1.75
WL562	150.00
WL616	85.00
Z225	1.95
ZB120	6.95
ZB3200	150.00
ZP477/12DP8	14.95
0A2	1.56
0A3/VR75	.98
0A4G	.94
0B2	1.74
0B3/VR90	.61
0C3/VR105	.78
0D3/VR150	.54
0Y4	.88
0Z4	.56
0Z4G	.56
01A	.24
1A3	.43
1A4	1.08
1A4P	.96
1A5GT	.48
1A6	.78
1A7GT	.66
1B3GT	1.49
1B4	1.18
1B5/25S	.88
1B7GT	1.06
1C5GT	.66
1C6	.88
1C7G	.88
1D5GP	.96
1D7G	.88
1D8GT	.94
1E5GT	1.38
1E7G	1.56
1F4	.74
1F5G	.74
1F6	1.56
1F7G	1.56
1G4GT	.68
1G6GT	.68
1H4G	.68
1H5GT	.53
1H6G	.86
1H6GT	.86
1J6GT	.88
1L4	.54
1LA4	.78
1LA6	.88
1LB4	.88
1LC5	.78
1LC6	.56
1LD5	.78
1LE3	.88
1LG5	.88
1LH4	.64
1LN5	.66
1N5GT	.58
1P5GT	.66
1Q5GT	.66
1R4	.68
1R5	.68
1S4	.78
1S5	.56
1T4	.56
1T5GT	.78
1U4	.58
1U5	.72
1V	.68
2A3	.96
2A4G	1.06
2A5	.68
2A6	.78
2A7	.88
2B7	.88
2V3G	.98
2X2A	.68
3A4	.36
3A5	.98
3A8GT	1.98
3B7	.34
3D6	.34
3LF4	1.28
3Q4	.58
3Q5GT	.66
3S4	.66
3V4	.80
5A74	.50
5R4GY	1.09
5T4	.88
5U4G	.56
5V4G	.88
5W4	.78
5W4GT	.66
5X4G	.58
5Y3GT	.36
5Y4G	.48
5Z3	.48
5Z4	.78
6A3	1.28
6A6	.88
6A7	.68
6A8	.78
6A8GT	.80
6AB5/6N5	.88
6AB7/1853	.78
6AC5GT	1.16
6AC7/1852	.76
6AD6	.88
6AD7G	1.28
6AF6G	.78
6AG5	.76
6AG7	.97
6AH6	1.28
6AJ5	.78
6AK5	.84
6AK6	.78
6AL5	.64
6AL7GT	1.06
6AQ5	.58
6AQ6	.58
6AQ7GT	.88
6AR5	.66
6AS7G	4.95
6AT6	.46
6AU6	.58
6AV6	.46
6B4G	.88
6B5	1.56
6B6G	.78
6B7	.88
6B8	.88
6B8G	1.28
6BA6	.54
6BE6	.56
6BG6G	1.46
6BH6	.56
6BJ6	.58
6C4	.24
6C5	.46
6C5GT	.46
6C6	.56
6C7	1.28
6C8G	.68
6D6	.46
6D8G	.87
6E5	.68
6E6	1.06
6F5	.46
6F5GT	.46
6F6	.64
6F6GT	.66
6F7	.84
6F8G	.86
6G8G	.68
6H6	.46
6H6GT	.46
6J5	.48
6J5GT	.48
6J6	.76
6J7	.66
6J7GT	.66
6J8G	1.28
6K5GT	.96
6K6GT	.41
6K7	.48
6K7GT	.48
6K8	.78
6K8GT	.78
6L5G	1.06
6L6	1.16
6L6G	.86
6L6GA	.86
6L7	.78
6L7G	1.16
6N6G	1.56
6N7	.78
6N7GT	.78
6P5GT	.96
6Q6G	1.06
6Q7	.58
6Q7GT	.58
6R7	.78
6R7GT	.78
6S7	.88
6S7G	.88
6S8GT	1.06
6SA7	.43
6SA7GT	.43
6SB7Y	.88
6SC7	.58
6SD7GT	.68
6SF5	.48
6SF5GT	.54
6SF7	.58
6SG7	.58
6SH7	.48
6SJ7	.56
6SJ7GT	.56
6SK7	.54
6SK7GT	.54
6SL7GT	.64
6SN7GT	.64
6SQ7	.43
6SQ7GT	.43
6SR7	.56
6SR7GT	.56
6SS7	.58
6ST7	.88
6SV7	.88
6T7G	.97
6U5/G5	.64
6U6GT	.72
6U7G	.54
6V6	.96
6V6GT	.62
6W7G	.88
6X4	.58
6X5GT	.48
6Y6G	.66
6Y7G	.88
6Z7G	1.14
6ZY5G	.68
7A4/XXL	.58
7A5	.72
7A6	.66
7A7	.56
7A8	.72
7AD7	1.06
7AF7	.72
7AG7	.71
7AH7	.88
7B4	.56
7B5	.72
7B6	.58
7B7	.58
7B8	.72
7C4/1203A	.36
7C5	.56
7C6	.72
7C7	.58
7E5/1201	.66
7E6	.58
7E7	.68
7F7	.68
7F8	1.06
7G7/1232	1.06
7H7	.63
7J7	1.06
7K7	1.06
7L7	.68
7N7	.66
7Q7	.58
7R7	.68
7S7	1.06
7V7	1.06
7W7	.88
7X7/XXFM	.88
7Y4	.56
7Z4	.56
10	.69
12A	.56
12A6	.18
12A6GT	.18
12A7	.97
12A8GT	.58
12AH7GT	.81
12AL5	.80
12AT6	.41
12AT7	1.16
12AU6	.66
12AU7	.78
12BA6	.56
12BE6	.48
12C8	.48
12F5GT	.57
12H6	.26
12J5GT	.26
12J7G	.80
12J7GT	.80
12K7GT	.53
12K8	.58
12K8GT	.66
12Q7GT	.48
12SA7	.56
12SA7GT	.56
12SC7	.56
12SF5	.56
12SF5GT	.56
12SF7	.56
12SF7GT	.56
12SG7	.56
12SH7	.34
12SJ7	.48
12SJ7GT	.48
12SK7	.56
12SK7GT	.56
12SL7GT	.58
12SN7GT	.51
12SQ7	.48
12SQ7GT	.48
12SR7	.48
12SR7GT	.48
12Z3	.78
12X3	.98
14A7/12B7	.68
14AF7/XXD	.88
14B6	.68
14B8	.88
14C5	.88
14C7	.88
14E6	.72
14E7	.88
14F7	.68
14F8	.88
14H7	.64
14J7	1.06
14N7	.88
14Q7	.56
14R7	.66
14S7	1.06
14W7	1.06
14X7	1.06
14X4	.88
19	.97
19T8	1.56
22	1.28
24A	.66
25A6	1.06
25A6G	1.06
25AC5GT	1.16
25L6GT	.52
25Y5	1.16
25Z5	.48
25Z6GT	.48
26	.56
27	.46
28D7	.34
30	.56
31	.86
32	.96
32L7GT	.96
33	.68
34	.68
35/51	.56
35A5	.66
35B5	.64
35L6GT	.53
35W4	.38
35Y4	.48
35Z3	.56
35Z4GT	.43
35Z5GT	.38
36	.39
37	.34
38	.27
39/44	.26
41	.51
42	.48
43	.48
45	.51
45Z3	.56
45Z5GT	.48
46	.68
47	.68
49	.88
50	1.56
50A5	.68
50B5	.54
50L6GT	.51
50Y6GT	.56
53	.86
56	.43
57	.37
58	.48
59	.88
70L7GT	1.16
71A	.66
75	.52
76	.38
77	.42
78	.44
79	.88
80	.38
81	1.28
82	.86
83	.71
83V	.88
84/6Z4	.62
85	.68
89	.72
89Y	.38
117L7GT	1.28
117M7GT	1.56
117N7GT	1.36
117P7GT	1.26
117Z3	.56
117Z4GT	1.16
117Z6GT	.64
FM-1000	1.28
UX120	1.38
UX200	1.28
9001	.36
9002	.28
9003	.32
9004	.36
9005	1.90
9006	.23

Minimum Order $5.00. Quantity Prices on Request. All tube types in stock now—subject to prior sale—prices subject to change without notice. 20% Deposit with orders unless rated. All Prices F.O.B., NYC.

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Dept. N-40 — 160 Greenwich Street, New York 6, N. Y.

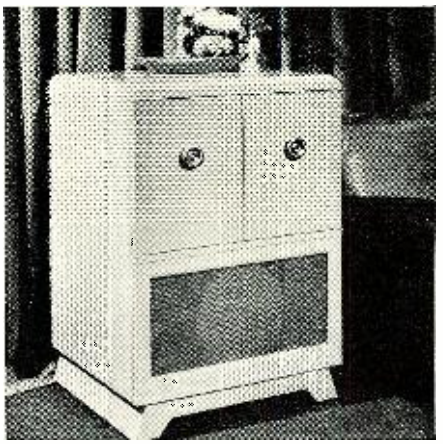
Phone Digby 9-1132-3-4

NEW TV PRODUCTS On The Market

HOFFMAN CONSOLE

Hoffman Radio Corp., 3851 S. Hill Street, Los Angeles 7, California, recently introduced its new 1950 Decorator line of television receivers.

One of the outstanding sets in the

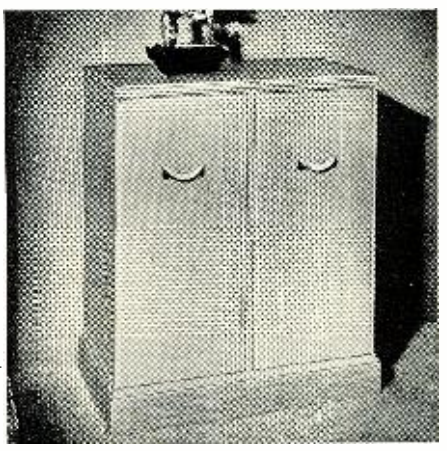


line is the Model 847 with a 16" rectangular black tube. Housed in a modern blonde cabinet, the new set features the company's "Easy Vision Angle" lens, "In-Dor" antenna for simplified operation, and an electronic black-and-white, lighted channelized station selector.

The receiver has 23 tubes plus 4 rectifiers and uses a 12-inch speaker. The cabinet is of hand-finished blonde oak which measures 36½" high, 25" wide, and 22½" deep.

"THE AVENUE"

The Magnavox Company of Fort Wayne, Indiana, has added "The Avenue" to its line of radio-phonograph



consoles. This new receiver includes the company's exclusive "Add-A-Television" feature that allows installation of a Magnascope "90" television

ORDER from ARROW!

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 Like New $5.95 Less Tubes $3.95

HERMETICALLY SEALED CHOKES

10 H. 100 M.A. ..... **59c** **3.7 H.** 145 M.A. **59c**
59 H. 100 M.A. ..... **95c** **10 H.** 20 M.A. **39c**
.5x.5x1x1 H—4 winding layer wound.
.5 H at 3.56 A 140 ohms
1 H at 1.56 A 320 ohms ..... New **$0.49**

TEN TUBE SUPERHET RECEIVER

with crystal controlled local oscillator. Has provisions for six crystal channels between 108 to 112 MCPS complete with tubes and crystals but less dynamotor ..... New **$7.95**
Like New **5.95**
Less Tubes and dynamotor but New **3.95**

Westinghouse Auxiliary Relay Type MC

Style 423396 C—110 V 60 cycle 4 pole.
Enclosed in glass case ..... New **$7.50**

Miscellaneous SPECIALS

	Used	New
ID 6/APN 4 Scope, Excellent.	$29.50	——
R 7/APS 2 Receiver-Indicator	——	$79.50
R 78/APS-15 Receiver-Indicator	34.50	——
BC 1287 A Scope	75.00	——
ASB 7 Indicator Scope	12.95	——
SCR 522 Transceiver 100 to 150 MC	34.95	75.00
BC 1206 Receiver, 200 to 400 KC	3.95	5.95
MN 26 C or **Y** Receiver	17.50	24.95
RA 10 DA Receiver	17.50	24.95
T26/APT2 Transmitter	8.95	——
RT7/APN1 Transceiver	5.95	9.95
APN 1 Complete	——	24.50
BD 71 6 Pos. Switchboard	9.95	12.95
EE 8 Field Phones	7.95	——
BC 347 Interphone Amplifier	——	2.95
I-70 Tuning Meter	——	.89
AM 61 Indicator Amplifier	——	9.50
SCR 625 Mine Detector	——	39.50
PE 237 Power Supply	——	12.95
BC 461 Veeder Root Counter	——	.59
BC 442 Less Condenser	1.49	1.95

	Used	New
BC 306 Antenna TU for BC 375	——	$1.50
A 27 Phantom Antenna	——	.98
APS 13 UHF Antenna, Pair	——	.98
Manual for **BC 312 & 342 J**	——	1.00
Manual for **SCR 269 G**	——	2.50
FL 8 Filter	$2.95	——
I-97 Bias Meter	4.95	3.95
RM 29 Remote Telephone Control	7.95	9.95
BC 602 Control Box	——	.98

One Tube Interphone Amplifier—Small compact aluminum case fully enclosed. 2¼"x3¾"x5¾". Less Tube **79c**
BC 717 Transmitter, New but less Tubes **$24.50**
96Q1 Complete Autotune assembly with motor and frame as used in **ARC-1** Transmitter ..... New **$35.00**
BC 709 Battery operated lightweight interphone amplifier. Complete with tube and shock mount, but less battery New **$3.95**
SCR 183 Complete ..... New **$49.50**
Motor—Universal Electric, 24 VDC, will also operate on 24 VAC Diameter 1⅝"; Length 2⅜", Shaft ¼"x¾" .. New **$1.49**

Information and Prices on Request

BC 639 Receiver with **RA 42** Rectifier
RTA 1B Transceiver
TA 2J24 Transmitter and **MP 10G** Power Pack
SCR 269 Compass Installation
R 5/ARN 7 Compass Installation
MN 26 Compass Installation
I. L. S. Installation (**R 89-BC733**)
SCR 584 Components
R-132/TPS 10 Radar Receiver
MD-22-URA/T1 Radar Modulator
AN APRI Receiver and Tuning Units
ASB7 Complete Radar Installation
TS-251 Test Set
BC 221 Freq. Meter

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Drastically Reduced from 10 to 50%—Nationally Advertised Brands

Type	Net Price	Type	Net Price	Type	Net Price
1A4P	$0.24	6SF5GT	$0.34	39/44	$0.24
1A6	.19	6S7G	.39	49	.39
1B5/25S	.24	6S8GT	.69	50	.39
1B22	1.49	6SG7	.69	56	.24
1B26	2.29	6SF7	.39	57	.24
1B29	.39	6SJ7	.69	76	.24
1B32-532A	2.29	6T7G	.39	77	.24
1C6	.19	6U7G	.29	211/Vt4L	.29
1C7G	.19	6Z7G	.39	316A	.34
1D5GP	.24	6ZY5G	.29	371B	.34
1D7G	.19	7C4/1203A	.24	700A	7.95
1F4	.24	7E5/1201	.39	703A	1.49
1F5G	.24	10YVT25A	.19	705A	.79
1H4G	.24	12A6	.34	714AY	5.95
1J6G	.24	12A6GT	.34	724B	4.95
1J6GT	.24	12A7	.34	801A	.39
1P5GT	.24	12A8GT	.19	813	5.95
1V	.24	12F5GT	.29	829	6.95
2A6	.39	12H6	.29	832	4.95
2A7	.24	12J5GT	.24	837	1.49
2C26A	.19	12J7GT	.24	841	.29
2V3G	.49	12K8GT	.24	864	.29
2X2/879	.25	12Q7GT	.24	872A	.98
3FP7	.98	12SF5	.24	954	.19
4AP10	.98	12SF5GT	.24	955	.34
5BP4	2.95	12SF7	.24	957	.34
5CP1	2.95	12SH7	.24	1625	.19
5D21	9.95	12SR7	.24	1626	.24
5FP7	.95	12SR7GT	.29	1629	.24
5J23	5.95	12SN7GT	.89	1630	.29
5T4	.49	12Z3	.29	1636	2.95
5W4	.49	16R	.19	1638	.69
5Z4	.49	19	.69	1642	.29
6AB7	.69	2J22	.24	2050	.89
6AJ5	.89	28D7	.34	2051	.49
6B8	.69	30SPEC (Vt67)	.69	7193	.19
6C4	.29	30	.24	9002	.34
6D8G	.69	304TL	1.29	9003	.39
6F5GT	.39	32L7GT	.39	9006	.29
6F6G	.69	33	.24	GL4A21	.29
6H6	.29	34	.24	Amperite 10T1	.29
6J7GT	.39	35/51	.24	Jan CRP72	.98
6K6G	.69	36	.24	WE331A	.89
6L5G	.39	37	.24	REL36	.69
6L7G	.39	38	.24	VR150	.39
6R7	.34			VR105	.69

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HS-23 Hi Imp	New	$2.95
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	Each
2 mfd. 4000 VDC. OIL FILLED	$2.95
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2 mfd. 5000 VDC. OIL FILLED	3.95
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1 mfd. 6000 VDC. OIL FILLED	1.98
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.4 mfd. 1500 VDC. OIL FILLED	.29
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2 mfd. 600 VDC. OIL FILLED	.39
	3 for 1.00
1 mfd. 600 VDC. OIL FILLED	.24
	5 for 1.00
.1x.1x.1—1200 VDC. OIL FILLED	.59
	2 for 1.00
50 mmfd—5KV—5 Amp. Vacuum Cond	1.19

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Easily converted to an ideal intercommunication set for office — home — or factory.
Original—New **$4.95**
Like New **3.95**
(With schematic)

All necessary parts and instructions to convert the above to AC operation with one remote station $8.25 additional.

BC-604 TRANSMITTER FM 20-28 MC

11 and 15 meters. Can be operated on 10 meters—10 channel push button crystal. With all tubes and meter but less dynamotor.
Excellent Condition **$12.95**
Crystals—Set of 80 ..... **14.95**
BC-603—Companion receiver to above with tubes but less dynamotor. Used **$17.50**

SURPRISE PACKAGE

20 lbs. Ass't radio parts. A $25.00 value for only **$1.95**

BEAM INDICATORS

I 82—5'	New	$4.95
Transmitter Selsyn for above		2.45
	both for	7.00
I 81—3'	New	3.45
Transmitter Selsyn for above		2.45
	both for	5.25
I 81	Used	2.45

T-85/APT5 UHF TRANSMITTER

operating over a frequency range of 300 to 1400 MCPC with a nominal output of from 10 to 30 watts. Unit is equipped with 110 V 60 CPS filament transformer; blower; lecher wire test frequency set, and 8 tubes—1-931A; 2-6AC7; 2-6AG7; 1-6L6G; 2-829B; 1-3C22 (GL522) (oscillator).
New in original box with Operating Instruction Manual **$69.50**

Send for free 8-page, illustrated **BULLETIN #103** listing many exceptional values

ARROW SALES, Inc.
Dept. N
1712-14 S. Michigan Ave., Chicago 16, Ill.
PHONE: HArrison 7-9374

DYNAMOTORS

DM-28—For BC-348 with Mount and Filter	New	$6.95
	Used	3.95
DY-12—For ART-13 less filter and base	New	6.95
DM-36	Used	.95
	New	1.95
BD-77	New	5.95
PE-206	New	6.95
	Used	2.75
PE-101	New	2.75
PE-73	New	3.95
DM-53	New	3.95
	Used .95	(3 for $2.00)
DM-32	New	1.95
	Used .95	(3 for $2.00)

BC 620

Receiver-Transmitter—2 crystal channels—20 to 27.8 MC FM—13 tubes. Metered, Plate and Filament ..... New **$14.95**
Used **9.95**
PE 97 Power Supply for above 6-12 volt vibrator type.
Used—complete **$6.95**
Used less tubes, vib. & cond **2.95**
FT 250 Mount for both BC 620 and PE 97 New **$1.50**

BC 223

Brand new Transmitter with all three tuning units, two tuning unit cases, spare tube carrying case, shock mount and brace; but less tubes at new low price of **$19.95**
Set of 5 tubes **$3.95**
Tuning units are available separately at .. Ea. **$2.50**
Cases at ..... Ea. **.95**
PE 125—12-volt Vibrator Pack ..... New **$12.95**
Used **8.95**
Spare parts kit for PE 125 containing 2 tubes; 2 vibrators and 13 fuses in metal container with handle and clasp (BX 41) ..... New **$2.95**

COMMAND (SCR 274 N) EQUIPMENT

	Used	New
BC-453	$12.95	——
BC-454	4.95	$6.95
BC-455	7.95	——
BC-456	1.95	2.95
BC-457	5.95	——
BC-458	5.95	——
BC-459 (or T22)	9.95	——
BC-696 (or T19)	14.95	24.95
BC-450—3 Receiver Remote Control	.89	1.95
BC-442	——	2.95
3 Receiver Rack	1.95	——
2 Transmitter Rack	1.50	——
BC 457 Transmitter—as is—fair condition—as they come, some with, some less tubes and Xtal	1.95	——
BC 458 Transmitter—as is—fair condition—as they come, some with, some less tubes and Xtal	1.95	——

Complete Command set as removed from aircraft—3 receivers—2 transmitters—Relay unit—control boxes—mounting racks—plugs—modulator and dynamotors—crated. Set **$34.50**

All shipments FOB Chicago. 20% Deposit required on all orders. Minimum order accepted—$5.00. Illinois residents, please add regular sales tax to your remittance.

receiver at whatever later date the owner may choose.

The equipment in the set includes an AM-FM receiver, a 12" dynamic speaker, and a three-speed record changer with a single tone arm.

The cabinet, of white oak finish, stands 36" high, 30" wide, and 18½" deep. Besides housing the radio and phonograph instruments, the cabinet provides ample storage space for 14 large record albums. Part of the album space is designed to accommodate the television receiver when this installation is desired.

TELEVISION CAPACITORS

A new series of paper tubular capacitors, designed for television applications, has just been introduced by *Sangamo Electric Co.* of Springfield, Illinois as its Type 13.

Available in nine different capacities, these 6000 volt units are mineral

oil impregnated to give longer life and more stable performance over a wide range of operating temperatures. The new series is designed to withstand continuous operation at 85 degrees C.

Special polyester end seals which will not crack or pull away from the varnished cardboard tube make the capacitors moisture-proof. These same polyester ends also provide excellent insulation for high voltage applications, according to the company.

A single page flyer, which carries comparison test and performance data as well as catalogue information on the Type 13 series, is available from the company on request.

NEW VIDEO TUBE

Production is now under way at the Allwood, New Jersey plant of *Allen B. Du Mont Laboratories, Inc.* on the new "Teletron," Type 12LP4A tube.

Designed to be used in initial equipment, this new tube uses the Du Mont bent-gun ion-trap design and features the new gray filter face plate. The elimination of ion blemishes by use of the bent-gun is said to result in sharper spot resolution. Modification in the bent-gun design in the Type 12LP4A permits the use of either a single or double magnet beam bender yet assures direct interchangeability with all Type 12LP4 tubes. -30-

CLEVELAND HAMS MEET

THE Cleveland Area Council of Amateur Radio Clubs in cooperation with the 145th Infantry, Ohio National Guard, is staging a gala hamfest on Saturday, April 8th at the Central Armory in Cleveland.

Varied types of entertainment have been provided. Full details are available from W8LYD, 12101 Brighton Ave., Cleveland 11. -30-

The electron tube that rivals the human eye

Invention of the iconoscope—TV's first all-electronic "eye"—led to supersensitive RCA image orthicon television cameras

No. 3 in a series outlining high points in television history

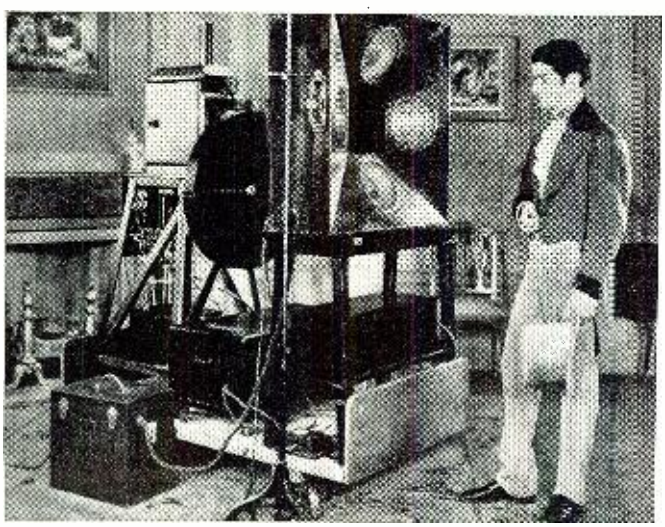
Photos from the historical collection of RCA

Dr. V. K. Zworykin *of RCA Laboratories with his iconoscope tube. Its successor, the image orthicon, has been developed by RCA scientists to have up to 1000 times greater sensitivity.*

● Had you attempted to invent a television camera from scratch, odds are you'd have followed the same path as early experimenters—and tried to develop it on mechanical principles.

Illogical? Yes, in the light of what we now know about electronics. But electronics was young in television's infancy. At that time the best way to take television pictures was with a mechanical scanning disk, invented in 1884.

Revolutionary was the invention of the *iconoscope* by Dr. V. K. Zworykin, now of RCA Laboratories. Here was an all-electronic "eye" for the television camera . . . no moving parts, no chance of mechanical failure!



Mechanical scanning equipment, *used at RCA-NBC experimental television station W2XBS in* 1928, *long before the present RCA image orthicon camera came into existence.*

Carrying forward the development of television pick-up tubes, RCA scientists have developed the image orthicon—eye of today's supersensitive RCA image orthicon television camera. So keen is this instrument's vision that it sees by candlelight or by the faint flicker of a match.

Despite its simplicity of operation, the RCA image orthicon tube is a highly complex electronic device. Integrated, within its slim 14-inch length, are the essentials of 3 tubes—a phototube, a cathode ray tube, and an electron multiplier!

The phototube converts a light image into an electron image which is transferred to a glass target, and scanned by an electron beam to create a radio signal. The electron multiplier then takes the signal, and greatly amplifies its strength so that it can travel over the circuits which lead to the broadcast transmitter.

Inside the tube itself, more than 200 parts are assembled with watchmaker precision. For example, a piece of polished nickel is pierced with a hole one-tenth the thickness of a human hair . . . a copper mesh with 250,000 holes to a square inch is used . . . and the glass target is bubble-thin! Yet all are assembled and made to work—at RCA's Lancaster Tube Plant—with precision.

Actually 100 to 1000 times as sensitive as its parent the *iconoscope,* RCA's image orthicon pickup tube literally rivals the human eye. And when an outdoor telecast may start in daylight and wind up in the dim light of dusk—that's a necessity!

Radio Corporation of America
WORLD LEADER IN RADIO—FIRST IN TELEVISION

(Advertisement)

International Short-Wave

(*Continued from page* 62)

less you *know* who it is—as occasionally very tiny-powered stations peak in quite strongly at periods and are stronger than stations using many times their power. When I first started listening, I passed over Nairobi on 6.05 for many weeks as I thought by its strength and programs it was a BBC short-wave outlet!"

* * *

Club Notes

England—J. Whitehead, editor of "QRP" for the International Short Wave League, London, writes that "'QRP' is dedicated to the advancement of low-power radio. I am anxious to include occasional notes on QRP conditions, activities, and other points of interest connected with QRP in America." Mr. Whitehead would like to contact someone in America who is interested in low-power radio to send him notes on developments in America in this field. His QRA is J. Whitehead, 6, Abbot's Tilt, Hersham, Walton-on-Thames, Surrey, England.

USA—The *Newark News Radio Club* will hold its 1950 annual convention on Sunday, June 25, at the home of Vice-president and Mrs. Harold Robinson, Lansdale, Pennsylvania. The Convention Committee is headed by Mr. Robinson and Director Dick Daneker.

* * *

This Month's Schedules

(*NOTE:* Some stations will be going on Summer Time soon; in such cases, schedules may be *one hour earlier* than listed herein.—KRB)

Albania—ZAA, 7.845.5, Tirana, noted 1515 with news by man; heavy CWQRM at times; musical program 1545; signed off 1602. (Oskay, N. J.)

Andorra—Radio Andorra, 5.985, is now announcing its frequency at closedown 1900; signal much improved lately but still has bad CWQRM after 1820. (Balfe, Mass.)

Angola—Nova Lisboa, approximately 9.245, is heard around 1400 to sign-off 1504; mentions "Radio Club do Huambo"; closes with Portuguese National Anthem. (Hankins, Pa.) *I would like to know the correct call of this station;* it has been reported to me in various combinations.

Antarctic—Vandecar, Mich., has received a letter from the Norwegian-British-Swedish Antarctic Expedition to the South Pole which stated: "Base will be busy until April; after that will be working as an amateur on 7-, 14-, and 28-megacycle bands, with call LA40C; operator's name is Rockstadt; *he speaks good English."* Signed by E. W. Walton.

Argentina—Stark, Texas, says the Latin station heard on approximately 5.985 is Buenos Aires; LRS1, *"Radio Splendid,"* is listed on 5.986.

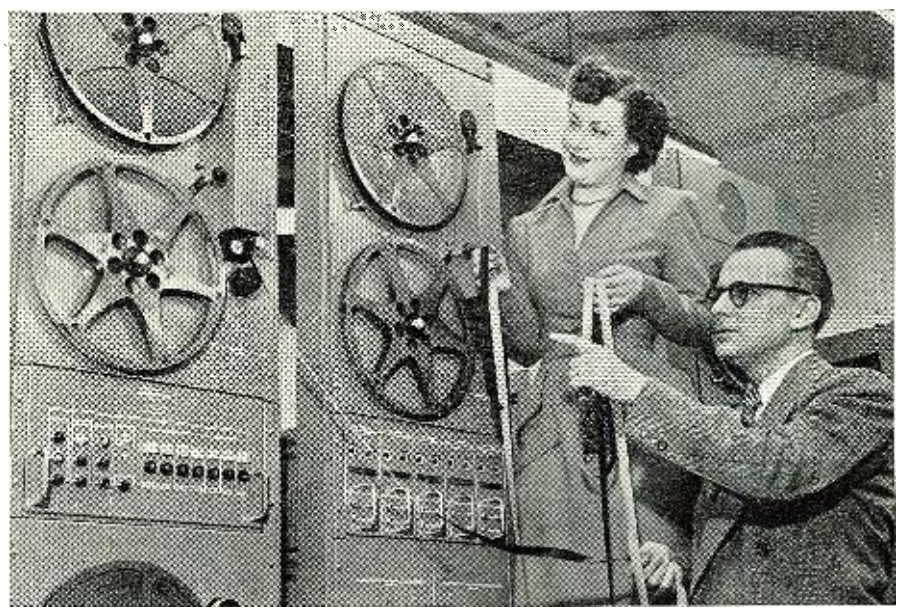
By this time, LRU, 15.29, was to have inaugurated broadcasts in Swedish and German, in addition to languages scheduled earlier; time for these additional languages was unknown at press time. (Serrano, Brazil)

All Argentina stations are required by law to mention the year 1950 as "The Year of the Liberator, General San Martin"; SRI is now transmitting many programs about the life of General San Martin, liberator of Argentina, Chile, and Peru, who died 100 years ago. (Serrano, Brazil)

Australia—At the time this was compiled, *Radio Australia* was using

---

This ingenious machine for aircraft communications records up to 28 sound tracks on a single magnetic paper tape less than three-quarters of an inch wide. Engineered by The Brush Development Co. of Cleveland, the new unit is hailed as a great advance for aviation safety. For the first time it makes possible a permanent record of all communications between pilots and control towers, thus permitting a detailed study of factors leading to air crashes. The unit was introduced to the aviation industry at the recent National Airways Communications Conference held in Cleveland.



POOR PLATT!

HE'S GIVING EVERYTHING AWAY BUT HIS PANTS

Everything—**but everything**—MUST GO! That's why Platt's priced these items so low that he's practically giving them away. But ACT NOW—ORDER TODAY—because the supply will go FAST!

SPECIALS-OF-THE-MONTH CATHODE RAY TUBES

3CP1 ..... 59c
801A 39c
211 ..... 39c
In lots of 10—10% off

TUBES

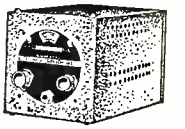
Standard Brands All New Tubes

304TL	$1.95
5BP4	2.45
872A	1.19
10Y	.39
4AP10	2.29
7CP1	2.95
832A	4.89
725A	6.95
726A	13.95
316A	.39
1625	.39

PLATT'S BARGAIN COUNTER

BEACON RECEIVER BC-1206-C

Manufactured by Setchell-Carlson



Frequency Range—195 KC to 420 KC. IF Frequency—135 KC. Receiver Sensitivity—3 Microvolts for 10 Milliwatts output. Output Impedance—300 Ohms and 4000 Ohms to be selected internally. Power Output—230 Milliwatts. Volume Control—RF Gain Control. Power Supply—24-28 Volts Aeroplane Battery. Current—.75 Amperes.

BRAND NEW—ONLY **$6.95**

RECONDITIONED SCR-522

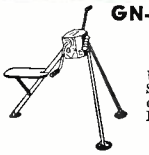
With New Components

Very High Frequency TRANSMITTER-RECEIVER 100-156MC, 4 Channels, Crystal-Controlled, Amplitude Modulated Voice. Electrically Tested.

Complete as shown

Only **$79.50**

GN-45 HAND GENERATOR



6 Volts, 3 Amps
500 Volts, 0.14 Amp

Used with Signal Corps Radio Set SCR-284. Has many applications. Brand New. Original Packing.

ONLY **$12.95**

MICROPHONES

T-24-G, 200 ohms, single button, 8 ft. rubber cord with PL-106 Plug and JK 38 Jack. BRAND NEW.. $1.95

T-17-B, Hand-held carbon microphone for use in voice communication. Effectively covers the audio frequency range from 300 to 2600 CPS. 200 ohms, with press-to-talk switch, 5 ft. rubber cord and plug. NEW $1.95

T-30 Microphone suitable for aircraft use. Responds to frequencies in the range of 400 CPS to 2000 CPS. Complete with cord and plug. Original Packing. NEW 1.29

T-36-C Hand Carbon Microphone. 24 ft. cord. 3 contact amphenol plug..... 2.95

OIL FILLED CONDENSERS

Famous Make TJH 50020. 2 MFD, 5000 VDC..... $4.25
Nationally Advertised, 2 MFD, 600 VDC ..... .29
Famous Makes, 4 MFD, 600 VDC ..... .79
Highest Quality 23F47, 2 MFD, 4000 VDC.... 3.25
Highest Quality .25 Mu-f, 6000 VDC..... 1.95
Highest Quality 30 Mu-f, 90 V, 3 phase, 60 cycles 1.19
Mica Capacitor, type GI ceramic .04 1000 Volts, 25 amps at 1000 KCS..... 1.29
Type DT-4W1, CAP. 1 MFD, 400 Volts, Tubular, Box of 25..... 2.98

274-N COMMAND EQUIPMENT

Sensational Buys!

	USED	BRAND NEW
BC-442	$ 1.85	$ 2.75
BC-450, 3 Receiver Remote Control	.89	1.95
BC-453	12.95	21.95
BC-454	4.95	6.95
BC-455	6.95	
BC-456	1.95	2.95
BC-457	5.95	
BC-458	5.95	7.95
BC-459		24.95
BC-696	14.95	24.95
3 Receiver Rack	1.95	
2 Transmitter Rack	1.50	

TRANSMITTER-RECEIVER

Conversion of BC-645 Bringing Excellent Results.

Navy Model ABA-1 (CG-43AAG)
Army Model SCR-515A known as the BC-645

450 MC—15 Tubes

BRAND NEW—ORIGINAL CARTON. Can be easily converted for phone or CW 2-way communication. Covering for the following bands: 420-450 MC ham band, 450-460 MC for fixed or mobile, 460-470 MC for citizens, 470-500 MC television experimental. Size 10½ x 13½ x 4¾. Contains 15 tubes: 4-7F7, 4-7H7, 2-7E6, 2-6F6, 2-955, 1-WE-316A door knob. Complete as shown above.....only $17.95

BC-645 ANTENNA.....only **39c**

BC-645 TRANSMITTER-RECEIVER ONLY, Brand New, ORIGINAL PACKING. Special **$12.95**

20 POUNDS OF ASSORTED RADIO PARTS

Transformers, Chokes, Wire, Condensers, Knobs, Sockets, Switches, Dynamotor. ONLY **$2.39**

100 ASSORTED RESISTORS

Non-insulated, various ohmages and wattages.

SPECIAL **97c**

KIT OF 15 CONDENSERS

Bathtubs and Electrolytics.

NOW **98c**

Multitester Foundation BIAS METER 1-97A

Contains a zero center 3½" round Marion voltmeter calibrated 0-100 volts each side. Movement is one mill each side of center. The unit is mounted in a steel box 7" x 5" x 4½" and contains 8 contact push button, line cord dual 100 MFD at 200 V DC condenser, a potentiometer 6 1RC 1% wire wound non-inductive resistors; one 400 ohm, two 2500 ohm, one 5000 ohm, one 10,000 ohm, one 15,000 ohm.

Excellent for building a zero center multitester with ranges of 1, 10, 100, 1000 volt.

COMPLETE BRAND NEW **$3.95**

BC-223 TRANSMITTER

30 Watt Transmitter with crystal or MO control on four pre-selected channels, 2000 to 5250 KC, by use of three plug-in coils. Five Tubes: 2-801 & 3-46. With TU-17-18-25 Tuning Units. Tubes and mount included. SPecially Priced.

BRAND NEW. Only..... **$25.95**

BC-348 Receiver—NEW	$165.00
BC-224 Receiver—Excellent Condition	135.00
BC-342 Receiver—Excellent Condition	135.00
BC-221 Frequency Meter—Excellent Condition	79.50
BC-939 Antenna Tuner for BC-610. NEW...	75.00
SCR-694 and SCR-284. Complete. New Conditioned.	Prices Sent Upon Request.
MN-26C Compass Receiver. NEW	29.50
433G Compass Receiver—Excellent Condition.	39.50
ARN7 Compass Receiver—Excellent Condition.	49.50
733D Localizer Receiver—NEW	8.95

FILTERS

FL5 Lazy Q Radio Filter Unit, high impedance, NEW $0.75
FL8 Filter. Good Condition..... 1.29

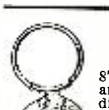
SELSYN INDICATOR

For use with beam antennas for indicating direction of antennas. I-82-B, 5" type. Now **$4.95**

FIELD TELEPHONES

Army surplus, completely reconditioned and electrically tested. LIKE NEW.

Only **$8.95**



TYPE MN-20E ROTATABLE LOOP UNIT

8" diameter, used with MN-26 Compass and RA 10DB. Manufactured by Bendix.

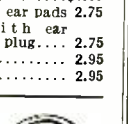
A TERRIFIC BUY!

ONLY **$11.95**

HEADSETS—Excellent Buys!

HS-33 with cord and plug, used, good condition $1.19
HS-23—Brand New with ear pads 2.75
HS-33—Brand New with ear pads, cord and PL54 plug.... 2.75
TH-37A—1200 ohms with dual plugs..... 2.95
HS-16A—520 ohms 2.95

CORDS AND PLUGS



CD 508A Cord Assembly with SW 14-U Switch and 2 cord attachments with JK 48 Jack and PL 68 Plug. Value—$5.00. Our Special Low Price, Brand New 59c
CD 307A with PL 55 and JK New 59c
JK 26 Jack with cord, good condition..... 12c
JK 26 Jack only—Brand New..... 8c
PL 55 Plug—NEW 35c
PL 68 Plug—NEW 15c

Minimum Order $2.00

Immediate Delivery — Send 25% deposit on C.O.D. orders. All shipments F.O.B., N.Y.C. (N.Y.C. residents add sales tax to your remittance.)

VISIT THE NEW PLATT STORE AT 489 BROOME ST., N. Y. C.

PLATT ELECTRONICS CORP.
DEPT. A, 489 BROOME ST., NEW YORK 13, N. Y.
PHONES: RE 2-8177 and WO 4-2915

VLC5, 9.54, to East Coast North America 0700-0900, and to Central North America 0900-0945; VLC7, 11.81, was still in use, however, to West Coast North America 1000-1115. A 25-m. outlet (most likely 11.81) was to be added soon for the period 0700-1000. For the 1643-1815 beam to Eastern North America, VLA6, 15.220, has been put into use, fine signal.

VLX, 4.897, Perth, is good level in Delaware 0700. (Cox) Is good signal here in West Virginia at 0800 when relaying BBC news.

Austria—Pearce, England, says the *Blue Danube Network* seems to vary around 9.533 to 9.560; has been heard 0600-0700 and at other times.

Belgian Congo—Leopoldville, 11.645, requests reports on its *new* transmission to Belgian seamen 1630-1845. (*DX Journal*) This transmission is in French, in parallel with 9.767. (Grove, Ill., others)

Belgium—Ruyselede, 17.845, heard recently at 1100 calling Leopoldville; at 1115 was buried by CKNC, 17.82, Canada, and WCBX, 17.83, U. S. (Drummond, N. J.)

Brazil—The Police Department of Rio de Janeiro station is now on a *new* channel of 9.290 and with a *new* call PRN9 (formerly PYZ2); transmissions are daily *except* Sunday 1730-1830 (approximately). A *new* station on 4.115 has just been identified as Radio Difusora Acreana, Rio Branco, capital of the Territorio do Acre: this Federal Territory lies on the border of Brazil and Peru, has an area of 148,000 sq. km. and a population of 80,000; it produces rubber of high quality. Rio Branco signals are quite weak, due to terrific QRN on the band; heard best around 1920 with news in Portuguese, followed by music. (Leven, Brazil)

Radio Ministerio da Educacao, Rio de Janeiro, PRL4, 9.77, 1 kw., has severe CWQRM in daylight and is QRM'd by OTC2 at night. (Serrano, Brazil)

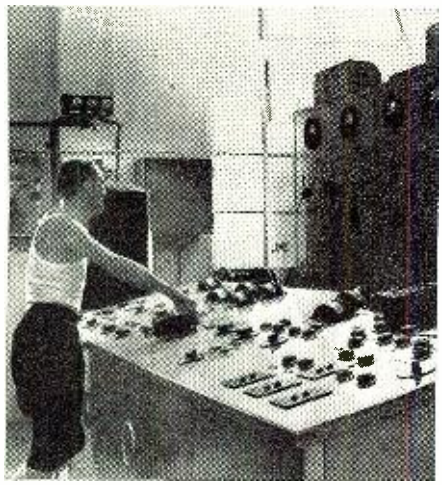
Burma—A station believed to be *Radio Mandalay* (may be Communist-controlled?) is heard by Cushen, N. Z., on 7.370 with news and messages in *English* from residents in North Burma at 0630-0700. (Radio Sweden)

Canary Islands—Tenerife, 7.520, closes 1800 with "Viva Franco!" (Aberg, Sweden)

China—Short Wave News, London, lists QRA of *Peking Radio* as 3 Chang An Tse Kai, Peking, China.

At the time this was compiled, the Chinese Communist outlet heard earlier on 6.100 had reappeared but on a lower channel of approximately 6.090 where it suffers QRM; carries Peking news relay 0830; this outlet is *not* announced and location is not known definitely as yet. Has been heard by Balbi, Calif., in phone contact with Nanking, 9.735, around 0230-0330, and in contact with Peking, 10.26, as late as 1115.

Darien, 7.100, is again audible with news relay from Peking 0830; is just *above* Jogjakarta, Indonesia, both



Control console of Radio Tahiti's modern station. Higher powered transmitters are reportedly under construction at present.

claim 7.100, but one must be off about 3 kc. (Dilg, Calif.)

Peking, 1026, is usually buried in QRM mornings here in West Virginia but occasionally the news 0830 can be read; is good level signing on 1800 with long march-anthem but is soon buried in QRM.

Colombia—HJEX, 6.053.4, Cali, noted with good signal at 1845 with *English* grammar lesson transcribed from BBC. (Oskay, N. J.)

Cyprus—Sharq-al-Adna heard on 11.720 from around 0930 to 1150; heard also on 6.790 and 6.135 afternoons to sign-off 1506 after news in Arabic at 1500.

Denmark—Gerran, N. Y., reports OZU, 7.260, "Danmarks Radio," listed 6 kw., heard on a Sunday 0430, probably with Home Service. *Radio Sweden* reports this outlet heard to 1730 sign-off carrying domestic programs.

Dominican Republic—HI4T, 5.970, Ciudad Trujillo, in parallel with HI2T, 9.735, now closes 2300. (Grove, Ill.)

Egypt—SUX, 7.863, Cairo, is heard some days around 1555 to sign-off 1620; has bad QRM. (Ferguson, N. C.) Heard by Hagen in Ala. at 1730-1800 recently when had five pips followed by the announcement, "Huna El Kahera," then anthem.

Patrick, England, confirms that two high-powered s.w. transmitters have been ordered by the Egyptian State Broadcasting System from a well-known British firm, for installation at a new station now under construction at Abu-Zabal, 12 miles from Cairo.

Ethiopia—Radio Addis Ababa, "The Voice of Ethiopia," has been heard on approximately 15.035 in Britain on Sundays with missionary broadcasts such as "Voice of Prophecy" and "Hymns You Love to Hear," around 1000-1115; weekdays has been heard with *English* 1020-1100; announces as operating in the 19-, 31-, and 49-m. bands. (Pearce, England)

Finland—Peddle says Helsinki's 17.800 outlet puts in a good signal in Newfoundland at 0715 with news.

Formosa—Taipei recently moved to the old Chungking channel of approxi-

mately 7.150 where it has news around 0610; good signal here in West Virginia at that time but it soon is buried in ham and c.w. QRM. Schedule is around 0500-1130. Calls seems to be BED2, BED4, BED7, and m.w. BED24. Oskay, N. J., has measured this one as 7.151.5.

Sanderson, Australia, airmails she is still hearing BCAF on 8.996 at 0545 with Chinese-*English* lesson, then Western music.

France—Widely reported is a Paris high-powered transmitter testing in French, English, German, and perhaps other languages on approximately 6.034 around 2330, giving QRA as Manager, Civil Aeronautic-Telecommunication Signals, 155 Rue de la Croix Nivert, Paris 15, France; asked for detailed reception reports; strong signal. Also reported heard around 0645-0830 on 20.090.

Paris, 6.145, noted with strong signal 1600-1630 sign-off. (Oskay, N. J.)

French Equatorial Africa—Radio Brazzaville, 11.972, noted on Sunday ending Mail Bag session (in *English*) at 1100.

French Indo-China—Saigon is reported moved from 11.780 to 9.524 where it has bad QRM from Hong Kong and South Africa.

Sanderson, Australia, reports FZS on 18.406 at 0605; news 0635, then Western music, chimes; she reports "Voice of Vietnam" on 9.670 at 0600 with recorded music, news 0615-0630, then news in Vietnamese; the "Voice of Vietnam" program is heard also in parallel on 7.205 which is the *Radio Hue* channel.

French West Africa—Bluman, Israel, says *Radio Dakar* appears to be testing a *new* transmitter irregularly on 15.340 around 1320-1700 in parallel with 11.896; the 15.340 outlet is *not* heard when the 11.896 transmitter reopens 0200.

Patrick, England, says *Radio Bamako,* FGJ9, 15.025, is now in operation with 2 kw., daily with weather

NEW AIR-SEA RESCUE TRANSMITTER-RECEIVER

THE Wright-Patterson Air Force Base at Dayton, Ohio recently unveiled a new air-sea rescue transmitter-receiver which is particularly outstanding because of its small size.

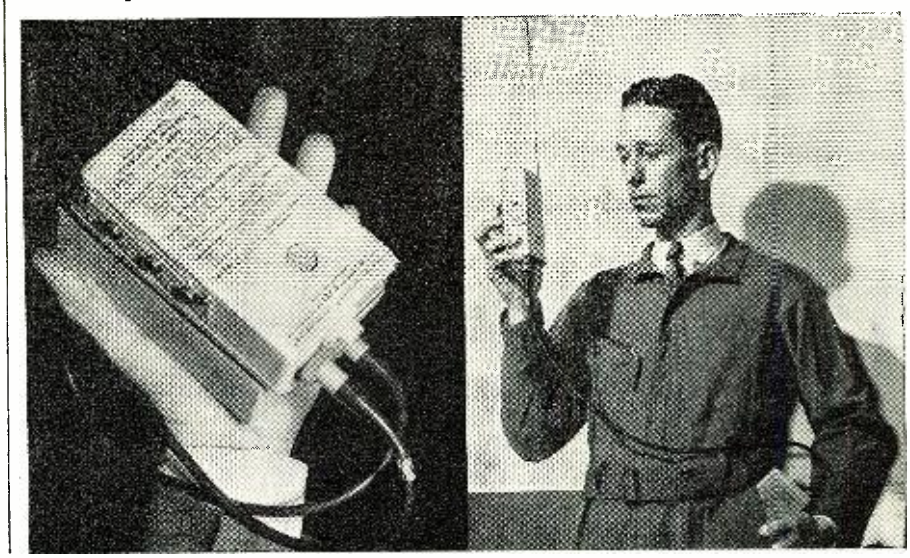
The unit, which was designed and developed by the Air Materiel Command's Communication and Navigation Laboratory, Electronics Sub-Division, is a miniaturized battery-operated unit which will, in time, become standard equipment for every USAF pilot and airman, replacing the old curvaceous "Gibson Girl." The unit is already in production in the Los Angeles plant of the Hoffman Radio Corporation and is the product of several years of research and labor on the part of the Wright Field and Hoffman engineers.

The new set, known technically as the URC-4, is small—not much larger than a ration kit. It can be held in one hand. The mercury-type battery is a separate unit with a rubberized cable connection attaching it to the transmitter-receiver section. The cable is just long enough to allow the battery to be slipped into a pocket while the set is in use.

Operating on two channels, v.h.f. and u.h.f., the set can be switched from one to the other instantaneously. Technicians are impressed by its stability and by the fact that the midget set is able to transmit and receive both voice and code signals.

The mercury-type battery will not deteriorate with lack of use or with age, while the entire unit is completely impervious to salt water and is designed to withstand temperature extremes ranging from +160 degrees F. to −50 degrees F. −30−

The Air Material Command's answer to the problem of faster air-sea rescues is shown in a close-up view of the midget transmitter-receiver developed by the Electronic Subdivision at Wright Field. Known officially as the URC-4, the unit is being manufactured by Hoffman Radio Corp. of Los Angeles. (Right) J. S. Horrigan, the USAF's Air Materiel Command project engineer on the URC-4, is shown demonstrating how the battery of the midget transmitter-receiver can be slipped into the pocket of an ordinary flying suit.



LOWEST PRICES TUBES and PARTS

29c ea.

1U4	6A3	112A	1A4	1D8GT	1H6GT
2C26	10	182B	1A4P	1F4	1J6G
2C34	12A	183	1A6	1F5G	1619
3A4	39/44	25S	1B5	1G4GT	1626
6S8GT	47	482B	1D5GT	1G6GT	E1148
01A	50	483	1D7	1H4G	7193
4A6G	71A				

FREE! $20.00 List Value Cornell-Dubilier, Mallory, Aerovox, Sprague, Solar. Filter Condensers—ten fast moving filters FREE with each 100 tubes.

79c each

1B3GT	50A5
2A3	307A
2A4	350B
3D24	371B
3Q5	446A
6A7	615
6AK5	707B
6BG6G	807
6E5	813
6G5	837
6U5	864
19BG6G	117L7GT
RK-34	117N7GT
RK-39	117P7GT

39c ea.

1T4	35Z5GT	6SD7GT	25Z6GT	32	35	37	46	57	80
5Y3GT	6C4	6X5GT	30	33	35Z4GT	38	VT-52	58	89
35W4	6F8GT	14X7	31	34	36	39	56	76	HY-615

49c ea.

3Q4	6AL6	6BE6	6J5	6SG7	6U7G	12AX7	12SA7GT	35B5	
3S4	6AQ5	6BH6	6J5GT	6SG7GT	6U7GT	12BA6	12SF5	35C5	
3V4	6AR5	6BJ6	6J6	6SH7	6V6GT	12BA7	12SF7	35Z6GT	
5W4GT	6AS5	6C5	6J7G	6SJ7	6W4	12BE6	12SH7GT	50B5	
5X4G	6AT6	6C8G	6J7GT	6SJ7GT	6X4	12F5GT	12SN7GT	50C5	
5Y4G	6AU6	6D6	6K6GT	6SL7GT	6X5GT	12H6	12SR7GT	50Y6 26	
6AB4	6A8G	6F5GT	6K7GT	6SK7GT	6Z4	12J5GT	1629 (eye)	51 27	
6AC4	6A8GT	6F6GT	6K8GT	6SQ7GT	12A8GT	12J7GT	24A	77	
6AC5	6B6	6G6	6P5GT	6SR7	12AT6	12K7GT	25L6GT	78	
6AC5GT	6BA6	6H6	6SA7GT	6U6G	12AU6	12K8GT	25X6	85	
6AG5	6BD6	6H6GT	6SC7GT	6U6GT	12AU7	12S8GT		99	

1C5 1C6 1L4 1R5 1S5 1U5 2A5 2A7

59c ea.

1LA4	5V4	6AR5	6D8G	6SS7	6Z7G	7C6	7L7	10Y	12SG7	20	43
1LE3	5Z3	6AS5	6F5	6SU7	7A4	7E5	7N7	12A7	12SJ7GT	32L7GT	50L6GT
1Q5GT	5Z4	6AV6	6F8G	6Q7GT	7A6	7E6	7Q7	12AT7	12SK7GT	35/51	53
1T5GT	6A8	6B4G	6K7G	6T7G	7A7	7E7	7S7	12AV6	12SL7	35L6GT	75
1V	6AC7	6BA7	6R7	6T8	7B5	7F7	7T7	12BF6		36	84/6Z4
1C5GT	6AJ5	6B8	6S8	6U7	7B6	7G7	7V7	12C8	12SQ7GT	40	117Z3
0Z4 1A7GT	2B7	6AK6	6C6	6SF5GT	6W7G	7B8	7H7	7W7	12J5	12Z3	41	VR150
1A5GT 1C7G	5U4G	6AL5	6D8	6SN7GT	6Y6G	7C4	7J7	7Y4	12Q7GT	19T8	42	XXL

69c ea.

1A3	1LB4	1LN5	2C34	35Z3	6BF6	6S7G	7C5	14A5	14B8	14J7	14X7	2050	81
1AB5	1LC5	1N5GT	2V3G	3LF4	6J8G	6SU7GT	12A6	14A7	14E6	14N7	14Y4	2051	83
1AD5	1LC6	1P5GT	2X2	4A6G	6L6G	7A8	12BF6	14AF7	14E7	14Q7	3SY4	50C6	117Z6GT
1H5GT	1LH4	1S4	25Z5	6B7	6L6	7C4	14A4	14B6	14H7	14W7	45	70L7GT	9001
1LA6													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**

10BP4 Picture Tube. Each **$17.95** | 12LP4 each **$24.95**

Miniature tubes 12AT6, 12BA6, 12BE6, 35W4, 50B5...5 tubes for **$1.89**

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

2½", 3", 4"—95c-$1.05

6"	$1.49		$1.59
8"	2.95		3.25
10"	4.25		4.50
12"	4.95		5.95

Utah Speaker Baffles—completely enclosed for 8" speakers and smaller.....ea. $2.00

Jobbers: write for quantity prices.

IF TRANSFORMERS

Standard Replacement
Regular size.....ea. **29c**
Midget.....ea. 39c

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—Sensational Value.... **$1.29** ea.

OCTAL SOCKETS.....10 for **49c**
MINIATURE TUBE SOCKETS.....10 for 49c

Standard replacement crystal cartridge. Each..... **$1.39**
Nylon 1J CARTRIDGE.....$2.59

SPECIAL—CONDENSER KITS

Kit of 25 BY-PASS CONDENSERS best assorted brands and sizes.... **$1.75**
Kit of 50 BY-PASS CONDENSERS very best, assorted sizes..... **3.25**
Kit of 50 MICA CONDENSERS complete..... **2.79**
100 resistors—packed in a box Best values only—½ watt, 1 watt, 2 watt IRC etc. **$1.98**

SELENIUM RECTIFIERS
Standard 100 mil.
Each..... **79c**

PUSH-BACK WIRE 100-ft. rolls **39c** each

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

FILTER CONDENSERS

Very best brands
Fresh stock

10 or more assorted 5% discount

450 Working Volts

8—450 V	ea. 21c
10—450 V	ea. 24c
10—450 V w/20-20—25 V	ea. 29c
15—450 V	ea. 29c
20—450 V	ea. 39c
30—450 V	ea. 49c
30—450 V with 20-20—25 V	ea. 29c
8-8—450 V	ea. 39c
8-8—450 V-50-50 V	ea. 39c
8-8-8—450 V	ea. 39c
8-8-8—450 V-50-50 V	ea. 39c
10-10—450 V	ea. 43c
20-20—450 V	ea. 49c

150 Working Volts

10-10—150 V	ea. 24c
10-10-10—150 V	ea. 29c
15—150 V	ea. 21c
16—150 V	ea. 23c
20—150 V	ea. 25c
30—150 V	ea. 29c
40—150 V	ea. 29c
15-15—150 V	ea. 25c
20-10—150 V	ea. 24c
20-20—150 V	ea. 25c
20-20-20—150 V	ea. 39c
30-20—150 V	ea. 29c
30-30—150 V	ea. 39c
40-20—150 V	ea. 39c
40-30—150 V-30-20-25 V	ea. 39c
40-40—150 V	ea. 39c
40-40—150 V 20-25 V	ea. 39c
50-30—150 V	ea. 39c
50-50—150 V	ea. 39c
60-60—150 V	ea. 39c
20-16-16—350 V Sprague type	ea. 39c
25-25—150 V-200-10 V	ea. 39c

Cathode Condensers 16c ea.

10—25 V
20-20—25 V
20-20-20—25 V
20—25 V
25—25 V
30—50 V
100—25 V

WESTON DC VOLTMETER 0-15, 0-600 volts, 500 microamp movement..... **$3.49**

Oscillator Coils for any 5 tube AC-DC..... **19c**
RF and Antenna Coils. Standard Broadcast Band..... **29c** ea.

OUTPUT TRANSFORMERS

For 50L6, etc. **39c** ea.
For 6V6, 6F6, 3Q5, etc. **45c** ea.

UNIVERSAL OUTPUT TRANSFORMER SPECIAL
Up to 12 watts to any speaker..... **98c** ea.
(while they last)

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**
No. 40 6-8 V. 15 Amps. | No. 44 6-8 V. 25 Amps.
No. 41 2.5 V. 50 Amps. | No. 46 6-8 V. 25 Amps.
No. 51 6-8 V. 20 Amps.

6-FT. LINE CORDS

Appliance Cord, up to 1,000 watts, 1 rubber plug 5 for..... **99c**

Good Rubber with plug. 10 for..... **$1.25**

Appliance Cord as above, with UL label 5 for **$1.29**

Underwriters' Approved. 10 for..... **$1.69**

BY-PASS CONDENSERS

100 Condensers assorted in package..... **$5.95**

.001	ea. 6c	.0005	
.002	ea. 6c	.00025	
.005	ea. 6c	.00005	
.01 (600 V.)	ea. 7c	500 mmf (600 V. MICA)	6c
.02	ea. 7c	250 mmf	
.05	ea. 8c	100 mmf	
.1	ea. 9c	50 mmf	

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
..... **15c** ea.

VARIABLE CONDENSERS

Two gang for superhet or TRF.....ea. **69c**

SPECIALS

TV PARTS and ANTENNAS

TV Antennas:
Conical price leader with 8-ft. mast.....$5.75
World's Best Delux Conical with 9-ft. mast and heavy cast fittings..... 8.95
Hi-Lo folded dipole array, 8-ft. mast..... 6.95
300-ohm line $1.59 per 100 ft. $14.95 per 1000 ft.
Horizontal output. RCA Type Flyback..... $3.45 ea.
Discriminator Transformers..... 1.29 ea.
TV Screen Filters with suction cups—best quality IND. BOXED for highest re-sale value | 10" $1.17 | 12" 1.95 | 16" 2.55

Rated accounts—10 days—all others 20% deposit with order, balance COD. 50c handling charge for orders less than $5.00. All shipments FOB Chicago. Prompt attention paid to foreign orders. ORDER TODAY. Our parts and tubes are warranted to be 100% replacements for the prototypes in the listings above. Satisfaction Guaranteed. To speed up delivery, sign your order and your remittance with the same name. Ill. residents add 2% sales tax.

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Phone: Andover 3-1590
"Your Tube Source Since 1926"

reports, government news, and occasionally some music; no definite schedule is listed by the station, but has been heard in England around 1300.

Germany—Radio Leipzig advises Gates, Conn., that its *new* interval signal is composed of the musical notes "B, A, C, and H" (?) to commemorate the 200th anniversary of the death of Bach.

Gold Coast—For a time, Balbi, Calif., was hearing ZOY, 7.295, Accra, at 0300-0400; native drums at opening, announced "This is the Gold Coast Station"; announced as operating on 41.4 meters; BBC records announced by woman; at 0343 had orders regarding troops, then news by a man; announced, "This is the end of the news from Accra," then the woman announced, "We now sign-off on the 41-meter band at 9 o'clock"; not heard lately, however.

Is heard in England on 4.915 with news 1250; closes 1300 with "God Save the King."

Greece—Hagen, Ala., reports the Greek Army Radio on 7.050 at 0000-0145; fair signal; comes on with chorus singing Greek song; has some band music; woman announcer.

Bluman, Israel, airmails that the Greek outlet on 6.340 he previously reported as "unidentified" is the Greek Forces station in Athens; heard from 0000 and at 1100-1645.

Kios, 6.520, is audible until 1500.

Guatemala—TG2, *Radio Morse,* on 6.621, now closes 2330; TG3, 6.410, is *not* in parallel. (Grove, Ill.)

Haiti—4VRW, Port-au-Prince is still moving around; at last report was again on approximately 10.210, heard mornings and evenings (EST).

Honduras—HRN, 5.880, Tegucigalpa, now closes 2300 with Ted Lewis' recording of "Good Night"; heard 2000-2300 sign-off; all-Spanish. (Grove, Ill.)

Hong Kong—ZBW3, 9.525, heard with news 1015, signing off 1130. (Balbi, Calif.)

Iceland—NNRC reports Reykjavik testing on 9.200 at 1437 after which went into inverted speech.

India—Madras, 4.920, continues to be heard well in the East at 0730 with news relay from Delhi which usually is followed by "local" (Madras) news, also in *English.*

Indonesia—Djakarta appears to be using YDF2, 11.785, now for the 1115-1400 transmission to Asia, Near East, and Europe; probably will add *English* at 1400-1500 soon. Although the press services list the *new* name of this city (formerly Batavia) as "Jakarta," the station gives it "Djakarta" and the "D" is definitely heard when it is pronounced over *Djakarta Radio.*

YDE, listed 11.77, Djakarta, noted in French to 1100 closedown, but seemed slightly higher than 11.770. (Dilg, Calif.)

Stark, Texas, has heard an Indonesian on 4.945 identifying at 0700; uses Indonesian language; may be YDB2, listed 4.910?

Iran—Chatfield, N. Y., Hagen, Ala., and others report *Radio Teheran* on 9.660 with news 1400 followed at 1415 with popular music; news in French 1430. *Radio Sweden* says this outlet is heard in Europe 1330-1400.

Bluman, Israel, says Teheran, 6.155, now opens 0830 with French-type music; Tabriz, 6.090, opens 0900 with Turkish half hour; from 0930 has Persian.

Iraq—YI5KG, 7.092, Baghdad, is heard in Europe at good strength 1000-1515. (Radio Sweden)

Israel—Tel Aviv is back on 9.000 from 8.900; news 1530.

Japan—WLKS, 6.105, Kure, noted closing down 0830; has Latin QRM from shortly before 0800; earlier is in clear. (Stark, Texas). Now relays (announced) AFRS news 0300-0315.

JKM, Tokyo, has moved from 4.93 to 4.95; fine, clear signal now; heard from 0300; much Western music noted lately. (Balbi, Calif.)

The chief of the International Broadcasting Section, N.H.K. (Nipon Hoso Kyokai or the Broadcasting Corporation of Japan), sent this list of Japanese s.w. stations (exclusive of those operated by occupation forces) to *DX Journal:*

A—First transmission relay and communications for Domestic Service—JKI, 4.910, 5 kw., Nazaki, 1525-1715 and 0255-0900; JHK, 7.257.5, 5 kw., Yamata, 1525-0900; JKI2, 9.655, 5 kw., Nazaki, 1725-0245.

B—Second transmission relay for Domestic Service—JKJ, 7.285, 5 kw., Nazaki, 1555-2200 and 0325-0900; JKM, 4.930, 5 kw., Kawachi, 0325-0900; JKM2, 9.695, 5 kw., Kawachi, 1555-2200.

C—AFRS, Far East Network of the Armed Forces Radio Service—JKK, 6.015, 5 kw., Nazaki, 1545-0930; JKL, 4.860, 5 kw., Yamata, 0355-0933; JKL2, 9.605, 5 kw., Yamata, 1545-0345.

D—Overseas transmission (for Japanese listeners abroad awaiting repatriation)—JBD, 9.505, 7½ kw., Kawachi, 0255-0900; JBD2, 9.560, 5 kw.,

(*Continued on page* 143)

Bill Wood, W4JWR, stands beside his car which is equipped with the special license plates that the state of Florida is issuing to amateurs. Lloyd F. Boyle, W4IMJ, state representative from Sanford, Florida, sponsored the bill authorizing the use of these special plates.

Within the Industry

(*Continued from page* 28)

Corp., vice-chairman; Frank Halock, secretary; and Harold W. Lindsay of *Ampex,* treasurer.

Members of the executive board include Dr. Vincent Salmon, Stanford Research Institute; Bob Hugh Smith, electrical engineering department of the University of California; and R. M. Beck of *R. M. Beck Co.*

* * *

ROBERT L. SHEARER has been appointed sales manager of the new Cleveland district office of *The Brush Development Company.*

In his new post Mr. Shearer will supervise magnetic recording sales in twenty counties in Northeastern Ohio and in Mercer County, Pennsylvania. Seven sales engineers will serve customers in these areas under Mr. Shearer's direction.

Prior to joining the *Brush* organization, he was associated with the British Broadcasting Corporation and served in the British Army from 1939-1946. He attended the University of Edinburgh, Heriot Watt College, and Swarthmore College in Pennsylvania. He is a member of the IRE and the Royal Scottish Society of Arts.

* * *

HARRY J. MAYER, former manager of Technical Products Service of the *RCA Service Company* in the Chicago district, has assumed new duties as New York district manager of the company's Technical Products Service Division . . . **HAROLD W. SCHAEFER** has been named special assistant to Leslie J. Woods, vice-president-director of Research and Engineering of *Philco Corporation.* He was formerly assistant manager of the *Westinghouse* home radio division . . . **DAVID DAVIS,** until recently corporate radio and television manager for all *R. H. Macy's* stores, has been appointed merchandise coordinator for radio and television receivers in the *General Electric Company's* Electronics Department . . . **B. L. STILPHEN** is the new director of industrial relations for *The Magnavox Company* . . . **WICKHAM HARTER** is the new sales manager of the distributor division of *Centralab Division* of *Globe-Union Inc.* He was formerly vice-president and sales manager of *Solar* . . . **CLARE C. FISHER** has been named chief engineer for *Utah, Inc.* of Chicago. He has been associated with many well-known radio and component manufacturers in the past . . . The appointment of **GEORGE L. MC KENNA** as assistant to W. W. Watts, vice-president in charge of the *RCA* Engineering Products Department, was announced recently by the company . . . **A. GEORGE ROGERS** is the new assistant manager of the *Westinghouse* home radio division. He will be responsible for radio and television engineering and manufacturing . . . **KENNETH C. MEINKEN, JR.** has been appointed to the post of Midwestern sales manager of tube sales to initial equipment manufacturers for *National Union Radio Corporation* . . . *General Electric Company* has named **E. B. EVERY** as district representative for the sale of replacement tubes and receiver parts in the Atlanta, Georgia area . . . **M. D. SCHUSTER** who was formerly general manager of the *Hoffman Sales Corporation* of Los Angeles, has taken over as district sales manager for *The Magnavox Company* in the Los Angeles area . . . **DOUGLAS DAY** has relinquished his post as executive vice-president of *Buchanan & Company, Inc.* to take the post of director of advertising for *Allen B. Du Mont Laboratories, Inc.* . . . The Premium Sales Division of *Emerson Radio & Phonograph Corporation* has a new manager. **LEO HAHN** has returned to the company to take over the post . . . **ROBERT HOOD** has been named chief mechanical engineer for *Gertsch Products, Inc.* of Los Angeles . . . **KENNETH E. PITNEY** is the new research engineer at *The J. M. Ney Company,* Hartford specialists in the application of precious metals for sliding electrical contacts. —30—

Multiplex Systems

(*Continued from page* 45)

since they do not load the line or otherwise consume the signal energy on the line. At the end of the line a 300 ohm carbon non-inductive resistor is installed so as to properly terminate the line in its own impedance, preventing standing wave effects and reflections. It will be recalled that if this is done, it will be unimportant where the coupling units are bridged across the line, since all points on the line will have the same impedance and current-voltage relationship.

The individual coupling units consist of a 12AT7 connected as a balanced dual cathode follower. Output for 300 ohm sets is taken from cathode to cathode, whereas that for low impedance sets is taken from one cathode to ground. Power for the coupling units is run in from a four wire cable that connects all the units to a common power supply. This supply is of standard design and need only supply 6.3 volts at .3 amp. and about 10 milliamperes at 100 or so volts d.c. for each unit. The total requirement can easily be calculated by multiplication. For instance in a setup of 10 units, the power supply is designed to provide 6.3 volts a.c. at 3.0 amps. and 105 volts d.c. at 100 ma. This is easily provided by the circuit suggested. It is important that an a.c.-d.c. supply is *NOT USED.* Use a transformer in order to isolate from the power line.

The VR-105 regulator tube is not absolutely necessary, but by its inclusion the power supply for the units is made quite constant irrespective of the number of units used or variation in the line voltage. When the system is first set up, it is only necessary to adjust the series resistor to such a point that the VR tube lights up to a normal brilliance. Then any small variations will be automatically compensated for by the regulator action of the tube. If desired, this point may be accurately placed so that a meter inserted in series with the VR tube to ground lead reads 25 ma. under normal conditions. This current is in about the center of the tube's range, and a difference of 15 ma. more or less will be compensated for by the tube.

The coupling units are constructed in 4"x4"x2" steel boxes, and each has on the 4"x2" top side a strip of three screw terminals. These are the cathode-ground-cathode connections and from them a piece of 300 ohm or 75 ohm twin-lead is run to each set. Thus it takes only a moment to change connections for either type of set. In making up the coupling units it is suggested that the layout shown in the photograph be followed rather closely to avoid headaches. The tube is mounted inside the steel box, in order to prevent accidental damage or tampering. The two-terminal input strip is run across the narrow dimension of the 4"x2" bottom so that the lead-in line is merely run through continuously from one unit across to the next. The wires of the twin-lead, being bared of insulation and held under the screw terminals, make a straight-through connection.

The 4"x4" back plate is drilled so as to pass two wood screws which then hold the whole unit to the wall. The power cable is run in one side and out the other through rubber grommets, and connections are made inside by means of a four-terminal strip mounted on standoff spacers bolted to the back plate. The nine-pin tube socket is similarly mounted on the bottom and placed so that short equal connections will be obtained between the grid terminals and the input strip, to prevent unbalancing the line. The length of the output leads is not critical. Nothing is mounted on the 4"x4" front plate, so that it is merely a cover, and may easily be removed for tube changes, etc. The various condensers and resistors are mounted by their own leads from point to point.

With this setup it is possible for any or all sets to be operated simultaneously, without mutual interference. Sets can be easily moved about, connected and disconnected. The signal delivered to each set is only about 2½ db. down from that delivered by the antenna, and therefore no trouble is encountered because of a weak signal. A good antenna installation with small line loss will more than make up for this slight loss. In weak signal

areas stacking of two antennas would be advisable, since stacking affords a gain of about 4 db. over a single antenna, and thus the loss in the coupling unit is more than made up. No ghosts or reflections are noted due to the coupling system, and the picture on every set is equal to its eventual performance on its own antenna.

The above discussion and circuit is based on the use of a folded dipole having its center connected to the mast and grounded. With other types of antennas where the dipole arms are not grounded at its midpoint, there will be a strong 60-cycle a.c. component on the twin-lead lead-in. If this is not eliminated it will tend to drive the 12AT7 into cut-off and operation will be very poor. In addition, with any type of antenna, if the location is very close to an AM transmitter, that will also tend to do the same thing.

Both of these effects can be completely eliminated by placing a trap across the lead-in at any convenient point. The trap consists of one of the popular double slug-tuned FM traps with the small condensers removed and the center point between the coils brought to a good ground. The outside end of each coil is connected to either side of the twin-lead. The slugs may be tuned in or out for best operation. The coils themselves usually consist of about 5 turns on a ⅜" form and may be easily constructed if not already on hand. The object is to obtain a shunt inductance of about 1 μhy. so as to short out all frequencies lower than the bottom of the TV band. This will protect the 12AT7 from any interference, and result in the properly operating circuit.

Another recommendation is to use two 150 ohm resistors center-tap grounded instead of the single 300 ohm resistor, R_c, specified.

Formulas for cathode follower design are:

$$Gain = M = \frac{\mu \times R_c}{R_c(\mu + 1) + r_p}$$

$$\frac{55 \times 500}{500(56) + 10000} = \frac{27500}{38000} = .73 =$$

2½ db. loss

$$Output\ Impedance = Z_o = \frac{1}{G_m + 1/R_c + 1/r_p} = \frac{1}{.004 + .002 + .0001}$$

$= 1/.0061 = 164$ ohms

each side, or total Z_o (cathode to cathode) = 328 ohms which is within 10% nominal tolerance of input circuit of receiver.

The various terms in the above equation are defined as follows:

μ = Mu of the tube
R_c = Cathode resistance
r_p = Plate resistance
Z_o = Output impedance
G_m = Mutual conductance of the tube

-30-

R.F. Output Meter

(*Continued from page* 63)

silver coated over the copper on the faces. The diameter is 0.75" and the thickness 0.25" with a hole ¼" in diameter in the center of each. The outside periphery is lathe-turned to standards of accuracy by cutting the rim until the resistance accurately matched the standard, and the ones the power meter was made from were stamped with the resistance on one face, either 2.50 or 1.25 ohms being the only resistances so far obtainable. These were used in high-current voltage regulators for automotive equipment by army contractors. The resistance of comparable discs is uncannily uniform and accurate by all meters against which compared. If otherwise unobtainable, sets of these discs may be obtained from the writer.

It can be seen that practically any resistance can be secured just by counting the number of discs to be mounted on the rods. The writer used 10/32 threaded brass rod, over which spaghetti of proper size was used to fit within the ¼" disc holes. Then discs were mounted on the high (live) input side, and ten 2.50 discs plus one 1.25 ohm disc on the ground side. This gives a total of 51.25 ohms for 51.5 ohm circuits and thus inaccuracy is negligible for practical measurements. As these discs came in 2.50 and 1.25 ohm resistances it is possible to come within 0.625 ohm of any desired termination resistance.

The principle of operation, as seen from the diagram, is essentially that of a capacitive voltage divider with an extremely small condenser in the live (high) leg. This is the type of high-frequency divider made so popular for measurements by *General Radio Co.* many years ago, and used in the input circuit of the "Chanalyst" for h.f. voltage attenuation.

The constants were chosen carefully for the purpose in mind. The extremely low capacity in the high leg of the divider is the determining factor which contributes to the wide frequency range and allows such a high frequency determination without appreciable error. The writer used 5 $\mu\mu$fd. after considerable theoretical analysis and found it so completely reliable and suitable that experimentation with other values seemed futile (as so many other factors had to be considered and changed subsequently). Briefly, however, this value was chosen as less capacity was considered unstable and more capacity would affect the standing wave ratio which was to be kept to a minimum. In addition the frequency discrimination might become critical.

The other series condenser in the voltage dividing network is an 0.25 μfd. unit (*Sprague*) which must be reasonably new and have a very high resistance. 100 to 200 megohms is satisfactory for this condenser.

Across this 0.25 μfd. condenser, the low side of which is grounded to the low side of the load resistor, ground bus and case, 83-1R shell, etc., is the 1N34 crystal rectifier. That is, the 1N34 crystal is directly in parallel with the 0.25 μfd. condenser. In parallel with both of these components is the resistive voltage dividing network for the meter indication.

This network consists of two resistors. One is in shunt across the meter itself, and in this case was arbitrarily made 100 ohms, 1 watt. The series resistor in combination with this shunt combination governs the meter range. With the resistances, crystal, condensers, and meter used by the writer, for 10 watts full-scale this series resistor was 10,000 ohms. A 5%, 1-watt, resistor was used.

It can be readily seen that once the meter is calibrated for one range and the value of the series resistor determined, other ranges can be calculated so the cut and try for these other ranges can be reduced to a minimum for accurate calibration.

The old trick of using a higher resistance in shunt with the series resistor chosen to reduce its resistance, or a very low 1-watt resistor value in series to increase it, will provide as accurate calibration as the constructor wishes.

For 100 watts full-scale the series resistor will be around 100,000 ohms. The 1-watt resistors were found completely adequate. And while on the topic of the adequacy of the resistors, it might be well to mention the power ranges which the meter can handle and the caution which should be exercised.

On 20 watts, the meter can be used continuously. The writer has even used it for a few hours at a time on 80 watts without any discernible heating. On wattages greater than 100, it has been found that eventually the element will heat up, although the resistance change under heat was not evident. Even on up to 500 watts it can be used for periods up to 6 to 10 minutes without getting more than lukewarm.

Back to the construction, the insulation for the high side of the 10/32 brass rod running through the discs (in order to further reduce the capacity and leakage to ground) is comprised of two polystyrene standoffs 1" long x ¾" diameter, threaded 10/32 (tapped) both ends for ⅜" depth.

The two carbon stacks are connected together at the rear end by two #6 a.c. cable connectors with #8 solid copper wire run into both. The whole combination is soldered together with plenty of solder to make a good solid low resistance joint.

The ends of each carbon stack (except the ground end of one) must be insulated from the compression nuts on the rod ends with fiber bushings. All wiring is kept as direct and short as possible.

The 1N34 rectifier was placed across the very low impedance circuit in

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3-Gang Broadcast Band Permeability tuner. Was $3.50. Now $1.50.

Eliminate the danger of fatal shock. Use our G.E. Interlock Safety Switches priced at only $1.00 each.

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Consists of 2 condensers and powdered iron core choke connected in filter network. Same as used in most jukeboxes. Connects instantly between pick-up and amplifier.....$2.00

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Latest type PM Speaker in a fully-enclosed metal cabinet. Speaker and case match communication receivers, in addition make perfect intercom remote stations, $4.50. Including output transformer $4.95.

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TWIN COAXIAL CABLE *at a Sensational Price*

Two No. 12 stranded conductors within a copper shielded, vinyl jacketed, polythylene core. Can handle over 5 KW. of R.F. power. The ideal TV leadin for the most exacting installations such as apartment house antenna systems. Perfect for any twinax use calling for cable within the range of 70 to 95 ohm nominal impedance. Regular price 72c per ft. Your cost **$15.00** per hundred feet. Ask for RG-57U.

RG-59U 72 Ohm Coax. The most popular TV type. Regular price 17c per ft. Your cost **5c** per ft. or **$4.50** per C.

LINE FILTERS—Each unit contains two 4 Mfd. oil filled condensers and a high inductance 50 Amp choke in fully shielded case. Suitable heavy current connectors are provided to attach to the input and output connectors at each end of the filter from your input and output wires. A filter with innumerable uses on oil burners, refrigerators, boats, automobiles and wherever noise is to be suppressed or interference abolished. A $17.00 value for **$2.98.**

SUPER SPECIAL

FAIRCHILD POWER UNITS. Our quantity of these is too limited to justify the space required by a photo, but each unit is brand new, contains 9 tubes which alone have a total value of $15.00; 8 electric motors or generators, 6 of which are of the permanent magnet field type; relays; and 20 valuable Precision resistors plus a multitude of the ordinary kind, in addition to many condensers and potentiometers. All for only $14.95. We will ship but one to a customer while our small quantity lasts.

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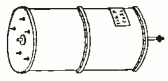
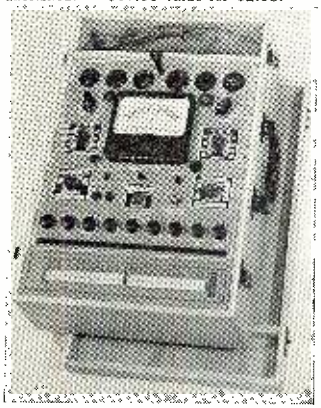
LAPEL MIKES — T-32 MIKE (Specify whether carbon or magnetic) 93c with desk or table stand $2.95

$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.



SOS EMERGENCY TRANSMITTER

- Famous Gibson Girl Transmitter that saved so many lives during the war. Distress call transmitter for boats and airplanes. No external power supply required for operation. It is merely necessary to turn the crank on the top of the transmitter and power is generated and the distress signal is automatically sent out on international distress frequency. Brand New Gibson Girl Transmitter complete with tubes, **$9.95.**

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For Gibson Girl transmitter, 300 ft. antenna wire, 2 balloons, 2 hydrogen generators, box kite for windy weather, searchlight. Complete kit.

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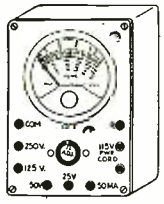
Sensational Value in AC-DC POCKET TESTER



This analyzer features a sensitive repulsion type meter in bakelite case. The result of 15 years in the instrument field by a large company specializing in electronic test equipment. Specifications of the AC-DC Model Volt-Ohm-Milliameter: AC-Volts 0-25, 50, 125, 250; DC Volts—0-25, 50, 125, 250; Milliamperes AC—0 to 50; DC Milliamperes—0 to 50; Ohms Full Scale —100,000; Ohms Center Scale—2400; Capacity—.05 to 15 Mfd. Total Price, prepaid in the USA—**$7.00.** Similar DC Meter, without the AC operated ranges of above, **$5.50** prepaid.

NO FOOLING

A real professional serviceman's tube analyzer that makes it possible to predict the life expectancy of a tube. The new, different, sensational 1950 Model Dynamic Mutual Conductance Tube Tester checks all tubes for gas, microphonics, hum, emission, shorts and mutual conductance in microhms. Detects more weak tubes. Unexcelled in accuracy. Completely new switching arrangement that is really obsolescence proof. Imagine the exclusive advantage of a tube tester with the astounding ability to instantly test future tube types or tube types not listed on the built-in roll chart. No other tester can make such a claim!!!! Portable Model **$68.50;** Counter Model **$64.50.**

Brand new APN1 Altimeters. Both 24 volt and 12 volt models available. Not just chassis, but complete with everything. Original factory packing. Descriptive literature on request. **$45.00 and $75.00.**

FCC AUTHORIZES RADIO FOR PRIVATE SERVICE!!!!

(The FCC announced that effective June 1, any American over 18 years of age is eligible for a 5 year station permit. In the "Citizens" band, neither code test nor technical knowledge is necessary.)

GENERAL ELECTRIC 15 TUBE TRANSMITTER-RECEIVER SET. This brand new 15 tube transmitter-receiver was designed for mobile storage battery powered service. It will operate in the "Citizens" band where no amateur license to transmit is necessary. It's a cinch for any experimenter to connect this unit for 110V AC operation by following the instructions and diagrams supplied, which cover numerous applications, including television. For those intending to use on car or boat, a new dynamotor, exactly as originally supplied, costs only $15.00. Don't fail to write for FREE descriptive bulletin. Order our RT-1248 for only **$29.95,** or **two** for **$53.90.**

Bayonet type radio pilot light sockets. $5.00 a hundred. Mazda licensed bulbs, per 10. **50c.**

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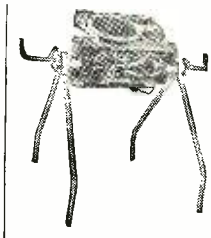

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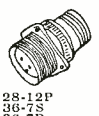
Pays for itself in a week—Saves and eliminates broken tubes, coils, dials, etc. Cadmium plated steel, finger-tip control. A necessity for Television Service. Your Cost.....$4.69

"AN" Government approved connectors built to Army-Navy specifications. Most complete stock in U.S.A. Inserts interchangeable between plugs and receptacles. Many besides those listed.



3100

28-12P
36-7S
36-7P
20-1S
20-1P
32-6P
20-22S
24-10S
28-16S
24-7S
18-2P
24-4S
20-13S
20-9P
18-1P
18-4S
36-15S
22-18P
18-12S
12-5P
20-19S
18-8P
24-5S
24-7P
20-11S
20-3S
20-8S
32-9S
32-18P
12S-4S
16S-1S
28-16S

3101

14S-5P
16S-6S

3102

18-10S
18-11S
20-24S
14-3S
16-7S
16-11P
24-11P
24-4S
18-8S
14S-1P
14-3P
16S-4S
16S-5P
16S-10P
18-12P
20-3P
20-8P
3-160
32-6P

3106

32-101S
28-9P
20-19P
10S-2S
12S-4P
20-8S
18-22
20-24P
20-11P
20-3P
18-13S
16S-7P
16S-1P
16-7S
8S-1S
18-11P
20-27S
20-9S
20-9P
12-5S
28-12S
18-4P
32-1S
18-3S
16-11S
16-11P
32-9P
14S-7P
18-1S
18-1P
14S-1S
18-20S
24-7S
18-12P
22-18S
24-4P
24-10P
20-1S
22-14S
22-10P
24-28S
18-11S
20-22P
12-5P
22-30P
16-11S
22-
10-15S
18-8S
22-30P
22-14S
12S-4P
14S-2S
16S-1S
16S-8S
18-12S
18-12S
20-3P
18-5S
18-19
16S-4S
22-2S
22-12S
20-23P
20-23S

3108

12-5P
22-30P
22-8S
12S-3S
16-11S
22-8S
10-15S
18-8S
22-30P
22-14S
12S-4P
14S-2S
16S-1S
16S-8S
18-12S
28-15P
14S-2S
16S-8S—No.1
16S-8S—No.2
28-1P
28-15P

PL Numbers

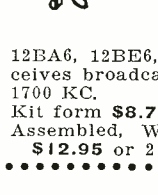
PL63
PL74
PL103
PL108
PL112
PL121
PL151
PL152
PL169
PL171
PL175
PL181
PL228
PL263

97-5107

28-7S

All Price Quotations Based on Quantity Ordered

DELUXE SUPERHET A.C.-D.C. RADIO KIT



Extra high quality standard production line radio in kit form with complete instructions. Features 2 iron core I.F. transformers, a 2 gang condenser, and polyethylene insulated edgewise wound antenna loop. Tubes include 12AT6, 12BA6, 12BE6, 50B5 & 35W4. Receives broadcast band from 550 to 1700 KC.

Kit form **$8.75** or 2 for....**$17.00**

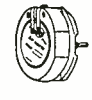
Assembled, Wired & tested **$12.95** or 2 for..... **25.00**

MOTOR DRIVEN Bandswitching Tuning Turret

4 bands above 100 Mc. ±14 silver plated coil wire. Tuning condensers, driving motor diagram included. Only **$2.95.**

POWER RHEOSTAT

- Exceptionally Rugged. Trouble-free design. Withstands severe overloading to many times 25 watt rating without burning or smoking. Perfect motor speed control or line voltage adjuster. 3 sizes available: 50, 60 and 200 ohms. Regular price $5.20. Special—**$1.00.**



order that the voltage across the rectifier would be within its limit of 40 to 50 volts. The total voltage necessary at 20 watts on a $P = E^2/R$ basis would be equal to the square root of $P \times R$ or about 30 volts, since P is 20 watts and R approximately 50 ohms.

For 10 watts, on the basis of the capacitive voltage divider, the ratio would be 1/50,000 of 22 volts. On the basis of the d.c. voltage division across the resistive network, the ratio across the meter would be 1/100, therefore the voltage appearing across the meter would be approximately $1.4 \times 1/5{,}000{,}000$ of 22 volts (a.c.).

In the design and calibration of the original model, the full-scale values were purposely held low to prevent meter burnouts in experimentation, for fear that the transmitters on which this was checked might exceed their normal rated output, which may occur when all components are new and in extra-good condition.

Light-bulbs were used as comparisons, each one properly matched to the transmitter. The illumination was then recorded on a grease-spot photometer standard. (Full details on this simple box-on-yardstick type of photometer can be secured from any good elementary physics book, and constructed for less than a dollar). The power output was recorded. Then the transmitter was connected to the power output meter and a meter recording was made. By varying the power output of a transmitter and making various recordings, a calibrated scale for the meter can be drawn (on the basis of 0-1 ma. scale).

When a 1 ma. meter is used there is a slight crowding at the low end of the scale due to the nonlinearity of the rectifier. This is not serious and for most uses may be disregarded. If desired, a new scale calibrated against a standard may be used, and pasted over the meter face. —30—

MICROPHONE ADAPTER

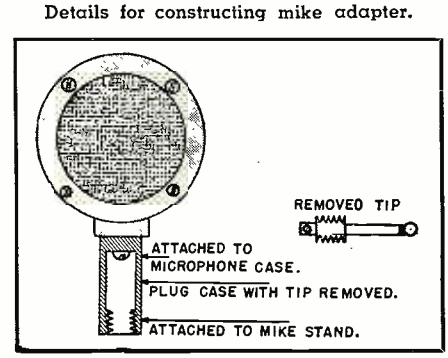
By G. MARKHAM

HERE is a hint that I thought worth passing on to your readers.

If a microphone adapter is not available, a satisfactory one can be made by using the screw-on case from an old jack plug, an item usually found in most junk boxes.

The back end is attached to the microphone case and the threaded end will fit most types of microphone stands. —30—

Details for constructing mike adapter.



TV Generator

(*Continued from page* 51)

crystal-controlled oscillator is half of a 12AU7 tube, V_{1a}. The output of this oscillator is taken off at two places, the cathode (for direct use as vertical lines), and the plate (for use as trigger voltage in the frequency divider chain). Note that a 1N34 crystal is used across the cathode take-off choke, RFC_1. The purpose of this crystal is to shape the pulse for fine sharp lines on the crosshatch pattern. On the plate side, C_3 couples the 219.24 kc. output to a buffer amplifier (half of a 12AT7, V_2). The amplified 219.24 kc. is used to trigger the multivibrator V_3, a 12AT7 tube operating at one-half the fundamental frequency of the crystal-controlled oscillator. C_9, a trimmer condenser, is an internal factory adjustment of the multivibrator frequency. The 109.62 kc. from V_3 is then fed back (through C_5) to the right hand section of V_2 which is operating, in this case, as another buffer amplifier.

The amplified 109.62 kc. is coupled through C_7 into V_{1b}, a blocking oscillator, operating at 1/7 of 109.62 kc. This half of a 12AU7 generates 15.66 kc. which is used as horizontal sync for the television receiver (coupled into the mixer through C_{18}) and is also used as a trigger pulse for a multivibrator operating at 1/29 frequency (540 cycles). The trigger pulse for V_6, the 540 cycle multivibrator, is coupled through C_{19}. R_{19} is a potentiometer, adjusted at the factory, which determines the frequency of V_{1b}. R_{35} is an adjustment of the 540 cycle multivibrator and is accessible through an opening in the back of the instrument. This 540 cycle output gives the 9 horizontal lines that appear on the television screen.

V_5, a 12AU7, is used as a mixer for the three signals that must modulate the main oscillator, V_4. Note that the output selector, S_1, has a standby position that removes "B plus" from the tubes. Filaments of the tubes can be kept hot while the instrument is inoperative. This is a handy feature since the 620 should be allowed to come to operating temperatures before adjustments are attempted on the receiver. The next position on the switch allows the output of V_6, the 540 cycle multivibrator to be coupled through C_{24} and R_{28} into the right hand section of the mixer. Note that in this position, the cathode signal from V_{1a} is open so that only horizontal lines and the 15.66 kc. sync pulse will modulate the oscillator. In the next position of the switch marked *"Vert Line,"* the output of the 540 cycle oscillator is not coupled into the mixer, but a connection is made from the 219.24 kc. cathode take-off on V_{1a}. This allows the signal to be fed into the cathode on the left hand section of the mixer tube, V_5. This will allow the vertical lines to appear on the

screen of the television receiver. In the next position, "*Cross Hatch*," both the 540 cycles and the 219.24 kc. are allowed to modulate the main oscillator, V_4.

The novel method of mixing in this circuit is interesting. Note that the 219.24 kc. (vertical lines) feeds into the left hand section of V_5 through the cathode. The 15.66 kc. output of the blocking oscillator V_1b (horizontal sync) is fed into the grid of this same section. The mixed output of these two signals is then coupled (through C_{21}) into the grid of the right hand section of V_5. Here it is mixed with the output of the 540 cycle multivibrator, V_6 (horizontal lines). The composite signal is then used to modulate the r.f. oscillator V_4. The output of V_4 (which tunes through the low frequency television channels) can then be used as a signal to the television receiver being adjusted. Since the output is r.f. in the television band, the crosshatch can be injected by a loose coupling to the 300-ohm antenna lead. If a coax input is used, the crosshatch can be injected at the antenna terminals of the receiver. —30—

Mac's Service Shop

(*Continued from page* 56)

screwdriver with a flexible shaft; but usually I slide the chassis out until I can reach the trimmer, give it an eighth of a turn, and slide the chassis back in. I keep doing this until the output meter shows the maximum reading with everything in place. In order to keep my temper during the tedious process, I play a little game in which I imagine various accidents befalling the muscle-head who designed the set. Falling into a vat of boiling transformer oil is one of the less-gruesome of these pictures."

"How's about those storage battery portables over there in the corner? Do they have any peculiarities I ought to know?"

"Plenty of them; and not the least important is *never* to do what the owner did to that one on the end of the bench: put in a heavier-than-recommended fuse. These sets have a small voltage-dropping transformer and a couple of copper-oxide rectifier assemblies hooked in a full-wave rectifying circuit to keep the two-volt storage battery charged. Occasionally one of the rectifiers shorts out, and then the quarter-ampere fuse in the primary of the transformer is supposed to blow and prevent damage.

"This man found the fuse blown, and a new ¼ ampere fuse went out, too; so he simply put in a one-ampere fuse and put the set on charge. By the time he saw the smoke curling out of the cabinet the damage was done. Now he needs a new rectifier and a new transformer."

"And a new ¼ ampere fuse," Barney added; "but how can you check one of these rectifier assemblies for short?"

"After you disconnect them, an ohm-

meter will do the trick. In the conducting direction, they will show almost a dead short; but they should show a resistance of at least 300 ohms in the opposite direction. If they are shorted, of course, they show a very low resistance in either direction. Incidentally, I never replace just one of the rectifier assemblies at a time. It is good insurance to replace them both when one goes bad.

"Finally, there is the matter of the two-volt vibrators. As you know, I am ordinarily opposed to tinkering with vibrators, for as you read in that *MYE Technical Manual* I told you to take home, these gadgets are precision-made and carefully adjusted at the factory with special equipment that the service technician does not have. However, on several occasions I have run into these two-volt vibrators that only operated a few days and then stopped vibrating. By experimenting, I found that the points that were normally supposed to be closed when the reed was at rest were not quite making contact. A slight clockwise adjustment of a screw found at the base of the reed restored the vibrator to action. Careful checks over periods of three and four years showed no later failures of these adjusted units; so I have no hesitancy about making this adjustment on vibrators that do not show excessive wear, burned and pitted points, etc.

"I made up that little adapter there on the bench that allows the vibrator to be in action while it is raised up out of its shield can until I can attach the scope leads to it and also reach the adjusting screw. As you see, the adapter is just an old vibrator base with a vibrator socket mounted on pillars about six inches directly above it and with heavy leads connecting the lower pins to the corresponding upper socket connections.

"The scope should always be used, for it allows you to set the adjusting screw for the optimum pattern as shown in the *MYE Technical Manual;* on top of that, it will show up any other troubles that may be present, such as a leaky buffer condenser."

"Hey, Boss," Barney interrupted, "I think I feel another attack coming on. Maybe I had better go home now."

"Oh no you don't!" Mac exclaimed. "You just grab your soldering iron and see what wonderful curative powers a little hard work has. It will surprise a fellow like you who has never tried it!"

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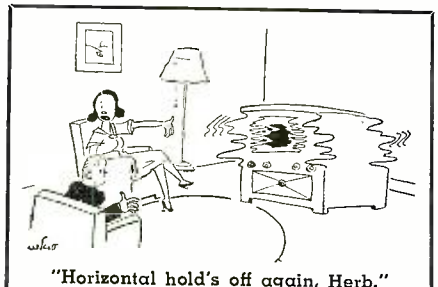


"Horizontal hold's off again, Herb."

Design Considerations

(*Continued from page 53*)

their well-known curves showing this effect, will not be covered in great detail here.

These curves do show, however, that as the over-all volume decreases the ear becomes less sensitive to low frequencies; at the threshold of audibility the bass sensitivity falls off below 800 c.p.s. at the rate of 12 db. per octave. At moderate levels this rate is approximately 6 db. per octave. If the system is to be used at several listening levels, means should be provided for adjusting the low frequency response according to variations in level. This is best accomplished by using an aurally compensated gain control such as *Tech Products* #PB-722 or *Livingston Electronics* Type MB loudness control. Greater flexibility is possible, however, by designing the proper characteristic into the bass control.

So much for the general departure from flat amplifier response, but why, you may ask, must we have flat response to begin with? Why must it be flat $\pm$ *X* db. or *Y* db.? If the average ear cannot perceive changes in level of less than 3 db., why should any amplifier be made better than perhaps $\pm$ 1.5 db.? These questions are important factors in audio philosophy; if the answers are known, a much more intelligent approach can be made to many amplifier design problems.

If a complex audio wave (Fig. 2A) is passed through a system with nonlinear frequency response characteristics, its higher frequencies will bear a different amplitude relationship to the lower frequencies and the "tone color" may be markedly changed as in Fig. 2B (resulting from the curve of Fig. 1C, or Fig. 2D resulting from the curves of Figs. 1D and 1E). This analysis indicates that a gradual tilt of the response curve is not nearly as serious as a sharp, resonant peak or dip. Experience bears this out, for the slope of the curve can be tilted in many ways; but as long as tonal balance is maintained, the ear is not greatly offended.

A greater problem is the condition under which a random band of frequencies such as record surface noise, FM or tube hiss, static, etc., passes through a system with a peak. That peak will amplify a relatively narrow band of frequencies more than the rest of the signal. The result is a decrease in the effective signal-to-noise ratio.

Generally, it may be said that in addition to properly balanced frequency characteristics a good system must be reasonably free of peaks and dips. I speak here of the entire system. A ½ db. dip at 2000 c.p.s. at three different points of the system means a total dip of 1½ db. Many parts of a system (microphone, mix-

ing panels, studio acoustics, recording heads, loudspeakers, etc.) are beyond the control of the individual designer. The more uniform he can make the response of his part of the system the greater guarantee he will have of faithful reproduction of the original sound.

Power Output Requirements

A rather involved and generally misunderstood audio concept concerns the power output rating of an amplifier and the power required to furnish a comfortable level in the average home.

The power output of an amplifier is frequently used as a figure of merit; it is as useless a figure as the maximum speed rating of an automobile. The average listener would no more use 30 watts of audio power than he would drive his automobile at 95 miles an hour. Of course, that reserve power is a nice thing to have available, but when it doubles the cost of equipment one may certainly inquire as to its value.

Measure the voltage across the speaker terminals in your living-room radio while the family is listening at a customary volume and you will readily see what is meant. The power formula $P = E^2/R$ indicates that four volts into an 8 ohm voice coil will produce 2 watts of power. You will be more likely to find fractions of a volt than you will 4 volts. Assuming that your radio will deliver two watts and that your family won't object to the unusual volume, adjust the volume control to deliver four volts of peak power and listen to the way two watts sounds.

Reduce the output to two volts and see if you can detect the 6 db. difference in the resulting ½ watt of power. Go even further—check the level with 4 volts and with 1 volt, a difference between 2 watts and ⅛ watt. The same effective 16 to 1 power difference would be true for a 2 watt amplifier and a 32 watt amplifier. Surprising, isn't it?

Although your individual requirements may call for large amounts of power, these experiments should prove that there are certain fundamentals which some slide rule theorists overlook when they say that one must have 20 to 30 watts of power to faithfully reproduce the impact of a symphony orchestra or the wallop of 18 hep be-bop artists. Variations of 6 to 10 db. between various types of speakers make any specific amplifier power rating meaningless since it is possible, with a highly efficient speaker, to produce more acoustic watts with 3 watts of electrical power than 20 watts (of electrical power) would produce with an inefficient speaker.

It should be pointed out here that in the special case where bass or treble boost is used to compensate for speaker system deficiencies (Figs. 1D and 1E), the total power will have to be raised to deliver the same

acoustic power at the peak of the curve as is delivered to the lowest point on the curve. In the case previously illustrated, where 25 db. total is used to compensate for speaker losses, it will be necessary to provide 25 db. more power to produce an equivalent volume. Obviously this presents a special problem and it should be seen that careful planning of the entire system is essential to good design.

The greatest dynamic range of the system will be the difference between the maximum undistorted power output and the hum and noise level. A more accurate expression of dynamic range is the difference between maximum power delivered with the volume control at its normal setting and the hum and noise level existing at that particular setting. To be inaudible, the amplifier hum and noise level should be 60 to 75 db. below a 10 watt power level when a high efficiency speaker is used. With less efficient speakers, particularly when the speaker system has a high and low frequency droop, 30 to 50 db. may suffice.

Controls

One of the major considerations of amplifier design concerns panel controls. These may include any of the following:

Master gain, mixing, plate, filament and a.c. master switches, program selector switches, bass and treble, recording turnover and equalizer, expansion, compression, and noise suppression, switching facilities for maintenance metering, power switching for phono motors and other auxiliary equipment, and any other beneficial control that the specific application requires.

These considerations must be based on the purpose for which the equipment is to be built and their selection will govern the electronic design to follow. *(To be continued)*

HIGHER EFFICIENCY FOR LOOP ANTENNAS

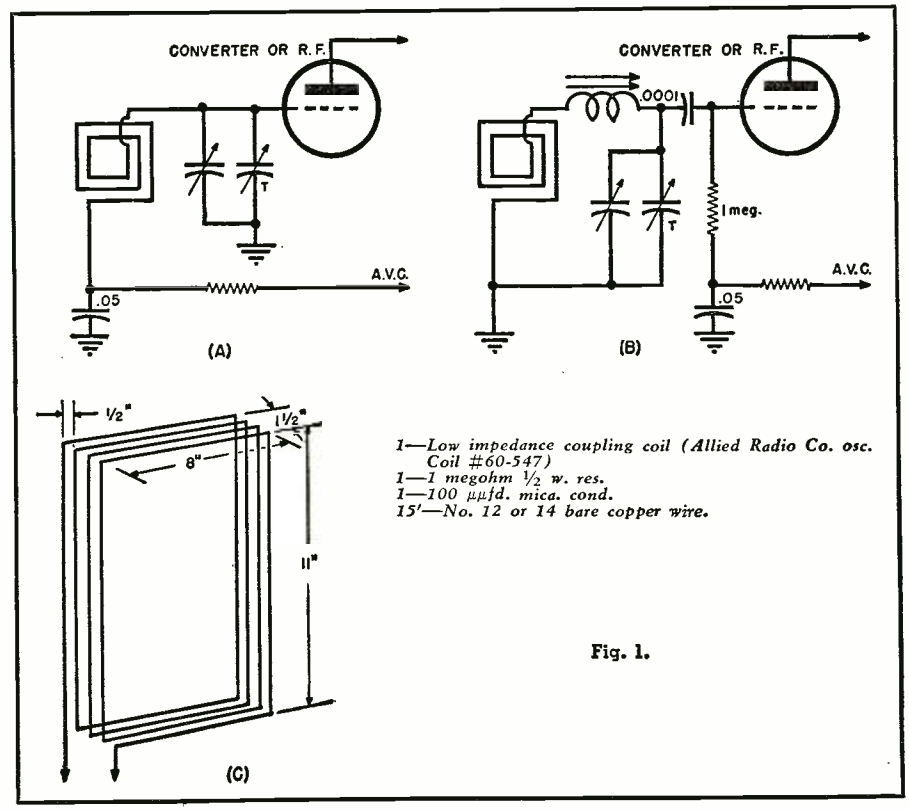
By WILBUR J. HANTZ

THE smaller radios equipped with built in loop antennas which are usually of the high impedance type could be made to perform much better if pains were taken to install a low impedance loop. It is very true that this type of loop is not so readily available and neither is the low impedance coupling coil that must be used with it. However, it is a simple matter to construct the loop, and the coupling coil (connected in series with the loop) is easy to find if you know where to look.

The particular coupling coil, as specified in parts list, was chosen because of its low impedance windings and adjustable iron core slug. It will provide proper coupling between the loop and the grid circuit of the tube.

Only the secondary or grid winding is used on the coil. This same circuit was used on a Zenith radio, model 6D815, and the results were more than satisfactory.

The loop was wound of bare copper wire in the shape of a rectangle 11x8 inches and is self-supporting. It had four turns spaced about ½ inch for each turn. In Fig. 1 is shown a conventional loop circuit and the changes necessary. This should be self-explanatory. —30—



1—Low impedance coupling coil (Allied Radio Co. osc. Coil #60-547)
1—1 megohm ½ w. res.
1—100 μμfd. mica. cond.
15'—No. 12 or 14 bare copper wire.

Fig. 1.

Technical BOOKS

"THE RECORDING AND REPRODUCTION OF SOUND" by Oliver Read. Published by *Howard W. Sams & Co., Inc.*, Indianapolis. 358 pages. Price $5.00. (Second Printing.)

This comprehensive text on all phases of the recording art contains much valuable information for both the professional and amateur recordist.

Where other books have limited their treatments to one phase of the recording medium, this volume covers wire, tape, film, and disc recording.

Beginning with an elementary and non-technical discussion of the behavior of sound waves, the author continues with a brief history of acoustical recording. The next four chapters are devoted to a discussion and an analysis of the basic recording methods and a description of lateral disc recording techniques, sound on wire and tape, and magnetic tape recorders. Space is devoted to the decibel, reproducers, filter networks, tone controls, attenuators and mixer controls, amplification, and audio amplifier measurements. An entire chapter is devoted to Microgroove and LP records.

The final chapter reproduces the "Proposed NAB Recording and Reproducing Standards," and the *American Standards Association's* "Acoustical Terminology" standard. The appendix contains many valuable charts and tables needed by the practical recordist.

For practical recording work, this text should prove to be a valuable addition to the recordist's library.

* * *

"THE BUSINESS HELPER" by Leslie C. Rucker. Published by *John F. Rider Publisher, Inc.*, New York. 133 pages. Price $2.00.

This handy little book packs a lot of good common sense into its 133 pages. It is written by a practical businessman who has had experience "on both sides of the counter."

Presented in a breezy, man-to-man style, the text covers such important points as the types of businesses, locations, customers and how to handle them, buying and stocking the store, selling, estimating for service type businesses, contracts, overhead, banking, bookkeeping, collections, advertising, employees, insurance, new business, partnerships, the use of the telephone as a business aide, being identified with associations and clubs as a business stimulus and credit.

The book is thoroughly readable and completely practical. It makes no pretentions of being the complete guide to business success but the points covered are well worth noting.

* * *

"THE RADIO HANDBOOK" edited by R. L. Dawley. Published by *Editors and Engineers, Ltd.*, Santa Barbara,

California. 310 pages. Price $3.00 (Twelfth Edition).

The latest edition of this well-known radio text is an all-constructional work which neither duplicates nor supersedes the Eleventh Edition released some time ago.

Complete and easy-to-follow instructions are given on the construction of antennas, power supplies, exciters and low power transmitters, test and measurement equipment, receiving equipment, high frequency power amplifiers, mobile equipment, single sideband and FM exciter transmitters, speech and amplitude modulation equipment, and transmitting equipment. Pertinent data on TV and broadcast interference, and mobile installations, as well as a listing of amateur station operating conveniences are also given.

The book is clearly written and lavishly illustrated with diagrams and photographs. Recognizing the importance of war surplus equipment to the amateur, the editors have wisely included several pieces of equipment which can be converted for use by the ham.

Service technicians, amateurs, experimenters, and hobbyists should all find this book rewarding and useful.

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HAMFEST

THE Central Wisconsin Amateur Radio Club is holding its second annual banquet and hamfest at the Elk's Club in Wisconsin Rapids, Saturday, April 29th.

The banquet is scheduled to begin promptly at 7:00 p.m. Reservations and further information are available from the secretary of the organization, Edward Fleisner, W9PIW, 1891 Riverview Drive, Wisconsin Rapids, Wis. —30—

ANNUAL PARTY

THE Delaware Valley Radio Association will sponsor its sixth annual "Old Timers' Nite" and banquet on Saturday April 15th. The affair will be held in the Terrace Room of the Hotel Stacy-Trent, West State and Willow Streets, in downtown Trenton, New Jersey. A turkey dinner will be served promptly at 6:30.

Guest speakers will include many personalities from all branches of radio, such as prominent old timers famous in the field of wireless and allied branches of the art. As in the past there will be a "Grand OM" award to the old timer whose experience in radio dates back the greatest number of years. There will also be prizes for the oldest commercial and amateur licenses submitted to the judges. Persons attending the affair are urged to bring along their ham and commercial tickets in order to participate in this competition.

ZI's famous collection of oldtime radio gear will be on display and there will be door prizes and other awards. Reservations should be made before April 8th. Tickets are $5.00 a head and should be purchased from Ed Raser, W2ZI, 315 Beechwood Avenue, Trenton, New Jersey. For latecomers, the tickets will be $6.00 at the door. As usual, the party will be stag. —30—

Spot Radio News

(*Continued from page 18*)

now used. *CBS* conceded, RMA pointed out, that there would be a 45 per-cent reduction in the ability to portray detail, which was certainly a step backward as far as picture quality is concerned.

The reorganized National Television System Committee, also described widely in bulletins released prior to the sessions, was discussed at length in the official halls. This group also fostered the development of a commercially practicable system of color TV, and offered vital statistics disclosing why the freeze should be removed immediately and how the ultra-high channels could be allocated to fit within the framework of the present very-high system.

Evidence of blistering testimony which would be heard as the days rolled on, hit the hearing room, as excerpts from earlier talks by Dr. Allen B. DuMont and others were released. Appearing before a group of eight Washington legislators, representing New Jersey, at a breakfast meeting in the Mayflower Hotel, Dr. DuMont had charged that the Commission had interfered seriously with progress of the art by the continuance of the freeze. Criticizing, in particular, the two gentlemen who appeared to be color's most ardent supporters, Senator Edwin C. Johnson and Commissioner Robert F. Jones, Dr. DuMont said: "The Commissioner condemns private interests because these interests think it would be a grave mistake to foist an unsatisfactory color system on the American public. He condemns the more than 100 manufacturers of receivers, television broadcasters, and the manufacturers of transmitting equipment, because we think it a criminal mistake to make the future allocation of additional channels for black and white wait for a decision on the matter of color. A truly intelligent and lasting decision on this matter of color may take years and the spokesmen for our industry do not think that the American people will be willing or should be forced to wait these years to enjoy adequate television reception. . . . I should like to assure both the Senator and Commissioner that television broadcasters and manufacturers alike will reap tremendous benefits from a really good system of color television transmission and reception. If there were such a system in existence, every industry spokesman would be camped on the Commissioner's doorstep urging and pleading for the immediate adoption of standards."

A prior talk by Commissioner Jones, before the Lima Section of the AIEE, also left its volcanic rumble in the halls. Chiding industry, the FCC gentleman declared: "I am amazed at the present thinking of the executives in the radio business. They

have been getting credit for the great changes in radio since 1920. But frequently these changes are not due so much to the ingenuity of the executives of the large corporations, as to the characteristics of radio itself. It is an empirical art, and many who have no big commercial stake in the status quo experiment with it and are responsible for many of the developments. Whereas a year ago I credited the big executives with imaginative genius, I now realize after listening to the manner in which they have approached the introduction of polycasting, opening of the ultra-highs, utilizing FM transmissions and color television, that they have a negative approach until economic necessity drives them to pitching in and finding answers for the Commission, and, of course, for themselves."

Commenting on allocations, and particularly an earlier statement from Walter Evans of *Westinghouse,* which disclosed that one of the major problems faced by the art has been distribution which could be solved by Stratovision, once the larger metropolitan markets have been provided with service, the Commissioner said that this concept of large city service first, appears to be shared by industry. "To me, Stratovision is not something to be considered *after* the large cities have been taken care of in the allocation plan," he added. "It is something to be considered at the very same time that we are trying to allocate stations to the big cities. The order in which allocations are made should not be big cities first and little cities second. Provision should be made for affording service to all the cities at the same time. In other words, if engineering concepts like Stratovision are to really do the job that they potentially have within them, they will have to be considered on a sound engineering basis, uncontaminated by selfish economic interests, or they will fail to achieve their full potentiality. . . . By this I don't mean that economics can be completely removed from the allocations plan. Stations have to make money if they are to survive. But new economic ideas are certainly possible."

TV appears to have sparked some rather searing opinions, which will be bouncing about the rooms of Washington for quite a spell.

TV's problems also prompted Commander Webster of the FCC to issue a blast, this time against the approval to proceed with the *Phonevision* tests, which would provide selected film transmissions over a telephone circuit for a fee. In a sharp dissenting note, the Commissioner said that broadcasting has always been a free service to the listener and the first move to change it should not be made without a public hearing. Amplifying this opinion, he declared: "I do not believe that very much vision is required to see that if the Commission should authorize subscription television, and it should prove to be the most profitable method of operating a television station, that the best evening hours, every day in the week, will be devoted to subscription television, rather than to free television programming. . . . Every television station licensee will be clamoring for a subscription television franchise and will be pounding on the Commission's door for regulations insuring that there will be no discrimination in the issuance of such franchises or the rates therefore. . . . Television receiver owners will expect the Commission to promulgate rules which will provide to each listener a choice of some free television programs during the best listening hours and which will insure that the listener will be charged a reasonable and non-discriminatory fee for viewing television programs. . . . These considerations point to a common carrier type of regulation of subscription television, not to the broadcast type of regulation."

As this column is being written, plans for telephone-circuit tests are under way among 300 viewers, each to be selected by the sponsors of the system.

RADIO AND THE ART of navigation, an intensely interesting topic, served as the basis of a highly informative talk by Commissioner Webster before the Institute of Navigation in Washington. Describing one of the most striking postwar applications of radio toward the safety of navigation, radar, the Commissioner said that in the marine field alone there are 962 ships which are radar-equipped, with the number increasing daily, even though the installation is not required by law. Its use aboard vessels of all nations is also of considerable proportion, he added.

Commenting on the frequencies used in radar, the Commissioner pointed out: "Three bands of operating frequencies have been made available, namely the so-called 3000, 5000 and 10,000-megacycle bands. There has been much discussion in scientific circles, both internationally and nationally, concerning the relative efficiencies of these frequency bands. . . . Commercial radar equipment in the merchant marine is now divided —using an over-all figure—between the 3 and 10 megacycle bands in about the proportions of 60 and 40 per-cent, respectively. Up to the present time no 5000-megacycle equipment is being offered commercially. This is due apparently to the head start in the development of equipment capable of satisfactory technical operation in the 9000-megacycle band, with the attendant practical equipment advantages and greater precision, and the acceptance of the atmospheric attenuation, which it was earlier thought would make use of the band undesirable. . . . Propo-

nents of the 3000-megacycle radar stated that 10,000-megacycle radar would be easily blocked out by rain and snow. . . . On the other hand, the proponents of 10,000-megacycle radar said that 3000-cycle radar would not provide adequate definition. . . . Both types were provided for and we went further, providing a band of 5000 megacycles in the hopes that such a band would provide a compromise."

The use of radar for peacetime harbor surveillance was also described by the Commissioner. He pointed out that radar systems are being used as an aid to harbor navigation in Baltimore, Maryland and Long Beach, California, and San Francisco will probably have an installation soon.

Probing the problems which are still to be solved in harbor radar installations, the Commissioner declared that one particular problem at hand involves the methods which should be used to effect an exchange of information between shore-based radar and ships. "Obviously some means of radio communication will be required," he said, "but there is a question of what delay, if any, can be tolerated in such a system. . . . There is also the related question of the number of radio communication circuits required. . . . Another unsolved problem is how to identify accurately and with sufficient speed the individual ships which are seen on the radarscope. And finally there is the question of whether frequency assignments to shore-based radar should be different so as to avoid interference to ship radar."

Describing with enthusiastic satisfaction the significant advancements this country's engineers have achieved in radio aids to navigation, the Commissioner said: "The U. S. leads the world today insofar as *know-how* in the telecommunications field is concerned. . . . However, we must protect our ideas and insure that the huge sums which American concerns have spent will not be wiped out at an international conference, where in the bargaining process of diplomacy, some other country is better able to sell its wares to the rest of the world. . . . L.W.

Linearity Distortion

(*Continued from page* 55)

over a wide range of amplitudes and frequencies in audio amplifiers, while in associated electroacoustic equipment the problem is even more complicated.

A technique used by the author for rapid experimental and test work is to use an adaptation of the increasingly popular panoramic method of analysis. In this procedure, modulated wave trains are used to secure rapid amplitude variations over a range of thirty to forty db. An oscilloscope with calibrated screen is then used as a means of recognizing and measuring the departure from linearity of the equipment under test. One means of doing this is borrowed directly from the conventional procedure for checking the modulated output of radio transmitters. In this case the output of the equipment under test is applied to the vertical input of the oscilloscope and the modulating frequency applied to the horizontal axis. This results in the familiar triangular pattern and nonlinearity may be detected by irregularities in the sides of the triangle. This system, however has the disadvantages of requiring a modulator with low distortion and, in certain cases, such as testing recording and playback equipment, it may be difficult to secure proper phase relationships between the horizontal reference frequency and the output of the equipment under test.

A second, more flexible system, is to use a sweep amplitude generator. This device modulates an audio frequency carrier with a saw-tooth wave to provide an essentially triangular pattern such as shown on the accompanying photographs. In operation, the output of the generator is applied to the scope and the outline of the triangular pattern traced upon a celluloid mask which, in turn, may be marked with a convenient reference scale. The output of the equipment under test may then be applied to the scope and departures from the original trace noted. This system has the advantage that perfect triangular modulation and absolute linearity in the scope sweep circuits are not required as the tracing on the celluloid mask provides the reference basis for the system. Similarly, a logarithmic or semi-logarithmic test pattern might be used if desired.

The panoramic method makes it possible to observe the amplitude characteristics of an audio system in a few minutes by tuning an oscillator through the audio range. An eighty decibel characteristic may be analyzed in two ranges by this method. Some of the oscilloscope patterns obtained by this system are illustrated in the photographs.

The schematic shows the circuit of a simple sweep amplitude generator, comprising a saw-tooth oscillator and balanced modulator, and together with

the photograph illustrate the modest character of the unit. Controls shown are audio input level, modulation level, and modulator bias control. A separate potentiometer is located at the rear of the chassis to balance the two halves of the 6SN7 modulator. The circuit constants given are for a modulation rate of approximately twenty cycles per second, a range covered by nearly all oscilloscope sweep circuits, and permit the observation of a one-hundred cycle waveform although the distance between peaks makes it necessary to interpolate the linearity curve at low frequencies.

A separate audio oscillator is required and on the modulation percentage as well as the linearity of the modulation will depend the adjustment of the modulator bias control. The two halves of the 6SN7 should be balanced for maximum suppression of the transient produced by the saw-tooth wave. Provision is made for oscilloscope synchronization by coupling the oscilloscope sync input to the output of the saw-tooth generator through a small condenser. This allows a stable trace to be obtained when testing audio amplifiers or other equipment with relatively little phase shift, but is usually inefficient when a relatively large lag is concerned, such as in testing recording or other electroacoustic equipment.

In making tests with this technique, the recovery time, or transient characteristics, of the equipment under test should be considered. For example, if it is desired to examine the dynamic characteristics of a limiting amplifier by this method, the recovery time of the amplifier should be low or else modulations following the initial one will tend to show the characteristics of the system under constant compression. A similar phenomenon may sometimes be found in conventional amplifiers when amplitude peaks cause grid current flow or secondary emission to occur, with consequent gain variations over an appreciable period.

In conclusion, it should be noted that the ear itself is a nonlinear device, both with respect to amplitude and frequency, and is capable of perceiving sounds over a dynamic range greater than one hundred decibels. As a result, the accurate reproduction of the various components of a complex wave at their original relative intensity is a prerequisite of naturalness. Due to the characteristics of hearing, the linearity of a reproducing system may affect the apparent frequency response of the system as much as the static frequency response characteristics taken at an arbitrary level.

The increasing attention being paid to this subject is illustrated by the fact that one manufacturer now offers high quality loudspeakers with a power handling ratio of five million to one, and the audio constructor would be well advised to pay attention to this factor in endeavoring to secure good audio reproduction.

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What's New in Radio

(*Continued from page 82*)

The unit records for a full hour on a 1200 foot reel of tape with 30 minutes for each half of tape width. Recording speed is 7½ inches per second, with rewind speed 20 times as fast. Other features include a special speaker switch that permits muting the speaker when recording from microphone, and a constant speed capstan drive. Proper recording level is assured by the neon bulb level indicator.

The recorder comes complete with a built-in, high-gain amplifier and PM speaker for playback, and also has provision for connection to an external amplifier and speaker. The unit can also serve as a medium coverage p.a. system with an output of 5 watts.

NEW PACK SET

Motorola Inc. is currently marketing a new FM two-way pack radio which has been designed especially for use by law enforcement agencies, fire protection departments, construction companies, forestry services and similar operators of mobile two-way radio equipment.

The new unit incorporates a 16 tube receiver and an 8 tube transmitter into a compact 19 pound station which measures 10½" x 13" x 4⅝". The set

can be hand carried, back carried, or used as a semi-fixed installation.

Equipped with a tip-up loudspeaker and a patented adjustable squelch circuit, it will broadcast directly over the operator's shoulder when back carried, or to nearby working areas when the set is left stationary, yet remains quiet during standby periods.

The set is designed for operation in either the 25-50 mc. band or the 152-174 mc. band and is available in three versions, the single frequency transmitter and receiver; two-frequency transmitter, single receiver; and dual transmitter, single receiver. All come complete with batteries, antenna, and microphone.

DISC CONDENSERS

Erie Resistor Corporation of Erie, Pa., is now manufacturing a .01 μfd. disc Ceramicon in a new small size.

This new midget condenser measures only $19/32$" in diameter and has been designed for easy application in small spaces. According to the company, capacity of the new Ceramicon is .01 μfd. + 100%-0%. Voltage rating is 400 volts d.c., which is based on a life test of 800 volts d.c. at 85 degrees C for 1000 hours. The power factor is 2.5% maximum at 1 kc. at not more than 5 volts r.m.s. Insulation resistance is 7500 megohms minimum.

FREQUENCY RELAY

A line of 400 cycle frequency sensitive relays, designed for the protection of instruments, accessories, etc., from the effects of under frequency or over frequency, has been announced by *Varo Mfg. Co., Inc.* of Garland, Texas.

Known as the 900 series, these new units consistently operate with a frequency differential of ¼ of 1%. The pull-in and drop-out spread can be set from 2 to 40 c.p.s. to operate within ¼ of 1% of the two independent settings.

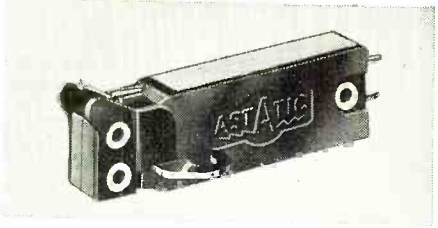
These relays are hermetically sealed against moisture, salt spray, fungus, and foreign matter. Multiple contacts may be used to either open or close a desired circuit. The design is said to be "fail-proof" inasmuch as a failure of the frequency sensitive relay removes all loads. The relay may be manually bypassed for emergency operation in case of relay failure.

PICKUP CARTRIDGE

A new development in miniature sized crystal phonograph pickup cartridges has been announced by *The Astatic Corporation* of Conneaut, Ohio.

Known as the "AC" series, these new units are said to provide exceptionally smooth response, better tracking characteristics, low needle talk, and assurance of long life for both needle and record.

There are four models in the "AC"



series. The Model AC-78 has a three-mil radius stylus tip, either precious metal or sapphire, for standard 78 r.p.m. records; Model AC, a one-mil stylus for narrow-groove, slow speed records, the Model AC-AG has the new All-Groove stylus for playing all three types of records, and the Model ACD, a turnover cartridge with dual needles to play narrow-groove records on one side and 78 r.p.m. on the other.

Frequency range is from 50 to 10,000 c.p.s. in all models. Needle pressure

of the AC model is 5 grams, the others six grams. Output at approximately 1000 c.p.s. is 1 volt.

RECORDING TAPE

Minnesota Mining and Manufacturing Co. of St. Paul 6, Minnesota, has developed and is marketing a new sound recording tape.

The new recording medium is a paper-backed tape that is said to provide better frequency response, lower noise level, and higher output than its predecessor. The tape, designed for home, school, and other non-professional use, is "Scotch" brand sound recording tape No. 101.

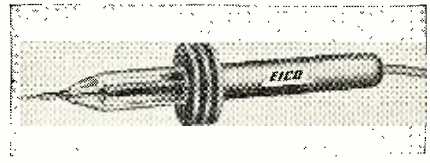
Its improved performance is said to be largely due to a new paper backing, and an improved binder which permits a smoother coating of oxide particles.

The new tape is made in 600 and 1200 foot lengths on both metal and plastic reels.

HIGH VOLTAGE PROBE

Electronic Instrument Company of 276 Newport Street, Brooklyn, New York, is currently marketing a new, low-cost high voltage probe which is capable of measuring up to 30,000 volts.

This probe, designed specifically for television service technicians, utilizes a special helical film, steatite rod



type, removable multiplier resistor.

Easily changed for various resistance values, the new *EICO* probe can be used with several different instruments. Both direct view and projection TV sets can be serviced with the unit. The probe matches most 20,000 ohm/volt meters as well as most v.t.v.m's now in use. Safety features include plywood bakelite handle and large guards for complete protection against flashovers.

The Model HVP-1 is being marketed through the company's regular parts jobbers.

DU MONT SCOPE

Allen B. Du Mont Laboratories, Inc. of Clifton, New Jersey, has recently introduced a new cathode-ray oscillograph, the Type 250-AH, which features an improved sweep circuit, fast sweep starting time, and high light output.

Recurrent, single, or driven sweep durations are continuously variable from 5 seconds to 10 microseconds. The cathode-ray beam rests at the left side of the screen, resulting in negligible sweep starting time on driven sweep. On the return cycle the trace is automatically blanked out. A Z-axis input is provided for intensity modulation.

The Type 250-AH uses a *Du Mont*

Type 5RP-A high voltage cathode-ray tube. The over-all accelerating potential for this tube, supplied by an external power supply, is 13,500 volts. This high potential makes possible the observation and photographing of high-speed signals recurring either at random or at slow, recurrent intervals.

Detailed information on this new oscillograph is available on request from the company.

EXPLOSION-PROOF SPEAKERS

Underwriters' Laboratories has granted approval to *University Loudspeakers, Inc.,* for two new hazardous duty speaker units.

Both models are complete reflex trumpet speakers with integral 25 watt driver unit and built-in multitap line matching transformer. The Model 7101 is *UL* approved for Class I, Group C and D which includes locations in which flammable volatile liquids, highly flammable gases, mixtures, or other flammable substances

are manufactured, used, handled, or stored. The Model 7102 is approved for Class I as well as Class II Group E, F, and G, which includes those locations in which combustible dust is thrown or suspended in air producing explosive mixtures, and in places where such dust may collect or settle on motors, lamps, or other electrical devices.

Specifications on the two models and complete details are available on request. Write to the company at 80 South Kensico Avenue, White Plains, N. Y.

MAGNEFILM UNIT

Movie-Mite Corporation, 1105 Truman Road, Kansas City 6, Missouri, has added a new magnetic film recorder to its line of sound photographic equipment.

Tradenamed the Magnefilm Recorder, the new unit is a synchronous motor-driven 16 mm. magnetic film recorder. The recorder can be used for location sound recording for film producers, radio stations, TV stations. The complete unit is housed in a single case.

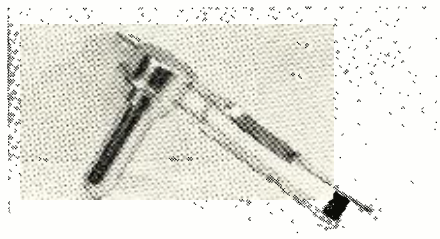
Complete specifications and performance data on the new film recorder are available from the company.

REPLACEABLE STYLUS

The *General Electric Company,* Syracuse, New York, has announced the availability of a modified replace-

able stylus assembly for use with its variable reluctance phonograph cartridge.

The new design, in which the horizontal stylus arm has been given a



double twist and is double damped, has been named the "Baton" stylus. As a result of this modification, the *GE* cartridge performs with much higher compliance and improved tracking ability, according to the company. The double damping greatly reduces needle talk, preventing it from being induced in the tone arm.

The modified stylus assembly, which fits any *GE* cartridge with the replaceable stylus feature, is currently being sold in new cartridges and as a replacement stylus.

NEW CONDENSERS

A new line of tubular paper condensers, the "Humidi-Seal" type, has been developed by *Pyramid Electric Company* of 155 Oxford Street, Paterson, New Jersey, for applications where high humidity and high temperatures are present.

The Type 85TOC condensers will operate at up to 85 degrees C and perform satisfactorily in television receivers, auto radios, etc., where high humidity might be a factor.

The outer tube is plastic impregnated to prevent moisture-absorption, and the ends are plastic sealed against moisture. The new line is available in seven different capacities ranging from .001 to .1 μfd. at 600 volts.

A data sheet is available on request.

-30-

ABC's Tape Recording

(*Continued from page* 41)

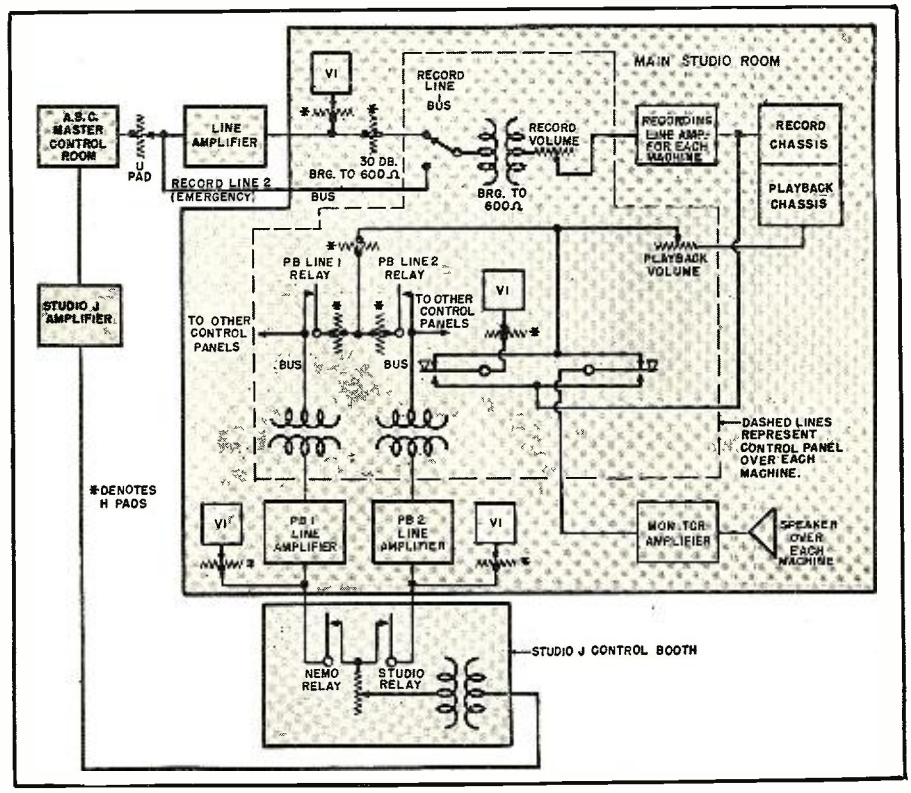
showed a life of 287 complete record-playback cycles.

When using the *Ampex* machine, tape is purchased in 5400 foot reels to allow about 34 minutes of recording. Tape speed is 30 inches per second, both for better fidelity, and to allow for ease in editing. The same size reels on *Stancil-Hoffman* machines will permit 67 minutes at a tape speed of 15 inches per second.

The recording day begins at 7 a.m. during Daylight Saving Time and runs for an average of 16½ hours per day. More network stations are fed from the delayed net than the regular net due to the limited use of Daylight Saving Time.

-30-

Fig. 1. Block diagram showing basic control and audio switching system. The PB line relays have "Preset" and "Operate" controls. In feeding a program, duplicate copies are run in synchronism. The "Master" feeds Line 1 while the "Safety" feeds Line 2 and is preset to feed Line 1. If the master unit fails, pushing an "Operate" button on any control panel will switch Line 1 to operate the "Safety" machine.



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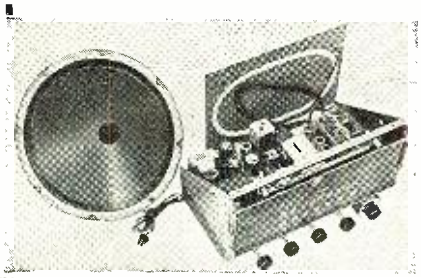

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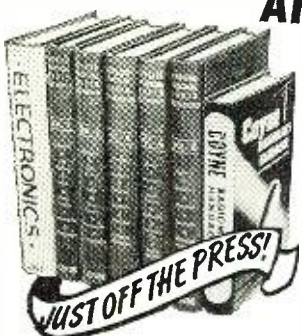

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*TOWN*_____ *ZONE*___ *STATE*_____

*Where employed*_____

Radioactivity "Sniffer"

(*Continued from page 47*)

tery supply. The plate of the tube connects to a regulated "B" supply through a 2.2 megohm plate loading resistor and feeds high impedance magnetic headphones through a .05 μfd. coupling condenser. Electronically and technically the operation of 2000-3000 ohm headphones across a plate-loading resistor of 2.2 megohms is unsatisfactory. However, in practice, plenty of volume is secured with the inexpensive phones supplied with the instrument. Purely as a check an expensive pair of high impedance phones was used with the instrument and the volume was excessive, hurting my ears. Technically a set of crystal headphones would really match this amplifier's output impedance, but again excessive volume would necessitate a volume control—so it would be a needless expense.

The high voltage power supply is of the vibrator type, employing a special three volt vibrator. In order to insure starting of the vibrator, a special three-position power switch is used. Moving from the "Off" position to the "Start" position places the full three volts of the series flashlight batteries on the vibrator, while the "On" position places the high voltage transformer primary in series with the vibrator and at the same time connects the amplifier tube filament. To start the "Sniffer" operating, move the switch directly from "Off" to "On." When the batteries age it may be necessary to hesitate at "Start" for a few seconds, and then go to "On." Never leave this switch in "Start" position more than five seconds, to do so will use up the batteries rapidly and possibly damage the vibrator. Average battery life is estimated at 50 hours when the instrument is used for four hours per day.

The high voltage from the secondary of the power transformer is rectified by a *Raytheon* CK1013, a cold cathode rectifier. This voltage is held constant by five special regulator tubes in series across the supply. A tap off of the fifth regulator tube gives regulated "B" voltage for the amplifier tube. The high voltage (and plate supply) negative lead is above ground and connects to ground through a 3.9 megohm resistor shunted by a .25 μfd. condenser. Thus all the grounded amplifier tube's plate current must flow through this resistor to the "B" negative supply. This is used to supply bias for the amplifier tube. The amplifier's grid return connects to the negative end of this resistor.

The G-M tube anode connects to the high voltage supply through a one megohm resistor. This resistor, at the anode, connects through a .02 μfd. condenser to the high voltage negative lead, above ground, and supplies filtered d.c. to the Geiger tubes. The Geiger tube cathode returns through

the 3.9 megohm grid resistor to the same condenser negative.

Several words on the field use of this instrument are indicated. Generally speaking, if the recorded count of an area, vein, or rock is three or four times the background count, the prospector may assume that he is in the vicinity or has an interesting radioactive prospect.

A comparison test with a known sample of uranium ore is the best bet for determining roughly the value of an ore sample. This is done by placing the counter on a flat place and recording the background count. Then a sample in which the uranium content is known is placed close to the G-M unit. Its count is recorded and it is moved far enough away so it does not affect the counter. The unknown sample, of approximately the same size as the known sample, is placed in the same position as the known sample and its count taken. The background count subtracted from these readings will give a basis for computing roughly the uranium content of the unknown sample. Samples of uranium bearing rock may be purchased at a number of mineralogical dealers.

The danger of mining or handling uranium bearing ores is negligible as long as they do not come in direct contact with the skin for long periods of time.

Contamination measurements are best made with equipment designed for this purpose.

—30—

A HANDY GADGET

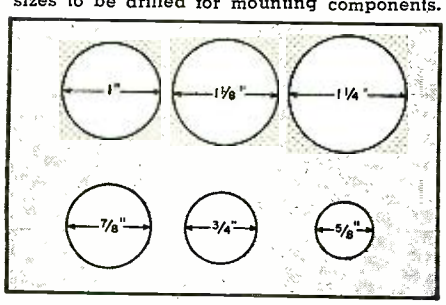
By NEIL A. JOHNSON, W2OLU

I HAVE found this handy construction aid of value in my work and would like to pass the idea along to other readers.

I use a piece of flexible cardboard—the back of a QSL card will do fine—and with the various socket punches that I ordinarily use, I make holes through the cardboard. After the punching is done, I label the holes with the proper sizes.

Now when there is any doubt in the constructor's mind as to what diameter hole to use for mounting that choke, tube socket, or condenser, it is very simple to slip the part to be mounted through the holes in the cardboard gauge (if we can call this thing a gauge) and thus ascertain the best size for the particular component under consideration. This idea surely makes it a lot easier for the occasional constructor or experimenter to turn out a nice looking job. —30—

A handy guide for determining proper hole sizes to be drilled for mounting components.



The May issue of RADIO & TELEVISION NEWS will be on sale April 28. Be sure to reserve your copy with your Newsdealer.

Modern TV Receivers
(*Continued from page* 59)

current through the tube ceases. The reader may, if he wishes, compare these differences between tubes to the difference between the flow of traffic along narrow and along wide roads. Along the narrow road failure of one car to move ahead can slow down traffic considerably; along the wide road, more room is available and the breakdown of one car has less effect.

The electron beam leaving the second slot of the accelerator approaches grid No. 2 also in the form of a thin sheet. Thus, this section of the tube may also serve as a gated-beam system. If this second grid is made strongly negative, the plate current of the tube is cut off no matter how positive grid No. 1 may be. Over a narrow range of potentials in the vicinity of zero, the second grid can control the maximum amount of current flowing through the tube. However if the second control grid is made strongly positive, it also loses control over the plate current which can never rise beyond a predetermined maximum level.

So much for the operating characteristics of the tube. Now let us see how it can be made to function as a limiter-discriminator. A typical circuit is shown in Fig. 9.

It has been noted that when FM signals reach the discriminator they contain amplitude variations. When the 6BN6 gated-beam tube is used, these signals are applied to control grid No. 1. If the signal has received sufficient prior amplification, it will have a peak-to-peak value of several volts. Upon application to grid No. 1, current through the tube will start to flow only during the positive part of the cycle, and remains essentially constant no matter how positive the signal may become or what amplitude variations it may contain. Thus, signal limiting is achieved in this section of the tube, the electron beam being passed during the positive half-periods of the applied signal and cut off during negative half-periods. The groups of electrons that are passed then travel through the second accelerator slot and form a periodically varying space charge in front of grid No. 2. By electrostatic induction, currents are made to flow in the grid wires. A resonant circuit is connected between this grid and ground and a corresponding voltage of approximately 5 volts is developed at grid No. 2. The phase of this voltage is such that it will lag the input voltage on grid No. 1 by 90 degrees, assuming that the resonant circuit is tuned to the intermediate frequency. Due to this 90° difference between grid voltages, grid No. 2 is often referred to as the quadrature grid.

In the gated-beam tube, both control grids (No. 1 and No. 2) represent electron gates. When both are open, current passes through the tube. When either one is closed, there is no current

flow. In the present instance, the second gate lags behind the first. Plate current flow starts with the delayed opening of the second gate and ends with the closing of the first gate. Now, when the incoming signal is unmodulated, and L_1, C_1 of Fig. 9 is resonated at the i.f. frequency, the voltage on grid No. 2 will lag the voltage on grid No. 1 by 90°. On the other hand, when the incoming signal is varying in frequency, the phase lag between the two grid voltages will likewise vary. This, in turn, varies the length of the period during which plate current can flow. See Fig. 5. Thus, plate current varies with frequency and the circuit is designed so that the current varies in a linear manner. By placing a resistor in the plate lead, R of Fig. 9, we can obtain an audio voltage to feed the audio amplifiers that follow. A typical discriminator response for an FM receiver with a 10.7 mc. center frequency is shown in Fig. 6. Note that this curve does not possess any sharp bends at frequencies beyond the range of normal signal deviations. This makes the receiver easier to tune.

In the circuit of Fig. 9, a 680-ohm resistor is inserted between the load, R, and the plate of the tube. Bypassing of the i.f. voltage is accomplished by C_2, but since this condenser is placed beyond the 680-ohm resistor, a small i.f. voltage appears on the anode of the tube. Through the interelectrode capacity that exists between the anode and grid No. 2, the i.f. voltage developed across the 680-ohm resistor is coupled into L_1, C_1. The phase relations existing in this circuit are such that this feedback voltage aids in driving the tuned circuit.

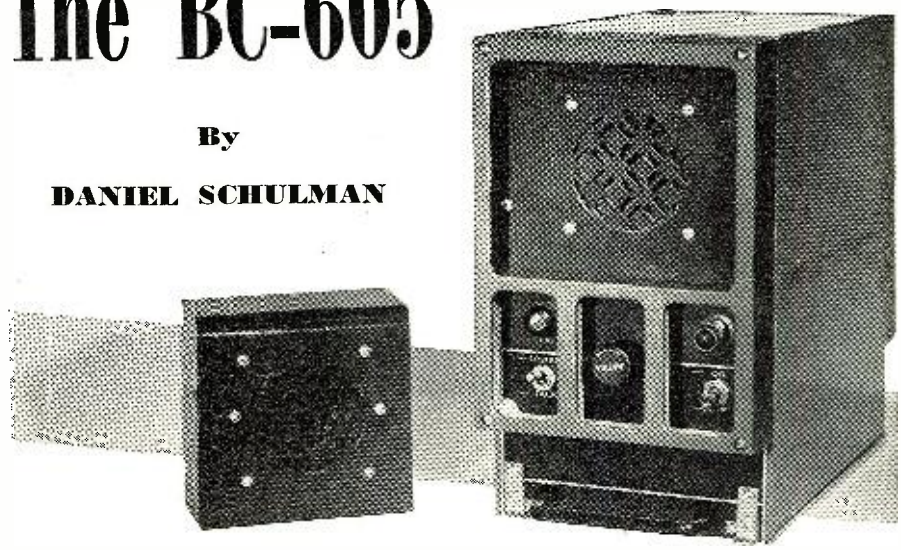
The limiting characteristics of the 6BN6 also enable it to be used as a sync separator. See Fig. 7. The video signal, with the sync pulses in the positive direction, are applied through a coupling condenser to the grid of the 6BN6. The pulses, having the most positive potential, draw grid current, charge up the coupling condenser and establish a negative bias across the grid resistor which prevents the tube from conducting except when the sync pulses are active. Due to the step-like form of the tube's characteristics, plate current, when it does flow, reaches its maximum value almost immediately and remains there as long as the sync pulse is active. This produces negative sync pulses across the plate load resistor having extremely flat tops.

EDITOR'S NOTE: *This is the concluding article of this series, "Modern Television Receivers." Other articles on television, written by Mr. Kiver, will appear from time-to-time. Both the editors and the author have received inquiries as to whether this series is to be published as a book. At the present time there are no specific plans for presenting the material in this form, but interested readers will find much of the same data incorporated in the new* Third Edition *of Mr. Kiver's book "Television Simplified," published by D. Van Nostrand Company.* —30—

An INTERCOM From The BC-605

By

DANIEL SCHULMAN



A simple conversion produces a very serviceable intercom.

Commercial panel and speaker grilles give converted unit a professional appearance.

OPERATORS of factories, warehouses, parking lots, garages, etc. can set up an inexpensive intercommunicating system for such locations by using the popular BC-605 intercom as the basic unit and then making a few simple circuit changes.

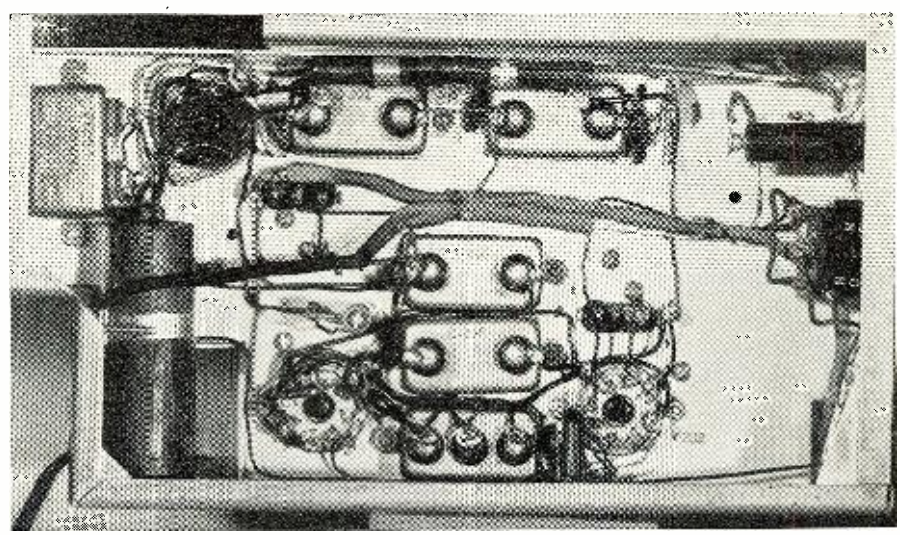
The BC-605 intercommunication set was originally part of the SCR 538 radio set which included the BC-604 transmitter and BC-603 receiver and was widely used in tanks, half-tracks, etc., during the war.

Because the original unit contains high quality components and is housed in a strong and sturdy steel case, it is particularly suitable for conversion for use in commercial establishments. Both the input and output transformers are wound on high grade silicon steel laminations and are moistureproofed, which will help to assure long life and trouble free operation under the fairly rugged conditions encountered in garages, factories, etc.

The conversion process, as outlined herein, was accomplished in just one hour and thirty-five minutes. There is nothing particularly complicated about the procedure and the reader should experience no difficulty in making the transformation.

The first step is to remove all of the wiring in the set. A highly skilled technician probably can utilize some of the wiring that is in the unit but, in the long run, a simpler and neater job will result from using an unwired

A view of the wiring after the conversion has been carried out.



chassis at the beginning. Next, the bank of five resistors, which is to be found on the tube side of the chassis, is removed. The 80 ohm, 10 watt resistor, R_8, is then removed and mounted in place of the 1.25 ohm, 10 watt resistor which is located between C204 and C205 in the original set. C210, the 2 μfd., 600 volt condenser is now removed. The mounting hole left by this condenser makes room for the installation of the 35Z5 tube (V_3) socket. A socket punch or a reamer will be needed at this stage of the conversion to enlarge this mounting hole to one and one-eighth inches to accommodate the socket.

Next, remove plugs 201 and 202 and then the 12 volt relay. Remove J201, the fuse mount 202, and the magnetic microphone jack from the front panel of the BC-605. Insert the d.p.d.t. intermittent switch, S_1, in the hole left on the panel when the fuse mount was removed.

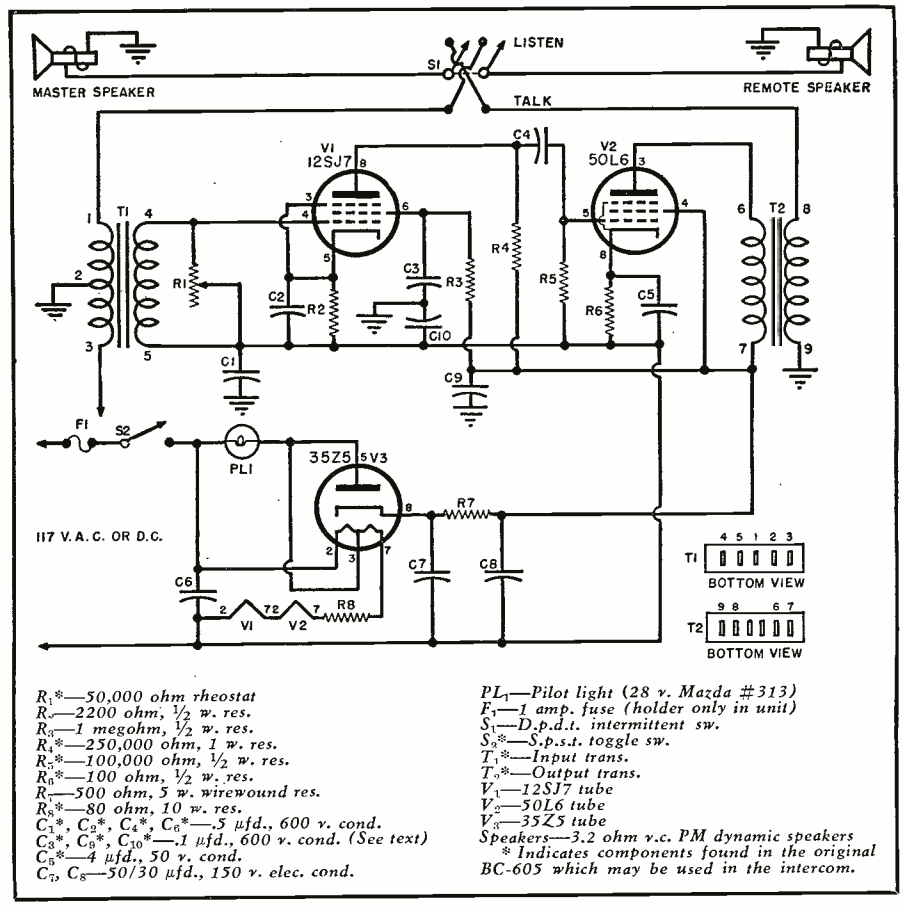
In the commercial adaptation of this unit, a special etched panel and speaker grille were used in order to give the finished product a "professional" look. However, a thin sheet of aluminum may be used by the home builder as it is easier to work. It can, of course, then be lettered any way the user may desire.

The next step is to mount a PM speaker in the door compartment. A back plate, made of Masonite, is mounted in the rectangular opening which was vacated by the removal of plug 201. The speaker is mounted on this plate and then holes are drilled in front of the speaker cone to permit the sound to emerge through the plate.

The set should then be wired as indicated on the schematic diagram and as shown in the photographs. The intermittent switch, S_1, is connected so that the normal position of the unit will be the "Listen" position. In this way sounds originating at the remote position will be carried to the master unit without the switch being operated. When the switch is in the depressed position it then becomes possible for the master station to communicate with the remote position or positions. With this arrangement there can be no "eavesdropping" on the master station by the remote position when the switch is in the "normal" position. The spring return on the switch automatically closes off the master station when the lever on the switch is released.

Although the 50,000 ohm potentiometer, R_1, across the secondary of transformer T_1, is not the conventional way of providing a volume control, it works satisfactorily and eliminates the necessity for buying a new rheostat as the pot is part of the original BC-605. This unit is rugged and so far has not produced excessive noise, at least not in the hundreds of units converted by the author.

It will be noted that the screen bypass condenser for the 12SJ7 tube, V_1, consists of two .1 μfd. condensers in



R_1—50,000 ohm rheostat*
R_2—2200 ohm, ½ w. res.
R_3—1 megohm, ½ w. res.
R_4—250,000 ohm, 1 w. res.*
R_5—100,000 ohm, ½ w. res.*
R_6—100 ohm, ½ w. res.*
R_7—500 ohm, 5 w. wirewound res.
R_8—80 ohm, 10 w. res.*
C_1, C_2*, C_4*, C_6*—.5 μfd., 600 v. cond.*
C_3, C_9*, C_{10}*—.1 μfd., 600 v. cond. (See text)*
C_5—4 μfd., 50 v. cond.*
C_7, C_8—50/30 μfd., 150 v. elec. cond.

PL_1—Pilot light (28 v. Mazda #313)
F_1—1 amp. fuse (holder only in unit)
S_1—D.p.d.t. intermittent sw.
S_2—S.p.s.t. toggle sw.*
T_1—Input trans.*
T_2—Output trans.*
V_1—12SJ7 tube
V_2—50L6 tube
V_3—35Z5 tube
Speakers—3.2 ohm v.c. PM dynamic speakers
** Indicates components found in the original BC-605 which may be used in the intercom.*

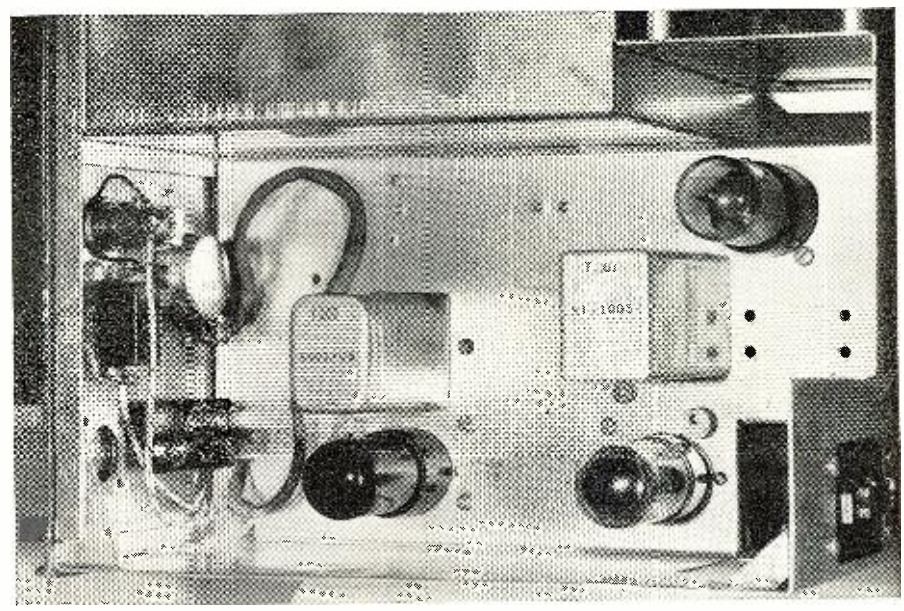
Diagram of converted unit. The numbering on T_1 and T_2 is arbitrary and does not necessarily agree with the terminal numbering used in the original BC-605.

series, with the center point grounded. This was done in order to make use of the triple .1 μfd. bathtub condenser (C203) which was already in the unit. If desired, a single .1 μfd., 400 volt paper condenser, connected from the screen to "B—" may be used in place of the bathtub unit and C_9 omitted.

As many as three speakers can be handled by this amplifier. When more than one remote speaker is used, however, all remotes should be connected in parallel. The unit will operate on either a.c. or d.c. Excessive hum on a.c. may be eliminated by reversing the plug. Non-functioning on d.c. should be cured by reversing the power line connection.

With a little work and only a few new or junk box components the BC-605 can be readily converted into a neat and useful intercom. —30—

Side view of the converted unit with the cover removed.



International Short-Wave

(*Continued from page* 109)

Kawachi, 0255-0900; JBD3, 15.225, 7½ kw., Kawachi, 1750-0230; JBD4, 15.235, 5 kw., Kawachi, 1750-0230.

Stations in the "A" and "B" groups relay m.w. programs to local stations; JKI and JKH should have "English Conversation Lessons" at 0400, and at 1630 should have a "Basic English Lesson."

It was explained that the short-wave transmissions are carried on for two specific purposes—inter-communication between the key stations of N.H.K. and for the benefit of Japanese nationals awaiting repatriation.

Kashmir—Radio Kashmir, Srinagar, sent letter verification by registered airmail from Officer on Special Duty, AIR, Radio Kashmir, Srinagar, Kashmir; gave no schedule but seemed surprised the station on 4.860 with power of only 1 kw. had been heard in England, and asked for further reports. This one has been heard in England 1030 relaying news from AIR. (Pearce)

Korea—Alcock, Ky., says he has positively identified the station heard 0400-0630 sign-off on 7.933 as Korea; usually is good 0600-0630; has *English* identification on the quarter-hour. Also heard by Oskay, N. J.

Lebanon—Beirut, 8.030V, heard 1530 in Australia with French news, then music; good signal. (Sanderson)

Luxembourg—Radio Luxembourg, 15.35, noted 0645 with news in French, then music; bad QRM. (Sanderson, Australia)

Malta—From Israel, Bluman confirms that the Forces Broadcasting Service, Middle East, is now using *two* s.w. transmitters in parallel; listed schedule as 4.965 at 2330-0200 (Saturdays 2330 to 0215 Sundays), and 0845-1700; 11.895 (replacing 6.140) at 2330-0200, 0430-1700 (Saturdays 2330-1700 Sundays); 7.270 at 0430-0830 (Sundays 0230-0830); occasionally uses 11.785 around 0430-0845. At times, 6.140 may be used afternoons to 1700 closedown in parallel with 4.965. The transmitters were still radiating experimentally and more changes may have been made by this time. Bluman has heard Malta, 7.270, at 0300 point-to-point to Cyprus, FBS Benghazi, and FBS Tripoli, in turn.

According to a letter from the station, QRA is Forces Broadcasting Service, M.E.L.F., Chief Broadcasting Officer, Middle East Land Forces, Malta. (Cox, Delaware)

Mauritius—NNRC reports V3USE, 15.050, Forest Side, signs on 2159 with a march; then relays BBC news in *English,* followed by popular recordings; around 2225 has an *English* lesson; French news 2230; signs off 2315 with "God Save the King"; slogan is "Ici le poste de l'Ile Maurice"; signal usually very poor. Has been reported direct to me by Ferguson, N. C., DeMyer, Mich., and others; this one is

also on the air daily 0930-1200 but has severe QRM.

Mozambique—Lourenco Marques informs Grove, Ill., it has effected *new* schedules: In *English*—CR7AA, 6.137, and CR7BU, 4.932, 2300-0200 Sunday-Friday; CR7BJ, 9.766, and CR7AA, 6.137, 0200-1200 daily; CR7BU, 4.932, and CR7AB, 3.490, 1200-1600 daily. In Portuguese—CR7BE, 9.671, 0000-0100 daily, 0430-0630 Monday-Saturday (0400-0700 Sunday), 1100-1500 daily, power 10 kw., wants complete reports on these transmissions. CR7BV, 4.819, 7.5 kw., 1100-1500 daily. CR7BG, 15.196, test transmission on Thursdays 1500-1530; wants complete report on this transmission. Did *not* list powers of transmitters used for *English* broadcasts; QRA is Radio Clube de Mocambique, Lourenco Marques, Mocambique (Mozambique); letter signed by J. Pinheiro, Manager. However, Laubscher, South Africa, airmails me that *English* programs on Sundays on 9.766 and 6.137 now begin at 0000, weekdays at 2300, and that on Saturdays the sign-off on 4.932 and 3.490 is an hour later than other days—that is, at 1700.

North Korea—Pyongyang, 4.498, noted fair in New Jersey 0645. (Oskay)

Outer Mongolia—Ulan-Bator heard with fine signal on 5.260 at 0300-0355, 0500-0600; all-native programs lately. (Balbi, Calif.)

Pakistan—Radio Pakistan was still wandering about the various bands when this was compiled. Was being heard in 0700 news on 7.635, 11.546, 11.845; at 1015 with news on 9.645, 11.546, and at 2145 with news on 9.645. 15.335. Karachi, 9.645, is reported in Afghan-Persia at 1200-1240; 11.885 at 1245-1300, 1400-1445 in Arabic. Bluman, Israel, reports Pakistan heard on 17.835 in *English* to 0330 sign-off when a clock chimes two o'clock. *Radio Australia* reports that a talk in *English* is given from a Pakistan outlet on 6.075 at 1100-1115; I presume this is Lahore.

Panama—Sutton, Ohio, reports HP5G is again active on 11.780, evenings (EST).

Philippines—Simpson, Australia, has had a letter from the Philippines which states DYB2, 4.985, is *not* at Davao on Mindanao, as reported earlier by Cushen, N. Z., but is at Bacolod City on Negros Island; DYBR operates on 1120 kc. and DYB2 on 4.965; stations are still testing, operating under construction permits; appear to be privately-owned by Mario Lizares; proposed power for DYB2 is 250 watts.

DZH7, listed 9.740, Manila, may move to 9.770 soon. (Cushen, N. Z.) This station operates 0500-1400 and desires reports. Power is now 3 kw. Station officials notified Halvorsen, Norway, that news is given daily at 0500 followed by dinner music for 15 minutes with announcements in *English* and that *English* is also radiated 0700-0800 on both 9.740 and 6.030. The m.w. channel is 680 kc. Stated that the new "V" beam is directed through Bombay, India, toward the Near East and Europe. This is a non-commercial, missionary broadcaster.

Portugual — CS2MF, measured 9.727.3, has been noted off regular channel some evenings 1900-2030; at times has been on measured 9.746, but at last report was back on normal fre-

DISASTER NET DEMONSTRATION

MEMBERS of the South Plains Amateur Radio Club recently held an emergency demonstration in McKenzie State Park, adjacent to Lubbock, Texas.

Present at the demonstration were the Chairman of the Red Cross Disaster Committee, the sheriff, the fire chief, the traffic manager of the local gas company, the superintendent of the city utilities, a representative of the Lubbock police department, and the commander of the Naval Reserve Unit, in addition to other interested citizens.

Three BC-654A's were set up at the scene with five 10-meter mobile stations. Contacts were established with Raton and Albuquerque, New Mexico, and Borger, Amarillo, Rule, Odessa and other Texas points.

Another series of demonstrations is planned by the club in the hopes of extending the emergency net to a 60-mile area. Additional information on the emergency disaster plan may be obtained by writing the SPAR Club secretary, W. T. Ward, W5INM, 2805 N. 1st Street, Lubbock, Texas.

—30—

Rogers Orr, W5NIC, SPARC president, operates a battery portable on 75 meters for visitors.

quency. (Oskay, N. J.) Lisbon, 15.145, appears to be carrying out tests from around 0700. (Radio Australia)

Portuguese India—Halvorsen, Norway, says *Radio Goa,* 9.610, has an *English* transmission each Sunday 0100-0230; power is 500 watts, but is to install a *new* 7.5 kw. transmitter soon.

Sao Tome (St. Thomas)—Sao Tome, Portuguese West Africa, is heard 1000-1200 over CR5SB, 17.677, and 1300-1500 over CR5SA, 9.615. (Bluman, Israel) The only time I have been able to hear CR5SA, 9.615, here in West Virginia has been from around 1445 to *after* 1500 (or until WNRA puts its carrier on the air and buries Sao Tome).

Saudi-Arabia—Radio Arabia, 11.950, Mecca, is heard erratically in England around 1200 to 1300, and occasionally as late as 1330; 5.98 is heard in parallel with better level. Transmitters may be at Djedda? (Pearce, England)

Suez Canal Zone—Bluman, Israel, airmails me that Fayid has been heard testing 0200-0230 on 7.220, announcing "This is Your Forces Broadcasting Service, Fayid," or "This is Your Forces Broadcasting Service, Middle East, calling from Fayid" (is easily confused with Malta); a later report says Fayid, 7.220, is now heard 0300-0330 (which *may not be complete schedule*).

Tahiti—Balbi, Calif., reports improved signals from Papeete, 6.982, 12.080, at 2315-2400.

Tangier—EA9AA, 7.060, *"Radio Africa,"* noted with French 1030 and 1200. (Aberg, Sweden)

Thailand—Bangkok appears to be using 15.910, approximately 7.205 (at times may be as high as 7.250), and 6.235 for the overseas transmission 0500-0630; news 0515, 0615; definitely announces now as "The Overseas Station of *Thailand.*"

USA—WWV now gives *GMT* in code each 5 minutes (24-hour system), and *EST* in voice each 5 minutes (12-hour system); interval tone now is 400 and 1000 cycles in alternate 5-minute periods; ionospheric-disturbance notices are still radiated in code at 19 and 49 minutes past each hour. (Grove, Ill.)

USSR—Khaborovsk, Siberia, is using 4.275, replacing 6.020, sometimes is dual with 8.82; is heard irregularly after 0200 and as late as 0600; Soviet transmitters are heard on 6.03, 6.18 around 1000 in Home Service. The Soviet on 6.075 is *not* Petropavlovsk at 0245; at 0300, Petropavlovsk comes on the air, after which both Soviet transmitters can be heard, with Petropavlovsk the stronger; all-Russian. (Balbi, Calif.)

Radio Tashkent, 6.820, is heard almost daily at 2100 sign-on; clear announcement 2115. (Moore, Calif.)

Moscow noted on approximately 6.010 opening Home Service in Russian 0030; good signal, in clear. (Fargo, Ga.)

Vatican—Patrick, England, reports that when the Vatican's *new* 100 kw. transmitter is installed, HVJ will carry the "Voice of the Vatican" to millions of people all over the world in 18 different languages. The transmitter, is being built by *Phillips* of Hilversum, Holland, and is to be completed this year. It will be presented to his Holiness Pope Pius XII on behalf of Dutch Catholics to commemorate the Holy Year which began last Christmas Eve. The new transmitter, when completed, should be heard over a world-wide area.

HVJ, 6.190, noted with good signal 1545 in Hungarian, in parallel with 7.262.2; latter had poor modulation. (Oskay, N. J.)

Venezuela—YVKO, 5.020, Caracas, noted recently in *English* 2000-2020, with program of music talks, poems. (Cox, Delaware)

* * *

Last-Minute Tips

The "mystery" station widely reported throughout the U.S. at 0045-0100 on approximately 9.460, has been identified as the *"Free Greek Radio."*

Balbi, Calif., reports *Radio Pakistan* on 11.885 at 1115-1145 in native. Hagen, Ala., hears this channel with Arabic music 1300-1330.

A last-minute report from Dilg, Calif., said he was hearing Communist Chinese outlets 6.090, 10.260, 7.100, 7.500 to 1120 sign-off; 6.090 was very good, others weak.

NATTUGGLAN, Sweden, has had a vague report of a station heard in

Arabic on 7.040 announcing as "Hona Radio Tripoly"; may be Tripoli?

Hannaford, South Africa, airmails that Salisbury is now using 3.320 and that 3.658, formerly in parallel, is now off the air; no schedules were given.

Aberg, Sweden, airmails he is hearing a station on approximately 6.440 in Spanish at 1100-1120 closedown; call sounds "Radio El Scana"; strangely enough, announces frequency as in the 49-meter band; he believes this may be a Spanish station in the Basque province of Spain; he says *"Radio Euzkadi"* on 6.095 gives call at end of transmission in Spanish and in another dialect, probably Basque; *"Radio Euzkadi"* is listed on 6.094 as a "Clandestine Basque" outlet. Aberg did *not* list schedule for *"Radio Euzkadi."*

Serrano, Brazil, flashes that he has heard PRL5, 11.95, in parallel with m.w. PRA2, 800 kc., instead of s.w. PRL4, 9.77; transmitter seems to be the same as PRL4 (1 kw.); signal good, stronger than PRL4 had been, but with CWQRM; PRL5, 11.95, is listed 15 kw. and as "inactive." May have moved from 9.77 to 11.95 to escape severe QRM from Leopoldville's 9.767 outlet. QRA is Radio Ministerio da Educacao e Saude, Praca da Republica 141-A, Rio de Janeiro, Brazil. Serrano reports that ZYB8, 11.765, *Radio Tupi,* was off the air; that a Spanish program, "Aquarelas do Brazil," is radiated daily *except* Sunday at 2030-2100 (closedown) over ZYB9, 15.156.

Radio Clube do Bie, Silva Porto, Angola, hopes to increase power soon from 200 watts to 1 kw. (Pearce, England)

A Swedish DX-er reports Damascus on a *new* channel of 6.165 at 0530-0612, broadcasting news in *English* and French, some music; asked for reception reports. However, a Danish listener reports he is hearing Damascus on its old frequency of 6.000 at 1000-1100. (Radio Sweden)

Laubscher, South Africa, flashes that Mauritius, approximately 15.050, has been heard with a weather report in *English* at 1045 and with an *English* talk at 1130, but that the station definitely does *not* have *English* news at 1145 as reported by some sources; signs off 1200 with "God Save the King."

Late tips from Balbi, Calif., include "Vietnam," 9.67, heard at 0500 under KGEI; is in clear 0530-0545. DZH7, Manila, is on 9.730, *not* 9.74 as reported from "Down Under"; is heard "below" Nanking's 9.735 channel from 0400; the 9.735 Nanking outlet signs on 0400 with regular program in parallel with 6.090.

A *new* station, *Radio Nigeria,* at Lagos, Nigeria, was operating experimentally with 300 watts on 9.655 and 6.035 at 0100-0215, 0600-1700. But shortly was to be radiating at 0100-0215, 0600-1700 on 7.255 with 1 kw., 0100-0215, 0600-1300 on 9.655 with 300 watts, and 1300-1700 on 4.990 with 300 watts; on Sundays, operation was to be continuously 0100-1700. Transmit-

ters are not regular broadcasting equipment; the 300-watt transmitter is an Air Ministry T1509, while the 1 kw. job is a *RCA* 4351. Programs are relayed from the BBC's General Overseas Service *except* during the last period of broadcast. Verified for Cushen, N. Z., and welcomes reports to Radio Nigeria, c/o Post and Telephone-Telegraph Headquarters, Lagos, Nigeria, Africa. (Radio Australia) I believe this is the "unknown" station heard by Dilg, Calif., on 9.655 with native singing around 1015 and with Western music around 1100 and later.

The station at Bacolod City, Negros Island, Philippines, is DYB2, 4.985, and the station at Davao, Mindanao Island, is operating on 3.950, no call-sign yet but relays m.w. DXAW, 1180 kc. (Cushen, N. Z., Simpson, Australia, via Radio Australia)

Cushen, N. Z., reports a station he believes to be *Berliner-Rundfunk,* Germany, on 6.115 from 0200 when GSL leaves 6.110; *Radio Sweden* says that while *Berliner-Rundfunk* is announcing 6.115, it has been wandering around the 41-meter band on such frequencies as 7.035 and others until 1430.

Radio Sweden confirms that EQC, 9.660, Teheran, has replaced EPB, 15.100, for the transmission to Europe 1330-1530, news 1400; says *Radio Shkodra* at Scutari, Albania, 8.220, gives schedule of 0100-0200, 0730-0900, and 1130-1500; that Sao Tome on 11.785 is being heard again to close-down 1600; that *Radio Nacional de Espana,* Madrid, has changed frequency from 15.620 to 15.636, according to station announcement, and is on the air daily *except* Sunday 1130-1200; that Ulan-Bator, Outer Mongolia, is operating on 8.400 to 1000 when it signs off with choral music; that an unidentified station has been heard in Sweden on about 5.050 announcing as "British Forces Network," no location mentioned; that *United Nations Radio,* 6.672, Geneva, Switzerland, has changed its schedule to 1420-1440, news in *English* 1420 and in French 1430, and that it has been heard testing on 11.715 at 1145-1200 directed to Middle East; confirms that Radio Ministerio da Educacao, Rio de Janeiro, is on 11.950 now with call of PRL5, heard from 1400, relaying m.w. PRA2; says that Lourenco Marques, CR7BJ, has moved from 9.653 to 9.600 where has been heard 1230-1330, 1430-1500.

Lourenco Marques, Mozambique, now appears to be using approximately 11.765 (widely reported in U.S.), 9.763, and 6.135 in parallel weekdays from 2300, Sunday from 0000, in *English;* announces the 25-m. outlet as "testing" and asks for reception reports on that channel.

Stark, Texas, reports South Africa (SABC) heard lately opening 2345 weekdays (0055 Sunday) on approximately 9.680; short newscast 0000. He flashes he has heard *Radio Tananarive,* 9.694, Madagascar, opening 2300 in French; has two or three series of notes on stringed instrument (presumably Malgache guitar), indentifies as

"Ici Tananarive," and uses "La Marseillaise" at start.

Press dispatches indicated that the name of Guatemala, Central America, was to have been changed to "ISTHMANIA" on February 1; however, on the day this was compiled, a check of TGWA, 15.170 (daytime) and 9.760 (nights) indicated the station was still announcing as "La Voz de Guatemala" in the Republic of Guatemala.

Station heard on approximately 7.090 with Near East singing 0950 is believed to be Baghdad, Iraq. (Dilg, Calif.)

DYH2, 6.139.6, Cebu City, Philippines, heard signing off 1100. (Triebel, Washington State, via Oskay, N.J.)

Officials of *Radio Australia* airmail me that VLC5, 9.54, will be continued in use at least for some months to East and Central North America daily 0700-0900 and 0900-0945, respectively; it is now impossible for *Radio Australia* to use 11.81 in parallel for these transmissions although that channel, as VLC7, will continue to be used to Western North America daily 1000-1115.

On March 11 at 1630 and 2300, a 15-minute special DX broadcast was radiated by Kol-Israel, 9.000, Tel Aviv, Israel, for the International Short Wave Club, London; it featured Herbert Bluman, Israel, valuable contributor to the ISW DEPT. I learned of this projected broadcast too late to announce it in the March issue—but if anyone picked up the broadcast, a report would be appreciated to Kol-Israel, Box 17, Hakirya, Tel Aviv, Israel. Thanks!

Sutton, Ohio, reports Khabarovsk, 4.275, Siberia, USSR, has been heard 0600 with news (presumably in *English*). At the time this was compiled, 4VRW, Port-au-Prince, Haiti, was still wandering about; was heard in *English* at 0800 to announce channel of 10.130; however, at times has been as high as 10.210.

Slutter, Pa., reports Godthaab, 5.942, Greenland, is heard very weak at 1650. Boice, Conn., has been hearing *Radio Omdurman*, 9.747, Anglo-Egyptian Sudan, on Fridays in *English* 1230-1300; he reports Lourenco Marques, 15.23, Mozambique, is back on the air daily from before 1400 to 1500 sign-off, may be testing. Leopoldville, Belgian Congo, notified Leinbach, N. Y. that the 11.645 channel, which has been used lately in parallel with 9.767 in French 1630-1845 to Belgian seamen, soon will be used at that time for Spanish and Portuguese language programs (presumably to Latin America). In a DX broadcast, Leopoldville said that ZKG, 8.290, Pitcairn Island, is now on the air; no further details were given.

Although station officials informed me the 19.345 channel of former *Radio Indonesia* (Batavia, now Djakarta) was to have closed down some time ago, at press time I received word from Fuller, Rhode Island, that he had heard the station to 1200 closedown. Taylor, Ill., reports HC2RL, 6.635, Guayaquil, Ecuador, has opera and concert music with announcements in both Spanish and *English* on Tuesdays around 2130 to closedown 2315-2330; station verified from Estacion HC2RL, Quinta Piedad, Guayaquil, Ecuador. He says HP5K, 6.005, Colon, Panama, has *English* program 2030-2200; QRA is Cadena Panamena de Radiodifusion, Apartado 33, Colon, Republic de Panama.

* * *

Acknowledgement

Thanks for the continued FB support, fellows! Keep your reports coming to 948 Stewartstown Road, Morgantown, West Virginia, USA. . KRB.

This group of Philippine amateurs turned out for a recent hamfest, at the home of Jess Escalante, DU1VVS, held in conjunction with Cavite City's fiesta. Those in the picture include: (kneeling) Pedro Aguinaldo, Jr., DU1DO, and Gregorio Orbeta, DU1AW. Standing from left to right are: Jorge Illenberger, DU1JI, David K. Pope, W3IJW, Mary E. Pope, XYL-W3IJW, Rose Illenberger, Celestina Marcelo Illenberger, XYL-DU1JI, Mrs. Jesse Escalante, XYL-DU1VVS, Lita Contreras, Nunilon Lim, DU1NL, and Jess Escalante, DU1VVS. In the back row are: Jack Santaromana, DU1JS, Gregorio Trinidad, DU1GT, Fred Hashim, Miguel Contreras, DU1MC, Victor Valenzuela, DU1AQ, Emmett M. Johnston, W7CEV, and Frank Tunison. E. G. DeCastro is club secretary.

Putting TV on the Air

(*Continued from page 37*)

almost as much equipment is required to put a film on the air as to produce a live show. The film room uses a single iconoscope camera into which can be projected any of the following; either of two 16 mm. sound projectors, which have *Bell & Howell* heads and *GE* synchrolite units, a 35 mm. slide projector and a Baloptican. These film machines are arranged in such a manner that the light from any one of them can be reflected into the camera by means of a pivoted precision mirror. This mirror is mounted on a pedestal so that it can be swung into the proper position for each machine. When the operator desires to change machines, he moves a handle attached to the mirror, the handle actuates a microswitch and fades the picture until the new position is reached. The 16 mm. projectors are interesting in that they do not use a shutter. As each successive film frame is moved into position an arc tube is flashed in the synchrolite lamp housing to provide timed illumination. The arc tube is keyed by the station sync pulse thus eliminating flicker. The 35 mm. slide projector is of the standard type found in camera stores and is used with prepared slides, such as commercials. The Baloptican is a variation of the regular slide projector and can project slides which are transparent or regular photo prints or printed signs. This takes a card size of 3¼" x 4". Regardless of which of the machines is being used the signal reaches the camera by means of the precision mirror. The iconoscope converts the projected image into pulses which are immediately amplified by a high gain amplifier in the camera housing. The signal is then fed to the camera control rack where it is further amplified and the picture is corrected for some of the faults, such as streaking, which may be present. From the camera control rack the signal is fed into the "Lass," (abbreviation for line amplifier and super sync) a device which combines the sync pulses from the sync generator with the signal from the camera. The combined signal from this unit is fed to the video patch panel, and from there to the master control desk where it is monitored for quality and signal level before being fed to the video transmitter.

The transmitter is a Type TT-6-D made by *General Electric,* consisting of a 5 kw. picture and 2.5 kw. aural combination. Operating on Channel 8, the oscillator frequency of KFMB-TV is 15,104.15 cycles with a crystal controlled 6J5 as oscillator. The output of the oscillator feeds into a 6V6 buffer amplifier followed by a 1614 first doubler, a 1614 as second doubler, and an 815 as tripler. This lineup, together with the power supply, com-

prises the exciter unit and is mounted in one cubicle of the complete transmitter. The modulator and power amplifier are housed in a cubicle adjacent to the exciter. The output of the 815 tripler is link-fed to an 832 in this cubicle which is the modulated stage. The modulator driving this stage consists of three 4D32's as video amplifiers feeding into push-pull 807's which act as output cathode couplers. The modulator also employs two 6AG7's as amplifiers and sync stretchers plus a pair of 6AL5's for d.c. insertion (d.c. insertion controls the average picture brightness). Included in this same cubicle are the linear r.f. amplifier stages. Output of the modulated 832 is fed into an 829B which is the first linear amplifier. This is followed by push-pull 5588's which, in turn, feed push-pull 5513's followed by another pair of push-pull 5513's. All tubes in the transmitter unit thus far are cooled by filtered air forced through the cooling fins and around the grid and filament connection. The final amplifier, consisting of a pair of 9C24's, is both air- and water-cooled, however. It is most interesting to note that the filaments of these tubes draw 125 amps. each and that the cooling water enters a special chamber inside the tube where it can directly absorb heat from the filament. Both the grid and plate are water-cooled as well. Suppression of the lower sideband has been somewhat of a problem in television. This problem has been licked in the TT-6-D by employing a system of bandpass coupling in each amplifier stage. No high-level sideband filter is required because all but the standard vestigial sideband signal is eliminated by the amplifier bandpass tuning. Tuning the transmitter is also performed in a very interesting manner. It can be likened to the alignment of the i.f. strip in the conventional TV receiver. The transmitter has a built-in sweep and marker generator and provision has been made for connecting an external oscilloscope for a visual check of tuning. Tuned and ready for operation, the video transmitter feeds its output to the Diplexer where it joins the FM sound signal before being put out over the air.

We have already followed the video signal from the camera through the transmitter. It is logical, then, that we should return at this point and pick up the sound signal. Monitored sound signals from the master console are fed into the FM sound transmitter which works in a manner very similar to the video transmitter except for the system of modulation. Modulation of the sound transmitter is accomplished by means of the *GE* Phasatron Unit. Standard broadcast stations and the video transmitter use amplitude modulation while FM broadcast stations and the sound transmitter of television stations modulate by varying the frequency. The Phasatron unit accomplishes this

by shifting the phase of the carrier in accordance with the modulating signal. This phase shift, after being fed thro ;h successive stages of doubling and tripling, becomes an actual frequency shift of the carrier.

Output of the transmitters is converted from push-pull to single ended output by a device called the Balun, better known as a Bazooka. Output from the transmitter is fed into the Diplexer. This device combines the aural and visual signals in a bridge arrangement, that is, the antenna appears as the resistor element in two arms of the bridge circuit with the video fed across one diagonal and the aural across the other. The combined signal leaves the Diplexer via coax line which is kept under constant dry air pressure to prevent arcing, and travels up the tower to the antenna from whence it is radiated.

The antenna mast is grounded by means of heavy copper strip to the main ground system of the transmitter, terminating in a bed of copper sulphate for the best possible ground. All precautions have been taken against lightning and winds up to 120 miles per hour. The antenna proper is a six-bay, super-turnstile, bat-wing radiator, constructed of seamless steel tubing. Impedance of the antenna is 51.5 ohms. Phase displacement between East-West and North-South pairs is 90 degrees. Antenna gain over a half-wave dipole is more than six times the power output of the transmitter.

Frequent checks are made of the power output of the station. This is accomplished by making use of a dummy load. This device is a resistor of 51.5 ohms (same resistance as the impedance of the antenna). The output of the transmitter is fed into this load while cooling water flows through it at a constant rate of 3.8 gallons per minute. Two thermometers check water temperature, one checks water temperature prior to entry into the load and the other the exhaust water temperature. At the standard rate of flow the power output of the transmitter will be equal to the difference in temperature of the incoming and exhaust water. As an example, a three degree rise in temperature would indicate a power output of 3 kw.

Both station and studio bustle with activity long before the station is to be on the air for the day's telecasting. At least an hour is required to warm up all equipment and establish normal operating characteristics. For a live show more than 450 tubes in the camera chain alone must be warmed up and their operation checked. The image-orthicon camera tube, with a life expectancy of as low as 100 hours, responds differently each time it is used and corresponding camera adjustments must be made. Remote equipment must be given an operation check since its characteristics will generally change with a shift of location or tempera-

ture. At the transmitter similar adjustments are required. It can be understood that with a total of more than 1000 tubes involved, and with many different circuit requirements with regard to temperature and frequency, considerable time is required for the various circuits to stabilize themselves. At specific periods tuning adjustments at the transmitter are checked. When the station is ready to go on the air, station engineers, cameramen, film room, studio engineers and the program director are all tied together by an intercom which is also a magneto-power telephone line between transmitter and studio. Instructions from the program director are heard by all personnel at once and all remain on the line during the entire production of the show, making a smooth flowing program possible. Despite the complexity of television, KFMB-TV was on the air in less than 60 days after construction of the building began and only 7 days after the equipment arrived, the first test pattern was transmitted.

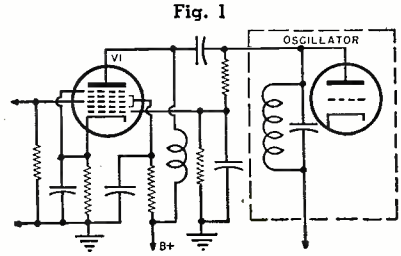
No, television isn't simple, but it is destined to be one of the most interesting trades with something new being developed continually. —30—

FM QUIZ

By ED BUKSTEIN
Northwestern Vocational Institute

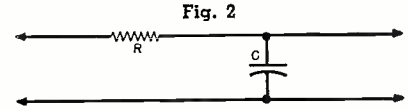
1. On the commercial FM channels (88 to 108 mc.), one hundred percent modulation is defined as a frequency deviation of plus and minus *(a) 88 kc. (b) 21.75 kc. (c) 75 kc. (d) 25 kc.*
2. If a commercial FM station produces a signal whose deviation is plus and minus 60 kc., its percentage of modulation is *(a) 20% (b) 60% (c) 80% (d) 100%.*
3. The rate at which the FM signal swings back and forth is determined by the *(a) amplitude of the audio signal (b) frequency of the audio signal (c) height of the antenna (d) effective radiated power.*
4. The deviation of an FM signal increases when the amplitude of the audio signal *(a) increases (b) decreases.*
5. If a 30 kc. deviation is produced by a 5000 cycle audio signal, the modulation index is *(a) 150 (b) 25,000 (c) 0.16 (d) 6.*
6. The ratio of the maximum frequency deviation to the highest audio modulating frequency is called the *(a) aspect ratio (b) deviation ratio (c) ratio detector.*
7. If an FM signal having a deviation of plus and minus 2 kc. is fed successively through a frequency doubler and a frequency quadrupler, the output signal will have a frequency deviation of plus and minus *(a) 6 kc. (b) 8 kc. (c) 16 kc. (d) 32 kc.*
8. The circuit designed to remove any undesirable amplitude modulation from a frequency modulated signal is known as a *(a) limiter (b) reactance modulator (c) voltage tripler.*
9. In the circuit shown in Fig. 1, tube V_1 is a *(a) reactance modulator (b) d.c. restorer (c) ratio detector (d) Wien bridge.*
10. Tube V_1 of Fig. 1 behaves like *(a) an inductance (b) a condenser.*
11. The second detector of an FM receiver is more properly known as a *(a) frequency modulator (b) frequency divider (c) frequency multiplier (d) discriminator.*
12. The circuit shown in Fig. 2 is a *(a) pre-emphasis filter (b) high-pass filter (c) de-emphasis filter.*
13. As specified by the FCC, the pre-emphasis filter should have a time constant of *(a) 25 (b) 75 (c) 500 (d) 10,000 microseconds.*
14. If C of Fig. 2 has a value of .0015 microfarads, R should have a value of *(a) 20,000 (b) 50,000 (c) 2,000,000 (d) 66 ohms.*
15. An FM signal generator employing a motor-driven variable condenser is known as a *(a) selsyn (b) PPI (c) rotating vector (d) wobbulator.*

Fig. 1



(See page 159 for answers)

Fig. 2



L-C-Q Meter

(*Continued from page 70*)

toward inaccuracy in "Q" measurements. For this reason, a certain amount of care is required in making these measurements, as well as in calibration. There are several methods, requiring the use of other pieces of test equipment, that may be used for determining Δf or ΔC with greater accuracy, although there is not room for discussion of them here.

If it should be desired to correct for the effects of R_s, the expression:

$$Q_L = \frac{RQ_a}{R - Q_a X_L}$$

may be used. Q_L, equal to X_L/R_L is the corrected value for the "Q" of the inductance L, Q_a is the apparent "Q" as measured by the means described, and X_L is the reactance of the inductance L at the frequency used in making the measurement of Q_a. R is 330,000 ohms, the value of resistor R_6.

A *Shure* reactance slide rule has proven to be an almost indispensable item.

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FOREIGN SET OWNERSHIP

By J. V. McCARTHY
U. S. Department of Commerce

U. S. Consulates and Embassies in five different countries have submitted radio ownership figures in Madagascar, Iraq, Aden, Nicaragua, and Indochina to the U. S. Department of Commerce for release to interested persons in the United States.

From Indochina comes word that there are an estimated 12,000 radio receivers in use in that country. Of this number approximately 95 per-cent are of French manufacture with the remainder principally of Dutch origin.

Of the estimated 11,360 radio receivers in use in Nicaragua, approximately half of them were manufactured prior to 1939. Almost 90 per-cent of the sets are table models. Of the receivers in use approximately 95 per-cent are equipped to receive medium and short-wave broadcasts.

Aden has approximately 1125 receivers in use as of October 1, 1949. About 35 per-cent of this number were Philips (Dutch), 25 per-cent His Masters Voice (British) and 20 per-cent G.E.C. (British). The remainder were various brands of European and American manufacture. Approximately 50 per-cent of the sets in operation were table models. According to the report, little preference is shown by consumers for quality, appearance, or performance. Low priced sets are preferred.

The Embassy in Baghdad reports an estimated 45,000 radios in use in Iraq. Of this number about 56 per-cent were manufactured after 1939. Approximately 83 per-cent of the sets are table models and about 50 per-cent of all radios are equipped to receive medium and short-wave broadcasts. The remainder are equipped for all-wave reception.

Imports of radio receivers into Madagascar during the period from January through May, 1949 totaled 752 units, of which all but one were from France.

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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.

NEW ADMINISTRATIVE HEAD

Completing the change of original AFCA officers, begun last year when Frederick R. Lack of *Western Electric* replaced David Saranoff as president, AFCA's first Executive Secretary, Brig. Gen. Stephen H. Sherrill, USA, ret., resigned his office on January 3, 1950, and was succeeded the same day by George P. Dixon (Colonel, AUS, ret.), who had retired December 31, 1949, as vice-president of the *International Telephone and Telegraph Company.*

The new Executive Secretary has had an extremely broad and varied experience in the communications field, in industry with the *Bell System,* 15 years in charge of communications at the *National City Bank of New York,* and with the *IT&T.* He has also had a total of some 10 years of active military service in both World Wars and over 22 years of reserve duty. He holds a large number of decorations, including the Silver Star, the Legion of Merit, Bronze Star Medal, Army Commendation Ribbon, Order of the British Empire (Military Division), Legion of Honor, and the Croix de Guerre of France and Belgium.

Colonel Dixon is especially qualified for his new work. He has headed and been active in the work of the AFCA and its predecessor organizations, the Army Signal Association and the American Signal Corps Association, for more than a score of years. He was president of the New York Chapter of the prewar American Signal Corps Association off and on for 16 years, and was the first New York Chapter president of the Army Signal Association, right after World War II. He was also a national director and executive committee member during the initial years of the former Army Signal Association. He served as president last year, 1948-49, of the AFCA chapter in New York. During the war, while overseas, Col. Dixon also organized and staged several meetings of the former Signal Corps Association in England and France.

Colonel Dixon served approximately 17 years with the *Bell System* during the first part of his communications career, with the *Pacific Telephone & Telegraph Co., Western Electric,* and the *New York Telephone Co.* While with the *National City Bank* he had charge of all types of communications. After World War II, he joined the *IT&T* in August, 1945. He was regional vice-president for 18 months in Brazil, and until his recent retirement from *IT&T* was staff vice-president at the headquarters in New York.

During World War II, his first major assignment from October 1940 to August 1942 was as Signal Officer of the Second Corps Area. After being sent, in the fall of 1942, to the European theater he served first as Signal Officer of the Eighth Air Force. He then became Signal Officer of the U. S. Strategic Air Forces in Europe under General Carl Spaatz, and, in the latter capacity directed the planning for radar use and equipment and for Air Force communications for the strategic air bombing program and the Normandy invasion.

* * *

AFCA CHAPTER NOTES

Augusta-Camp Gordon

A vigorous membership drive has put the Augusta-Camp Gordon Chapter in the lead in the AFCA "Chapter of the Year" contest which ends on April 30th.

The chapter opened its second year's activities with the installation of new officers at a dinner meeting at the Sheraton-Bon Air Hotel, Augusta, on January 20th. They are: President—Lt. Col. Henry J. Hort, Commanding Officer, Unit Training Group, Signal Corps Training Center, Camp Gordon; Vice-Presidents—George Weiss, Manager, Radio Station WBBQ, Augusta, and Lt. Col. Thomas K. Trigg, Chief, Training Division, SCTC, Camp Gordon; Secretary-Treasurer—P. K. Jones, *Southern Bell Tel. & Tel. Co.,* Augusta.

Hugh Fleming of *Southern Bell Tel. & Tel. Co.,* the chapter's first president, reviewed the organization of the chapter and some of the highlights of the 1949 activity, and then introduced his successor. The new president, Lt. Col.

Henry J. Hort, paid tribute to the retiring officers and assured the membership that the new leaders would attempt to expand the 1949 program throughout the coming year.

Chicago

The February meeting of the Chicago Chapter was held jointly with the Western Society of Engineers at the latter group's headquarters.

Rear Admiral John R. Redman, USN, recently appointed Chief of Naval Communications, spoke on "Communications in Our Navy."

Col. George P. Dixon, the newly-named executive secretary of AFCA, spoke on the subject, "AFCA—Now and in the Future."

Cleveland

Following its policy of combining chapter meetings with inspections of local communications activities, the Cleveland Chapter visited the *Ohio Bell Telephone Company* on January 12th for a tour of its crossbar toll switching system. The February meeting featured an inspection tour of AM-FM transmitter station WHK, television transmitter station WEWS, and television transmitter station and studio WXEL, Pleasant Valley.

Greater Detroit

Chapter members met at the Michigan Naval Armory in Detroit on January 26th to hear a talk on "Sonar" by Commander W. H. Groverman, head of the Underseas Warfare Branch of the Office of Naval Research in Washington. At the close of the discussion period which followed the address, the group inspected the sonar equipment in use at the Armory.

Kentucky

The February 10th dinner-meeting of the Kentucky Chapter was held at the Officers' Club of the Lexington Signal Depot. Carl Neilson, studio supervisor of radio station WHAS, Louisville, was the guest speaker. He addressed the chapter on the subject of "Inside Glimpse of a 50 kw. Clear Vision Broadcasting Station" and then showed a film entitled "Television Today."

New York

The first meeting of 1950 of the New York Chapter took place on January 25th at the Fraunces Tavern Restaurant, New York, and featured an address by Federal Communication Commissioner E. M. Webster.

Chapter President Thompson H. Mitchell of *IT&T* announced the formation of a convention committee, headed by Brig. Gen. A. W. Marriner, to handle arrangements for the fourth national AFCA convention which will be held May 12th and 13th in New York City and Fort Monmouth, N. J. Col. George P. Dixon, AFCA Executive Secretary was present and reported on the results of the meeting of the convention committee and covered at length the very fine program being arranged by Gen. Lanahan and

his staff at Monmouth for the second day of the convention.

Commissioner Webster's address on the manifold problems of frequency allocations was most timely as, with the integration of the armed services, it appeared that more frequencies may be made available for commercial communication use. A discussion period followed and many members expressed their agreement with the points made by Mr. Webster.

Philadelphia

Air Force color films, including one on photographic developments and a wartime film shot by Thunderbolts in action over Italy, were shown to an audience of 500 at the Philadelphia Chapter meeting in the Franklin Institute on January 30th. These films were shown in lieu of the scheduled feature on the program—Col. George W. Goddard's tri-dimensional color photography show—which was postponed until the next chapter meeting since Col. Goddard was grounded by bad weather at Wright Field, Ohio. Col. Goddard, who is Chief of the Photographic Laboratory, Engineering Div., Air Material Command, first presented the show to AFCA members at the national meeting in Dayton in 1948 and since then to several AFCA chapters.

After opening remarks by Chapter President W. W. Watts, vice-president of *RCA Victor Div.,* the chairman of the chapter's membership committee, Leslie J. Woods, vice-president of *Philco Corp.,* spoke on the present policies and aims of the AFCA and of the advantages offered to members.

The AFCA national Executive Secretary, George P. Dixon, was present and further elaborated on AFCA's activities in the immediate future. Speaking of the association's publication, Col. Dixon announced that *SIGNALS* would be considerably improved during this year and that it would be published monthly.

Southern California

Following the practice of other AFCA chapters, the Southern California Chapter is varying its meetings with visits to local communications and photographic activities. Its January 12th meeting featured an inspection tour and demonstration of the facilities and operation of the Armed Forces Radio Service in Hollywood.

Washington

Following out its program of service sponsored meetings for the 1949-50 season, Washington chapter members were guests of the Military Transport Service's Airways & Air Communication Service at Andrews Field, Md., January 18th.

A luncheon at Fort McNair was presided over by Chapter President Francis H. Engel (Washington manager of *RCA Victor*) and was highlighted by a talk delivered by the new AFCA Executive Secretary, George P. Dixon,

CORRECTION

In the January 1950 issue, the item A . . . S-C personalized radio was listed in error at...$21.95
This should have been.....$23.95
We regret this error.

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in his first appearance before a chapter since he took office January 3rd.

Before leaving for Andrews Field, the major air installation near the national capital, the more than 130 members present at the luncheon were welcomed on behalf of the Air Force by Maj. Gen. Francis L. Ankenbrandt, director of communications for the U. S. Air Force.

Nearly a hundred of the chapter members went from the luncheon to the air base, where they were greeted by Brig. Gen. Wallace G. Smith, commanding general of the AACS. On the tour of the field the members watched operations in the communications center; GCA out near the runways; the control room which utilized the AN/CPN-18, a precision search radar with a 40-mile range; and the facsimile center, where weather maps are received from all over the United States and from military installations in Europe and the Far East, and relayed on to other points. —30—

SERVICE GROUP MEETS

THE annual meeting of the Television Installation & Service Association, held at the Stevens Hotel in Chicago, resulted in the re-election of President Frank J. Moch of the Aide Sound & Radio Service Corporation to a third term. Re-elected with him were Irving Kaluzna of Television Engineers, Incorporated as vice-president, and Fred H. Levine of A West Side Radio & Television Service as secretary. Martin Reese of Television Technicians, Incorporated was named to the treasurer's post.

The meeting also considered the television servicing problems which have arisen as a result of attempts at reduction in rates coupled with general poor quality. Amendments to the bylaws of TISA were made to expedite the solution of these and other servicing problems. The organization is also putting on a concerted drive to enroll every ethical service company in the metropolitan Chicago area. —30—

TV DEMONSTRATION

AN international group of television technicians, representing member countries of the C.C.I.R. (International Radio Consultive Committee) of the International Telecommunication Union is currently visiting the United States at the invitation of the State Department.

United States television technicians are conducting demonstrations for the group in the New York, Philadelphia, and Washington areas. After viewing U. S. television operations the group will study the French, Dutch, and British systems as a basis for recommending a single set of standards to their respective governments for adoption on a regional or world basis. If such an agreement can be reached, it will facilitate the interchange of programs among nations, and provide an international television system based on the best available technical knowledge.

Persons from Austria, Belgium, Czechoslovakia, Denmark, France, Hungary, Italy, Netherlands, Sweden, Switzerland, United Kingdom, Yugoslavia, and the United States are members of the group. —30—

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ERRATA

The photographs accompanying the article "Processing Radio Transcriptions" appearing in the February issue of this magazine were taken by the author at Recorders Labs, Limited, 6916 Santa Monica Blvd., Hollywood 38, California.

* * *

In the January issue, in the article "Aircraft Radio," was a misstatement regarding the operation of the "Z" marker. The "Z" marker is modulated by a steady 3000 cycle tone. "Z" markers (also called station location markers) are installed at most radio range stations (low frequency ranges) to identify the cone of silence. They operate on a frequency of 75 mc. and are modulated by a steady 3000 cycle tone. The output is approximately 5 watts.

Radiation is vertically upward into the cone of silence and the radiation pattern conforms roughly with the cone. The cone of silence identifies the station by the absence of the signals from the radio range.

The "Z" marker gives a positive identification of the cone. Signals from the "Z" marker may be converted into visual or aural indications depending on the receiver installation in the particular aircraft.

ANSWERS TO "FM QUIZ" PAGE 152

1. c	6. b	11. d
2. c	7. c	12. c
3. b	8. a	13. b
4. a	9. a	14. b
5. d	10. a	15. d

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

INDEX OF Advertisers

APRIL 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.

Network Inductor Design

(*Continued from page 48*)

must be approximately equal to one-half the inner diameter (1½ inches). Since the cross-section of the winding has been assumed to be square, the available winding area is .75 × .75 = .563 sq. in. Dividing 250 turns by .563 sq. in. will equal the number of turns per sq. in., or 444 in this case. A good copper wire table will give the number of turns per sq. in. for various sizes of wire. Number 18 enamel s.c.c. will wind approximately 454 turns per sq. in., therefore using this size of wire will allow a small margin in winding space.

Suppose the series circuit was used instead of the parallel circuit, then the number of turns would be 250 × .707 = 176. This value divided by the winding area (.563 sq. in.) equals 313 turns per sq. in., in which case number 16 s.c.c. should be used.

The value of inductance obtained by this method will not be the exact value required by the network, but it will be approximately correct and satisfactory for practical purposes.

For convenience, values of inductance and capacity can be read directly from the chart in Fig. 2. If the crossover frequency is 600 cycles and R_o is 8 ohms, then values of C and L can be obtained simply by following the 600 cycle line upward until the appropriate C and L lines are intersected. Thus, if the circuit is the parallel type the 600 cycle line intersects C for the parallel network at 24 μfd., and the inductance L required is 3 mhy. For other values of R_o the procedure is the same except that the values of C and L obtained are substituted in the formulas shown on the chart.

REFERENCES

Terman, F. E.; "Radio Engineer's Handbook", McGraw-Hill Book Company, New York

Read, Oliver; "The Recording and Reproduction of Sound", Howard W. Sams & Co., Inc., Indianapolis

-30-

NEW ENGLAND IRE

THE Somerset Hotel in Boston will be the scene of a one-day engineering meeting on April 15th.

The 1950 New England Radio Engineering Meeting will feature such well known authorities as Calvin Ellis of General Electric, Osman K. Mawardi and Arthur A. Janszen of Harvard, C. Robert Paulson of Dartmouth, V. K. Zworykin of RCA Labs, E. F. Buckley and T. W. Farnell of MIT, Jack Donal and Donald S. Bond of RCA, and M. W. P. Strandberg of MIT and Dale Pollack, consulting engineer.

Lawrence B. Grew and Hermon H. Scott will preside at the morning and afternoon sessions respectively.

In addition to the regularly scheduled panel sessions, engineers attending the meeting will have the opportunity to visit the television facilities of WBZ, Boston and inspect the toll dialing equipment of the New England Telephone & Telegraph Co. -30-

"TAB" THAT'S A BUY

AH&H TOGGLE SWITCHES—UL Appvd 6Amp/125V. Hi-Nickel Finish. Remvd from Equip. Bklte Csd. CLEAN. A Real Bargain! **SPDT,** 5 for $1.00; **DPDT,** 4 for **$1.00.**

4 Year FLASHER
IndispensableOverBoat.
NeonBulbFlashesBrilliantly in Dark. Four Yr Life. NoServicing. . . . **$1.98**

UHF ANTENNA 12"/30cm AT5/ARRI

Usable Citzn&HamBand Insltd Coax Term SilvPlCont wptGask Flange & Hardware MOBILE mtg. New **39c;** . . . . . **4/$1**
PL 259 for Above. **29c**
ANT AN130B 33" Whip. . **98c**
ANT MS49to52, 12½ ft. **$1.69**
ANT MS49to53, 16 ft. . . **2.49**
ANT MS49to53xtra 53, 19 ft. **3.69**
ANT MS49to56 (2-53's) 26½ ft. **5.98**
ANT AN131A, 11 ft. 8 sections **1.89**
MP22 Mast Base **3.95**
MP37 Mast Base **3.95**
MP48 Mast Base **3.98**

"Williamson" 15 Watts Hi-Fi Kit

Internationally Famous. Simplicity of Design-Extraordinary linearity and lack of distortion. 10 cycles to 20kc with ease. To 1 Mc. for Experimenters & other applications. With RCA chassis, less Outpt Xformer **$19.95**
Super Wide-Range High Fidelity Amplifier Kit 20 to 20,000 cycles. Max. Harmonic Distortion 1¾% at Full Outpt, only 0.5% at 5W out. Works w/ ANY Mike, pickup or Revr. Pre-Amp Stage, 2 Tone Controls. RCA Chassis, less Outpt Xfmr **$24.95**
G-E Var. Reluc. Cartridge **$1.98**
"LP" Record Anti-Static Fluid. Enough for 800 Applications, only **69c**

High Fidelity Output Transformers

20 Watts PP6L6/2A3/6A5G/etc. Pri 5000 ohms CT; Sec 7 taps 2.5 to 600 ohms PLUS feedback winding **$20.35**
With 1201D G-E Hi-Fi Spkr **$24.95**
30 Watts UTC High Fidelity Output PP6L6/2A3/6AG5/etc Pri 4000 ohms CT; Sec 5 taps 2.5 to 250 ohms **$5.98**
With 1201D G-E Hi-Fi Spkr **$21.35**

"TAB" Hi-Fi Pickup Assemblies

"TAB" Pickup Arm & G-E Var Reluc Cartridge with Replaceable Stylus; Standard, RPX040 or "LP", RPX041 (Specify) **$7.29**
As Above with G-E Triple-Play Cartridge RPX050 (33⅓,45,75RPM)&Stylus. **$9.49**

TUBES...

"TAB" TESTED & GUARANTEED

0A3/VR75	$ .98	2B4	$ .98	5X4G	$ .71	6K6GT	$ .42	7R7	$ .63	25Y5	$1.08
0A4G	.94	2B7	.78	5Y3GT	.38	6K7	.48	7S7	.89	25Z5	.47
0B2	1.72	2B22/GL559	.73	5Y4	.45	6K8	.75	7T7	1.03	25Z6GT	.47
0B3/VR90	.74	2C21/1642	.81	5Z3	.51	6L5	.84	7V7	.85	26	.42
0C3/VR105	.75	2C22/7193	.15	5Z4	.74	6L6	.98	7W7	.85	FG27A	9.50
0D3/VR150	.47	2C26	.25	C6A	7.85	6L6G	.82	7X7/XXFM	.85	28D7	.35
0Z4	.56	2C34/RK34	.27	6A3	.98	6L6GA	.82	7Y4	.44	30	.39
C1A	4.80	2C39	21.00	6A4	1.29	6L7	.77	7Z4	.55	31	.49
01A	.45	2C40	5.50	6A6	.88	6N4	1.08	10Y	.60	32	.89
1A3	.42	2C43/464A	9.39	6A7	.68	6N7GT	.90	12A6	.17	FG32	4.98
1A4	1.00	2C44	1.69	6A8GT	.70	6P5G	.81	12A7	.96	32L7GT	.63
1A5GT	.48	2C51	8.10	6AB4	.69	6Q7	.57	12A8GT	.48	34	.33
1A6	.78	2D21	1.10	6AB5/6N5	.88	6R7	.77	12AH7GT	.99	FG33	8.49
1A7GT	.88	2E22	.89	6AB7/1853	.77	6S7	.85	12AL5	.72	35/51	.59
1B3/8016	.81	2E22	1.15	6AC5GT	.89	6S8GT	.77	12AT6	.43	35A5	.65
1B4	.98	2E24	4.50	6AC7	.70	6SA7GT	.43	12AT7	.70	35B5	.54
1B5/25S	.84	2E25/HY65	4.00	6AD6G	.81	6SB7Y	.81	12AU6	.52	35C5	.49
1B7GT	.98	2E26	3.45	6AD7	.98	6SC7	.57	12AU7	.62	35L6GT	.54
1B21/471A	2.85	2E30	2.35	6AF6G	1.17	6SD7GT	.45	12AX7	.81	35W4	.38
1B22	4.50	2G5	.98	6AG5	.77	6SF5	.48	12AV6	.51	35Y4	.49
1B23	9.00	2J21	11.45	6AG7	.59	6SF7	.58	12AW6	.55	35Z3	.61
1B24	4.65	2J21A	11.45	6AH6	.97	6SG7	.57	12BA6	.56	35Z4GT	.49
1B26	4.50	2J22	9.75	6AJ5	.89	6SH7	.35	12BA7	.75	35Z5GT	.49
1B27	8.49	2J26	8.45	6AK5	.73	6SJ7GT	.45	12BD6	.59	36	.61
1B29	3.39	2J27	14.50	6AK6	.80	6SJ7GT	.40	12BE6	.45	37	.36
1B32/532A	2.75	2J31	9.95	6AL5	.81	6SL7GT	.58	12BF6	.54	38	.34
1B37	45.00	2J32	14.85	6AL7	.55	6SN7GT	.59	12BH7	.55	39/44	.25
1B38	36.00	2J33	18.95	6AN5	1.00	6SN7WGT	.89	12BL6	.27	41	.54
1B41	49.95	2J34	17.50	6AQ5	1.08	6SQ7GT	.89	12BL8GT	1.59	43	.49
1B42	7.50	2J37	13.85	6AQ6	.47	6SR7	.56	12BY7	.55	45Z3/VT52	.49
1B53	49.95	2J38	12.70	6AR5	.54	6SS7	.57	12Q7GT	.55	45Z3	.27
1B54	49.95	2J39	29.00	6A55	.50	6ST7	.75	12SA7GT	.79	45Z5	.54
1B56	49.95	2J47	49.95	6AS6	.59	6SU7GTY	.85	12SA7GT	.55	46	.51
1C5	.86	2J48	45.00	6AS7G	1.89	6T7G	.75	12SF5	.55	48	.65
1C6	.87	2J49	22.50	6AT6	4.29	6T8	.84	12SF5GT	.54	50	1.56
1C7G	.89	2J50	39.00	6AU6	.40	6U5/6G5	.63	12SF7	.50	50A5	1.49
1D5GP	.95	2J56	81.00	6AV6	.53	6U6GT	.89	12SG7	.52	50B5	.40
1D7G	.84	2J61	39.00	6AW6	.43	6U7G	.48	12SH7	.44	50C5	.54
1D8GT	.94	2J62	39.00	6B4G	.89	6V6GT	.52	12SJ7GT	.45	50C6	1.18
1E5	1.08	2K25	23.75	6B6	.75	6V6GTY	.90	12SK7GT	.51	50L6GT	.52
1E7G	1.00	2K25	24.89	6B7	.89	6V6M	.98	12SK7M	.52	50X6	.98
1F4G	.75	2K29	24.95	6B8G	.65	6W4GT	.59	12SL7GT	.54	50X6	.63
1F7GT	1.55	2V3G	.49	6BA4	1.08	6W7G	.87	12SN7GT	.47	50Y6	.84
1G4GT	.69	2W3GT	.98	6BA6	.49	6X4	.52	12SQ7GT	.45	57	.47
1G5G	.98	2X2	.36	6BA7	.79	6X5GT	.42	12SR7	.48	58	.53
1G6GT	.63	3A4	.32	6BE6	.49	6Y5G	1.85	12X3	.90	59	.84
1H4G	.87	3A5	.75	6BF6	.52	6Y6G	.65	12Z3	.72	RK65	24.95
1H5G	.54	3B5	.98	6BG6G	1.39	6Y7G	.98	14A7/12B7	.67	HY69	2.29
1H6G	.99	3B7/1291	.29	6BH6	.52	6Z5/12Z5	1.08	14AF7	.86	70A7	1.49
1J5G	.98	3B22	2.64	6BJ6	.55	6Z7G	1.08	14B6	.65	70L7GT	1.10
1J6	.72	3B24	1.75	6BQ6GT	.89	6ZY5G	.67	14B8	.77	71	.65
1L4	.45	3B25	4.85	6BA6	.49	7A4/XXL	.57	14C7	.86	72	.95
1LA4GT	.99	3B28	5.89	6BA7	.79	7A5	.65	14F8	.75	CRP72	1.37
1LB4	.99	3C22	3.98	6BE6	.49	7A6	.55	14H7	.63	73	1.67
1LC5	.64	3C31/C1B	3.75	6BF6	.52	7A7	.56	14J7	.80	NR74	.29
1LC6	.75	3C45	12.85	6BG6G	1.39	7A8	.69	14N7	.86	75	.53
1LE3GT	.85	3D6/1299	.29	6BH6	.52	7AF7	.70	14Q7	.55	76	.38
1LH4	.64	3D21A	1.20	6BJ6	.55	7AG7	.69	14R7	.65	77	.45
1LN5	.52	3E29/829B	7.98	6BQ6GT	.89	7AH7	.70	14X7	.98	78	.84
1N5GT	.59	3LF4	1.25	6C4	.29	7B5	.70	15E	1.44	80	.35
1N6G	.98	3Q4	.45	6C5	.45	7B6	.58	15R	.75	81	1.29
1P5GT	.54	3Q5GT	.65	6C6	.52	7B7	.57	FG17	3.98	FG81A	4.45
1P24	.85	3A4	.54	6C8G	.65	7B8	.57	RK18	.98	82	.84
1P25A	98.00	3V4	.67	6C21	23.95	7C4/1203A	.36	19	.95	82V	.95
1Q5GT	.96	4C33	81.00	6CB6	.69	7C5	.44	19BG6G	1.98	83	.99
1Q26	75.00	4C35	19.30	6D4	2.75	7C6	.69	19T8	.89	83V	.89
1R4/1294	.65	4J31	95.00	6D6	.47	7C7	.57	20	1.17	84/6Z4	.56
1R5	.59	4J32	95.00	6D7	.98	7CZ3	69.00	RK20A	6.98	85	.57
1S4	.96	4J42/700	29.85	6D8	.75	7E5/1201	.65	RK20Y	6.98	89	.32
1S5	.48	4J47	75.00	6E5	.69	7E6	.57	PJ21	4.98	FG104	14.98
1T4	.51	4T4/2	9.95	6E6	1.03	7E7	.59	REL21	4.85	FG105	10.75
1T5GT	1.05	5C22	47.00	6E7	1.20	7F8	.59	RX21	3.20	VU111	.49
1U4	.49	5C30/C5B	8.49	6F5	.47	7G6/1203A	.36	24A	.40	HY114B	.81
1U5	.69	5D21	24.50	6F6	.55	7H7	.64	24G/3C24	.45	HY115/145	.80
1V	.49	5J23	13.45	6F8G	.84	7J7	.98	25A6	1.04	117L7	1.23
1X2	.78	5J29	17.39	6G6	.99	7K7	1.03	25A7	2.98	117M7GT	1.36
1Z2	3.98	5J32	99.00	6H6	.45	7Q7	.98	25AC5GT	1.08	117P7GT	1.20
2A3	.84	5R4GY	1.08	6J5	3.90	7R7	.63	25B5	1.39	117Z3	.49
2A4G	1.06	5T4	.86	6J6	4.65	7S7	.89	25B6	1.49	117Z6GT	.77
2A5	.65	5U4G	.47	6J7	.37	7T7	1.03	25C6	1.18	117Z7GT	1.49
2A6	.78	5V4G	.88	6J7GT	.55	7V7	.85	25B06GT	.89	FI27A	16.95
2A7	.75	5W4	.66	6J8GT	.95	7W7	.85	25L6GT	.49	CV148	7.90
				6K5GT	.79	7X7/XXFM	.85	25N6	1.69	155	.98
								25W4GT	.70	FG166	49.00

FG172	$19.50	829B	$7.29	***P1	$1.98						
FG190	12.98	832A	4.87	5BP4	4.50						
205B/VT2	1.69	836	.98	5CP1	1.75						
211/VT4C	.42	838	2.35	5CP7	3.70						
RX215	9.95	842	3.20	5FP5	6.49						
WE215A	.25	843	2.75	5FP7	1.26						
227A	2.90	845	.39	5FP14	18.95						
231	1.20	851	13.95	5GP1	6.95						
250TH	24.98	860	2.98	5HP1	4.95						
250TL	24.98	861	10.79	5HP4	6.75						
282B	8.49	864	.45	5JP2	15.75						
304TH	3.70	865	1.90	5LP1	18.00						
304TL	4.49	866A	1.04	5MP1	4.75						
307A/RK75	3.60	866Jr	1.00	7BP7	4.65						
316A	.49	863/PJ23	1.90	7CP1	12.95						
323A	8.98	869	30.00	7HP7	5.95						
327A	2.70	872A	1.49	9GP7	12.33						
350	1.88	GE872A	2.98	9LP7	18.00						
350B	1.88	874	.55	10BP4	20.95						
355A	14.15	876	.36	10FP4	12.95						
368A5	3.75	878	1.95	12AP1	12.49						
371B	.79	884/6QSG	1.59	12GP1	49.98						
380A	.39	885	.87	12GP7	18.00						
388A	.89	920	2.70	12JP4	27.00						
393A	3.65	922	1.19	12LP14	34.00						
394A	3.65	923	.85	12LP4	27.45						
395A	1.23	927/CE25	1.26	12QP4	32.00						
417A	19.95	930	.80	12RP4	36.00						
GL434A	2.90	931A	3.95	15DP4	36.00						
446A/2C40	1.17	954	.18	16GP4	55.00						
446B	17.75	955	.24	16FP4	57.50						
450TH	49.95	956	.24	16DP4	49.98						
450TL	49.95	957	.20	16TP4	49.98						
GL451	1.90	958	.35	19AP4	96.00						
460/HF200	9.98	5D968	2.98	902	3.15						
WL468	6.75	991	.23	905	2.90						
RH507	9.98	1000UHF	59.95	910/3AP1	4.63						
527	12.95	1000	.95	912	89.98						
530	12.95	FM1010D	.18	914	45.00						
531	1.80	CK1005	.64								
WL531	1.95	CK1006	.98	**TUNGAR BULBS**							
GL534/1521	1.95	CK1089	2.69	16X897	$2.49						
544	4.95	CK1090	5.00	299X677	2.95						
GL546	4.69	RI100	12.00	1890480E	3.49						
550P1	19.95	RI130B	5.98	199698	2.95						
575A/975	12.65	1609	.19	289881	2.50						
601B	.19	1613/6F6X	.45	859483	3.98						
HY615	.24	1614	1.42								
WL619	19.75	1616	.75	**MAZDA PILOTS**							
KU627	7.49	1619	.16	44,Box 10	$0.50						
631P1/SN4	3.98	1620	4.95	49,Box 10	.60						
WL632A	1.98	1622	1.75	55,Box 10	.50						
701A	2.90	1624	1.25	64, Each	.07						
702A/702B	2.75	1625	.33	86/T4/3W	.18						
703A	3.75	1626	.35	1000W/20V	.25						
704A	1.08	1629	.23	291,Box 10	.36						
705A/8021	1.05	1632	.89	311/28V	.15						
707	7.98	1633	.97	313/28V	.15						
710A/8011	.65	1635	1.49	323/3V	.10						
713A	1.49	1641/RK60	.48	Sylvania S6/6W/120V	.15						
715A	6.75	2050	.87	Wstghs C7/7W/120V	.09						
717A	.61	R4340	36.00	MED. SCR. BASE							
721A	2.65	5514	4.85	15W/125V	$0.08						
722A/287A	9.95	5516	5.85	25W/125V.	.08						
723A	6.95	WUX6653	.99								
723AB	14.95	8012A	1.35	**NEON BULBS**							
724A/B	3.90	8013A	2.50	NE2,100for	$3.98						
725A	6.90	8020	.97	NE16/991.	.23						
726A	4.98	9001	.44	NE32	.25						
726C	14.95	9002	.23	NE45,1/4W	.24						
730A	10.90	9003	.30	NE51/NE20	.07						
801A	.45	9004	.34								
802	4.15	9006	.17	**Xtal Frequency Standards**							
803	9.95			100 Kc.	$7.98						
804	6.90	**C'RAY TUBES**		200 Kc.	3.98						
805	3.59	2AP1	$4.98	1000 Kc.	2.95						
807	1.49	3AP1	4.63	1700 Kc.	.98						
808	1.25	3BP1	2.55								
809	4.70	3BP1A	7.98	**HeaterOvenXtals**							
810	7.90	3CP1	2.65	5010/5025/5055 Kc. Ea.	$14.98						
811	2.45	3CP1-S1	2.49								
812	2.98	3DP1	2.75	**Tubes Gtd Exc**							
813	4.95	3FP1	2.65	**OpenFil&B'kage,**							
814	2.61	3FP7A	.98	**Shipped via**							
815	2.40	3GP1	8.95	**R'exp. Only. Min.**							
816	1.05	3HP7	4.80	**Order $5.**							
826	.39	4AP10	4.70								
SD828	2.98	5AP1/1805	3.75								

NAVY LINE FILTERS

10 amp/130V AC DC Cased filters 0.1 to 1000 mc's/USN Cased Cont duty **$1.29**
TOBE 30 amp/250V AC DC filters 0.15 to 1000 mc's USN Cased Cont duty **$4.50;** TWO for **$8.00**
GE 100 amp filter & 2x5 mfd/50V/pyranol Condsrs works 110V AC DC SPECIAL **98c**
2 for **$1.75**
50Amp 600Voit Filter—ContDity Dual Filter "Elim-O-Stat", NEW, **$9.98; 2/$18; 5/$39**

New Television Components!

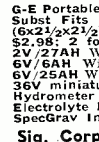
HiV Horiz & Def. Outpt Xformer Sim RCA 211T5 for 15-16" Picture Tubes. . . . **$2.49**
Width Control Sim 201R4 . . . . . **.39**
Focus Coil Sim 202D2. . . . . **4.98**
UTAH9318 HBO Xfmr H'Sld. . . . . **.89**
UTC 88662 VBOXXfmr H'Sld. . . . . **.89**
TV Yoke SPECIAL **2.49**
Focus Coil Magn Kineseps. **2.98**
ERIE HiV Cndsr 500mmf/10KV. . . . . **.39**
HiV Cndsr 500 mmf/15KV . . . . . **.54**
JEFFERS Cndsr 500 mmf/20KV. . . . . **.69**
IonTrapMagnetRCA203D1 . . . . . **.98**
RCA HiV DefXfmr211T1 . . . . . **4.98**
V'OutptXfmrSimRCA204T2. . . . . **2.69**
12 or 12½" Tube Picture Frame Mask . . . **.59**
TWINEX TV 300ohmCable 100ft. . . . **1.10**
HELLER TWINEX TACKER, Special. . **2.98**
500HvyDtyStaplesBoxed **2.98**

BLOWERS—Cool that Tube!

40 CFM 28vacdc. . $ **3.49**
70 CFM 115V400cy USN **4.49**
100 CFM 28vacdc. . **4.95**
100 CFM 12vacdc. . **5.95**
Xfmr 12 or 28v to 115vac **1.98**
250 CFM 28vacdc. . **9.95**
250 CFM & 28/115 vac Xfmr **11.95**
100 CFM 115vacdc **7.98**
180 CFM 115vacdc **10.98**

G-E 2J1G1 SELSYNS 400cycc, usable 24V or 110vac. Tested, used. Guaranteed. W/data 2 for **$1.49**
G-E Liquid Level Transmitter. Amazing. $100 "TAB" Special! G-E TJ Selsyn for RemoteIndication of Liquid present in tank. Approx. Govt Cost $100. NEW! . . . . . 2 for **89c**

METER SPECIALS!



BEST BUY! 5 Ma DC Tuning Meter 2½" dia. Bklt Csd SPECIAL **98c**
0-1,25MaDC, Min. Dipper, 1¾" sq. **$3.49**
0-50MaDC, General Electric **3.68**
0-1AmpDC, 3½" Wstghs **3.98**
0-15AmpDC, 2½" Hoyt **3.85**
0-60AmpDC, 2½" IntlShuntWECo **3.49**
50-0-50AmpDC, 3"IntlShuntWECo **4.49**
0-120MaRF, 3½" Weston JAN Accy to 65 Mc's B'Csd **10.95**
0-1AmpRF, 2½" GenElec. USN **3.95**
0-8AmpRF, 3" Triplett HiFreq Int. Couple **4.98**
0-8VoltAC, 3½" Weston, Rd. **3.49**
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BA37	1½V Walky-Talky		.29c
BA38	1031½V Walky-Talky		$1.49
BA39	150/7½VBurgFSA100		1.69
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36V	28V	1.5	1.49
	Full-Wave Bridge Rectifiers		
18V	14V	3.5	3.98
18V	14V	6.4	5.25
18V	14V	8	6.98
18V	14V	13	8.95
18V	14V	17.5	11.55
36V	28V	3.5	6.49
36V	28V	5	8.49
90V	75V	0.15	1.49
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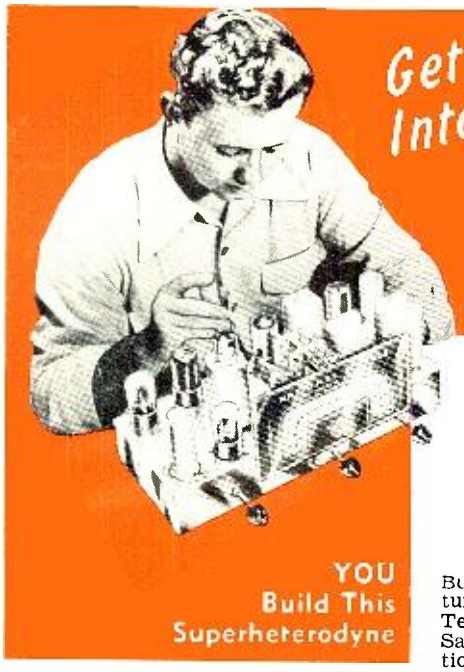

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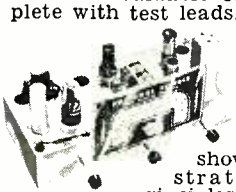

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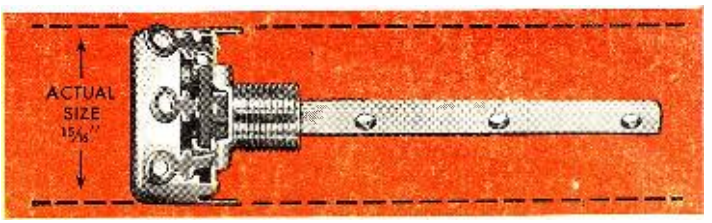

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