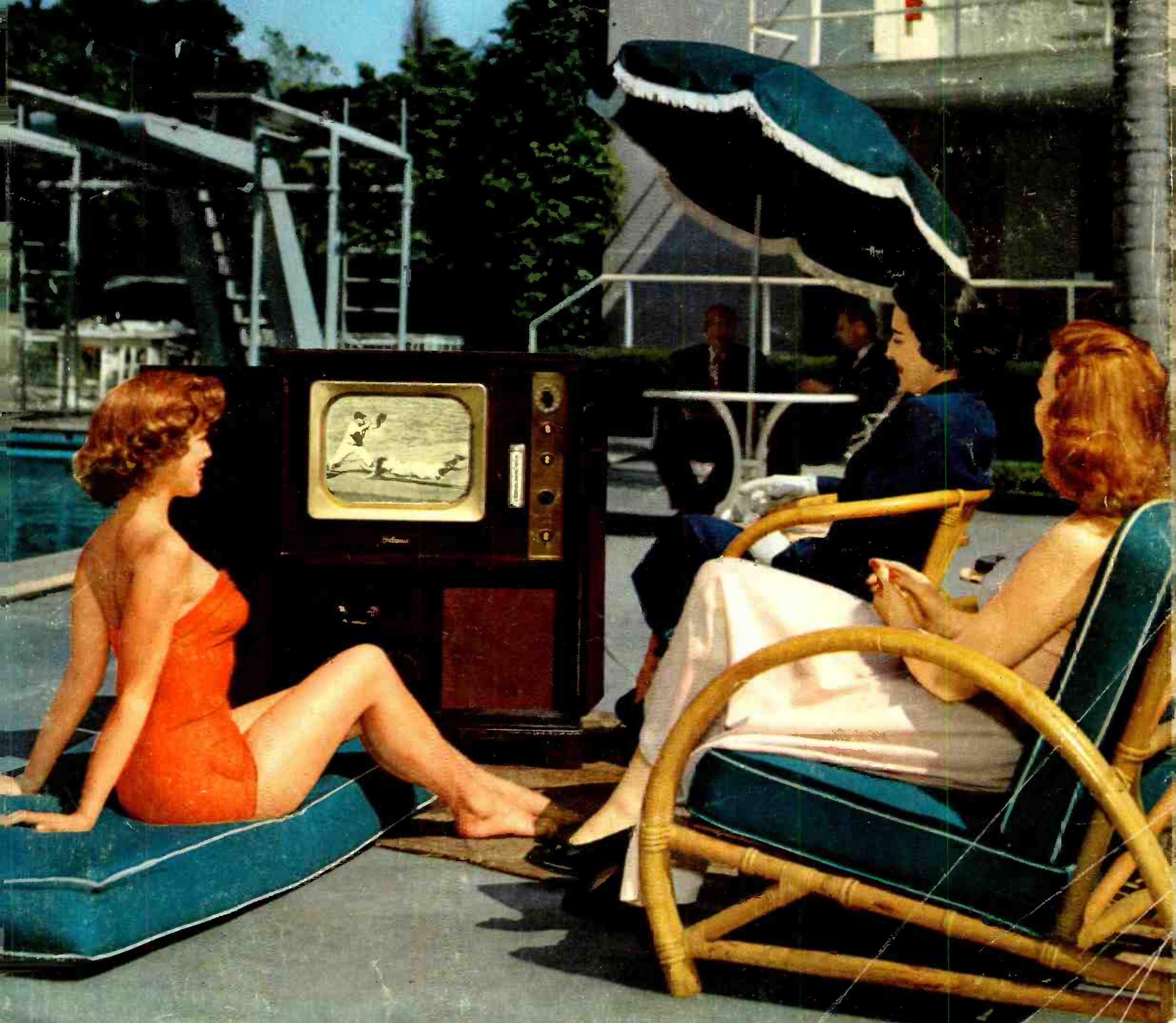
RADIO & TELEVISION NEWS

JULY
1950

RADIO-ELECTRONIC ENGINEERING EDITION

NEW TECHNIQUES MAKE OUTDOOR TV PRACTICAL

PAGE 100



Seven of the Top Ten are RCA

... pioneered for AM, FM, and TV

AMONG THE RECEIVING TUBES used *industry-wide* during 1949, seven of the top ten volume types were RCA pioneered. Of the remaining three, two were of basic RCA design. Almost one-half of these industry-wide leaders were also among the top ten volume types used in the radio and television *service business* during 1949.

Only tubes of unquestionable quality—both as to design and manufacture—could merit such acceptance by the industry. Here are leaders designed by the Leader—familiar types, such as the RCA 6SN7-GT and 6AG5 . . . and more recently the 1B3-GT, 6BA6, 6J6, 6AU6, and 6AL5. Their widespread application has permitted production to be concentrated on fewer types . . . which, in turn, has accounted for lower costs, improved quality, and greater uniformity.

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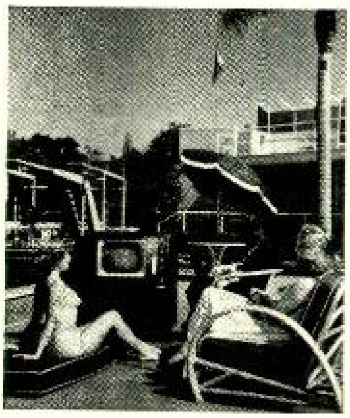

COVER PHOTO: An added attraction at the Beverley-Wilshire's Copa Club swimming pool is the Hoffman TV set installed on the poolside patio. (Kodachrome by John Shul)

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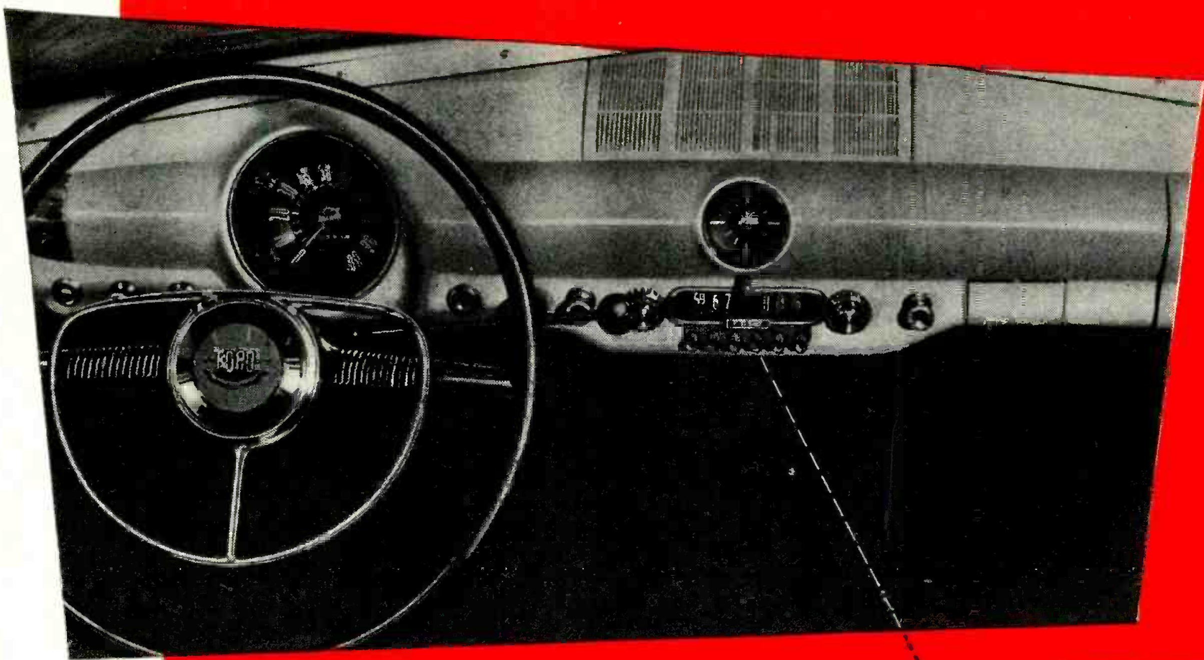

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Thrifty, nifty fifty Ford. On the dash a fine new Ford radio receiver. And again tubes by Hytron. Hytron continues as a major supplier of Ford auto radio tubes. Because Hytron *specializes* in auto radio tubes. Engineered for leaders like Ford, these Hytron tubes are leaders too. 'Nuff said! Buying auto radio tubes? Buy wise . . . like Ford. Buy Hytron!

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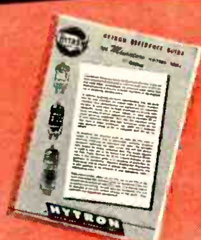

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For the RECORD

BY THE EDITOR

TV TECHNICIANS SEEK INDUSTRY COOPERATION

A SITUATION exists in the Midwest which may, or may not, be symptomatic of a condition in other areas as well, between television technicians and TV set manufacturers. In Chicago, for example, the Better Business Bureau has been flooded with complaints from television purchasers who claim that their sets do not function properly and that they are sometimes given a three-way "brush-off" by the retailer, service organization, and the manufacturer.

The Bureau, in a recent report (Vol. XXI, No. 4) states: "Specifically, these complainants allege that, when they contact the retailer for service they are referred to a service concern. The service company, in turn, then involves the manufacturer. The manufacturer, it is claimed, says the customer should 'look to the retailer' for satisfaction. Sometimes even a finance company becomes involved.

"The situation is unique in the annals of merchandising in that a servicing organization, twice removed from the manufacturer, is supposed to 'make good' on the advertised claims and promises of performance by the manufacturer.

"With the thousands of television sets sold in the Chicago area monthly, a certain number of complaints is inevitable. However, the volume of such complaints received recently indicates that too many customers feel they are not getting the quality of reception they have a right to expect from reading manufacturers' and retailers' advertising.

"In other fields, complaints to the Bureau are directed, generally, against only a few companies or individuals. In television, however, a substantial portion of the sets manufactured today are apparently involved. Most complaints have come from sources where the retailer also sells the purchaser a service contract.

"The retailer 'sublets' service to a separate organization which reportedly may not always have the same high regard or appreciation of the obligations that the manufacturers and retailers themselves naturally entertain for their respective advertising claims. Analysis indicates there are relatively fewer complaints when the retailer does his own servicing.

"When contacted by the Chicago Better Business Bureau, representatives of the great and growing television field say these complaints are the growing pains of an industry which has expanded too rapidly, and hence has not had sufficient time to acquire the proper technique for handling adjustment matters.

"They further allege that there are still an insufficient number of trained technicians for the huge volume of work required to install and service television receivers properly and hence customers expect too much in the way of both reception and service. The industry's further position is that, considering these very real problems, television is doing a remarkable job in satisfying thousands of purchasers.

"Because many complaints from the public involve the manufacturer, retailer, and the service agency, the Bureau recommends all three collaborate more closely in sifting their causes with a view to forthright and effective action."

Television service associations in the same area are complaining bitterly against practices by the television set manufacturers in approving service companies that are not qualified to do satisfactory installation and service jobs and who establish rates which cannot permit legitimate, ethical operations. The Television Installation Service Association reports that "investigations invariably reveal that the offending companies are chiselers who are representing themselves as legitimate companies."

There are now many service organizations in our Industry doing their utmost to maintain a healthy, clean service profession for the benefit of the entire industry and the set buyers. The real solution to these problems will be achieved only when all, not just a few, manufacturers and service organizations sit down together in an honest attempt to extend their mutual cooperation.

Television — the greatest industry potential of our time—is destined to follow a most rugged trail on its way to becoming our country's accepted mass communications system, unless the TV industry itself insists that the public enjoy and benefit from properly installed and properly maintained receivers. We must have trained technicians ready to meet the ever-increasing demand for service. Our technical schools are making a real contribution to the industry by supplying qualified technicians, and even many "old-timers" have burned the midnight oil to prepare themselves and to learn the new circuitry and television techniques. These men will have ample opportunity to succeed in the TV industry, provided they are given support by the TV manufacturer. . . . . O. R.

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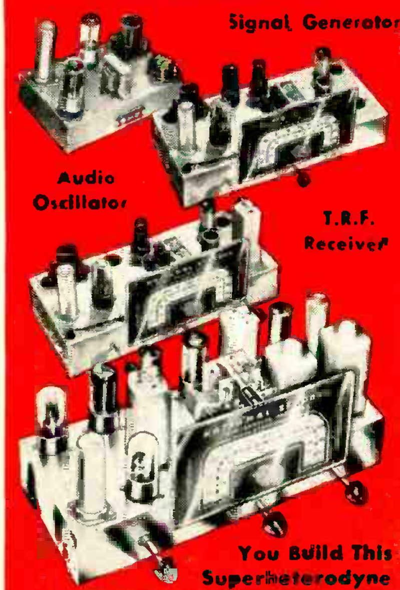

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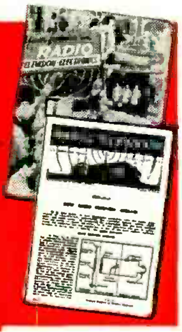

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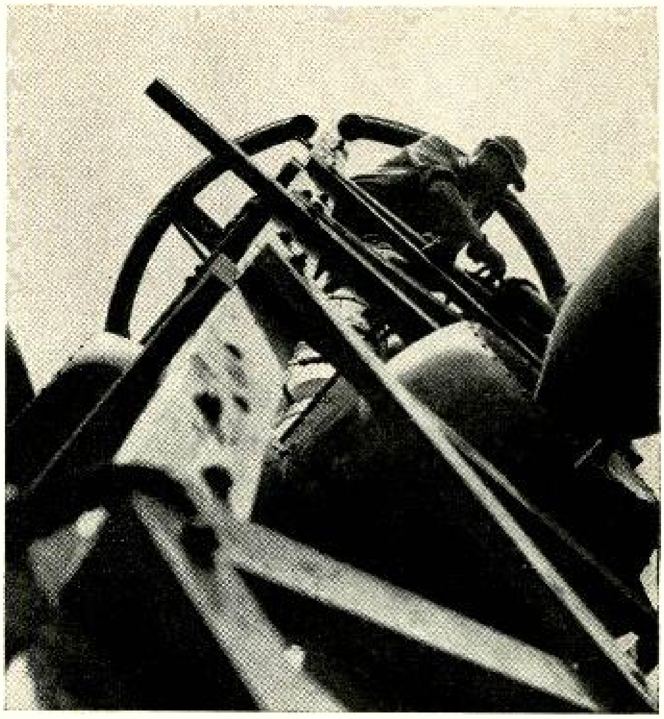


Steeplejacks at work *on an NBC television antenna—1250 feet above the sidewalks of New York. Its height gives telecasts a wider range in the New York and New Jersey area.*

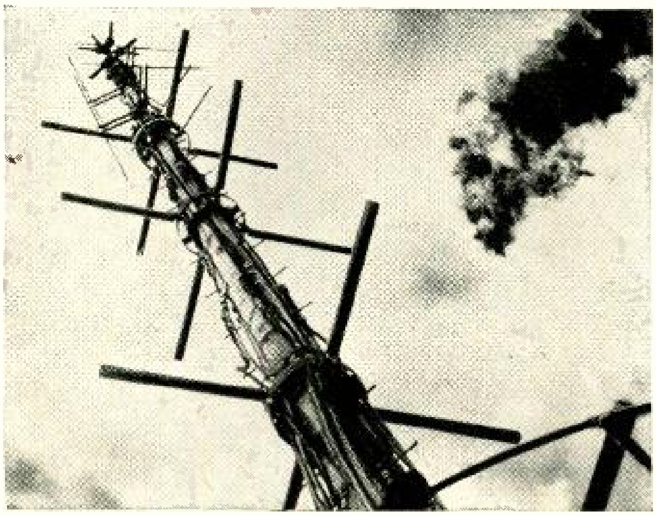
Installation of NBC's television antennas has been a job for daring steeplejacks!

No. 6 in a series outlining high points in television history

Photos from the historical collection of RCA

● Dwarfed ant-small by their height above Manhattan's streets, skilled and daring workmen—in 1931—offered New Yorkers a sight as exciting as the highwire act at a circus . . . but much more significant.

Task of these men, as they clambered about atop the tower of the Empire State Building—1250 feet in the air—was to install an antenna for experimental telecasts from NBC's television station. "Why did it have to be so high?" was a question on thousands of watchers' lips.



A familiar sight *on the New York skyline, NBC's television antenna—installed in 1946—was the successor to those erected in 1931, 1936 and 1938, and used by RCA and NBC to perfect television.*

As might have been expected, with television an unfamiliar art, the average layman thought of it in relation to radio broadcasts, whose waves he knew could circle the globe. That telecasts were fundamentally limited by the line of the horizon was little known. To increase this limiting range, scientists, engineers, and technicians, sought the highest available vantage point.

With its antenna installed, this experimental television station was able to transmit pictures a distance of about 42 miles, and farther under highly favorable conditions. Receivers dotted around the New York area picked up the first telecasts, providing encouraging and instructive information to be studied by RCA's scientists.

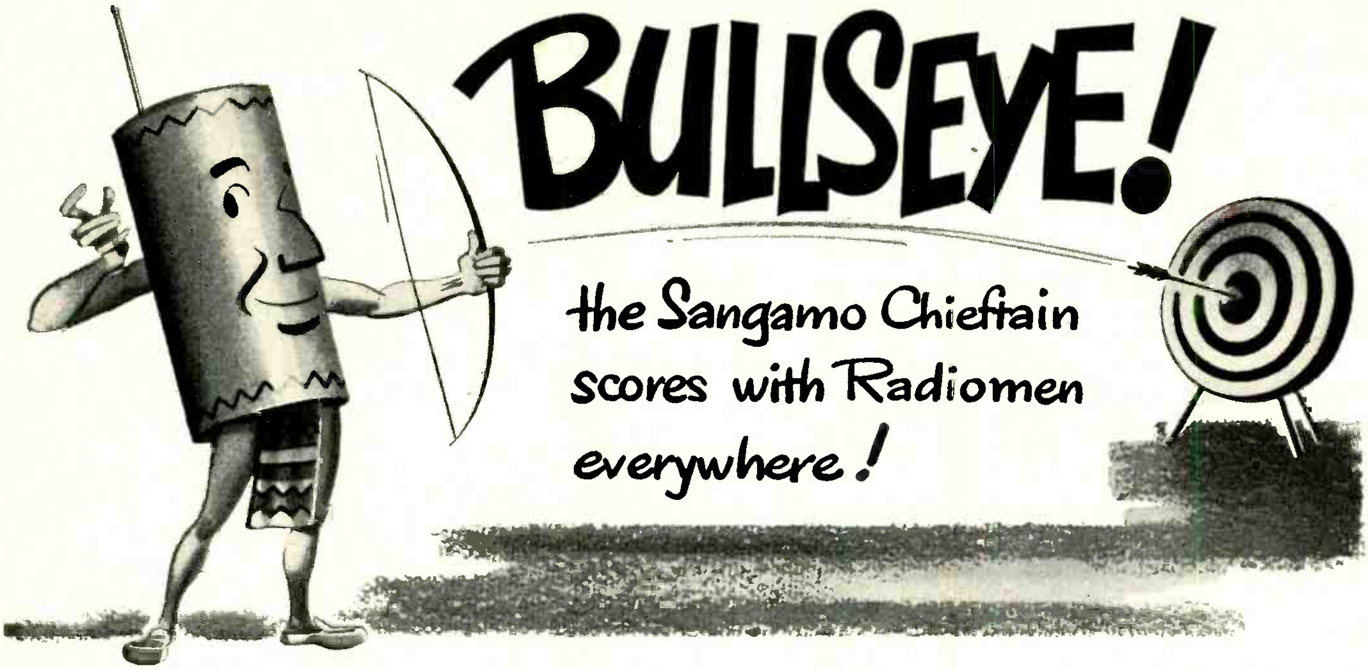
Facts gathered in this period included new data on the behavior of very short waves, as well as how to handle them. New knowledge about interference was acquired, including the fact *that much of it was man-made* and therefore could be eliminated.

Other studies undertaken at the time included basic work on the "definition" most suitable for regular commercial telecasts. Definition as coarse as 60-lines was used in early days. Then came 341-line, and 441, until today's standard of 525-line definition was finally adopted.

That we may now, as a matter of course, see sharp, clear pictures on the screens of our home television receivers is in good part the result of experimental work initiated by RCA scientists, and carried out by NBC engineers since the erection of the first station in the Empire State Building. A share should also be credited to the steeplejacks who climbed to dizzy heights so that you could see farther!

Radio Corporation of America
WORLD LEADER IN RADIO—FIRST IN TELEVISION

(Advertisement)



Types MT, MTD and MTH electrolytic capacitors, the Sangamo Chieftains, are ideal for assembly lines or for replacements. Tiny, but durable, they fit anywhere! Their small physical size makes them a "natural" for application in tight spots beneath a chassis, and the bare tinned-copper wire leads make them easy to mount.

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IF: 300 kc to 50 Mc, continuous tuning. Covers video band and all intermediate frequencies for prewar and present TV picture and sound, as well as for FM radios.

SWEEP: continuously variable for both IF and RF ranges. Sweep Frequency is not less than 10 Mc.

OUTPUT VOLTAGE RANGE (RMS) . . . 0.1 volt to 5 microvolts.

OUTPUT IMPEDANCE (AT CABLE TERMINALS):
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IF RANGE: 100 ohms

MAXIMUM ATTENUATOR RATIO:
RF RANGES: 20000 to 1
IF RANGE: 4000 to 1

MAXIMUM AMPLITUDE VARIATION OF SWEEP ENVELOPE: All ranges, less than ± 1.5 db

HORIZONTAL SWEEP FOR OSCILLOSCOPE: Phase Range, 0°-160°; Frequency, power line

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If you want the best—you will ask for the instrument demanded by most television set manufacturers the WR-59B SWEEP GENERATOR.

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. . . *FOR DEPENDABILITY*—you get fundamental oscillator signals on all TV channels; and filtered beat-frequency fundamentals on if/vf range.

. . . *FOR TV TROUBLE-SHOOTING AND ALIGNMENT*—you get all the sweep signals you need with the WR-59B BLUE RIBBON Television Sweep Generator.

DESIGNED FOR THE TV SERVICEMAN

DESCRIPTION

The RCA WR-59B Television Sweep Generator is designed for the aligning and the general servicing of television and FM receivers. Used with an oscilloscope, this instrument will provide a pattern on the oscilloscope screen representing the response curve of the circuit under test.

The WR-59B Television Sweep Generator will furnish a wide-band frequency-modulated signal to cover each of the 12 standard television channels as well as all other frequencies between 300 kc and 50 Mc. The frequency width of the sweep may be controlled for each position.

The output from the RCA WR-59B is frequency-modulated at the fundamental frequency by a precision-type vibrating capacitor. The moving element of the capacitor is suspended by beryllium-copper corrugated straps. This design insures long life, good linearity, and a wide sweep range. Both rf and if/vf outputs are essentially flat over all sweep ranges. The output signals are free from spurious responses and other frequency components, such as are characteristic of unfiltered beat-frequency oscillators and harmonic generators. The if/vf output is obtained by mixing the output of the sweep oscillator with the output of a variable-frequency oscillator and passing the result through a low-pass filter to provide a clean fundamental-frequency signal.

In addition, the WR-59B features a blanking circuit which produces a zero-reference line on an oscilloscope. This base line, the point of zero signal from the Sweep Generator, is exceedingly helpful in aligning television and FM discriminator circuits, in checking phase adjustments, and in determining the slope of the frequency-response curve.

The WR-59B also provides a phase-controlled sweep voltage at power-line frequency, which may be applied to oscilloscopes lacking a phase control or a sync control.

The RCA WR-59B Television Sweep Generator is a light-weight, compact, and versatile instrument. It can be employed in any application which requires a frequency-modulated signal of 0.1-volt down to 5 microvolts and within the frequency range of the instrument. Used in conjunction with the RCA WR-39B Television Calibrator and an oscilloscope, it will provide outstanding facilities for aligning and servicing television receivers.

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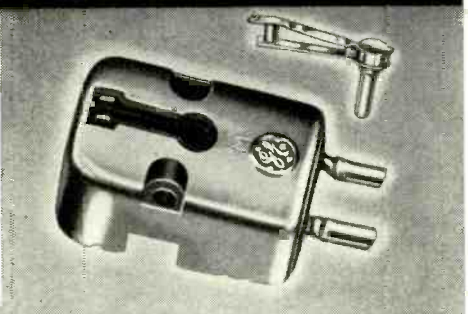

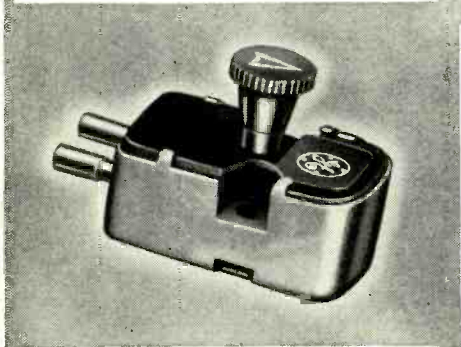

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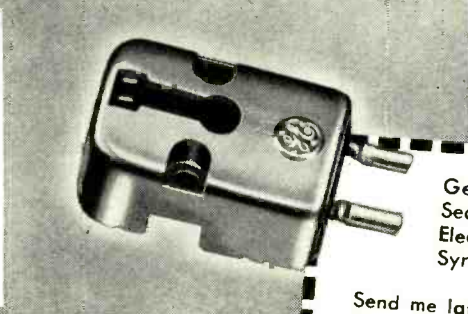

You can't beat these General Electric Variable Reluctance Cartridges for superb reproduction, sturdy construction, and low cost. That's why manufacturers, radio stations, and the listening public everywhere continue to select the G-E Cartridge that fits their needs best.

You can get a bigger share of the valuable replacement business by stocking the models shown here. Don't delay—place your orders today!

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Spot Radio News

★ ***Presenting latest information on the Radio Industry.***

By RADIO & TELEVISION NEWS'
WASHINGTON EDITOR

THE TRI-COLOR ERA of TV, the official beginning of which has been a pet topic of the largest collection of armchair-expert forecasters on record, is now well on its way to receiving a well-documented sanction, with the end of the summer offered as the period when the fully-authorized inaugural-date news will be released.

Preparation of a lengthy notice from government headquarters, requesting detailed findings and conclusions from the three proponents of color, *RCA, CBS* and *CTI,* before the summer is in full swing, and subsequent comments by Congressional committeemen specializing in broadcast legislation, have been cited as the clues to the anticipated decision.

The lengthy notice should provide the answer, for the color experts were asked to supply an encyclopedic array of data, which the FCC felt would surely produce the key facts as to when we should have color and what kind or what system should be approved. Specifically, here is what the Commissioners asked the color scientists to disclose:

A complete description of the receiving and transmitting setups, with an analysis of the over-all picture quality; brightness; color breakup and fringing; color fidelity and color contamination; contrast; picture texture; flicker, dot crawl, line crawl, etc.; picture size limitations; viewing angle and distance; registration; vertical and horizontal resolution. In addition, the government men wanted to know when the transmitters and receivers might be available for color, what the cost would be not only for the original package, but for maintenance. They were also interested in being told about the possibilities of network transmission, including the capability of transmission over existing and proposed network facilities. Convertibility of existing receivers to receive color represented another vital factor in which they were concerned. In this instance, the Commissioners wanted to know just what types of converters would be necessary, their possible cost, how much it might cost to maintain them, when they would be available, what types of production schedules can be planned. The FCC men also asked whether existing receivers might be able to receive color transmissions, if relatively minor modifications were to be effected.

An extensive set of queries concerning black and white reception on color models was also included, the questions, in the main, duplicating those involving the color sets.

Interference received substantial coverage in the questionnaire, too, data requested covering co-channel interference, adjacent channel interference, oscillator radiation interference or other in-channel interference such as diathermy harmonics and other station harmonics including interference to any subcarrier employed in the system, image interference, noise, ghosts, and ignition interference.

Field tests and public-reaction tests were also subjected to a quiz, proponents being asked to provide a summary of all such tests, and a statement of the adequacy and weight which might be given to these tests in setting up standards.

In a section devoted to proposed conclusions, the FCC asked for a precise statement of the specific transmission standards proposed; the rules and regulations suggested; and recommendations as to the policies with respect to compatibility; convertibility; patents; the desirability or undesirability of promulgating color standards at the present time in the light of the development of the art; the minimum and maximum hours of color telecasting; and the handling of the transition from the present situation in TV broadcasting to color transmission. Also asked for was a statement covering the social value and economic cost to the American public of the adoption of any specific system at this time or at a later time.

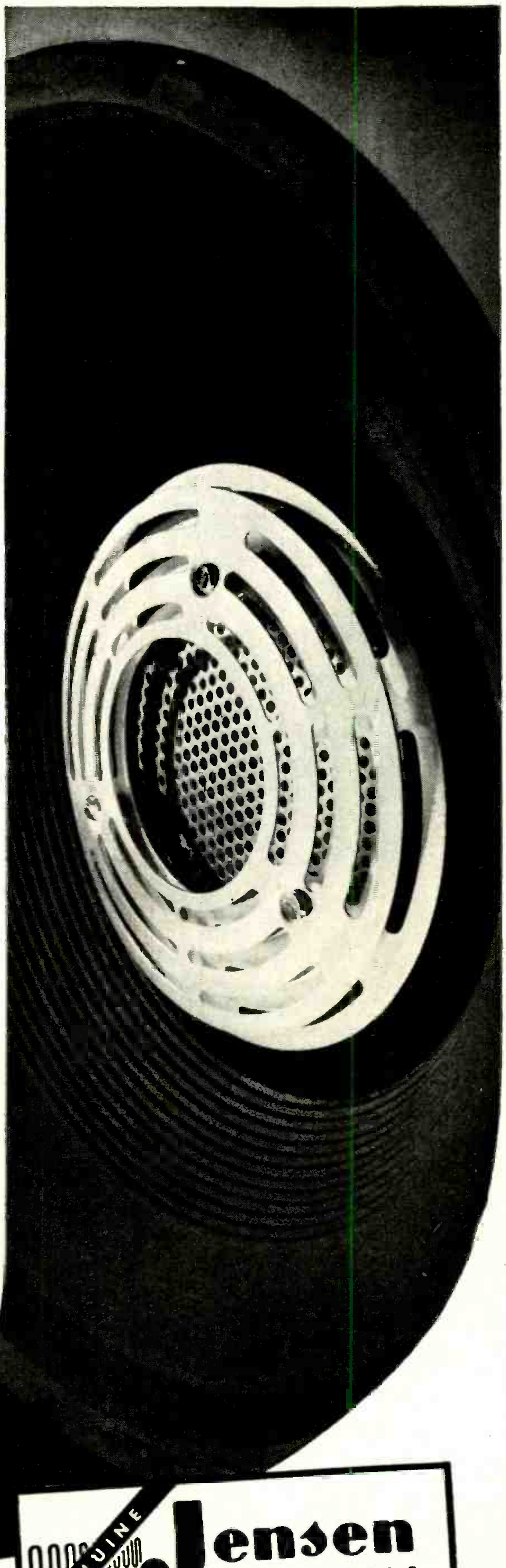
Many days, perhaps weeks, will be required to present and discuss this voluminous assortment of information. But the time will be well spent, for this library of facts should contain the solution to industry's most complicated mystery.

CLUES as to what might appear in many of the answers in FCC's comprehensive fact-finding notice were heard on the witness stand, as the color hearings began to draw to a close. Among those presenting these particularly important answers were *RCA's* board chairman, Brig. Gen. David Sarnoff,

Unsurpassed!

Jensen Model 510

Coaxial Speaker



With its new high frequency driver . . . new high frequency horn . . . new low frequency unit . . . plus the new Jensen Acoustic Lens—all skillfully engineered into a coordinated unit, the H-510 gives you reproduction unsurpassed by any integral two-way system regardless of price!

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GENUINE Jensen WIDE RANGE

JENSEN MANUFACTURING COMPANY *DIVISION OF THE MUTER COMPANY*

6617 South Laramie Avenue, Chicago 38, Illinois • *In Canada: Copper Wire Products, Ltd., 351 Carlaw, Toronto* whose testimony and official policy statements had been sought eagerly by the Commission and especially by the FCC legal staff. The General offered an extensive report which crackled with caustic comments about the merits of the color systems offered by *Columbia* and *Color Television*.

Slashing away at the *CBS* method, General Sarnoff declared that: "The adoption of the *CBS* system, whose obsolescence is already foreshadowed in this fast developing electronic art, would earn the scorn of the world. At the very moment I am appearing before you, the United States delegates are at a meeting of the International Consultative Committee in London to advocate world-wide television standards on a basis equivalent to the present American black-and-white standards. For this Commission to degrade the standards of American television by adopting the inferior *CBS* system only would be to show the world that we do not have any faith in the standards which our State Department is recommending to the world. . . . Adoption of the *CBS* system exclusively would also earn the dissatisfaction of American families. They would be induced to buy *CBS* type sets by a decision of this Commission made at a time when it was evident that *CBS* itself would shelve its mechanical system, in favor of an all-electronic system."

General Sarnoff emphasized that there was no doubt about the desirability of color for television, but there now existed a fundamental issue to solve, and that issue was . . . "Shall American television move forward or backward?" Elaborating on this point, the General said: "*CBS* has asked this Commission to adopt a system which would saddle an all-electronic art with a mechanical harness. You are being urged by *CBS* to build a highway to accommodate the horse and buggy, when already the self-propelled vehicle is in existence and has been demonstrated."

And then the *RCA* Headman went on to say that . . . "On the other hand, the Commission is asked by *RCA* to adopt color television standards which will permit the utilization of an all-electronic, compatible color television system, which does not have those defects and which has picture quality at least equal to that provided by existing black and white standards."

The Commissioners were told that *RCA* had demonstrated that their system . . . "has the full geometric resolution of existing black-and-white standards . . . and color fidelity equal to that of any other system and we expect this to be further improved."

Continuing his acid attack of *CBS*, the *RCA* Board Chairman declared that *CBS* . . . "have been trying desperately to improve the quality of their picture and to increase their picture size. They have borrowed dot interlace from the *RCA* system in their effort to increase the defintion of their pictures. They testified that they look forward with anticipation to use of the *RCA* single tri-color picture tube in order to eliminate their mechanical disc. They say now that, with the use of dot interlace, the quality of the *CBS* pictures will be improved."

Reviewing the requirements, which it was believed color TV standards should meet, the General offered three basics: Channel width of six megacycles; color pictures, by whatever system transmitted or received, which should not be inferior in quality and definition to present black and white pictures; and a color system which should be compatible with existing black and white standards.

"Broad standards based upon these requirements will enable color television," the General continued, "to move forward as a service to the public . . . In my judgment, a color television system that does not meet these broad standards will not be acceptable to the public and should not be approved by the Commission."

Then the General offered the information for which the FCC had pleaded in earlier sessions, information disclosing the plans *RCA* would follow under any one of five different decisions the FCC might make in settling the color question.

"If the Commission were to adopt the *CBS* proposal only," *RCA's* spokesman said, "we would be confronted with a field-sequential color system . . . which is non-compatible. . . . We would then find ourselves saddled with a system which we firmly believe is inadequate . . . and which we seriously doubt would prove acceptable to the public. . . . Under these hypothetical circumstances, *RCA* would . . . make and sell transmitting equipment, on order to anyone; make and sell tubes, including our tri-color picture tube, and parts to anyone; make and sell field-sequential color receivers, utilizing the tri-color tubes, as the public demand for such receivers might exist; make and sell tri-color tube converters on the same basis; and make and sell separate adapter units for television sets already in the hands of the public, as well as for new sets thereafter manufactured."

Describing the problem of adapters, the General declared that *RCA* would not build adapters in their sets at the factory. Explaining this point, he said . . . "It has been estimated that the present annual production of television receivers is at the rate of five million a year. With an estimate minimal figure of $20 for built-in automatic adapters, the public would have to pay more than $100,000,000 a year for an adaptation to a degraded system which is non-compatible."

Detailing the virtues of the recently-demonstrated color tube, the General declared that the company had such confidence in the tube that they were prepared to manufacture them on a wide scale, with mass production a certainty in a year from now.

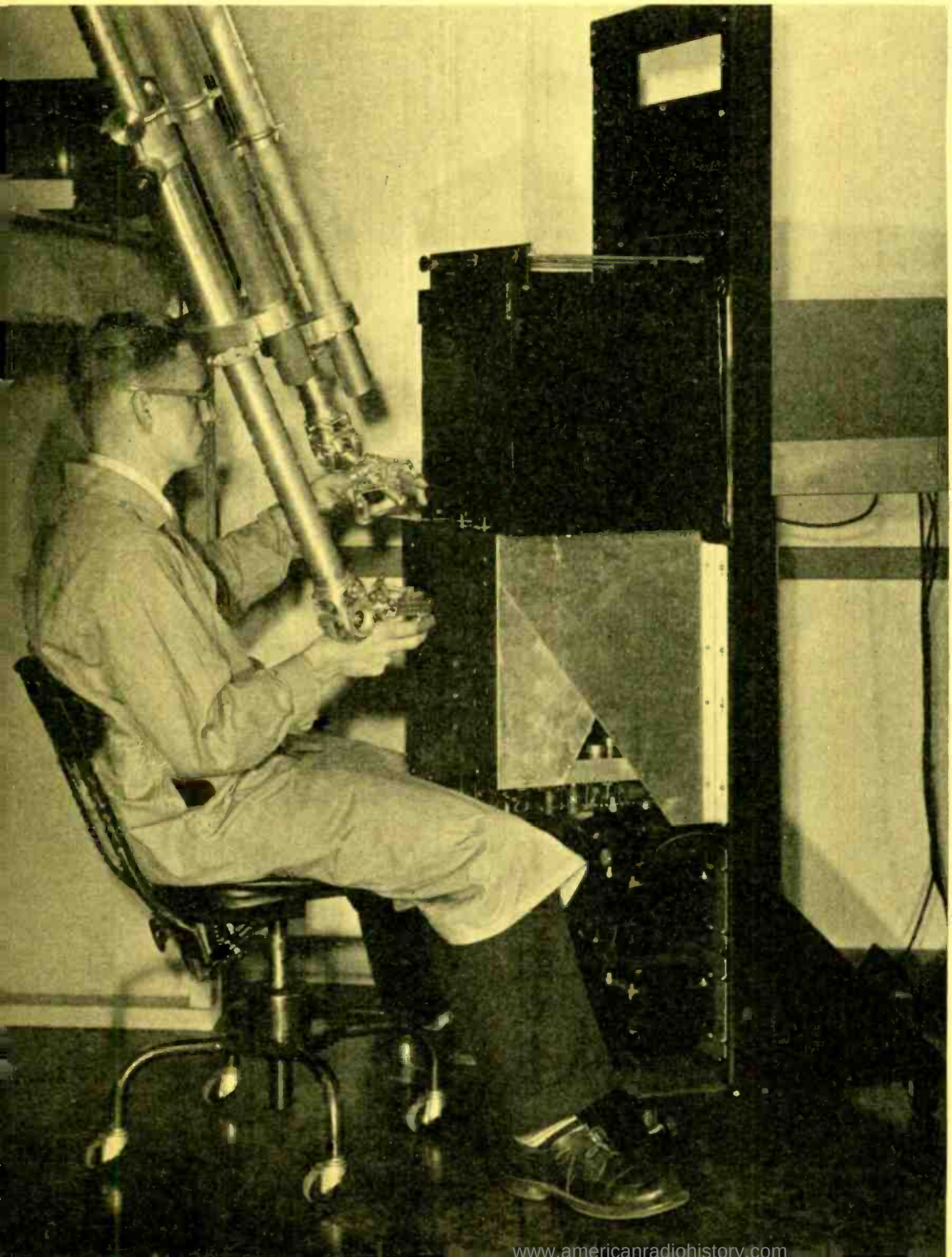
Were standards to be authorized, the

(*Continued on page* 112)

JULY, 1950

RADIO & TELEVISION NEWS

RADIO-ELECTRONIC Engineering



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JULY, 1950

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COVER PHOTO—Courtesy of Argonne National Laboratory

Carl A. Hermanson performing remote control operations which he observes by the use of three-dimensional TV. The lens of a standard TV camera is replaced with twin lenses, giving two images which may be made to appear on separate cathode-ray tubes placed at right angles. By proper use of polarizing filters, the images appear as one three-dimensional image on a half-silvered mirror located between the tubes.

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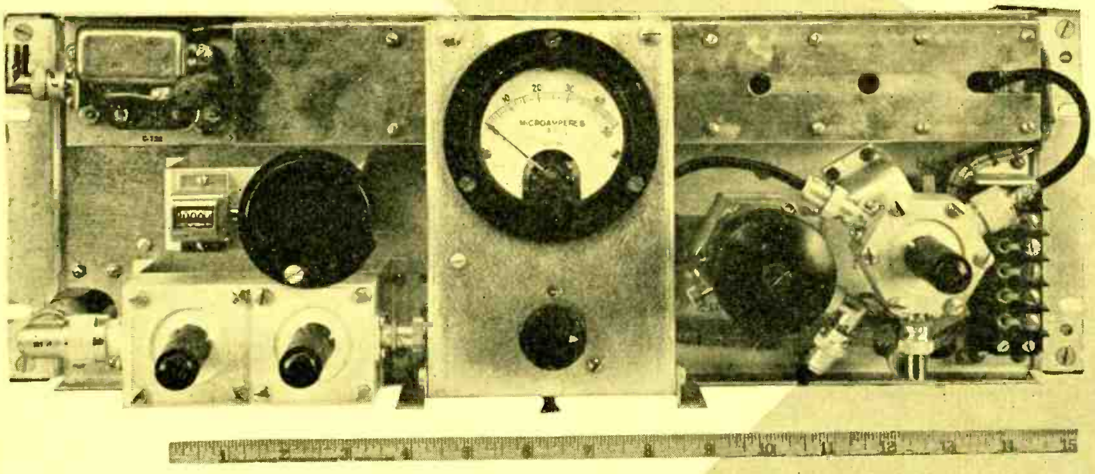


Front view of microwave receiver used in pulse time modulation communication links.

First commercial traveling wave tube offered to industry—the type X-190-J.

By J. RACKER

Federal Telecommunication Laboratories, Inc.

MICROWAVE RECEIVERS

Part I. A discussion of front-end design with particular emphasis on noise figure.

NOISE introduced in the receiver, while always of some interest at lower frequencies, becomes a primary design factor in microwave equipment. In many cases the receiver noise places a limitation on the entire system and sometimes this parameter alone will determine the type of transmitter, method of modulation, and system bandwidth to be used. Because of its importance, many authors have redefined the term receiver "sensitivity" to include its "noise factor" since specification for a given receiver sensitivity actually indicates the maximum noise that can be tolerated.

There are a number of reasons why receiver noise has become so important at microwaves. One fact is that the level of atmospheric noise is very low at these frequencies and hence a major part of the noise in the system originates in the receiver. Secondly the noise introduced by most practical networks is proportional to the frequency of operation so that microwave amplifiers and mixers are inherently more noisy. Finally, as will be noted subsequently in this article, most of the noise appearing at the receiver output originates in the first and second stages which, of course, will generally be operated at microwave frequencies. At lower frequencies with the atmosphere introducing more noise and the r.f. amplifier less, the effect of the receiver on the over-all signal to noise system was small. But from the foregoing it is obvious that the signal to noise ratio of a microwave system is very much affected by the design of the first two receiver stages and hence the statements made in the opening paragraph.

For economic reasons as well as the noise factor, most microwave receivers employ a superheterodyne circuit in which the incoming signal is dropped to an i.f. frequency as soon as design parameters such as local oscillator radiation, image sensitivity, and antenna "pulling" effects permit. In most receivers, the incoming signal is fed directly to a mixer and more than one r.f. amplifier is rarely employed.

Noise Factor

There are three sources of noise in the receiving system. The first, known as the Johnson noise, appears across the antenna. The antenna noise power, assuming that it is matched into a resistance equal to its radiation resistance, is equal to:

$$N_a = k\,T\,B \qquad (1)$$

where k is Boltzmann's constant $= 1.37 \times 10^{-23}$ joules/degree
T is the absolute temperature of antenna
B is receiver bandwidth in cycles per second

This antenna noise sets a definite limit on the improvement of usable sensitivity which can be obtained by perfecting the receiver and provides a basis for defining the noise factor. Noise generated in the receiver itself will be due to two factors, thermal and shot noises. These noise sources are primarily functions of the type of tube and circuit used and will be discussed when individual circuits are described.

The noise factor, also called the noise figure, is a measure of the amount of noise power introduced by the receiver. For reasons outlined above, the antenna noise should be distinguished from that introduced by the receiver and hence noise factor is defined as:

$$F = \frac{S_{IN}/N_a}{S_o/N_o} \qquad (2)$$

where: F is the noise factor of the receiver
S_{IN} is available signal power from the antenna
N_a is antenna noise power
S_o available signal power applied to demodulator
N_o available noise power applied to demodulator

It should be noted that the noise fac-

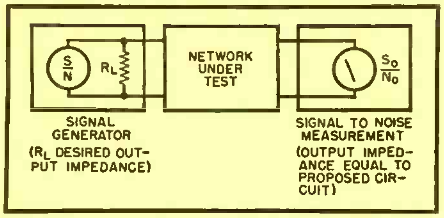


Fig. 1. Test setup for measuring the noise figure of a network.

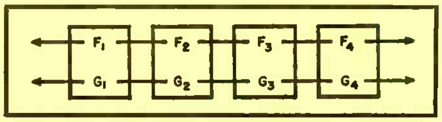


Fig. 2. Networks in cascade.

tor covers all stages of the receiver up to but not including the demodulator. This distinction is made because the signal-to-noise ratio at the output of the demodulator is a function of the method of modulation and hence is not directly a measure of the receiver performance.

The ratio S_o/S_{IN} in Eqt. (2) is of course the signal amplification of the receiver. If we denote this amplification by G (Power Gain) and express F in terms of db., Eqt. (2) becomes:

$$F_{db} = 10 \log \frac{N_o}{G\,k\,T\,B} \quad . \quad . \quad . \quad . \quad . \quad (3)$$

The receiver is comprised of a number of stages and it is convenient to be able to calculate the total noise figure due to the individual noise figures for each stage. Fig. 1 shows the test setup for determining the noise figure of each network. Given the noise figures F_1, F_2, F_n for each network the noise figure of all networks in cascade F_{1n} as shown in Fig. 2, is equal to:

$$F_{1N} = F_1 + \frac{F_2-1}{G_1} + \frac{F_3-1}{G_1G_2} + \cdot\cdot \frac{F_{n-1}-1}{G_1G_2 \ldots G_{n-1}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

It should be noted that F_n is the noise figure of network N under the condition that it is fed from a source whose impedance is equal to the output impedance of network N-1.

Eqt. (4) brings out two important factors. To simplify it let us consider a two stage receiver. In this case Eqt. (4) reduces to:

$$F_{12} = F_1 + \frac{F_2-1}{G_1} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

It is readily seen that when network 1 amplifies the signal (G_1 greater than 1) the effect of noise generated in network 2 is much smaller than that generated in network 1. This can readily be seen by considering a typical problem. Assume that all of the noise in a given bandwidth introduced in each of the two stages is equivalent to 10 microvolts of noise introduced at the grid of the tube, and that the gain of the stage is 10. The total noise of the two stages may be accounted for by adding the amplified noise of the first stage; i.e., 10 x 10 = 100 microvolts, to the equivalent noise of the second tube at its grid. Since noise voltages are composed of many different frequency components, the r.m.s value of the sum of two such voltages is the square root of the sum of the squares of the individual r.m.s values. Thus the total noise of the two stages is equivalent to $\sqrt{100^2+10^2}=100.5$ microvolts. Thus the noise at the grid of the second tube is only 0.5 per-cent greater than the noise caused by the first stage alone. Of course the effect of any succeeding stages (if they existed) is even further reduced. This illustrates the importance of the first several stages in a receiver.

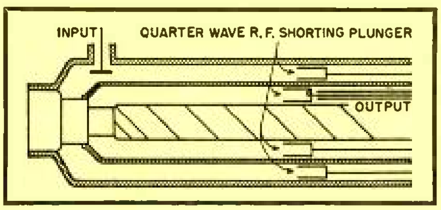


Fig. 3. Simplified schematic of typical grid-separation circuit for lighthouse tubes.

A second factor brought out by Eqt. (5) is that when the network attenuates the signal, so that G is less than one, as in a crystal mixer circuit, the noise present in network 2 is amplified. To illustrate this effect, consider the design of a mixer-amplifier system in which each amplifier has a noise figure of 30 and a gain of 12, and the mixer has a noise figure of 5 and a conversion loss of 0.2. If the signal is fed directly into the mixer the noise figure is:

$$F = 5 + \frac{30-1}{0.2} + \frac{30-1}{(0.2)12} + \cdot\cdot = 163 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

If one stage of amplification is used before mixer, the noise figure becomes:

$$F = 30 + \frac{4}{12} + \frac{29}{12(0.2)} + \cdot\cdot\cdot\cdot = 43.5 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (7)$$

and for a two stage amplifier before the mixer:

$$F = 30 + \frac{29}{12} + \frac{4}{12^2} + \frac{29}{12^2 x (0.2)} + \cdot\cdot = 33.5 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (8)$$

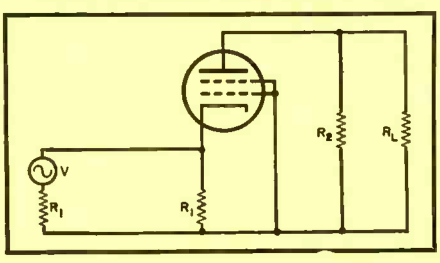
For three stages of amplification very little improvement will be effected ($F=32.7$). Of course, as is the case in many practical design problems, if it is possible to design an amplifier after mixing (usually about 30 mc.) with a much smaller noise figure than that possible at microwave frequencies, then use of r.f. amplifiers may not be justified. For example, if after mixing it is possible to design an i.f. amplifier with a noise figure of 6, then equation (6) would become equal to 15 and it obviously would not be useful to employ r.f. amplifiers (with noise figures of 30)—at least from the viewpoint of improvement of noise figure.

R.F. Amplifiers

It has previously been indicated that receiver sensitivity has been redefined to include noise power. In many cases the noise factor is given as a measure of sensitivity for microwave receivers. As a result of the discussion on noise factor, the reason for this should now become clear. It is always possible to amplify the signal as much as desired through the use of a sufficient number of stages. However the signal may not be of value if it is accompanied by excessive noise. At microwaves this noise will be encountered to a large degree in the first few stages of the receiver because of the small amount of atmospheric noise and the relatively large amount of noise introduced by microwave amplifiers. As a consequence, if sensitivity is defined as the smallest r.f. signal that can be picked up to provide the desired intelligence, the sensitivity of a microwave receiver will be dependent upon the magnitude of signal necessary to override noise in the first two stages, or more specifically the noise factor.

At conventional frequencies this difficulty is not encountered to an appreciable degree because one or two stages of r.f. amplification (desirable for many other reasons) prior to the mixer stage provides the effect indicated by Eqts. (6), (7), and (8). As the frequency of operation increases to beyond approximately 1000 megacycles, the noise introduced by the i.f. is so small in comparison to that developed in an r.f. amplifier, that a smaller noise factor can be evolved by feeding the r.f. signal directly to a mixer than to use any stages of r.f. amplification. Of course there is an additional factor to be considered and that is that an r.f. amplifier, because of the special tubes required, is far more costly than an i.f. amplifier. Hence economic factors alone would dic-

Fig. 4. Equivalent circuit for grid-separation amplifier with both input and output circuits tuned to resonance.



tate using a mixer stage at the input even if some gain in noise factor could be attained.

As a result of these considerations very few microwave receivers employ r.f. amplifiers. However there are some applications, either because of operation at 1000 mc. or below where improvement can be obtained, or due to need for isolating the antenna from the mixer and local oscillator, that an r.f. amplifier is used. Furthermore the recently developed traveling wave tube, as will be shown, shows promise of being a useful amplifier.

As described in previous articles [1, 2] covering the design of microwave transmitters, special tubes must be used for operation at about 900 mc. and above. These tubes, with the exception of the magnetron, can also be used for r.f. amplification. Actually only the lighthouse triode and traveling wave tube are employed in this manner, while the klystrom is very rarely used as an amplifier —particularly in receivers.

A lighthouse triode is used as an amplifier in much the same manner as it is used as an oscillator (previously covered[1]) except that the feedback loop is either omitted or reduced. The input is applied to the grid-cathode cavity and the output obtained from the plate-grid cavity. This circuit, shown in Fig. 3, is known as a grid-separation amplifier (sometimes called a "grounded grid" amplifier) because the grid actually separates the input and output circuits physically.

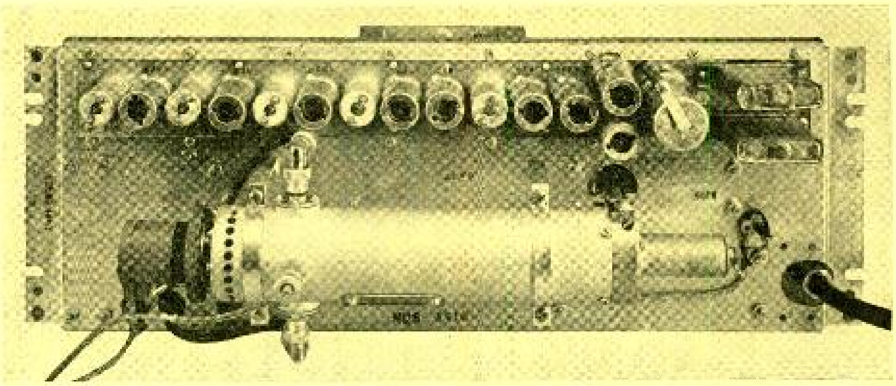
When such an amplifier has its input and output circuits tuned to resonance, so that they appear as pure resistances, and when the input circuit is matched to the antenna (or previous stage output impedance). The equivalent circuit is as shown in Fig. 4. The tube is drawn as a tetrode to emphasize the separation of input and output circuits. The input line is assumed to be matched so that no standing waves are set up. This is done physically by varying the position of the probe until no standing waves are noted on the line (the term 'no standing waves' is used in the sense that the mismatch is so small that it is safe to assume that all the power transmitted down the line is dissipated in resistor R_1). If an r.f. power P_1 is applied to the line, an r.m.s voltage V_1 is developed between cathode and grid where:

$$V_1^2 = R_1 P_1 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (9)$$

This voltage produces an r.f. current in passing through the first grid having a value:

$$i = g_m V_1 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (10)$$

where g_m in this case is the effective transconductance which includes transit



Rear view of typical microwave receiver operating in the 2000 mc. range.

time effects.[1] If V_2 is the r.f. voltage developed across the output circuit, the total power delivered by the beam is:

$$P_2 = V_2^2\left(\frac{1}{R_2} + \frac{1}{R_L}\right) \quad . \quad . \quad . \quad . \quad . \quad (11)$$

and the useful power P_L, is V_2^2/R_L. If the full current, i, arrives in the output circuit, V_2 is given by:

$$V_2 = i\frac{R_2 R_L}{R_2 + R_L} \quad . \quad . \quad . \quad . \quad . \quad . \quad (12)$$

and therefore:

$$P_2 = \frac{i^2}{R_L}\left(\frac{R_2 R_L}{R_2 + R_L}\right)^2 = i^2\frac{R_2^2 R_L}{(R_L + R_2)^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (13)$$

By combining Eqts. (9) and (10) and substituting for i in Eqt. (13), the following relation for power gain is obtained:

$$G = \frac{P_2}{P_1} = \frac{g_m^2 R_1 R_2^2 R_L}{(R_L + R_2)^2} \quad . \quad . \quad . \quad . \quad (14)$$

For a constant-current generator such as this amplifier, the maximum value of P_L is obtained when $R_L = R_2$, in which case

$$G_{max} = \frac{g_m^2 R_1 R_2}{4} \quad . \quad . \quad . \quad . \quad . \quad . \quad (15)$$

From this it is clear that the maximum gain obtainable is dependent not only on the transconductance, but also on the shunt resistances of the input and output circuits, which are partly functions of the tube and partly of the cavities. The shunt impedance of the cavities can be determined through the use of relationships developed in earlier articles [1, 2], while the tube parameters can be obtained from the manufacturer.

The gain of an amplifier has little meaning unless the bandwidth is specified. In most grid separation amplifiers the loading on the input circuit is so heavy that the bandwidth of the output circuit is the determining factor. If C_2 is the effective capacity across the output circuit, the bandwidth $2\Delta f$ between half power points is given by:

$$2\Delta f = \frac{f}{Q} = \frac{R_2 + R_L}{2\pi C_2 R_2 R_L} \quad . \quad . \quad . \quad . \quad (16)$$

Combining this result with that of Eqt.

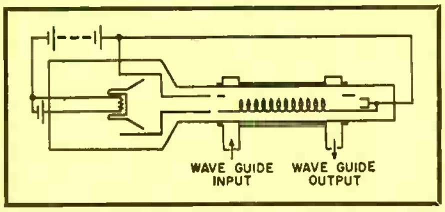


Fig. 5. Schematic diagram of a traveling wave amplifier tube.

(15), an expression for a figure of merit is obtained which is the power gain multiplied by the bandwidth or:

$$G \cdot 2\Delta f = \frac{g_m^2 R_1}{2\pi C_2} \cdot \frac{R_2}{R_L + R_2} \quad . \quad . \quad (17)$$

If the amplifier is loaded for maximum gain, $R_L = R_2$, the figure of merit is:

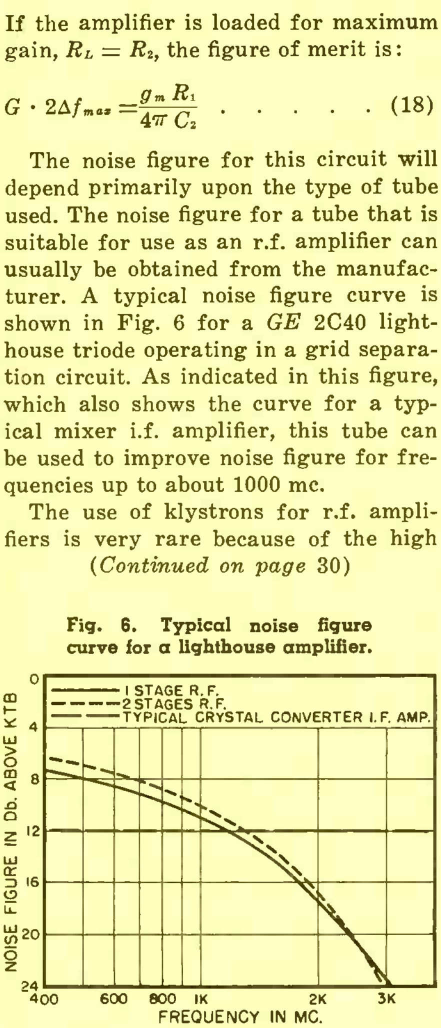
$$G \cdot 2\Delta f_{max} = \frac{g_m R_1}{4\pi C_2} \quad . \quad . \quad . \quad . \quad . \quad (18)$$

The noise figure for this circuit will depend primarily upon the type of tube used. The noise figure for a tube that is suitable for use as an r.f. amplifier can usually be obtained from the manufacturer. A typical noise figure curve is shown in Fig. 6 for a *GE* 2C40 lighthouse triode operating in a grid separation circuit. As indicated in this figure, which also shows the curve for a typical mixer i.f. amplifier, this tube can be used to improve noise figure for frequencies up to about 1000 mc.

The use of klystrons for r.f. amplifiers is very rare because of the high

(*Continued on page* 30)

Fig. 6. Typical noise figure curve for a lighthouse amplifier.



Helical Coils as TRANSMISSION LINES and Radiators

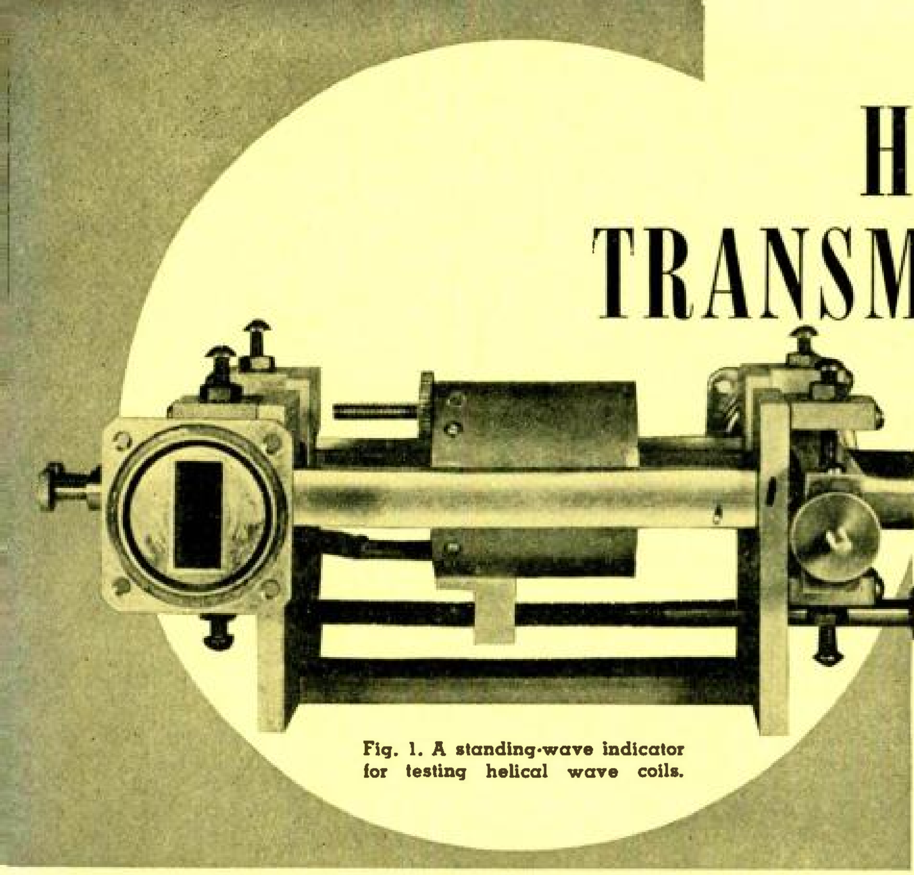


Fig. 1. A standing-wave indicator for testing helical wave coils.

By SAMUEL FREEDMAN
Technical Products & Services Co.

Construction, application, and testing of helical coils for use in the ultra-high frequency range.

ELECTROMAGNETIC wave propagation can take place along a solenoidal coil or simple coiled spring. Such helical wave coils comprising no more than a coil of wire or spring may serve as a substitute for wave guide or coaxial transmission lines. They can also be used as a coupling device in lieu of a transformer, a rotary joint transition, a substitute for flexible wave guide, as an actual radiator or antenna device, or as a single device possessing all or some of these capabilities.

A combination of imagination, initiative and experimentation can result in very ingenious and rather revolutionary developments for the microwave art when the helical wave coil techniques are employed. This can be particularly true in connection with u.h.f. developments (frequencies below 3000 megacycles), where dimensions have been inconveniently large for the utilization of super-high wave guide techniques.

As a transmission line, the coil or spring terminates or enters into a coaxial cable inner conductor directly or to the inner conductor of the coaxial fitting of a wave guide.

As a radiator, the same coil or spring terminates into an unwound section as shown in Fig. 6A for a non-directional type or Fig. 6B for a directional type.

The coils themselves are very simple in physical appearance and are not frequency sensitive. Only the terminations or the parts to which they may connect have that characteristic, particularly where the dimensions are appreciable with respect to the wave length.

Helical wave coils are tested with equipment similar to that of any microwave test bench in which unknown transformations are to be investigated. The general layout of the test bench is blocked in Fig. 3 with the exception of one additional non-standard unit. This is the standing wave indicator for helical wave coils as illustrated in Fig. 5.

The coupling sections at each end of the helix represent a transformation of unknown characteristics. It would be quite possible to have flat line characteristics within the rectangular guide on each side of the helix and still have a high standing wave ratio along the helix itself.

Fig. 2. Coupling test for helices of minimum attenuation.

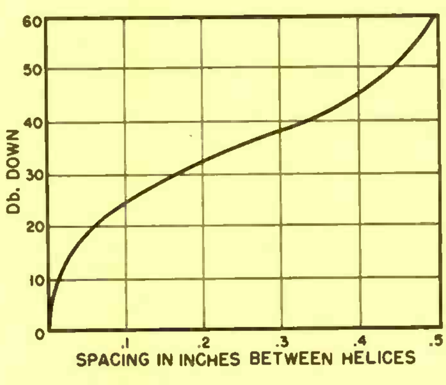


Fig. 7 illustrates a coupling section between the standing wave indicator (Fig. 5) and the wave guide termination at either end. The internal constructional details of the coupling section are shown in this figure.

Any helical wave coil has a reduced phase velocity. It is less than that of the velocity of light by approximately the ratio of coil length to wire length. Thus far, its most important use has been in the traveling wave amplifier tubes developed for the microwave region. Its use in lieu of a wave guide or a radiator is much more novel, particularly where it has no cut-off frequency or cut-off wavelength as a transmission line. Persons of limited qualifications and with a minimum of facilities can build such coils out of wire and get a variety of results from the way the coil ends are tapered or ended.

Referring to the standing wave indicator (Fig. 5), normal probe or loop measurements are not feasible due to the relatively weak field about the helix at a feasible coupling distance. To assure maximum coupling with minimum field interference, a tunable re-entrant cavity is placed circumferentially about the helix. Energy is electrostatically coupled through an open annular ring at the inner radius of the re-entrant section. This section is so tapered as to be effectively coupled to only a small area of the helix. This assures proper field indication and minimum effect on the helix's field by allowing a maximum clearance between its main body and the test section.

In practice, there will be some interaction between the helix and the re-entrant cavity which will tend to introduce reflections. This effect can be reduced by enlarging the coupling hol^ The cavity is tuned to resonance to assure maximum coupling. Tuning is accomplished by moving a choke type

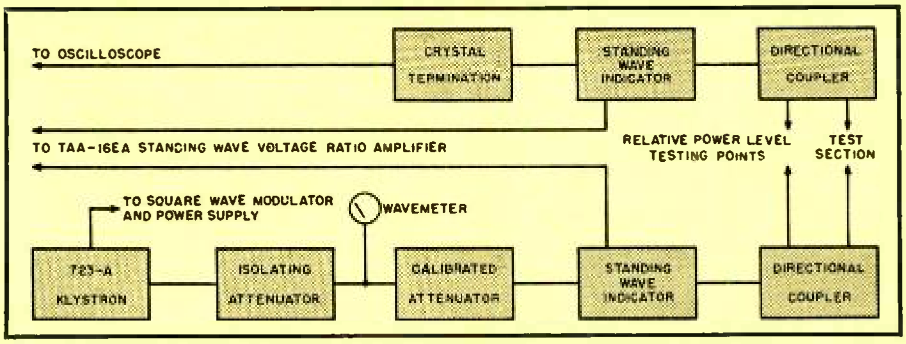


Fig. 3. Block diagram of test setup for testing helical wave coils.

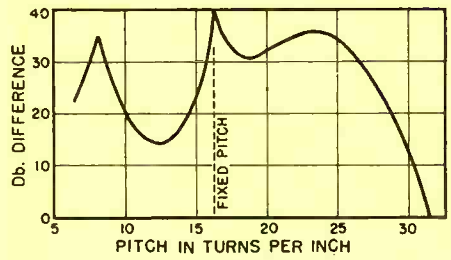


Fig. 4. Coupling between two helices of different diameters.

plunger along the coaxial section of the cavity. The choke plunger is designed with a center wavelength of 3.2 centimeters and is made slightly broadband by choosing a large characteristic impedance ratio between quarter-wave sections. The cavity will tune to both quarter-wave and three-quarter wave resonances.

Monitoring energy can be magnetically coupled from the cavity by a loop at the plunger face. This in turn is connected to the input of a spectrum analyzer through a coaxial cable. Since the spectrum analyzer is inherently a power device, standing wave power ratios are measured.

Transformation Section

The development of a transformation section between the helical wave coil and rectangular wave guide may be accomplished through the use of either a resonant section or a tapered section. Only the latter has been used by the authors. To obtain proper coupling between two transmission media of dissimilar physical characteristics, it is necessary that their corresponding fields be properly positioned. This can be done either electrostatically or magnetically. For coupling between helical wave coils and rectangular wave guides, electrostatic coupling is more readily obtained. Such a coupling is referred to as an "E" type coupler (Fig. 7).

The transition can be considered as consisting of three steps.

1. A rectangular wave guide to coaxial line.
2. Coaxial line to a coaxial line whose center conductor is a helix.
3. Finally, from the helical type of coaxial line to a helical wave coil.

The straight section of the helix is parallel with the "E" field of the rectangular wave guide for a distance a little greater than half the wave guide width. The wire is then tapered in both pitch and helical diameter for two to two and a half turns to the final helix size in the remaining distance across the guide. It is brought out through a hole in the rectangular wave guide. The end plate of the wave guide is approximately a quarter of a guide wavelength from the coupling, so that it reflects radiation in phase with that radiated directly down the guide.

Even with variation of physical parameters such as post diameter, helix to post termination and exponential transition section for various "E" couplings, a double stub tuner on the transmitter side of the junction has made it possible to match any reasonable configuration of the coupler to a low standing wave ratio. A match has not been found possible, however, if the helix is simply passed through the guide and terminated on the far side. Best results have been obtained by the configuration shown in Fig. 7, and at the left in Fig. 6, top and bottom.

The helix is terminated by smoothly decreasing its pitch for the last two turns and by spiraling the same two turns inward to a point where the helix becomes a straight wire. This is then soldered into a hole drilled at the apex of the coupling stub. The band pass characteristics of a given coupler critically depend upon the exact configuration of the coupling. If the exponential section is eliminated, the coupler becomes extremely frequency sensitive. Small differences can be corrected by use of a double stub tuner. However, movement of the coupling stub itself is far more effective and easier to adjust.

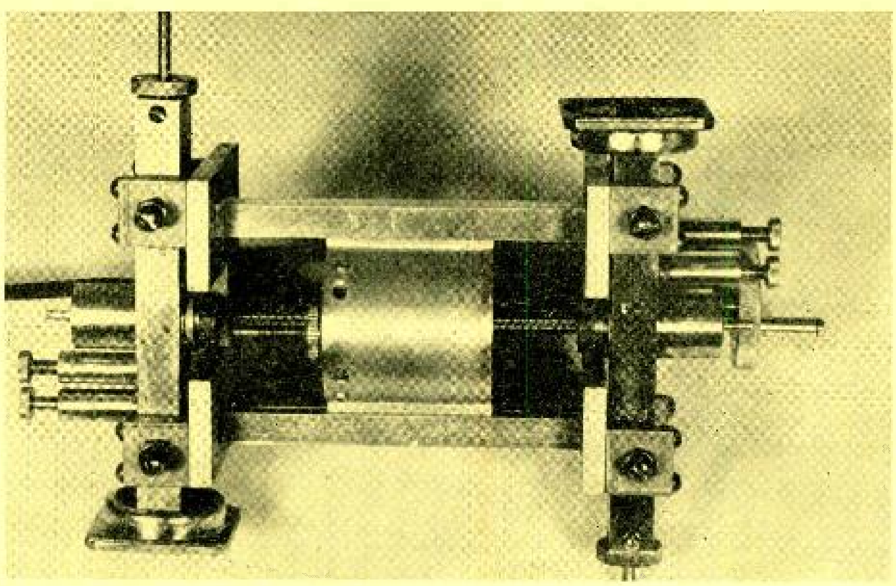
The stub is mounted within a half-wave coaxial choke section in such a manner that a short is reflected at the wave guide's inner surface. A quarter-wave radial choke circumferentially about the helix of the coupling hole is advantageous since it eliminates any direct radiation from that area and at the same time discourages a $TE_{1,1}$ mode from forming. That mode might exist when the mean circumferential distance around the coupling hole between the rectangular wave guide and the helix is approximately equal to or greater than one wavelength.

With both chokes in place and the helix properly terminated at the apex of the stub, the coupler is easy to adjust. It can be adjusted to have a standing-wave ratio of unity at any given wavelength and has considerable bandwidth depending upon the fineness of adjustment of the transition section. A typical coupler with a mean wavelength of 3.2 centimeters (X band) may have a standing wave ratio of 1.13 at 3.15 centimeters and 2.4 at 3.4 centimeters.

Coupling

Maximum coupling occurs with helices of equal diameter and pitch. Mini-

Fig. 5. Standing wave indicator for helical wave coils.



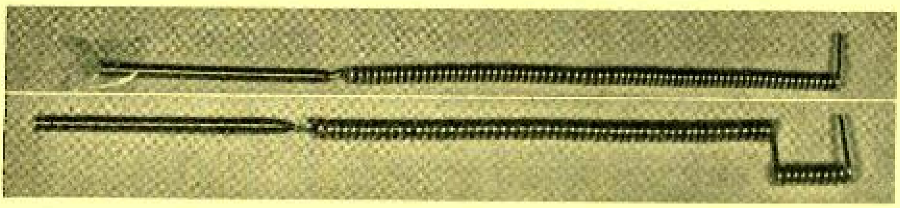


Fig. 6. (Top) Helix unwound and terminated in a radiating section. (Bottom) Unwound radiator driven by wound helical coil section.

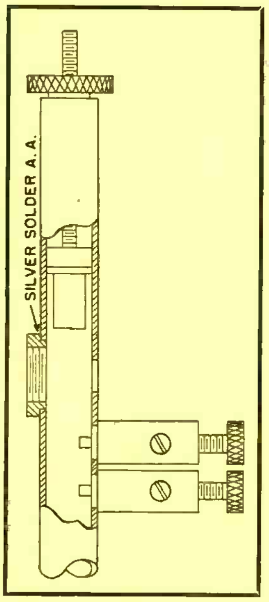


Fig. 7. Internal details of coupling section.

mum coupling occurs when the helices have a pitch ratio of approximately two to one. This indicates a change in the relative amount of constructive and destructive coupling between the two helices due to their differences in phase velocity. With helices of equal pitch and diameter, all coupled components are in the same direction; thus, a maximum power transfer. Helices with comparative values of half or double pitch have an equal number of constructive and destructive coupled field components; thus, a condition of minimum power transfer.

This leads one to deduce that if a phase velocity difference of two to one can be introduced between parallel helices in any manner, a similar result will be obtained. Such phase velocity difference can also be introduced by a change in helix diameter. For minimum coupling between two parallel helices, it is therefore desirable to choose a combination of turns and diameter ratios such that their phase velocities will be in the ratio of two to one as shown in Figs. 2 and 4.

Comparing both attenuation characteristics and coupling characteristics of the helix, two helices .177" outside diameter wound with a .040" wire, one with a pitch of 8 turns per inch and the other with a pitch of 4 turns per inch, would represent optimum conditions from a standpoint of minimum attenuation and coupling for a dual feed system. At a spacing of ½ inch, the power difference was found to be 60 db. between them.

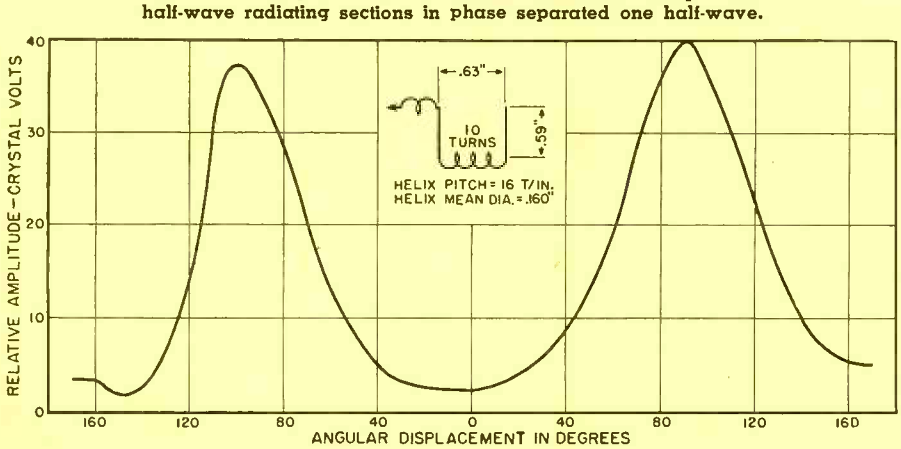
The peak power input at breakdown for several helices of .37", .177" and .269" outer diameter, wound with .040" diameter copper wire was noted as a function of pitch. The helices were terminated in the *E* type coupler shown in Fig. 7. The r.f. power was obtained from a pulsed Type 725-A magnetron and measured by means of a Johnson Bridge type r.f. wattmeter. The wave guide at the receiving end was terminated in a dry sand load. All helices had similar characteristics. The power at breakdown varied linearly with pitch from approximately 7 kilowatts peak at a pitch of 20 turns per inch to 25 kilowatts peak at a pitch of 9 turns per inch. At this time, arcing would occur within the coupler rather than between the turns of the helix. The smaller diameter helices have somewhat greater power capabilities than the large diameter helices. With a safety factor of two, the power limit of a normal helix (4-10 turns per inch) would be approximately 12 kilowatts at atmospheric pressure. This can be increased by pressurization. The average power approaches peak power because breakdown is not due to heating. It is due to voltage arc-over.

In addition to being able to terminate a helix in a dry load consisting of aquadag or some similarly absorbing substance, it can be directly terminated in a radiator. The characteristics of the slow speed helical mode are such that its termination in a radiator will result in a linearly polarized wave.

The helix, exponentially unwound and terminated in a straight section of wire one half-wave in length, is an effective radiator. Such a termination is similar to the transformation section of the "E" type coupler. This type of termination can be slightly varied by bringing the straight half-wave section off at a tangent to the helix as shown in Fig. 6A. A quarter-wave termination has proved ineffective.

In addition to a simple half-wave termination, the helix offers an excellent method for forming directional arrays. This is effected by properly winding and unwinding the helix. The unwound section represents the radiation surface driven by the wound surface and is shown in Fig. 6 (bottom). Its primary radiation pattern is shown in Fig. 8.

Fig. 8. Field pattern for a helical broadside array — two half-wave radiating sections in phase separated one half-wave.



For proper phasing of the various elements forming an array, it is necessary to maintain a proper number of turns within the helices forming the transmission lines between them. For a given size helix and spacing between elements, the turns required for physical reasons will, in general, not be in integral agreement with electrical phasing requirements. This difficulty can be eliminated by introducing a dielectric within the coupling helices in the form of a phase shifter.

In applications where back to front ratios and beam widths obtainable from simple arrays will suffice, it is felt that a helical array may offer a solution.

The major difference in field distribution between helical wave coils and more standard types of wave guides is that the field is not enclosed between conducting boundaries. This results in considerable loss due to radiation and can also be a means of coupling between two parallel helices. A helix is good mechanically for two-dimensional flexibilities and has characteristics identical with those of a normal spring.

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CURVE GENERATOR for ELECTRON TUBES

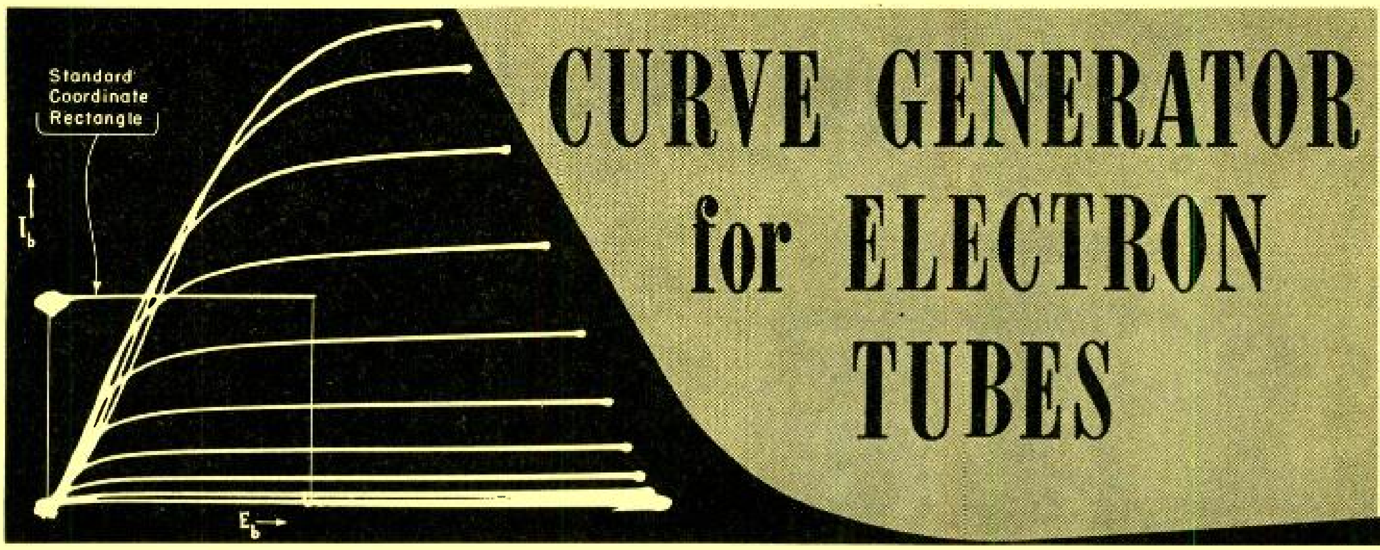

Fig. 1. Typical display (6AC7 plate characteristics).

A device developed at NBS for plotting tube characteristic curves directly on the screen of a cathode-ray oscilloscope.

AN instrument which gives an instantaneous display of electron tube characteristics has been developed by Milton L. Kuder at the National Bureau of Standards. The curve generator plots directly on the screen of a cathode-ray oscilloscope the family of plate current versus plate voltage curves for any receiving tube. A standard rectangle is displayed along with the characteristic curves to provide a direct scale of voltage and current readings. In cases where the tube characteristics are not known or where an unusual combination of supply voltages is to be used, the curve generator can provide the necessary tube data at a great saving in time and labor.

The plate voltage applied to the tube under test is swept continuously from zero to predetermined positive values. The voltage drop appearing across the plate load resistance is then a measure of the plate current. This voltage drop is applied to the vertical deflecting plates of a cathode-ray oscilloscope and the plate voltage itself to the horizontal plates. The combined voltages generate a plate current—plate voltage curve on the oscilloscope screen for the entire sweep interval. The sweep sequence is repeated automatically for several values of grid bias, forming the family of plate characteristic curves. A series of bright dots appearing at the end of each curve in the family gives a useful representation of the load line of the tube for the operating conditions selected.

In addition to producing plate characteristic curves, the new instrument can provide a visual representation of plate current versus grid voltage. In this case the oscilloscope display is particularly convenient since grid voltage increments are directly defined by calibrated vertical bars appearing on the oscilloscope screen; a standard current reference is given by a horizontal bar. All of the possible displays are produced by the curve generator without overloading the tube under test. Over-all accuracy of voltage and current readings from the oscilloscope screen is within plus or minus five per-cent.

A complete family of curves is retraced sixty times a second; the resulting image is stationary and free from flicker. Characteristic curves may be quickly obtained in permanent form by photographing the screen image with a regular oscillograph camera. Electronic research and development organizations would find this procedure extremely valuable on many occasions.

All of the driving signals are produced in the generator by a single master oscillator. Voltage excursions for the tube under test are obtained from the oscillator in the form of a rising sawtooth wave whose magnitude is controlled without any oscillator loading effect. A cathode follower isolates the power supply for the tube under test from the rest of the generator circuit, so that only the plate current of the tested tube is plotted on the oscilloscope.

When the sawtooth plate sweep signal is most negative, the master oscillator sends a pulse into a pulse former. Pulses

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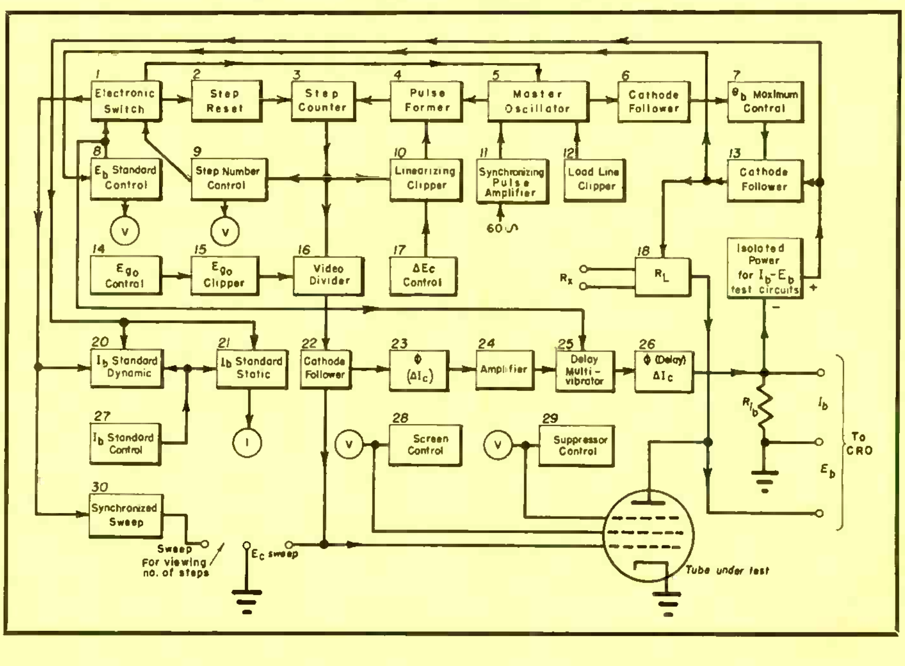
Fig. 2. Block diagram of the curve generator.



A Compact GEIGER COUNTER

By RONALD L. IVES
Indiana University

Design and construction of a cheap, easily-built counter incorporating a novel high-voltage power supply.

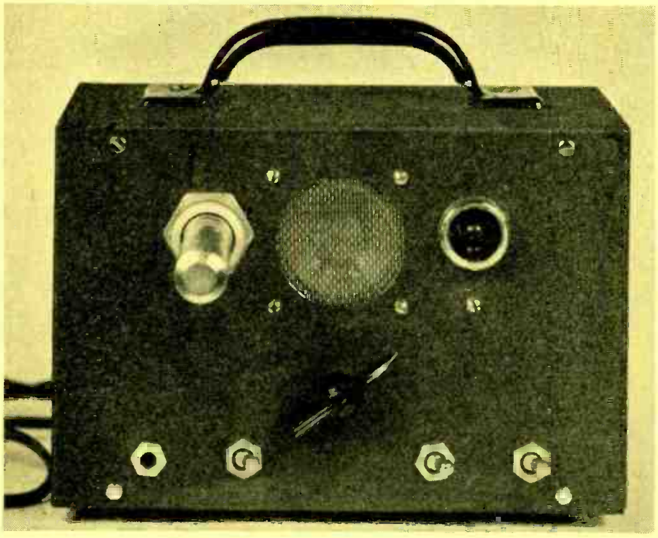


Fig. 1. Panel view of the compact counter in its case.

LARGE bulk and high cost of most line-powered laboratory Geiger counters has resulted in the use indoors, and within easy access of power lines, of portable instruments, even though battery replacement costs are very high.

Chief obstacle to the construction of a compact and inexpensive device for determining roughly whether or not a substance is radioactive has been the bulk and cost of power transformers, or the complexity of substitutes for them.

By use of a "voltage adding" rectifier circuit, related to the familiar "voltage doubler" used in "transformerless" radio receivers, cost and bulk of power supply is brought within reasonable limits, so that a very compact and inexpensive Geiger counter can be constructed almost entirely from standard radio receiver components.

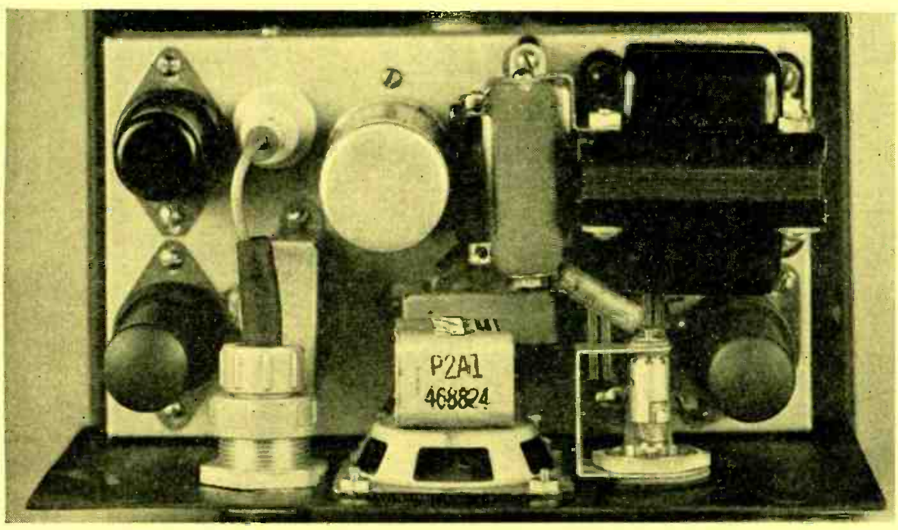
General Description

This instrument consists of a standard beta-gamma tube (1 B 85 Thyrode), two stages of audio frequency amplification, a speaker and flasher output device, and a power supply. Dimensions are small, so that the entire device, constructed for 24-hour operation, can be housed in a standard 5" by 6" by 9" radio utility cabinet. Weight is only ten pounds, and power consumption is about 50 watts.

General appearance of this Geiger counter is shown in Fig. 1.

Wiring diagram of this counter is shown in Fig. 4, and is quite conventional except for the power supply and output circuits.

Fig. 2. Back-of-panel above-chassis arrangement of parts.



Power supply for this counter is a "voltage adding" device. 300 volts at about 40 ma. is produced by one-half of the transformer, through the selenium rectifiers, and the low-voltage filter consisting of C_{12}, L_1 and C_{13}. Additional filtering for the 6SJ7 is provided by the choke L_2 and condenser C_5. This is necessary not only to prevent hum, but also for circuit isolation. If this additional filter is omitted, the circuit will tend to oscillate violently at about 5000 cycles.

High voltage is provided by the whole transformer winding, through a half wave rectifier tube, 5Z4, and *R-C* filter consisting of C_{10}, R_{11}, and C_{11}. This high voltage, which is about 650 volts, is added to the potential of the other supply circuit to produce the 950 volts, approximately, required by the G-M tube. Note that the high voltage filter condensers do not have their negatives grounded, but are connected to the "hot side of the low-voltage filter condensers. This connection makes unecessary the use of 1000 volt filter condensers, resulting in a saving of cost and space.

Output voltage of the high potential portion of the power supply can be regulated with great precision by varying either the bleeder resistor (R_9) or the filter resistor (R_{11}), the current drain of the G-M tube being substantially zero.

The amplifier is an entirely conventional two-stage unit, with a 6SJ7 first stage and a 6F6 output stage. Standard resistance—capacitance coupling is used, but both coupling and bypass condensers are smaller than in voice amplifiers, not only to lower hum response, but to permit greater sensitivity. In a surge amplifier, tone quality is unimportant.

Values of resistors R_1 and R_2 in the input circuit are made as large as possible, and tendency to oscillate at high frequencies is reduced by use of a small output bypass condenser (C_6), and by use of a two-step filter in the first stage plate supply. Shielding or isolation of the 6F6 plate lead and of the high voltage lead to the G-M tube is desirable.

A jack is provided to permit headset operation of the counter from the first stage of the amplifier. Output of the second stage is dual—sonic output is by the 2" PM dynamic speaker on the panel, visual output is by means of a neon flasher tube (NE-30) in series with a condenser (C_9) shunted across the primary of the output transformer.

A switch (SW_3) is provided to turn off the speaker if desired. Should the visual output circuit tend to motorboat at a very slow rate, this can usually be prevented by reversing the neon bulb in the socket, or by shunting the bulb with a very high resistance, such as 10 megohms.

Input of this counter is designed to work from a *Victoreen* type 1B85 Thyrode, or similar 900 volt Geiger-Muller tube. To protect the tube against warmup surges, and to lengthen its life when counting is unnecessary, a switch is provided so that the high voltage can be removed when desired. This (SW_2), in the "ON" position, connects the input resistor to the tube. In "OFF" position, the input resistor is grounded, partially draining the high voltage filter, and disconnecting the tube. The other side of the switch turns on a small pilot light, mounted behind the neon tube bezel, when the G-M tube is out of service. When the tube is in service, the intermittent flashes of the neon tube in the output serve as an "ON" indicator.

Internal electrical parts are mounted on a 1½" by 4" by 8" open end chassis, firmly bolted to the panel. Exact arrangement of parts is not important, except that heat-sensitive parts should be as far as possible from heat-producing elements, such as the tubes. One satisfactory arrangement is shown in Fig. 2.

Under-chassis arrangement is also not critical except that input and output components should be separated as far as possible. Careful planning, plus use of tie strips in strategic places, makes possible access to any sub-chassis component with ordinary tools. Under-chassis appearance of this counter is shown in Fig. 3. To prevent chafing of insulation, with resultant later breakdown, all wires going through the chassis are protected by rubber grommets. High voltage wiring is protected by use of spaghetti.

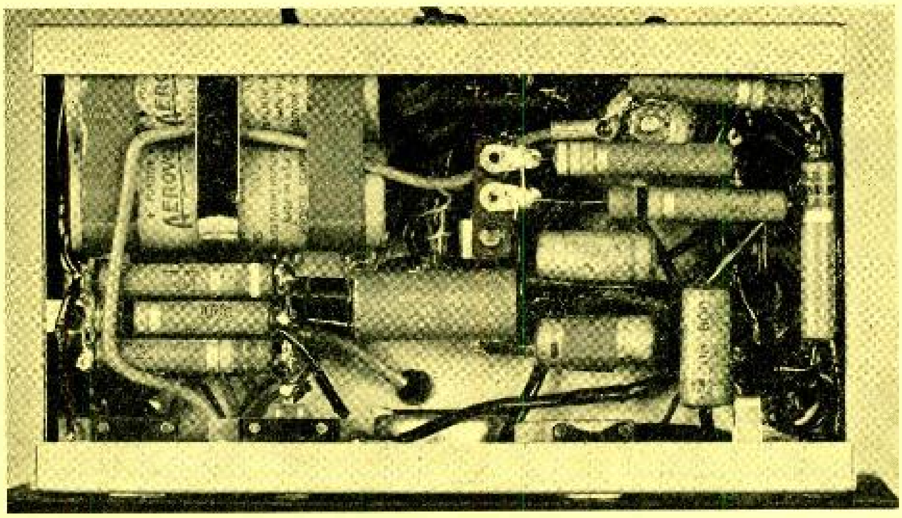


Fig. 3. Under-chassis view of the counter.

Life of many electronic components is a function of the temperature at which they are operated, and is markedly shortened if the operating temperature is too high. For this reason, some consideration should be given to ventilation, even of a small device such as a small Geiger counter.

With no ventilation, and the case tightly closed, this counter stabilizes at an internal temperature about 130° F. above room temperature, and requires almost an hour to stabilize. Under most conditions, internal temperatures will be too high for long component life.

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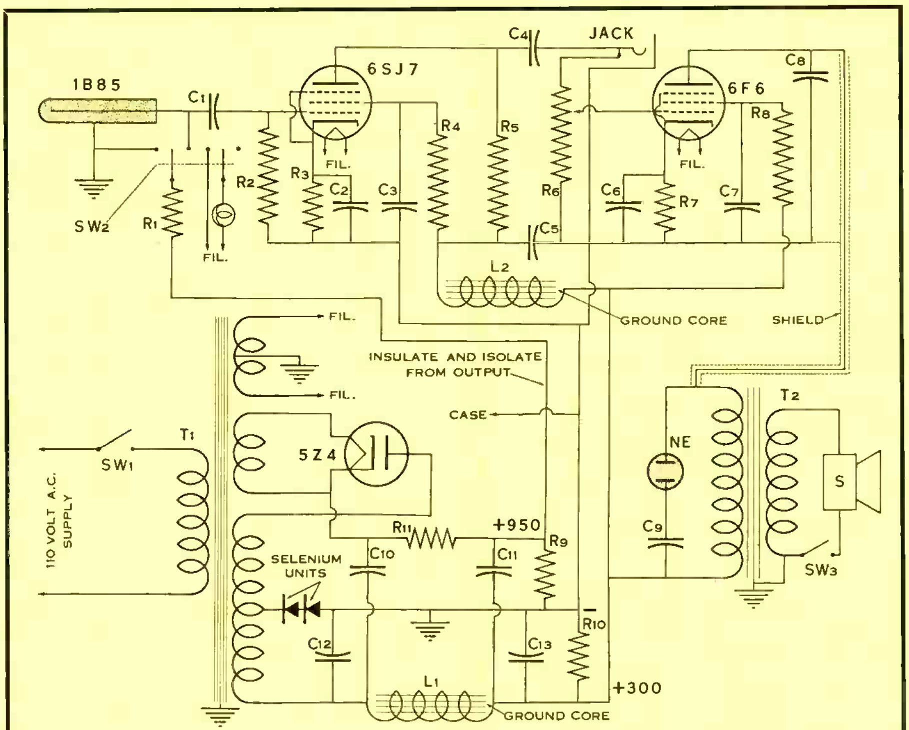
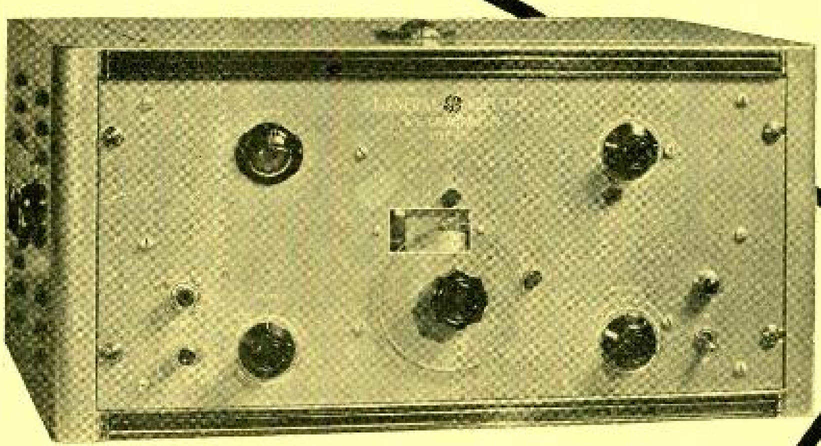
Fig. 4. Wiring diagram and parts list of the counter.



R_1—2-10 megohm, 2 w. res.
R_2—2-5 megohm, 2 w. res.
R_3—600 ohm, 2 w. res.
R_4—500,000 ohm, 2 w. res.
R_5—100,000 ohm, 2 w. res.
R_6—250,000 ohm, 1 w. pot
R_7—500 ohm, 2 w. res.
R_8—5000 ohm, 2 w. res.
R_9—1 megohm, 2 w. res.
R_{10}—50,000 ohm, 5 w. res.
R_{11}—50,000 ohm, 2 w. res.
C_1—.0005 µfd., 2500 v. mica cond.
C_2, C_3, C_6, C_7—.06 µfd., 600 v. paper cond.
C_4—.002 µfd., paper cond.
C_5, C_{12}, C_{13}—40/40/10 µfd., 450 v. dry elec. cond. (all parts of a triple common-ground unit)
C_8—.0001 µfd., or less, 600 v. paper cond.
C_9—.5 µfd., 600 v. paper cond.
C_{10}, C_{11}—10 µfd., 700 v. dry elec. cond.
L_1—8 hy., 40 ma., filter choke
L_2—35 hy., 15 ma., filter choke
T_1—Power trans. 240-0-240 @ 40 ma.; 5 v. @ 2 amps; 6.3 v. @ 2 amps (Thordarson TS-24R00-U or Stancor P-6297)
T_2—Universal output trans. to match tube to speaker (Stancor A-3856 or Thordarson T-22S86 or T-22S87)
S—2" PM dynamic speaker
Selenium Units—65 ma., 130 v. half-wave rectifier
SW_1, SW_3—S.p.s.t. toggle sw.
SW_2—D.p.d.t.—toggle sw. (good insulation)

Fig. 1. Front view of YCL-1 Capacitometer.



Improved R.F. Capacitometer

By E. F. TRAVIS
and T. M. WILSON
General Engineering & Consulting Lab., G. E.

A negative resistance oscillator provides increased stability. Other refinements improve accuracy.

WHILE there are many inexpensive instruments on the market to make rapid measurements of capacitance and inductance, most of them are too inaccurate for industrial use. On the other hand, a laboratory setup which gives accurate results requires an experienced operator, takes considerable time to operate, and includes several pieces of expensive equipment.

At the beginning of the war the *General Electric* R.F. Capacitometer was developed to meet the need for an instrument to make rapid, accurate measurements of capacitance from 0 to 1000 micromicrofarads and inductance from 0 to 1000 microhenries. The original r.f. capacitometer provided accurate results and was rapid in operation, but it was soon found that the limited range was a handicap.

To meet the need for an instrument to measure wider ranges, the original unit was redesigned to extend its range and increase the ease of operation. The improved r.f. capacitometer shown in Fig. 1 has a measurement range of 0 to 20,000 micromicrofarads capacitance and 0 to 10,000 microhenries inductance, while retaining the same accuracy as the original instrument.

The simplicity of the new unit is shown by the few controls on the front panel. These are the ON-OFF power switch, range selector switch, SENSITIVITY CONTROL for the tuning indicator, ZERO SET control and the main tuning control and dial. The ease of adjustment of the main tuning control is increased by the use of the large lucite disc integral with the tuning knob. This is designed for use as a vernier, permitting exceptionally close setting of the control.

Two ranges are provided for capacitance measurements and three for inductance measurements. The desired range is selected by the RANGE SWITCH located on the front panel.

The first capacitance range (0 to 1000 $\mu\mu$fd.) is direct reading with an accuracy of $\pm(0.2\% + 0.5$ $\mu\mu$fd.). On the second capacitance range (1000 to 20,000 $\mu\mu$fd.) a calibration curve is used, and the accuracy is $\pm(0.2\% + 30$ $\mu\mu$fd.). It should be noted that these accuracy specifications are not in terms of per-cent of full scale but in terms of per-cent of the value being measured.

The inductance ranges are 0 to 1250, 1250 to 4000 and 4000 to 10,000 microhenries. Calibration curves are furnished for each of those ranges and the accuracy is $\pm(0.5\% + 0.5$ microhenries) on all ranges.

The speed of operation of the capacitometer results from the use of the simple principle of comparing the frequency of two stable radio frequency oscillators. One oscillator operates at a fixed frequency of 75 kc. while the other, called the variable oscillator, is tuned to this same frequency before and after the unknown element is connected in its tank circuit. The electron ray tube indicates when the two frequencies are equal or zero beat. The change in oscillator tuning capacity necessary to compensate for the insertion of the unknown element is a measure of the value of the unknown.

The elementary diagram (Fig. 4) shows the important circuit elements of the Capacitometer. A Type 6SA7 tube is used as a combined oscillator-buffer amplifier for both the fixed and variable oscillator circuits. The output of the fixed oscillator is applied to one grid and the output of the variable oscillator is applied to the other grid of a 6SA7 mixer. The difference frequency which appears at the plate of the mixer tube is applied to the grid of a 6E5 electron ray tube so that the rate of opening and closing of the shadow represents the difference frequency between the two oscillators.

The measurement procedure to be followed in measuring capacitance is simple. With the main tuning control dial set at zero, the variable oscillator frequency is adjusted to zero beat with the fixed oscillator by the zero set control. During this operation only the ground or low side of the unknown capacitor is connected to the Capacitometer using the shielded cable furnished. Next, the high side of the unknown is connected and the frequency of the variable oscillator is again adjusted by the main tuning control until the indicator tube shows that the frequency is the same as that of the fixed oscillator. Since the main tuning control dial is marked to indicate the capacitance removed from the tuned circuit the dial reading is the value of the capacitor being measured for the 0 to 100 $\mu\mu$fd. range. Between 1000 and 20,000 $\mu\mu$fd. the actual value is obtained from calibration curves.

For inductance measurements the zero adjustment is made with the inductance shorted. After the unknown is connected, the variable oscillator is returned to its original frequency by means of the main tuning control. The scale reading is translated to inductance by means of a chart.

As mentioned before, the original Capacitometer was redesigned to provide wider measurement range, and ease of operation. These additional requirements necessitated considerable re-design even though the original principle was still retained.

A two terminal negative resistance type of oscillator circuit was selected for use in the Capacitometer because:

1) The circuit has good frequency stability with respect to fluctuations in tube element voltages.

2) It will maintain oscillation over a wide range of circuit impedance.

3) The range switching circuit is less complicated than with the ordinary *L-C* type.

The conditions to produce oscillation in the circuit (Fig. 2) are: (1) the feed back capacitor (C_F) must have negligible reactance compared to the grid circuit resistance, and (2) the tuned circuit must have a parallel resonant impedance greater than the absolute magnitude of R_n. The frequency of oscillation will be very nearly equal to the resonant frequency of the tuned circuit. Over a limited range the grid to screen transconductance of the 6SA7 is negative; that is, the screen current (i_{SG}) increases as the grid voltage (e_g) decreases. Since more electrons are deflected to the screen as the grid voltage decreases, the plate current is correspondingly reduced. Therefore, a decrease in voltage causes an increase in current (looking in at the grid), and the tube acts like a negative resistance ($-R_N$).

The cathode resistor (R_K) and capacitor (C_K) provide self bias for the oscillator tube. Grid No. 1 is operated at ground potential. The output load rather than being directly connected to the oscillator circuit is in the plate circuit of the 6SA7 which acts as a "buffer" amplifier so that changes in load have very little effect on the oscillator frequency. Thus an oscillator possessing good frequency stability with respect to changes in element voltages and load changes is obtained by the use of only one tube.

During the development, it was discovered that changes in oscillator transconductance (g_m), due to heater voltage fluctuations or actual tube changes affected readings obtained on the capacitometer when the impedance of the tuned circuit was high. It was noted that tubes of different g_m in the variable oscillator circuit gave different dial readings for the same unknown inductance. This effect was finally reduced to a negligible amount by decoupling the oscillator tube from its tuned circuit by the network C_g, R_g, and R_f (Fig. 3). This made the oscillator frequency less dependent upon changes in tube transconductance (g_m) and more dependent on the tuned circuit constants.

To maintain the accuracy of the instrument over long periods of time, it was necessary that the fixed oscillator frequency be stable. It was found that the expense of the crystal controlled oscillator used in the original Capacitometer was not necessary as the negative resistance type of oscillator with a regulated plate supply and temperature compensation would give the required stability. The drift in the frequency of the fixed oscillator was measured over a five day period. The unit was turned on in the morning, was operated for 8 hours and was turned off at night. During the period of the test the frequency never deviated more than 25 c.p.s. from its original frequency. This would cause a maximum error of .06% in measurements.

The frequency stability of the variable oscillator does not affect the accuracy to any great extent. However, since any shift in the variable oscillator necessitates resetting the zero its frequency should be as constant as possible for convenience in making measurements.

When two closely associated oscillators are operating at nearly the same frequency, there is a tendency for one oscillator to be pulled into synchronism with the other. In the RF Capacitometer this effect would seriously limit the instrument's precision and accuracy. Special precautions were therefore taken to prevent this so called "locking."

The *Q* of the oscillator coils was made as high as possible to reduce the tendency for the oscillators to shift in frequency. In addition, the two oscillators were decoupled as shown in Fig. 2 by the dividing network (R_{p1} and R_{p2}) the ratio being approximately:

$$R_{p2}/(R_{p1}+R_{p2}) = 30$$

Also, special shielding and wiring precautions were taken: the tank coil of the fixed oscillator was mounted on top of the chassis and shielded, while the coil for the variable oscillator was placed under the chassis. The components of the fixed oscillator were further isolated by a shield on the under side of the chassis and the plate supply leads to the two oscillators were decoupled.

The effectiveness of these methods is shown by the fact that it is possible to approach the correct tuning point and tune to zero beat without any noticeable pulling effect. Any perceptible motion of the main tuning dial in either direction can also be detected on the indicator tube.

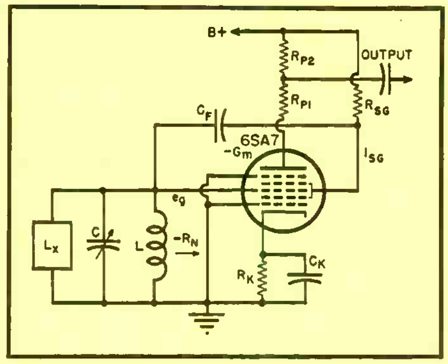


Fig. 2. Elementary circuit of the 6SA7 negative resistance oscillator.

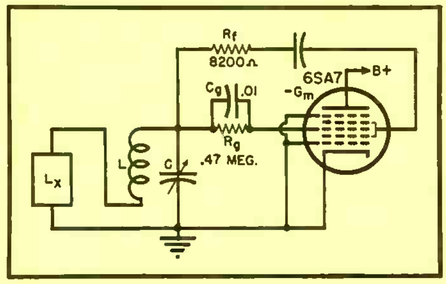
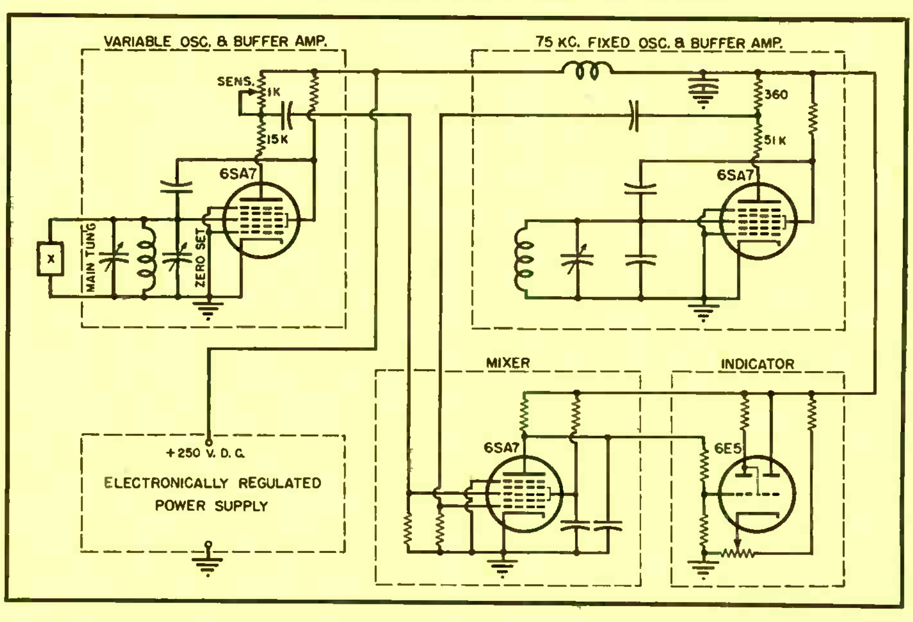


Fig. 3. 6SA7 negative resistance oscillator showing decoupling network.

Fig. 4. Elementary diagram of the R.F. Capacitometer.



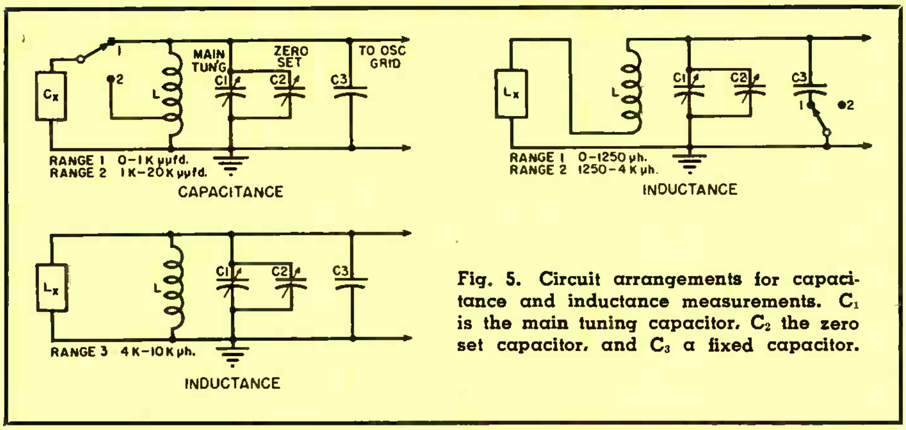
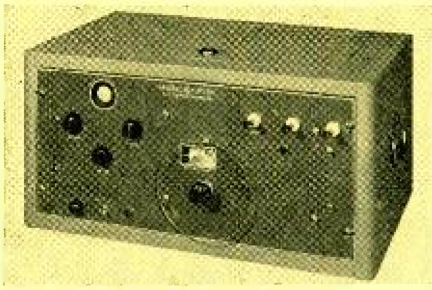


Fig. 5. Circuit arrangements for capacitance and inductance measurements. C_1 is the main tuning capacitor, C_2 the zero set capacitor, and C_3 a fixed capacitor.



Photograph showing front panel arrangement of the original capacitometer.

To maintain oscillations over such a wide measurement range the circuits were arranged as shown in Fig. 5. For the first capacitance range the tuned circuit consisted of coil L and capacitors C_1, C_2 and C_3. The unknown capacitance C_x was added in parallel with the tuned circuit. On the second capacitance range, the unknown is connected to a tap on the coil to reduce the effect of C_x at the oscillator grid approximately 20 to 1, so that capacities up to 20,000 $\mu\mu$fd. can be measured by means of the 1000 $\mu\mu$fd. tuning control. For measurements on the first and second inductance ranges, the unknown L_x is inserted in series with the coil L; C_1, C_2, C_3 again being the capacitances for the lowest inductance range. For the second range C_3 is removed from the circuit. In order to keep the tuned circuit resonant impedance down to a low enough value, the unknown is connected across the tuned circuit rather than in series for the highest or third range of inductance, which covers 4000 to 10,000 microhenries.

To meet the high accuracy requirement, careful selection and calibration of capacitance and inductance standards was necessary. The most precise 1000 $\mu\mu$fd. variable capacitor available was selected as a standard and was calibrated at the U. S. Bureau of Standards. The calibration accuracy on this type of capacitor is $\pm$(.05% + 0.2 $\mu\mu$fd.) for values of capacitance difference between any two settings. This is the manner in which the capacitor is used and so furnished a satisfactory calibration.

A decade capacitor with 1000 $\mu\mu$fd. steps was made for calibrating the Capacitometers on the 1000 to 20,000 $\mu\mu$fd. range. Each step was calibrated against the 1000 $\mu\mu$fd. secondary standard capacitor just described. Intermediate points to aid in plotting the calibration curves were furnished by paralleling the decade capacitor with the 1000 $\mu\mu$fd. variable capacitor which had previously been calibrated.

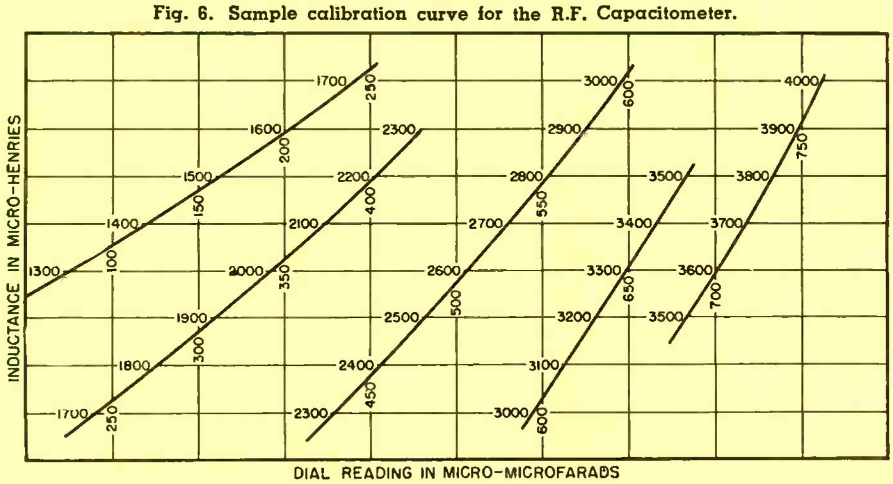
Special inductance standards were made for calibrating the Capacitometer. The inductance of these coils was measured at 75 kc. by the frequency comparison method using the 1000 $\mu\mu$fd. secondary standard capacitor. As a further check, several of these inductances were calibrated by the National Bureau of Standards, which provided very accurate standards.

Since the main tuning dial is calibrated directly in capacitance removed from the circuit, the capacitance may be read directly from the dial for the range of 0 to 1000 $\mu\mu$fd. Above this and on the inductance ranges, calibration curves are furnished to convert dial readings into actual values of capacitance or inductance. Here, the problem of supplying graphs of sufficient reading accuracy in a reasonable size was overcome by breaking each graph up into segments and overlapping. Five curve sheets were supplied with each Capacitometer, two for capacitance and three for inductance. A typical calibration curve for a Capacitometer is shown in Fig. 6. This particular curve is for the 1250 to 4000 microhenry inductance range, but the other ranges are similar. Circles represent calibration points. To avoid confusion all of the graph divisions are not shown in this figure. Although not shown in this figure, the graph is so divided that the smallest division represents two microhenries. Points on the curve can easily be read closer than the smallest division. This means the reading accuracy is at least within 0.1% which is five times better than the guaranteed over-all accuracy on inductance.

The precision of measurement with the R.F. Capacitometer, that is, the agreement between readings of the same quantity, is limited by (1) the error in reading the dial, (2) backlash in the main tuning capacitor drive mechanism, (3) the sensitivity of the indicator, and (4) stray effects caused by shifting of leads. It was found that with care measurements could easily be made, even by non-technical workers, with a precision of 0.2 $\mu\mu$fd., one part in 500, which is the smallest division on the main tuning dial.

For comparative measurements where indication of deviations from a standard capacitor rather than absolute value is desired, the R.F. Capacitometer also proves to be a useful instrument. In measuring small deviations, of the order of two or three $\mu\mu$fd., the accuracy is approximately equal to the precision of the instrument (0.2 $\mu\mu$fd.) on the 0-1000 $\mu\mu$fd. range.

Fig. 6. Sample calibration curve for the R.F. Capacitometer.



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Design of Acoustic Systems by Electromechanical Analogies

By D. FIDELMAN

Part I. The design of equipment for converting electrical impulses to sound and vice versa.

Dual-cone loudspeaker having a uniform output from 30 to 15,000 cycles.

THE reproduction of sound by any method must always involve, somewhere in the system, the conversion of mechanical vibrations to electrical energy or of electrical to mechanical vibrations. Sound itself is a mechanical vibration, while all present amplification and transmission systems operate upon electrical signals—therefore the incident sound must be converted into an electrical signal, and the final electrical signal must again be converted into sound. If the signals are to be recorded for reproduction at a later time, the recording process is also likely to involve the conversion of electrical to mechanical energy.

At the present stage of audio system development, the performance of the electrical systems is generally much better than that of the units which involve mechanical motions. Much of the current development and research in sound reproduction is therefore being directed toward the improvement of the electromechanical components. When these have been properly perfected, it will then be possible to obtain even better fidelity of reproduction than the best we have today.

The fundamental requirements of a system which will give good sound reproduction may be summarized briefly:

(a) It must be able to reproduce a wide frequency range — the entire range of human hearing would be the ultimate goal.

(b) The response should be uniform over the entire frequency range.

(c) It should not introduce detectable distortion or noise into the reproduced sound.

(d) Transient sounds should be reproduced exactly as they occur.

(e) It should be able to reproduce the entire dynamic range of the original sound.

Present systems of sound reproduction meet these requirements to a large degree—but not completely. The difficulties exist mainly in the electromechanical components of the system.

The basic difficulties are better understood when the problem is considered closely. For example, a loudspeaker is required to be able to reproduce accurately all the sounds, both singly and in combination, which can be produced by all musical instruments. The degree to which this has been accomplished is one of the successes of modern engineering. This article will describe the methods which are used to design electromechanical devices for the reproduction of sound, to show the basis of practical designs using these methods, and how they are used for the improvement and perfection of existing designs.

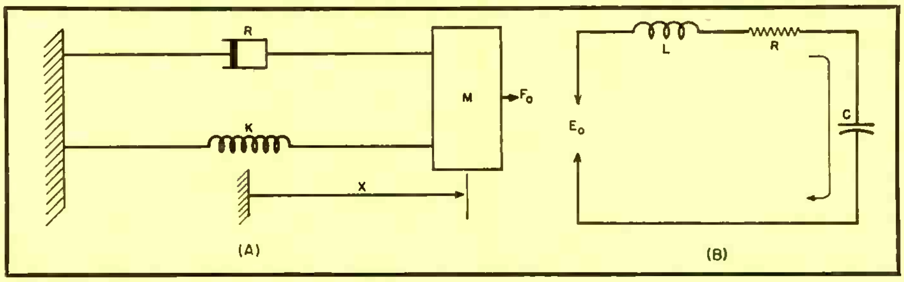
Electromechanical Analogies

Essentially, the performance of mechanical systems is analyzed by writing the differential equation of the system and obtaining the response to some applied force. However, the mechanical systems which are used in sound reproduction are usually too complex to permit direct calculation of the response, and the most direct method is to measure it.

This measurement, and any calculations which are to be performed, are best done by making use of the differential equation instead of the actual mechanical system. This makes it possible to make use of the fact that mechanical systems are represented by the same differential equations as electrical networks, so that the method of electromechanical analogies can be used. Thus all the results of network theory are available for the design of mechanical systems, and the operation of a proposed new design can be measured by setting up the analogous electrical circuit, saving the expense and time required to construct mechanical models.

The theoretical basis of the method can best be understood by consideration of the simple mechanical system shown in Fig. 1A. It consists of a mass, a spring, and a dashpot connected to-

Fig. 1. (A) Simple mechanical system consisting of a mass, a mechanical resistance, and an elastic spring, caused to move by an external applied force. (B) Mathematically equivalent electrical circuit consisting of an inductance, a resistance, and a capacitance, with an applied voltage.



Actual electrical circuit	Electrical analogy circuit
$L' = \frac{aL}{n}$	$L' = \frac{aM}{n}$
$C' = \frac{C}{an}$	$C' = \frac{1}{anK}$
$R' = aR$	$R' = aR$

a is arbitrary constant, n is ratio of frequencies in analogous circuit to those in actual system.

(1) If known excitation function is represented by a voltage E'_0, actual voltages or quantities they represent are given by equations

$$e_n = \frac{E_0}{E'_0}\, e'_n \qquad f_n = \frac{F_0}{E'_0}\, e'_n$$

and currents or their analogies by equations:

$$i_n = \frac{a\,E_0}{E'_0}\, i'_n \qquad v_n = \frac{a\,F_0}{E'_0}\, i'_n$$

(2) If known excitation junction is represented by current I'_0

$$i_n = \frac{I_0}{I'_0}\, i'_n \qquad v_n = \frac{V_0}{I'_0}\, i'_n$$

$$e_n = \frac{I_0}{aI'_n}\, e'_n \qquad f_n = \frac{V_0}{aI'_0}\, e'_n$$

gether. The motion is then given by Newton's second law, and is represented by the differential equation:

$$F_0 = M\frac{d^2x}{dt^2} + R\frac{dx}{dt} + Kx$$

If the simple LCR circuit of Fig 1B is considered, the electrical charge (and therefore the current) in the circuit is given by the well-known differential equation derived from Kirchhoff's second law:

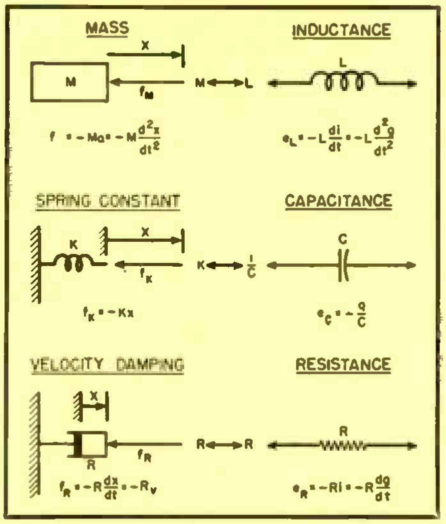


Fig. 2. Methods of representing mechanical elements by equivalent electrical circuit elements, when using the force-voltage analogy.

Fig. 3. Conversion formulas for determining the various circuit constants.

$$E_0 = L\frac{d^2q}{dt^2} + R\frac{dq}{dt} + \frac{1}{C}q$$

It is obvious that the equations for the electrical and the mechanical system become identical if the following substitutions are made:

charge (q)	$\longleftrightarrow$ displacement (x)	
voltage (E_0)	$\longleftrightarrow$ force (F_0)	$\left(\frac{1}{K}\right)$
capacitance (C)	$\longleftrightarrow$ compliance	
inductance (L)	$\longleftrightarrow$ mass (M)	
resistance (R)	$\longleftrightarrow$ damping, friction (R)	

This identity between the mathematical equations holds true for mechanical and electrical systems of any degree of complexity, therefore the electromechanical analogous circuits may always be set up without any further investigation into the exact mathematical solution to the equations of the mechanical system. All the known methods of circuit and network analysis can then be applied to the electrical circuit, and the results will be completely valid for the mechanical system.

It may be noted that when the electromechanical analogous circuit is set up as indicated, the basis for the analogy is fundamentally the differential equation, even though it is not explicitly used. (Another analogous circuit may be set up by considering a force-current analogy, and using Kirchhoff's first law. Both systems are equally valid, but the force-voltage analogy is much more widely used.) The details of application of this method are given graphically in Figs. 3 and 4 which give the basic analogies together with the dimensions of the various factors.

When setting up the analogous circuit, if the mechanical system gives impractical values the circuit constants and the time base can readily be changed by any desired scale factor to obtain the most practical circuit values, without affecting the accuracy with which the mechanical system is represented. A consistent set of formulas for accomplishing such conversions is given in Fig. 2. When testing the circuit it is generally best to set the applied voltage at some convenient value, and then record the solutions as ratios of this value according to these conversion equations.

In the design of any electromechanical transducer, perhaps the most important information which must be known about it is its response to an applied signal. The electromechanical analogous circuit is not only much faster, easier and cheaper to set up than the original mechanical device, but it offers additional advantages in ease of measurement and adjustment of constants. Sound measurement on transducers requires calibrated microphones, specially treated listening rooms, and sources of sound designed to minimize standing waves and other spurious effects. The electrical circuit, on the other hand, is measured by the standard methods and no special equipment is needed.

The electromechanical equivalent circuit is also valuable in showing that acoustic and mechanical "networks" can be constructed, and that these can be designed and analyzed on the same basis as electrical networks. The elements which make up mechanical and acoustic networks are shown in Fig. 5, which also shows which elements are analo-

Fig. 4. Analogous quantities in the two systems, and their corresponding dimensions.

Mechanical Systems			Electrical Circuits		
Symbol	Quantity	Dimensions	Symbol	Quantity	Dimensions
v	Velocity	cm./sec.	i	Current	amperes
f	Force	dynes	e	Voltage	volts
x	Displacement	cm.	q	Charge	coulombs
M	Mass	grams	L	Inductance	henries
$\frac{1}{K} = C_M$	Compliance $= \frac{1}{\text{Stiffness}}$	cm./dyne	C	Capacity	farads
Z_M	Impedance	mechanical ohms (dynes/cm./sec.)	Z_E	Impedance	ohms
R_M	Resistance	"	R_E	Resistance	"
$X_M \begin{cases} j\omega M \\ \frac{1}{j\omega C} \end{cases}$	Reactance	"	$X_E \begin{cases} j\omega L \\ \frac{1}{j\omega C} \end{cases}$	Reactance	"
$\frac{1}{2\pi\sqrt{M/K}}$	Resonant frequency	cycles/sec.	$\frac{1}{2\pi\sqrt{LC}}$	Resonant frequency	cycles/sec.

gous in the various systems. The analogue of electrical resistance is sliding friction which causes dissipation in mechanical systems, and the dissipation caused by viscosity when fluid is forced through narrow slits is the analogue in acoustic systems. The analogue of electrical inductance is mass in mechanical systems, and in an acoustic system is represented by the fluid contained in a tube in which all the particles move with the same phase when actuated by a force due to pressure. The analogue of capacity is a spring in the mechanical system, and a volume which acts as a stiffness or spring element in the acoustical system.

Another analogy which is valid with certain restrictions is the transformer as shown in Fig. 6. The lever in the mechanical system is analogous to the transformer; however, the transformer operates only for alternating current, while the lever performs its function for static as well as for alternating forces. There is no d.c. electrical analogue for the transformer, but this is not important in acoustic design since only audio frequencies are of interest. The acoustic analogue of the transformer is the exponential horn, which transforms large pressures and small volume velocities to small pressures and large volume velocities above the cut-off frequency. The equation of the taper of such a horn is:

$$L_x = \frac{2.302}{m} \log_{10} \frac{A_x}{A_t}$$

where L_x is the length (in cm.) from the throat, A_t is the area of the horn throat, A_x is the area at L_x, m is the rate of taper$=A\pi f_c/c$, c is the velocity of sound in air$=$34,400 cm./sec., and f_c is the theoretical low-end cutoff frequency.

An example of the use of these principles in the design of acoustic and mechanical networks is the low-pass acoustic filter shown in Fig. 8. This consists of three sheets of perforated metal to form a number of two-section filters. The mass of the air in the openings acts as the series inductance, and the compliance of the air between the sheets acts as the capacity to ground—thus the network has the configuration shown in 8B, which is the standard type of low-pass filter circuit. A typical frequency response of such a filter is shown in 8C.

Applications to Specific Designs

An indication of the method of application of the method of electromechanical analogies in the design of audio systems may best be obtained by considering its application to the design of several specific devices.

Loudspeaker Design. The application to the design of a simple direct-radiator loudspeaker is shown in Fig. 11. The diagram in 11A shows the constructional details of a standard single-coil, single-cone dynamic loudspeaker. Consideration of this structure shows that its mechanical characteristics are determined mainly by: M_c, the mass of the cone and voice coil; K_s, the compliance of the cone suspension; R_s, the mechanical resistance of the cone suspension; M_a, the mass of the air load on the cone; and R_a, the mechanical resistance of the air load. These factors are indicated in the diagram. There are, of course, several other factors which haven't been indicated—such as the stiffness of the voice coil form, the mass and compliance of the air in back of the voice coil, and the fact that most of the constants are distributed rather than lumped—but these do not usually have too great an effect upon the accuracy of the representation, if their efforts are properly taken into account. (This is the same approximation which is commonly made in electrical circuit calculations, where small-order stray capacitances, resistance and inductance are usually neglected, and distributed parameters are considered as lumped.)

The electrical circuit which supplies driving power to the voice coil is shown in Fig. 11B. The voltage e is supplied by a generator having an internal impedance Z_G, in the voice coil having a resistance R_{VC} and an inductance L_{VC}. The effect of the coupled mechanical system appears in this circuit as the impedance Z_{EM}.

The electromechanical analogue circuit which represents the mechanical system can also be written as shown in Fig. 11B. The effect of the electrical circuit appears here as an impedance Z_{ME}, which is therefore the internal impedance of the generator that supplies the signal. Thus the "mechanomotive force" of the generator is f_{MO}, and the force supplied by the voice coil is f_M. By the principles of electromechanical analogies which have been described, the mechanical circuit representing the loudspeaker can then be drawn as indicated. This gives a series circuit, with the mass of the cone, and the compliance and resistance of the suspension all in series with the load, consisting of the mass and resistance of the air load on the cone.

This gives two circuits for the loudspeaker, which contain the unknown impedances Z_{EM} and Z_{ME}. Since the force in the mechanical system due to the current in the voice coil and the inverse e.m.f. in the voice coil due to its motion in the magnetic field are related by the same factor, the circuit can be simplified by eliminating these unknown impedances. The mechanical impedance is obtained from the electrical impedance by the relation:

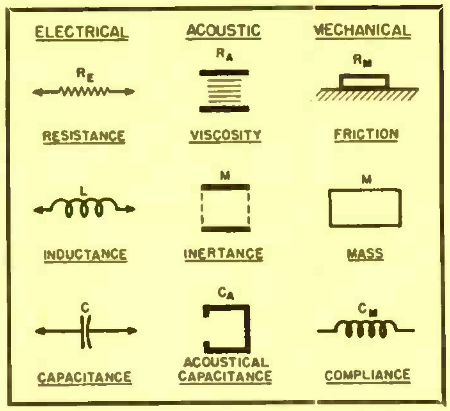


Fig. 5. Elements which can be used in the construction of electrical, acoustic, and mechanical networks.

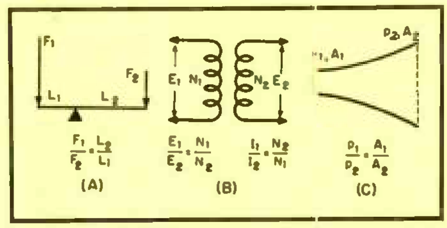


Fig. 6. Analogy between the lever, the transformer, and the exponential horn.

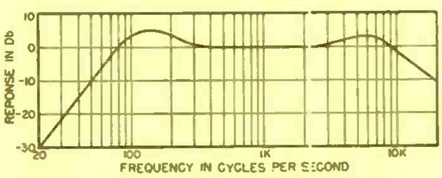
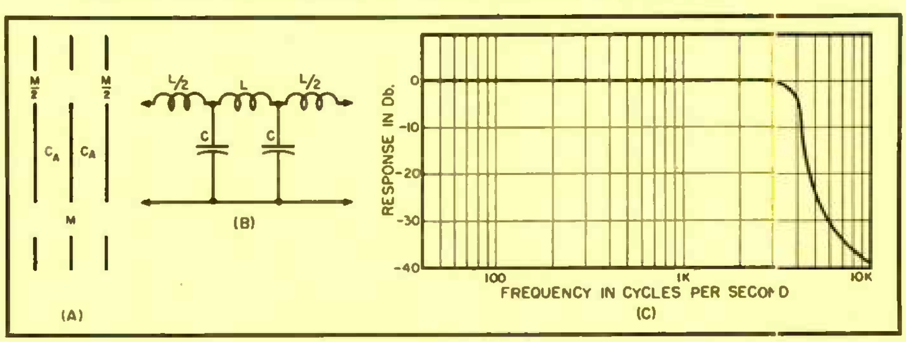
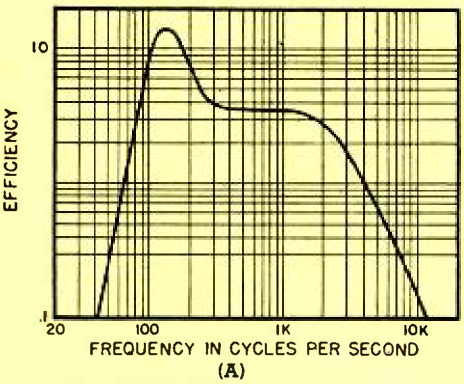


Fig. 7. Frequency response on the axis of the loudspeaker shown in Fig. 9.

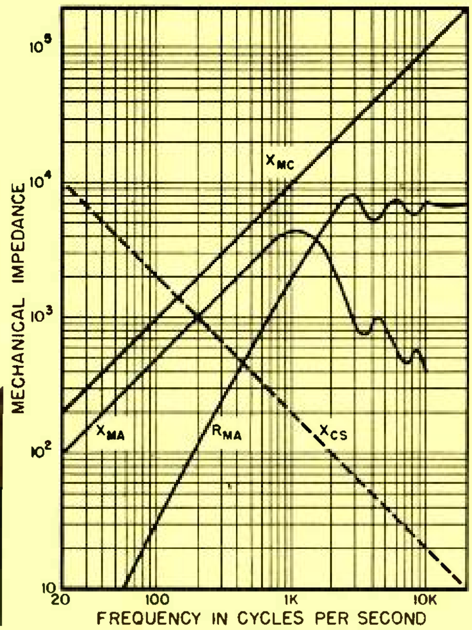
Fig. 8. Design of a low-pass acoustic filter. (A) Low-pass acoustic filter. (B) Equivalent electrical filter. (C) Typical frequency response of above filter.





Cone diameter	4 in.
Mass of cone	1 gm.
Mass of voice coil	9.35 gm.
Compliance of suspension	8.0 x 10^{-7}
Mech. res. of suspension	200
Voice coil material	copper
Air gap flux	10,000 gauss

(B)



(C)

Fig. 9. Practical application of the electromechanical equivalent circuit of Fig. 11 to the design of a loudspeaker. (A) Efficiency characteristics of loudspeaker. (B) Mechanical characteristics. (C) Various mechanical impedance components as a function of frequency.

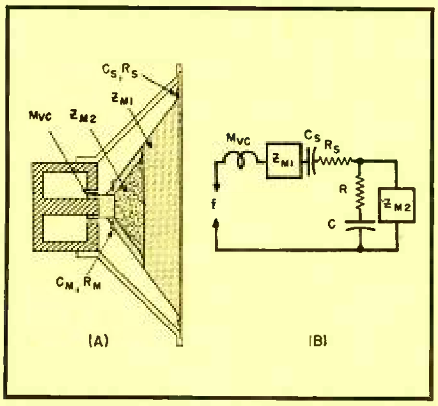


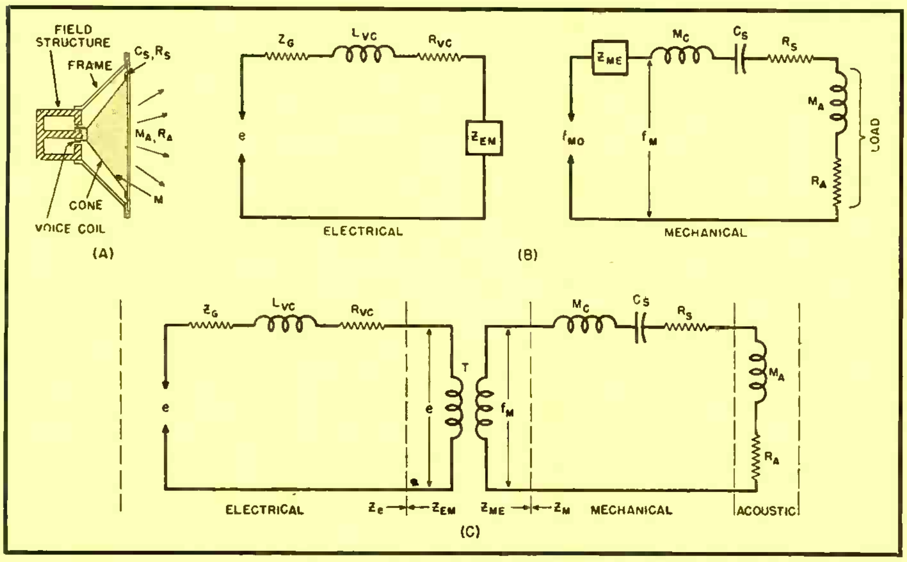
Fig. 10. (A) Mechanical system of double-cone single-coil loudspeaker. (B) Equivalent electrical circuit of the double-cone speaker.

$$Z_{EM}=\frac{(Bl)^2}{Z_M}\times 10^{-9}$$

where B is the magnetic flux density, and l is the length of wire in the voice coil. This relation shows that the entire system can be represented as a single network, if the proper transformer is inserted between the two sections, the actual turns ratio of the transformer will depend upon the electromagnetic structure of the specific loudspeaker.

The final circuit then becomes that shown in Fig. 11C. This circuit can be analyzed by any of the standard methods of circuit analysis, or it can be set up with ordinary coils, condensers and resistors, and its response measured. It

Fig. 11. Equivalent electrical circuit of a direct-radiator loudspeaker.



is basically a band-pass circuit, giving good response at the center frequencies, and dropping off at the high and low frequencies.

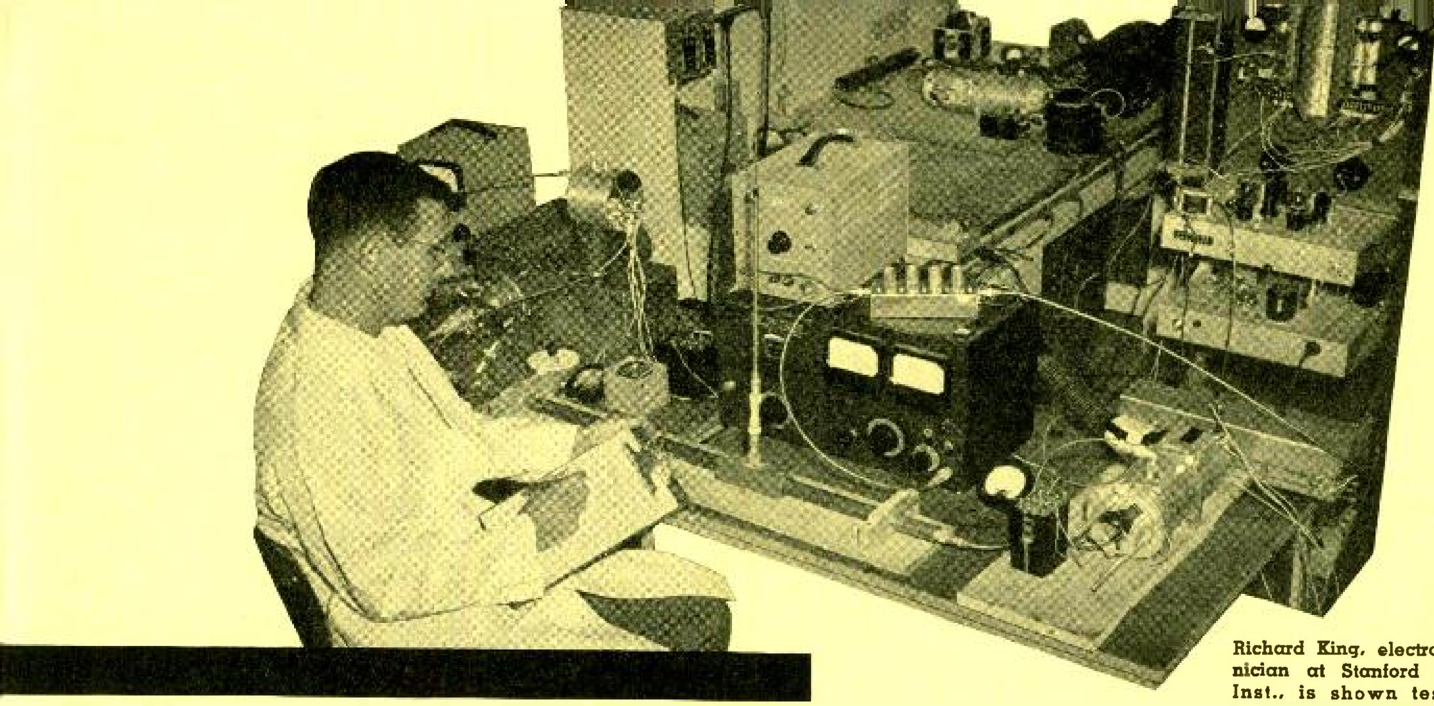
The manner in which this circuit applies to a practical loudspeaker design is shown in the graphs of Fig. 9. The characteristics of the speaker which are being considered are shown in 9C, and the various impedance components as a function of frequency in 9A. The efficiency, which is the ratio of the sound power output to the electrical power input, is shown in 9B. If the loud speaker were nondirectional, the efficiency characteristic would be the frequency response characteristic. However, the response is measured on the axis, and the directional effects give a proportionately greater sound pressure on the axis at the higher frequencies. If this is taken into account, calculations show the sound pressure response on the axis to be as shown in Fig. 7, and this is very close to the actual measured frequency response characteristic.

The curves in Fig. 9 show that a loudspeaker with a small and relatively lightweight cone and voice coil is capable of giving good reşponse and efficiency over a wide frequency range. However, a loudspeaker with a small cone is not able to deliver much acoustic power at low frequencies because the required amplitude of vibration is too great. One method of avoiding this difficulty is by use of the dual-cone system, in which the use of a mechanical network makes it possible to obtain the advantages of the small cone at high frequencies, and of the large cone at low frequencies.

This system is illustrated in Fig. 10. It consists of a single voice coil coupled to two cones as shown in (A), with the two cones coupled together by a compliance. The operation can be understood by reference to the analogue circuit in (B). At low frequencies the reactance of the compliance is large compared to the mechanical impedance Z_{M2} of the large cone, therefore the entire current flows through Z_{M2} and the entire system moves as a whole. At high frequencies the reactance C_M is small compared to Z_{M2} and shunts it, therefore the small cone moves while the large one remains stationary. A system of this type makes it possible to extend the frequency range of the loudspeaker by almost a full octave, depending upon the mass and electrical characteristics of the voice coil.

This article has been concerned primarily with the design of loudspeakers by means of electromechanical analogies. Part 2, which will appear next month, will deal with microphone design incorporating these same principles.

(To be continued)



Richard King, electronic technician at Stanford Research Inst., is shown testing an experimental amplifier chain.

P.T.A. (Phase to Amplitude) MODULATION

This novel system of modulation has been successfully applied to television for the first time by Stanford engineers at KM2XAZ.

IT HAS been evident for some time that the present v.h.f. band is entirely inadequate for a truly nationwide television service. The logical solution is to move to the u.h.f. band above 300 mc., where many more television channels would be available. To stimulate research at these higher frequencies, the FCC has alloted experimental licenses to several stations for operation between 500 and 1000 mc.

One of the stations so licensed is KM2XAZ, at Long Beach, Calif., owned by Mr. John H. Poole. Stanford Research Institute has been carrying on a development program for u.h.f. television transmitters and receivers under the sponsorship of Mr. Poole, and Mr. W. E. Evans, Jr. of Stanford described the transmitter at the Cincinnati Spring Television Conference, April 29.

This television transmitter, which operates at 530 mc., uses a type of modulation called P.T.A. (phase to amplitude), or sometimes referred to as "outphasing" modulation. The system is not new, having been used quite extensively in foreign countries, but has not until recently been developed to any great extent in this country. It permits the amplitude modulation of large amounts of power using small receiving tubes as modulators.

The system consists basically of two identical phase modulated transmitters driven from the same oscillator and fed into the same antenna. The phase modulation is so arranged that on modulation peaks the two channels are in phase and, when combined, give maximum amplitude of the carrier, while on modulation troughs, the two channels are out of phase, giving minimum modulation of the carrier. From this it can be seen that the phase modulation of the two channels must be kept equal and opposite—that is, if one channel is phase modulated by +15°, the other channel must be modulated *exactly* —15° at the same instant.

This system of modulation permits the use of high-efficiency nonlinear class C amplifiers following the modulator. Since modulation takes place at a very low level, large modulation transformers and reactors are eliminated, along with the need for high modulating powers. Modulation is possible practically down to d.c., and the upper frequency is limited only by the bandwidth of the power amplifiers. This makes the system ideal for a television transmitter, particularly in the u.h.f. range.

The transmitter at station KM2XAZ has a power output of 150 watts peak at 530 mc. A crystal oscillator output is multiplied up to a power level of about 4 watts at 265 mc., where it divides and goes through the two halves of a twin-channel phase modulator, each side of which is capable of linear modulation up to ±22.5 degrees. This output is then passed through identical doublers and power amplifiers to give an output of 75 watts peak from each channel at a phase modulation up to ±45 degrees. Two 4X150A coaxial cavity stages are used to provide this amplification. The outputs of these two channels, constant in amplitude but varying in phase, are then fed into the antenna, where they combine to produce an output which is constant in phase but varying in amplitude—in other words, the output is amplitude modulated.

The output combining network consists of a configuration of quarter-wave transmission lines having the property that when two equal r.f. voltages are fed into the input terminals, the impedance that each channel sees is resistive and constant, regardless of the relative phase between the two voltages. The network feeds into the antenna and a dummy load, thus the distribution of power varies smoothly between these two loads, depending upon the phasing of the inputs.

The relationship between "volts output" and the relative phase angle is sinusoidal. It would seem that this nonlinearity would introduce a great deal of distortion, but a sine wave departs from a straight line by only 4 per-cent over the first 75 per-cent of its total amplitude. In a television signal, the picture information is contained in the lower 75 per-cent of the waveform and the upper 25 per-cent is devoted to sync pulses, making this sinusoidal characteristic ideal. The sync pulse amplitude may be restored by sync stretching.

As mentioned before, the r.f. power amplifier sections are of the conventional coaxial cavity type. Each channel uses one 4X150A as a straight-through amplifier on 265 mc. followed by another 4X150A which doubles the frequency to 530 mc. A bandwidth of 9 mc. is maintained in this power amplifier.

The phase modulator, which could well be called the heart of this type of transmitter, poses several difficult problems, not the least of which is that of providing linear modulation at carrier frequencies of 265 mc. A network similar to that used in the output for converting phase modulation to amplitude modulation can be reversed to provide amplitude to phase modulation. The total linear modulation range is about ±25°, so to obtain the necessary ±45° shift at 530 mc., the phase modulator must be operated at 265 mc.

A special twin-channel phase modulator tube has been developed at Stanford to do the entire job of phase modulation with practically no adjustments. The maximum power output thus far obtained from such a tube has been in the milliwatt region, which prevents its use in the present transmitter because of the extra amplification required. Development is continuing, and if a tube can be built to provide an output in the order of one to ten watts, the problem of a simple phase modulator will have been solved.

Tests have indicated that the performance and stability of the transmitter now in use are adequate to meet the most stringent requirements. The video response of the complete system is flat within 1 db. to 4.8 mc., and a horizontal resolution in excess of 400 lines has been realized.

It is apparent that this system of modulation will have very little, if any, advantage at low power levels, but will be superior to conventional systems at higher power levels. Above 500 to 1000 watts, distinct advantages in physical size, initial cost and efficiency may be realized over grid-modulated systems.

With a basic unit of the type now in use at KM2XAZ, additional power output may be obtained merely by the addition of class C amplifiers designed for operation at 530 mc. Use can be made of such tubes as klystrons, resnatrons and traveling wave tubes.

The development of this transmitter has been one long-sought step toward the opening of the u.h.f. region for commercial broadcasting. Another is the development of converters for bringing u.h.f. signals down to the v.h.f. level of standard commercial TV receivers. Such a prototype converter has been designed and built by engineers at Stanford Research Institute, also under Mr. Poole's sponsorship. Several tunable versions have been built, thus completing the necessary steps for the development of a truly nation-wide, competitive television broadcasting system. It is expected that the FCC will complete its hearings sometime this fall, and shortly thereafter will probably open the u.h.f. band for TV broadcasting. In the meantime, intensive research for the development of additional techniques, antennas, etc. is continuing in all branches of the industry. Other experimental u.h.f. television stations have been in operation for some time, and a great deal of data has been collected regarding propagation characteristics, shadow effects, ghosts, etc. Preliminary results indicate that radiated powers considerably in excess of those used at v.h.f. will be necessary for equivalent coverage at u.h.f.

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2. *Villard, O. G. Jr., and Evans, W. E., Final Report to Air Materiel Command, Watson Laboratories, Red Bank, N. J., on Project* W-28-099-ac-121, *August,* 1947.
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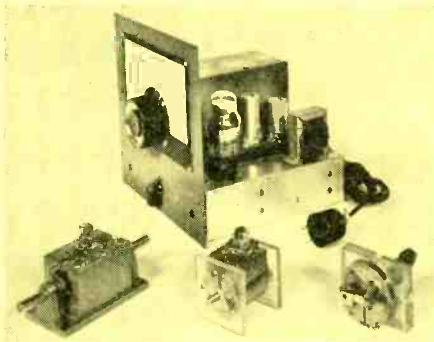
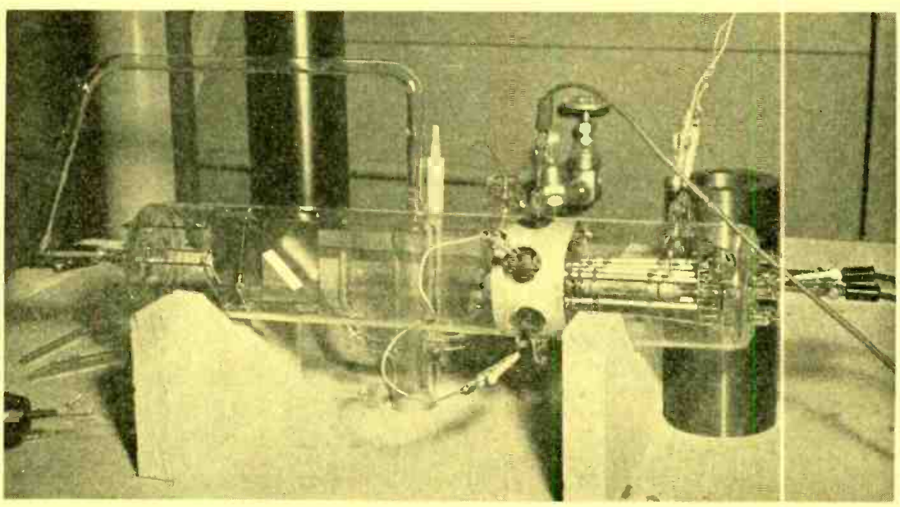


Chassis view of the TV converter for the u.h.f. band developed by Stanford Research Institute for John H. Poole of Long Beach, Calif. In the foreground are special circuits, which are, left to right: cylinder oscillator with acorn tube, modified semi-butterfly type of oscillator, and a special crystal mixer.

The 200-watt phase to amplitude transmitter is being subjected to exhaustive tests before being delivered to experimental TV station KM2XAZ. William E. Evans, research engineer, is shown with some of the testing instruments.

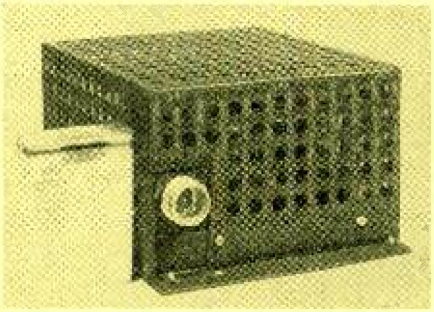
Special phase-modulator tubes have been designed by the laboratory staff to incorporate the modulating jobs of several conventional u.h.f. tubes into one. The model is shown connected to the vacuum pumps during processing. Work is continuing on the development of a tube having from one to ten watts output, rather than the milliwatts output of preliminary experimental models.



NEW PRODUCTS

ELECTRONIC PHASE ADAPTER

Varo Manufacturing Co. Inc., Box 638, Garland, Texas has announced its



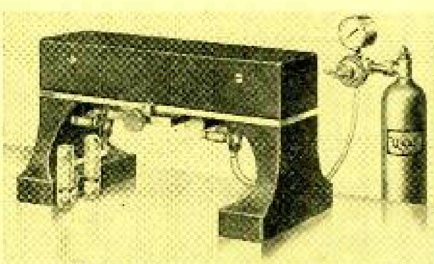
Model 160 Electronic Phase Adapter which is an electronically controlled phase splitting network capable of dividing single phase 400 cycle current into balanced three phase current over a large range of power up to 100 va.

This device consists of a reactor and capacitor in series directly across the line, the third phase terminal being their common connection. Output voltage on all phases is equal to input voltage ±3% over wide ranges of input voltage, frequency, load, power factor, temperature, and altitude.

Designed for maximum resistance to fungus, salt spray, sand, dust, and humidity, this phase adapter has no moving parts and has a life expectancy of 1000 hours.

FLOW COUNTER

Nuclear Instrument & Chemical Corporation, 223 West Erie St., Chicago, Illinois, has announced a low background gas flow counter using the famous Q-gas mixture. Known as Model D46A, this new counter has the long plateau and low voltage operation which were obtainable with the former

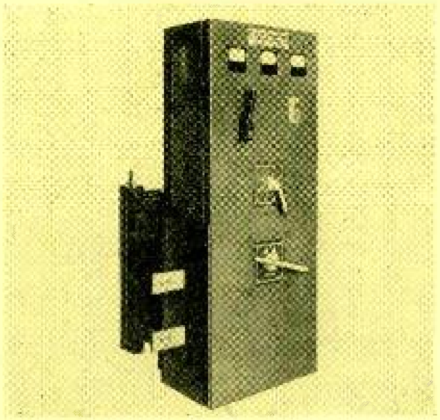


counter.

In addition, this instrument has a shielded background of only 17-18 counts per minute at Chicago elevation and a still lower background may be expected at sea level. The counter now has a flush time between samples of only ten seconds. Resolution time is approximately 100 microseconds, and a sample as large as 1¼" in diameter may be used. Starting potential is 1025 volts, and the plateau is 400 volts long with a slope of less than 3% per hundred volts.

TRANSFORMER FOR HEATING

Eisler Engineering Co., Inc., 750 So. 13th St., Newark 3, N. J., has developed a low voltage heavy current transformer for heating applications, com-



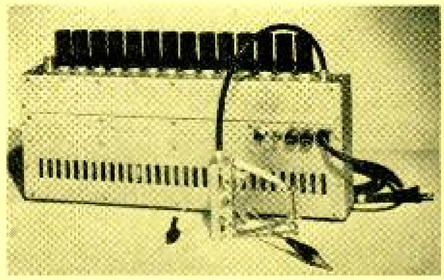
plete with control panel. Available in a wide variety of kva. capacities up to 500 and in any required combination of voltages and frequencies, the unit shown is of 40 kva. capacity for 440 volt supply and has secondary voltages ranging from 25 to 100 volts with secondary current up to 1600 amperes.

The control equipment includes, in addition to the tap switches, a magnetic contactor and suitable indicating meters for voltage and current. In other cases, additional equipment such as recording meters, safety entrance switches and various arrangements of tap switching are supplied.

CHAIN PULSE AMPLIFIER

A chain pulse amplifier designed to amplify very fast pulses and transients and employing fourteen 6AH6 vacuum tubes in a traveling wave circuit is now offered by *Spencer-Kennedy Laboratories, Inc.*, 186 Massachusetts Ave., Cambridge 39, Mass.

Model 214 has a bandwidth of 40 kc. to 100 mc. and a gain of 30 db. The input impedance of 180 ohms is de-



signed to match the output impedance of the Series 200 Wide-Band Chain Amplifiers for additional gain up to 60 db. A special termination at the end of 15" of cable is provided for convenient use with a *DuMont* 5XP cathode-ray tube for the viewing of high speed pulses.

Housed in an aluminum chassis, this amplifier can be supplied for either table or rack mounting. Further information may be obtained by addressing inquiries to Dept. RT.

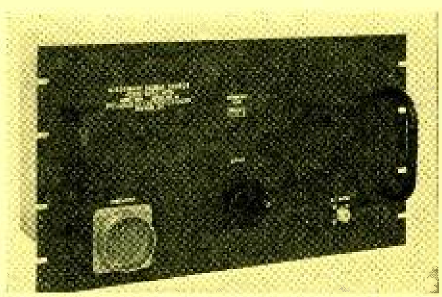
PORTABLE RADIATION DETECTOR

A long-probe radiation detector which permits the operator to measure radioactivity from a safe distance has been developed by the Special Products Division of the *General Electric Company*, Schenectady 5, N. Y.

This instrument can be used for monitoring areas in which radioactivity is suspected, or for other types of radiation metering. A detector located at the tip of a 4 ft. probe converts radioactive emanations into electrical energy. This detector consists of an electronic tube and a phosphor; and light from the phosphor acts upon the electronic tube which converts the light energy into electrical energy and amplifies its magnitude.

SIGNAL SOURCES

A series of microwave signal sources, covering the range of 634 mc. to 8340 mc. in four units, is now available from *Polarad Electronics Corp.*, 100



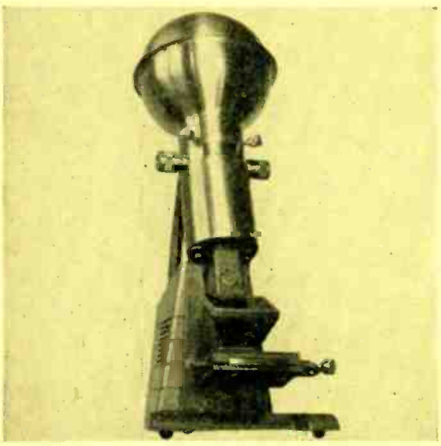
Metropolitan Ave., Brooklyn 11, N. Y.

These reflex klystron signal sources are controlled by one dial only and frequency is read directly from a linear indicator to accuracies of ½%. The reflector voltage is automatically tracked with the cavity tuner. Non-contacting shorts are used to eliminate noise and reduce mechanical wear, and terminals are provided for applying modulation to either the grid or reflector.

Model SSR covers the range from 634 to 1174 mc.; Model SSL—1140 to 2184 mc.; Model SSS—2145 to 4310 mc.; and Model SSM—4290 to 8340 mc. The signal sources are supplied complete with tube.

ELECTRON MICROSCOPE

RCA Victor, Camden, New Jersey, has announced a table or bench model of the famed Universal electron microscope, standing only 30 inches high and



expected to sell for less than $6000.00.

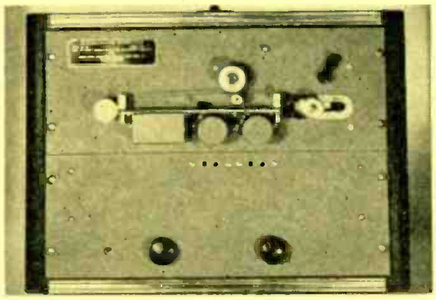
Revolutionary in design and employing for the first time permanent magnet lenses requiring no stabilization circuits and controls, the *RCA* Permanent Magnet Electron Microscope will provide useful magnifications up to 50,000 diameters by photographic enlargement with direct magnification in the instrument ranging up to 6000 diameters. It has the same 50,000 volt accelerating potential as the Universal model.

According to *RCA*, the simplicity of operation achieved in the new design makes it safe for operation in the hands of a high school student or unskilled laboratory personnel. The lower cost and smaller size of this instrument make available the benefits of electron microscopy to most colleges, high schools, hospitals, and industrial laboratories.

REVERBERATION GENERATOR

A new unit for the addition of reverberation to radio, video, and recorded sound channels is announced by the *Audio Facilities Corp.*, 608 Fifth Avenue, New York 20, N. Y.

The Artificial Reverberation Generator uses a magnetic tape delay system combined with a new reentrant electronic system. The basic unit consists of two seven inch rack panels and will work in conjunction with most broadcast type audio consoles. Input and out-



put levels are at zero VU, and the frequency response is suited to wide range live program material.

For use in other services, the unit is available with its own microphone preamplifier, isolation amplifier, control panel, VU meter, and sound effects filter.

SEALING FOR TIMERS

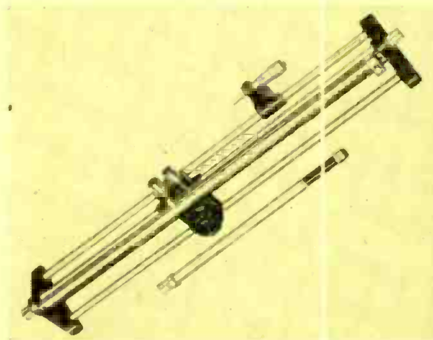
A. W. Hayden Company, Waterbury, Conn., is now furnishing hermetically sealed enclosures for its timers to give maximum protection against fungus growth, salt spray, humidity, oil spray, sand and dust, explosive atmospheres, and climatic changes.

All enclosures are evacuated to 100 microns and filled to one atmosphere with dry nitrogen so that full switch ratings can be used even at extremely high altitudes where contact capacity is normally reduced. Deterioration of motor brushes is completely eliminated.

COAXIAL MEASURING EQUIPMENT

The Type 874-LB Slotted Line and Type 874 Coaxial Elements announced by *General Radio Company*, 275 Massachusetts Ave., Cambridge 39, Mass., provide a convenient and accurate system for impedance, standing wave, voltage and power measurements at ultrahigh frequencies.

This equipment uses the Type 874 Co-



axial Connectors previously announced. Adaptors are avaliable for connecting

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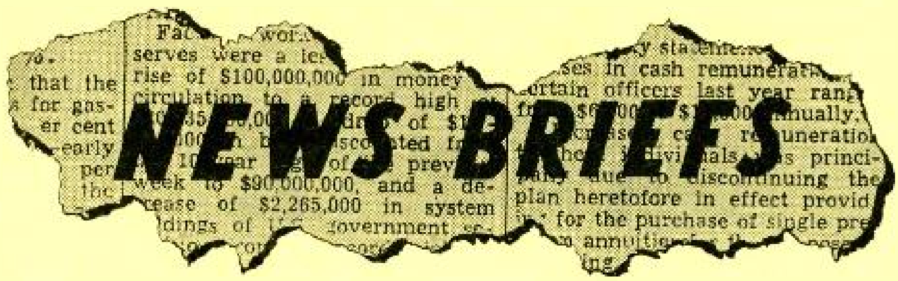


PLAN THEATRE TV

Spyros P. Skouras, President of the *20th Century-Fox Film Corporation,*

has announced that the company will proceed immediately with plans for installation of theatre television equipment in twenty theatres in the Los Angeles area.

Mr. Skouras disclosed these plans when addressing members of the Society of Motion Picture and Television Engineers at their 67th Semi-Annual Convention in Chicago recently.

STATIC CONTROL

Now available for the control of fire or explosion hazards in industry due to static electricity is equipment called the Takk Static Control marketed by *The John Hewson Company,* 106 Water St., New York, N. Y. Many industrial companies are now using this equipment successfully to control the hazard in locations where static-caused fires were frequent and where the danger of static-caused explosions was constant.

Takk equipment will control static on any type of material and on most types of machines, even at speeds in excess of 2000 feet per minute. It will control both mild and intense static charges. Operating cost is negligible as current consumption is less than 15 watts per bar.

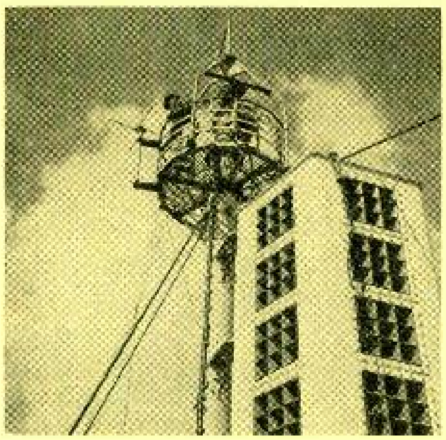
DR. COOK RECEIVES AWARD

The Washington Academy of Sciences Award for distinguished scientific achievement in the engineering sciences by researchers under forty years of age has been awarded to Dr. Richard K. Cook, chief of the sound section of the National Bureau of Standards.

Dr. Cook joined NBS in 1935 in the Bureau's engineering mechanics section where he took part in the design of apparatus for producing longitudinal vibrations in airplane wing beams and assisted in the calibration of proving rings, testing machines, and strain gages. After transferring to the sound section in 1938 he conducted research on methods for securing absolute pressure calibrations of microphones and also worked on the Bureau's proximity fuse project during the period of the war.

ROBOT LIGHTSHIP

The U. S. Coast Guard disclosed in Washington recently that a robot lightship manned only by an electronic crew is nearing completion at Curtis Bay,



Maryland. The 91-foot-long lightship "EXP-99" will be given a two months' dock trial at Curtis Bay and will be given further tests under actual service conditions near Scotland Lightship, one of three lightships marking the approaches to New York Harbor.

A single operator at the Sandy Hook, New Jersey, Coast Guard Station will have complete control over the lightship's signalling system. W. A. Derr, *Westinghouse* engineer, who helped plan the installation for the Coast Guard, explained that the key to the successful operation of the crewless lightship is the remote control system, called Visicode, developed by *Westinghouse.* This equipment uses short radio waves to send orders from the shore station to the ship. There the waves are picked up by a receiver, executed by sensitive relays, and a return signal is sent to the operator.

With a mast height of 40 feet above the water, the lightship will throw out a 10,000-candlepower beam of light, visible for 10 to 15 miles.

TESTS PLASTICS

At the Johns Hopkins University's Institute for Cooperative Research a high voltage transmitter goes on the air, but its signals go only six feet, subjecting samples of plastic materials to tests that have uncovered new data of both practical and scientific importance.

The power of the high frequency oscillator has been bridled by lining the 7 by 15 foot room with copper sheathing. When the equipment is at work, no one can remain in the red-walled room, yet a sensitive receiving set in an adjacent workshop is unable to pick up the faintest signal from the oscillator.

According to Dr. R. K. Witt, Associate Professor of Chemical Engineering of The Johns Hopkins University, who heads the team investigating plastics for use in electronic equipment, the information now being made available on the various makes and types of plastics will enable electronic equipment to be redesigned with a realistic safety factor in mind. Those on the scientific team with Dr. Witt include: Dr. John J. Chapman, John W. Dzimianski, and Dr. C. Frank Miller.

NEW DEVELOPMENT IN COMPUTERS

Bell Telephone Laboratories has developed an apparatus for modern computers which makes it possible for these machines not only to detect their own mistakes but actually to correct them. The discovery is regarded as one of the most important and fundamental advances in computer techniques and is expected to be of significance in the general communication field where transmission is on a code basis.

The basic concepts underlying the new technique are the result of mathematical research carried out by Dr. R. W. Hamming (left), *Bell Laboratories* mathematician, and apparatus incorporating

the mathematical discovery has been constructed under the direction of B. D. Holbrook (right), *Bell Telephone*

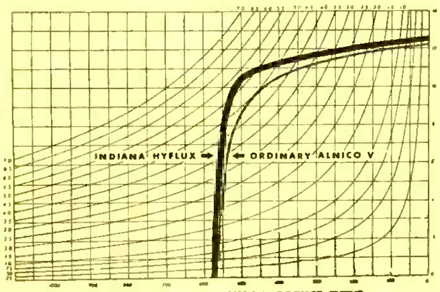
Lab's. switching research engineer.

A general discussion of the theory is contained in the Bell System Technical Journal for April 1950 and the Bell Laboratories Record for May 1950.

PERMANENT MAGNETS

The Indiana Steel Products Company of Valparaiso, Indiana has just announced new permanent magnets with a guaranteed energy product of at least 5¼ million BHmax, yet priced on a par with Alnico V.

According to F. A. Hayden, vice-president, the energy product for many types of these magnets will average 5½ million BHmax, or even more. Since



DEMAGNETIZATION AND ENERGY PRODUCT CURVE

these new magnets are not a new alloy but the result of a wholly new production technique applied to dependable Alnico V, the *Indiana Steel* designation for this product is "Hyflux Alnico V."

Graph shows increase in strength guaranteed for Hyflux.

NEW PLANT FOR POTTER INSTRUMENT

Operations of the *Potter Instrument Co. Inc.,* have been transferred to a

newly constructed plant at 115 Cutter Mill Road, Great Neck, L. I.

Of modernistic design, the new plant contains double the floor area of the former location at Flushing, N. Y. The sales, research and manufacturing departments will all be centered at this new location.

MILLI-MICROSECOND PULSE GENERATOR

The announcement of an electronic device capable of the generation of pulses of energy existing for only 1,000th of 1,000,000th of a second has been received from the U. S. Signal Corps. This development of the Signal Corps Engineering Laboratories at Fort Monmouth, N. J. is expected to provide the basis for many advancements in military electronic equipment, particularly in the field of radio communications.

Similar circuits are currently being embodied in various preliminary experimental models of radio communications equipment ranging from the short range portable and vehicular equipment up through the trunk microwave radio relay stations. In the v.h.f. spectrum these narrow-pulse-generating circuits appear to make possible the simplification of wide-frequency-band stabilizing-circuits to a point where in the not too distant future a signal officer may have a much wider choice of highly stable radio frequency channels incorporated into a single package.

SOUND CHANNEL EQUIPMENT

Federal Telecommunication Laboratories, Inc., 500 Washington Ave., Nutley 10, N. J., American research and development unit of the *International Telephone and Telegraph Corporation,* has announced a new system for transmitting television programs in which both high-quality sound and picture can be relayed simultaneously over a common radio link.

A departure from existing techniques, this system may be used with FM radio links and repeaters or with video cable circuits, thus eliminating the need for high-quality telephone lines. It can be employed to relay television programs between cities, between studio and transmitter location, and from remote pickup points to studio.

A bulletin describing the FTL 38-A Sound Channel Equipment may be obtained by writing *Federal Telecommunication Laboratories, Inc.*

ELECTRONIC COMPUTERS

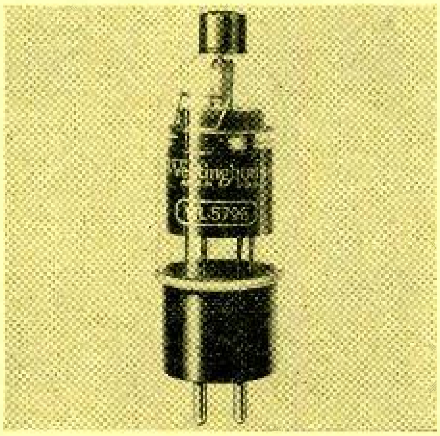
Members of the American Institute of Electrical Engineers recently heard five staff members of an M.I.T. research program in digital computer development sponsored by the Office of Naval Research predict that electronic computers will take over routine bookkeeping jobs as well as other tasks far more complex in their logic, and that they will be both fast and accurate and will be serviced so that most errors are eliminated before they occur.

C. Robert Wieser spoke on computers as engineering control mechanisms and George C. Sumner described "marginal checking," a new technique for servicing such computers to eliminate errors. Ways to lengthen the life of computer parts were discussed by Edwin S. Rich and new developments in pulsed circuit test equipment were described with movies by Robert Rathbone. Stephen H. Dodd, Jr. described the electrostatic storage tubes developed at M.I.T. for digital computer "memory."

NEW TUBES

GAS THYRATRON

A grid-controlled, inert-gas rectifier, the type WL-5796 thyratron, is avail-



able from the *Westinghouse Lamp Division*, Bloomfield, N. J. Designed for industrial control and ignitor firing service, the WL-5796 is a three-electrode, temperature-free tube.

Maximum peak anode voltage, both inverse and forward, is 1500. For general control service, maximum cathode current is 20 amps. peak, 1.6 amps. average. In ignitor firing applications, the tube's maximum cathode current peak is 30 amps., and the average 0.5 amps. For both types of applications, the maximum negative control grid voltage before conduction is 250; after conduction, 10. The maximum commutation factor rating is 10 and therefore, the tube can be used in polyphase rectifiers on inductive loads with very small or no cushioning circuits. The cathode voltage is 2.5 v. and the cathode heating time is 10 seconds.

The tube utilizes air convection cooling and can be operated in any position. It has a net weight of 3 ounces.

NEUTRON COUNTER TUBE

The Special Products Division of the *General Electric Co.*, Schenectady 5, N. Y., has announced a new proportional counter tube sensitive to thermal neutrons designed by the *GE* General Engineering and Consulting Laboratory.

The boron lined neutron counter tube will enable measurements of slow neutron intensities for nuclear scientific purposes. The cathode cylinder is made from seamless steel tubing. The internal surfaces of the cylinder are coated with metallic boron enriched in the isotope Boron 10 which has a large effective area for the capture of the slow neutrons.

The counter is so constructed as to have all external high voltage points shielded electrically and physically. Tubes of 8-inch and 12-inch sensitive length are available.

SYLVANIA TUBES

Heater-Cathode Rectifier

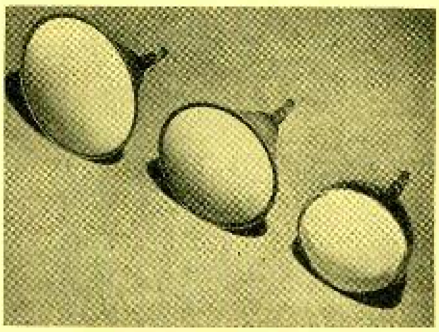
A full wave heater-cathode type rectifier which does not require a special filament transformer has been announced by the Radio Tube Division, *Sylvania Electric Products Inc.*, 500 Fifth Ave., New York 18, N. Y.

The tube, type 6AX5GT, when used with other heater-cathode types in a receiver complement, requires the same heating time as the other tubes, thus preventing excessive voltages across filter capacitors. High d.c. output also makes the tube suitable for rectifier replacement in automobile radio receivers.

19" Metal TV Tube

A nineteen inch metal television picture tube which provides useful video image measuring 11¾ x 15¾ inches with high brilliance and definition is announced by the Television Picture Tube Division of *Sylvania*.

The 19AP4 is designed for magnetic focus and deflection and utilizes an



electron gun with bent structure for use with a single external magnetic field to eliminate ion spot screen blemish.

Type 19AP4, shown at left, contrasts with 16 inch tube in center and 12¼ inch all-glass tube at right.

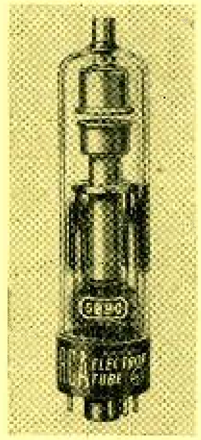
Double-Triode Tube

Also available from *Sylvania* is the new double-triode subminiature tube providing high performance for a wide range of applications in television receivers, industrial electronic applications, servomechanisms, and radio communications receivers.

Available with pigtail leads as type 6BF7, and with short pins for socketing as type 6BG7, this subminiature tube is supplied in a T-3 bulb measuring only 0.400" in diameter and 1½" long. These tubes are supplied with separate cathodes for each triode section so that each section may be operated independently and to provide flexibility in circuit and equipment designs where compactness is essential.

LOW-CURRENT PENTODE

A low-current beam pentode of the remote cutoff type intended particularly for the voltage regulation of high voltage d.c. power supplies has been announced by *RCA's* Tube Department, Harrison, N. J. Designated the *RCA*-5890, it has a maximum plate dissipation rating of 30,000 volts, a maximum d.c. plate current rating of 500 microamperes, and a maximum plate dissipation rating of 10 watts.



Tubular in shape, the 5890 has a length of 6½ inches and a diameter of 1½ inches. It is provided with a small-shell duodecal 7-pin base.

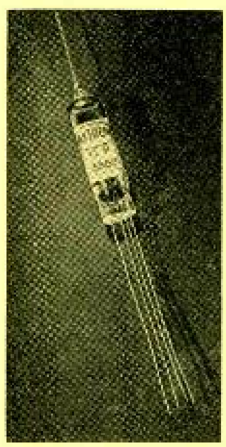
TWIN TRIODE

A double triode having semi-high perveance units has been announced by *Hytron Radio & Electronics Corporation* of Salem, Mass.

Type 12BH7 is intended for use in television receivers and other applications where the use of two similar triode sections in a single envelope is desirable from the viewpoint of space saving and lower cost.

SUBMINIATURE ELECTRON TUBE

The CK5889 subminiature electrometer pentode having several new mechanical design features has been announced by the Special Tube Section of *Raytheon Manufacturing Co.*, 55 Chapel Street, Newton 58, Mass.



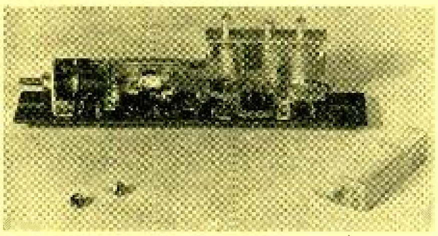
The new features include the 7.5 milliampere low microphonic filament, the double-ended construction, and the guard ring. The maximum grid current is $3X10^{-15}$ amperes but the nominal value will be $1X10^{-15}$ amperes. In the single-stage type of circuit, where the tube must actuate the indicating or recording device, the CK5889 has sufficient reserve emission, notwithstanding the extremely low filament current, to provide operation for

(*Continued on page* 28)

Television

V.H.F. — U.H.F. TV TUNER

Mr. J. F. Bell of *Zenith* described a turret tuner with a special u.h.f. channel strip at the 1950 Cincinnati Television Conference. This strip converts the con-



ventional turret tuner to a conventional superheterodyne with a mixer operating on a local signal which is derived from a harmonic of the v.h.f. oscillator already in the receiver.

The antenna problem is solved by a special filter which effectively isolates the u.h.f. and v.h.f. antennas, making it possible to feed both signals down a single transmission line.

The u.h.f. channel strip incorporates a preselector, crystal mixer with its local signal derived from a crystal multiplier placed between the mixer and v.h.f. oscillator, and circuits converting the r.f. and converter tubes to i.f. amplifiers. The u.h.f. tuned circuits are helical coils wound with flat strip, and have an unloaded Q of 500 to 600. Turret strips have been built and appear quite practical for frequencies as high as 900 mc.

Oscillator drift cannot be detected on intercarrier receivers, and actual use in the field has shown the oscillator stability to be entirely adequate on the u.h.f. band.

VIDICAM SYSTEM

Tests have been completed on the new Vidicam system which is a radical departure from any system now in use, and which is expected to definitely revitalize the motion picture industry for television. The idea for this system was conceived by *Television Features, Inc.*, a division of *Larry Gordon Studios*, and is a direct application of the *RCA Victor* Vidicon tube.

The Vidicam system utilizes a new and unique camera chain, unit controlled, with the monitoring done off the set in the director's booth. The TV cameras are synchronized with specially adjusted 35 mm. or 16 mm film cameras and *RCA Victor's* new industrial television camera chain, the three cameras acting simultaneously in perfect unity.

William Van Praag, vice-president of *Television Features, Inc.* announced that preliminary productions using Vidicam will be filmed in their newly acquired studios where they will also augment it by the use of Filtelite, the new lighting system they have just perfected.

TRAVELING WAVE TUBE

A weird looking vacuum tube like the one being held by S. E. Webber in the *General Electric* Research Laboratory

is expected to be used when color television comes into common use. An electron beam is fired through the tube, and action of the beam on current flowing through the spiral causes a large increase in the power of the current.

Color television will have to be broadcast at very high frequencies over a wide band, and this coiled spring in a vacuum, called a "traveling wave tube," is one of the most promising types of tubes for handling these special requirements. The tube would serve as an amplifier in color TV transmitters.

This type of tube was developed during the war by the British for use in radar. *General Electric* scientists have modified the original designs radically to make the device into a tube capable of remarkably high power output.

INDUSTRIAL TELEVISION

Mr. R. W. Sanders of the *Capehart-Farnsworth Corp.* described a closed-circuit TV system suitable for many industrial uses at the 1950 Cincinnati TV Conference. The unit, originally developed for the *Diamond Power Specialty Corp.*, is called the Utiliscope.

The Image Dissector pickup tube is used, and only 15 standard receiving types and the cathode-ray tube are required in addition. Horizontal and vertical resolution of 300 lines is obtained and a standard aspect ratio of 4 to 3 is used. A 6L6 Beam Relaxor circuit oscillating at 21.5 kc provides the high voltage as well as the horizontal deflection voltage.

The transmitter and receiver are connected by three coaxial cables which may be as much as 1000 feet in length. The camera unit is connected to the power unit by a multiple conductor cable which may be up to 25 feet in length.

Some of the proposed uses for this equipment include watching plant gates, furnace ignition, combustion and slag, infrared observation, and underwater observation.

TELEVISION TUNER

Just announced by the *Radio Corporation of America*, Harrison, N. J. is a 12-channel television tuner employing printed circuit coils, rotary turret switching, and a circuit offering outstanding advantages in performance. The 206E3 is for use with a stagger-tuned picture i.f. system having a carrier of 25.75 mc. and a sound i.f. system having a carrier of 21.5 mc. as employed in the 630TS type of television receiver.

This new tuner provides a voltage gain of between 28.7 and 34.9 db. for all channels under typical operating conditions.

TV VISUAL DEMODULATOR

Now available for commercial use is *General Electric's* television visual demodulator, Type TV-21, which allows the transmitter operator to measure accurately the transmitted signal.

The new unit feeds both picture and waveform monitors simultaneously and

is easily installed in a standard equipment rack. It is crystal controlled, eliminating the need for tuning, and is practically impervious to stray r.f. fields. In addition to its primary use as a transmitter monitor, the new demodulator can be used as a double sideband detector or a transient demodulator.

Further information on this unit may be obtained from the Commercial Equipment Division, *General Electric Company*, Syracuse, N. Y.

SPECIAL TV STUDY

An investigation of transmitter requirements for u.h.f. and color television broadcasting is now being conducted by a special panel of electronics engineers headed by P. J. Herbst of the *RCA Victor* Division of the *Radio Corporation of America*, according to an announcement from the National Television System Committee. The panel's final report will recommend any modifications in existing transmission standards which may be needed; will specify additional requirements applying specifically to u.h.f. or color transmission; and will summarize existing information on available and anticipated equipment and components.

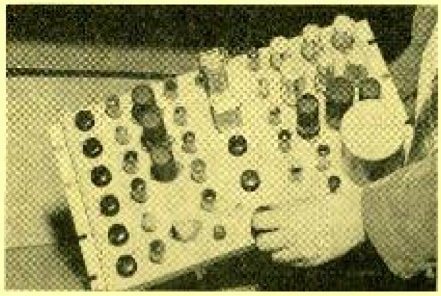
Participants in the panel include: A. Talamini, R. D. Chipp, and Harry Smith, *Allen B. DuMont Laboratories, Inc.;* W. F. Bailey, *Hazeltine Electronics Corp.;* D. L. Balthis, *Westinghouse Electric Corp.;* F. J. Bingley, *Philco Corp.;* Dr. J. G. Brainerd, Moore School of Electrical Engineering, University of Pennsylvania; L. Morgan Craft, *Collins Radio Co.;* William E. Evans, Stanford Research; F. G. Kear, *Kear and Kennedy;* C. D. Kentner, *RCA;* R. M. Morris, *ABC;* John Siebert, *NBC;* W. P. Short, *Raytheon Mfg. Co.;* I. R. Weir, *General Electric Co.;* and N. H. Young, *Federal Telecommunications Laboratory.*

The above panel is No. 4 in a series of eight which have been established by the National Television System Committee. When all panel studies have been completed the NTSC will submit a comprehensive report to the FCC, containing proposed technical standards and other recommendations.

ELECTRONIC TV MIXER

The *General Electric Company*, Syracuse, N. Y., has announced an electronic television mixer for automatic and manual fading, lapping and dissolving of television pictures. When combined with *GE* control panels TC-21-A or TC-31-A, the Type TV-19-A mixer will provide split second timing between channels. It is built for both portable and studio use.

The power input of this electronic mixer is 117 volts at 50/60 cycles and 275 volts d.c. regulated. The signal input: four non-composite, 1 volt black negative—75 ohms; signal outputs are 2 volts composite, black negative—75 ohms, and 1.4 volts non-composite black negative—75 ohms. The monitor output level is .2 volts or .8 volts. The mixer



has a frequency response which is flat to 6 megacycles and is about 1 db. down at 8 megacycles.

Further information on the Type TV-19-A may be obtained from the Commercial Equipment Division.

New Tubes

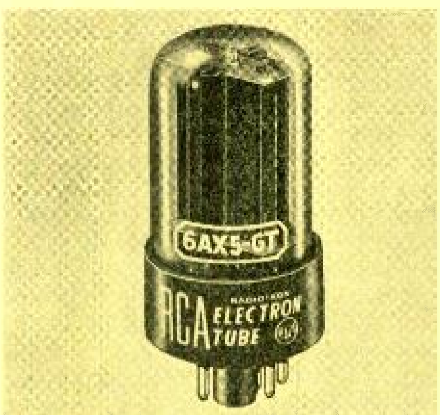
(*Continued from page* 26)

several thousand hours. In multi-stage circuits, where the tube is operated at low space currents in the high-gain, pentode connection, the filament power may be reduced to 5 milliwatts, or approximately 6 milliamperes at 0.85 volts.

The electrical characteristics are similar to those of the CK5886/CK571AX, including high transconductance, good emission stability, low drift and low microphonics.

VACUUM RECTIFIER

RCA Tube Department, Harrison, N. J., has announced the 6AX5-GT, a full-wave rectifier especially designed to provide for the economical design of



a.c. receivers and to facilitate the design of automobile receivers having high power output.

This tube features a unipotential cathode having a 6.3-volt heater and a relatively wide plate-cathode spacing chosen to minimize sputter and yet provide good regulation. The heater can be operated from the same transformer winding that supplies other 6.3-volt heater types in the receiver.

TECHNICAL BOOKS

"SHORT-WAVE RADIO AND THE IONOSPHERE" by T. W. Bennington. Published by *Iliffe & Sons Ltd.*, London, England. Available through the British Books Centre, 122 East 55th St., New York 22, N. Y. 138 pages. $2.40.

Professionals and amateurs who do not have the time to make a special detailed study of ionospheric propagation and the part it plays in the maintenance of short-wave communication will welcome this volume designed with special reference to everyday problems of short-wave transmission and reception.

This book presents all the available information in simple form so that it is of use to those with only limited technical knowledge. The use of mathematics has been avoided and the physical processes involved explained in simple descriptive language. Formation and structure of the ionosphere are discussed and its effects upon a radio wave are explained. The methods of applying the ionospheric information to short-wave transmission and reception are also discussed.

The first edition of this volume appeared six years ago under the title Radio Waves and the Ionosphere. Mr. Bennington has completely rewritten the material and fifty-six new illustrations have been added.

"QUESTIONS AND ANSWERS IN TELEVISION ENGINEERING" by Carter V. Rabinoff and Magdalena E. Wolbrecht. Published by *McGraw-Hill Book Co., Inc.*, 330 W. 42nd St., New York, N. Y. 300 pages. $4.50.

Here is the first television semi-textbook of its kind for students, radio amateurs, and television engineers which gives practical and detailed answers to hundreds of questions concerning all phases of television engineering.

This useful volume is designed to coordinate technical facts in this rapidly expanding field and provides concise study and reference material in all phases of television. Typical mathematical problems and their solutions are included together with Government laws, standards and regulations. Many questions are similar to those in the first class radio-telephone license examination given by the FCC. The majority of answers are presented in essay form and are written to be informative as well as explanatory.

All the material in this volume is as complete and up-to-date as the rapid developments in the field of television will permit.

Geiger Counter

(*Continued from page* 11)

Internal temperatures of this counter were stabilized at about 70° F. above room temperature by cutting a 1½" ventilating hole in the center of the bottom of the case, and one 3" in diameter in the back. Natural convection produces a circulation of air over the components, so that no part is overheated. Copper wire screening over the ventilating holes keeps bugs out and removable parts in. Time needed to cut a ventilating hole is about the same as that needed to replace a filter block, the cost is much less and the remedy is far more permanent.

Service Life and Performance

Service tests of three counters of this type show that component life is somewhat longer than factory ratings, and that no operational vagaries are to be expected.

Sonic output is a direct function of count frequency up to 1000 counts per second, where output into a resistive load is approximately 6 watts. At higher rates, power output falls off, as might be expected. As most laboratory tests are in the range from background (40 counts per minute approximately) to 100 counts per second, power output is adequate for ordinary test needs.

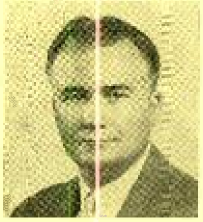
Operational tests show that a counter of this type is ideal for use in a laboratory where most of the measurements are made in answer to the question "Professor, is this radioactive?", and for rough determinations of the amount of radioactivity.

Cost of construction of a counter of this type is about $50.00 for components (at 1950 retail prices) and four hours of work. Current drain being only 50 watts (or less), cost of operation is negligible. Component depreciation is estimated at about two cents per hour on the basis of rated life of the various components.

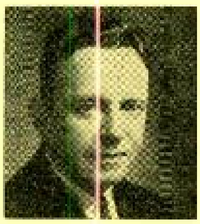
Alternative Designs

Several alternative designs are entirely workable, but in general, do not produce any great change in operation. If current drain is important, reduction by about eight watts is possible by replacing the rectifier tube (5Z4) with a high-voltage selenium unit. This change reduces the current drain, but raises first cost of the device considerably. Likewise, a small reduction in bulk is possible by use of miniature or subminiature tubes, but this saving in bulk and weight is offset by a small loss in power output, and a probable decline in ruggedness.

Personals



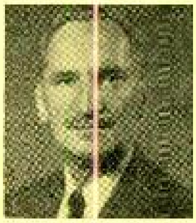
MARVIN HOBBS, consulting electronics engineer of Chicago, has been appointed Deputy Executive Director of the Electronics Division of the Munitions Board in the Department of Defense. During the war, Mr. Hobbs was associated with the War Production Board and the Army Air Forces in the Pacific Area. Since then he has engaged in consulting engineering practice for several radio and TV manufacturers, including *RCA* and *Scott Radio Labs.*



CAPTAIN DAVID R. HULL, USN (Ret.) has been named assistant to Wallace L. Gifford, vice-president in charge of Equipment Divisions, *Raytheon Manufacturing Co.*, Waltham, Mass. In the past, Captain Hull has been associated with *International Telephone and Telegraph Corp.*, *Capehart-Farnsworth Corp.*, and *Federal Telecommunication Laboratories.* He is a Fellow of IRE and member of ASA, AIEE, AIP, and the Society of Naval Engineers.

NEAL HUNTER has joined the field engineering staff of the *Sprague Products Company* of North Adams, Massachusetts. Mr. Hunter comes to *Sprague* from the electronic research staff of the *Taylor Instrument Company*, Rochester, N. Y. A graduate of Syracuse University, he was a war-time instructor in the United States Navy radar and electronic program and has been an engineer for broadcast stations WSYR and WFBL in Syracuse.

LOUIS KAHN, Assistant Chief Engineer for the *Aerovox Corporation* of New Bedford, Mass., has been appointed Director of Research. Mr. Kahn has been with *Aerovox* since 1937 and during the war was a member of the Capacitor Industry Committee. He is a member of the Receiver Executive Committee, Chairman of the Fixed Capacitor Committee, and Chairman of the Components Sampling Committee, all of R.M.A.



DR. FRANCIS B. SILSBEE, chief of the Electricity and Optics Division of the National Bureau of Standards, has been elected President of the Washington Academy of Sciences. Prominent in many aspects of electrical research, Dr. Silsbee has served as a consultant with the National Advisory Committee on Aeronautics, the National Defense Research Committee, the Office of the Chief of Ordnance and directed research on lightning hazards to aircraft.

K. E. WEITZEL has been appointed Manager of Commercial Engineering for *General Electric's* Tube Division in Schenectady, N. Y. Mr. Weitzel, formerly an application engineer in the Chicago sales office, began his career with *General Electric* in 1942 after receiving a B.S. degree in Electrical Engineering from Ohio University. He was first assigned to the application engineering section of the Tube Divisions and then to the Chicago office in 1948.

Microwave Receivers

(*Continued from page* 5)

noise figures of these circuits (of the order of 1000). The high degree of noise present in these tubes is partly a result of their poor efficiency. Perhaps improvement in the efficiency of this tube will also improve its noise characteristics. Modifications of the klystron have been tried with advantage by substituting a non-resonant wave guide for the resonant cavities. This is the principle used by traveling wave tubes and experimental results indicate that considerable improvement is possible.

Traveling Wave Tube

At a number of points throughout this series of articles, and throughout many other articles covering microwave design, an equivalent phrase to "however development of the traveling wave tube may effect a decided improvement" has been used. So far most information available on traveling wave tubes is either in the experimental stage or is classified. However, in view of an increasing number of articles on this subject ([8, 9, 10, 11]) and since a commercial traveling wave tube has been made available (*Federal Telecommunication Laboratories, Inc.*), it seems likely that this tube will be used to a greater degree in the near future.

Fig. 5 shows schematically the important parts and their arrangement in a typical traveling wave tube. Briefly the operation of this tube is as follows: An electron beam is produced by means of the cathode and anode electrodes to the left of the tube. This beam is shot through the helix and a magnetic field is used to focus the "beam" so that a large percentage of electrons will hit the collector. Electrons are collected on the collector electrode at the right end of the tube. The helix itself is kept at a very high positive potential with respect to the cathode. The r.f. input is applied at the left hand end of the helix. This energy then travels down the tube around the helix with the velocity in the x direction approximately equal to the velocity of the electron beam. This sets up traveling waves up and down the tube. It can be shown that when the velocity of this wave is approximately equal to the electron beam the wave traveling in the forward direction (due to the interaction between the electron beam and the wave in such a manner that energy is fed from the beam to the wave) increases in amplitude exponentially (over a given range) as it travels. Thus the longer the tube, the greater the amplitude of the signal. A probe located at the right hand side of the helix couples this increased signal energy to an output load.

The traveling wave tube represents a very low impedance and can, if sufficiently long, provide a high degree of amplification. Since it is a low impedance device, extremely wide bandwidths can be obtained (600 megacycles and better at 3000 mc.). In fact the only real limitation of the bandwidth is the characteristics of the input and output coupling circuits.

The most important characteristic of this tube, for the purposes of this article, is that the noise figure is much better than any other previous tube for a given frequency in the microwave range. Noise figures as low as 12 have been reported[11] and it is possible to design receivers with noise factors as good as, if not better, than those using a crystal detector at virtually any microwave frequency. The low noise traveling wave amplifier now appears to be almost competitive with the crystal mixer on a noise figure basis and has some advantages, notably very great bandwidth, antenna isolation, and better mechanical characteristics. A typical traveling wave tube has the following characteristics: frequency—3000 mc.; bandwidth—600 mc.; gain (power)—20 db.; noise figure—11.5 db.

A very important application of this tube is in microwave repeaters. The function of such a repeater would be to pick up, amplify, and retransmit microwave signals. Heretofore, because of the disadvantages listed previously, the incoming signal could not be amplified directly to the power output desired. Instead, a receiver was used to detect the signal and provide an audio or video output. This signal was then used to modulate a microwave transmitter. Thus a complete receiver and transmitter was required at each repeater. Use of traveling wave tubes may permit amplification of r.f. signal directly to power desired without introduction of excessive noise, thereby simplifying repeater design to a considerable degree. Furthermore, because of the wide bandwidth available, this can be done without any distortion of the r.f. signal.

There are four primary disadvantages to the use of this tube at the present time; namely, availability, cost, requirements for well-regulated supplies (as in the case of klystrons[2]), and difficult magnetic field problems. As previously indicated, only one traveling wave tube is now available commercially and this has been placed on the market very recently. As de-classification permits, and demand increases, more tubes should become available at lower prices. There is no inherent reason why this tube should be more expensive than other tubes operating at these frequencies, once it can be produced in quantities. Further research and development should also make operation of these tubes less sensitive to d.c. voltage changes and simplify magnetic focusing.

In the next article in this series local oscillators and mixers will be considered.

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(*To be continued*)

Curve Generator

(*Continued from page* 9)

from the pulse former then operate a step counter to provide a fixed bias voltage for the grid of the tube under test, successively becoming more positive. Each time the plate voltage is driven negative the grid bias voltage rises to a new level. These stepwise increasing bias voltages are fed through a video divider which reduces their amplitude to the desired level. From the divider they go through a cathode follower to the test grid. A special control acting on a clipper circuit allows manual selection of a definite calibrated voltage for the highest positive grid step.

A special linearizing circuit provides for uniform increments in the step sequence of grid voltages, each oscillator pulse, through an inverse feedback arrangement, transferring a fixed charge into a large capacitor. The feedback can be controlled manually to provide any size grid voltage increment. The number of steps is controlled indirectly by the output of a step counter, arresting the entire process after a predetermined number of steps.

Two circuits have been included in the design of the characteristic curve generator which are not vitally necessary but which add to the convenience and reliability of the instrument. One is a "servo-sweep" circuit whose timing is controlled through the frame synchronizing switch. This circuit is especially useful for viewing the step-function signal at the grid of the tube under test. Another circuit, using four tubes, identifies the curves which have positive values of grid bias by means of a small marking "pip" superimposed on the positive grid lines. The curve generator, essentially as described here, will be available commercially in the near future.

New Products

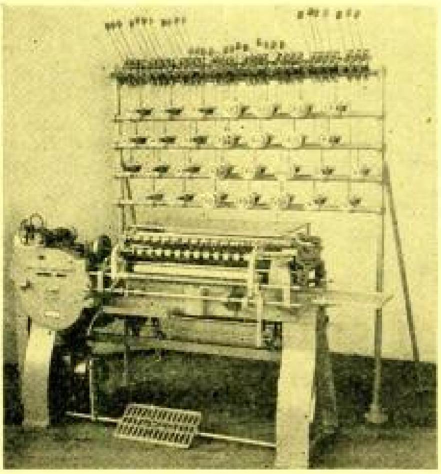
(*Continued from page* 23)

the measuring equipment to Type N systems.

The Type 874-LB Slotted Line has an over-all standing wave ratio of less than 1.02 at 1000 megacycles, and constancy of probe penetration is ±2½% or better. Also available are crystal rectifiers, bolometers, a bolometer bridge, stubs, fixed line elements, a line stretcher, a tee, an ell, terminations, attenuator filters, coupling elements and patch cords.

AUTOMATIC COIL WINDER

The high-speed automatic No. 107 winder for paper-insulated and acetate-



insulated coils is the third in a series of new coil winders introduced by *Universal Winding Company*, Box 1605, Providence 1, Rhode Island.

Automatic feeding of single or laminated insulating sheets achieves a rate of 25 inserts per minute. A new type of delivery shelf has been designed which handles either "Kraft" or glassine, from .0006 inches to .003 inches thickness and in widths of 24 inches up to 25 inches maximum. A static eliminator can be installed when acetate is to be handled.

Special attachments include an auxiliary "space-wind" traverse for spacing the first and last layers of high-tension coils, and a "mid-tap" attachment which permits shifting the wire guides at the end of a wire layer for "tap" location or to arrange for starting and finishing leads.

ELECTRONIC POTENTIOMETER

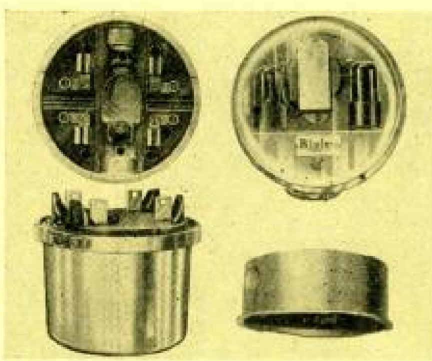
Southwestern Industrial Electronic Co., 2831 Post Oak Road, Houston 19, Texas now has on the market its Model P-2 Precision Electronic Potentiometer which is available for making precise potential measurements on high impedance electrochemical cells or electronic tubes and circuits.

The instrument is suitable for the measurement of potentials from zero to three volts in three ranges. Current flow in the measured circuit is less than 10^{-11} amperes. A built-in standard cell, combined with a 0.1% potentiometer and dual range dial, provides an accuracy of plus or minus (one millivolt plus 0.1%).

A brochure giving a complete description of this potentiometer is available upon request.

STREET LIGHT CONTROL

Ripley Company, Inc., of Middletown, Connecticut, has announced a Sunswitch mounted in a standard glass watt-hour meter case. Using the famous Sunswitch time-tested circuit, this street light control permits quick and easy



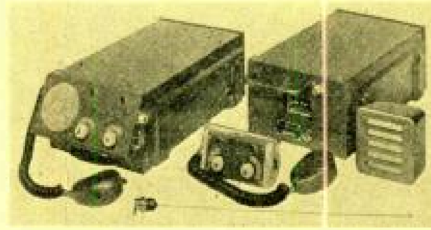
inspection of relay contacts and components during operation.

A time delay prevents intermittent operation as the result of lightning flashes, automobile headlights, etc. It uses only two tubes and the power relay carries a 3000-watt incandescent lamp load. A 500-watt size is also available.

FM TWO-WAY MOBILE UNIT

Motorola Incorporated, 4545 Augusta Blvd., Chicago 51, Illinois is now producing a completely new FM 2-way mobile radio unit designed specifically for true adjacent-channel systems. Designated as the "Uni-Channel Sensicon Dispatcher," the unit is described as an extremely compact and economical model.

The unit is available for operation in the 25-50 mc. or the 152-174 mc. land



mobile service bands. It has a rated r.f. power output of 12 watts in the low band and 10 watts in the high band. Models are available for operation from 6-volt d.c. or 117-volt a.c. primary power sources. The basic mobile package features a 3-unit type of chassis assembly drawer-fashion in a sturdy metal, welded, construction housing.

Two versions of the unit are offered. The front mount type allows complete permanent installation under any car or truck dashboard. The rear mount version is provided for mobile trunk-mounted installations or where space is not available in the front compartment.

POWER SUPPLY

Electronic Associates, Inc., Long Branch, New Jersey, has announced its Model 107 regulated power supply which has a high voltage continuously variable from 100 to 400 volts by means of switch and variable control. Output current is 0 to 250 ma., with less than 1% variation for the regulated voltages from no load to full load.

Other available outputs include a fixed d.c. voltage of -150 volts at 15 ma., and unregulated output of 400, 520 and 660 volts at 250 ma. Output impedance is less than 0.5 ohm between 20 cycles and 20 kc., and less than 1 ohm between 20 and 200 kc.

Hum voltage is 5 millivolts or less at any voltage or load within the ratings. Line input voltage is 100 to 130 ± 5 volts a.c.; 60 cycles; power consumption 320 watts at full load, 120 watts at no load.

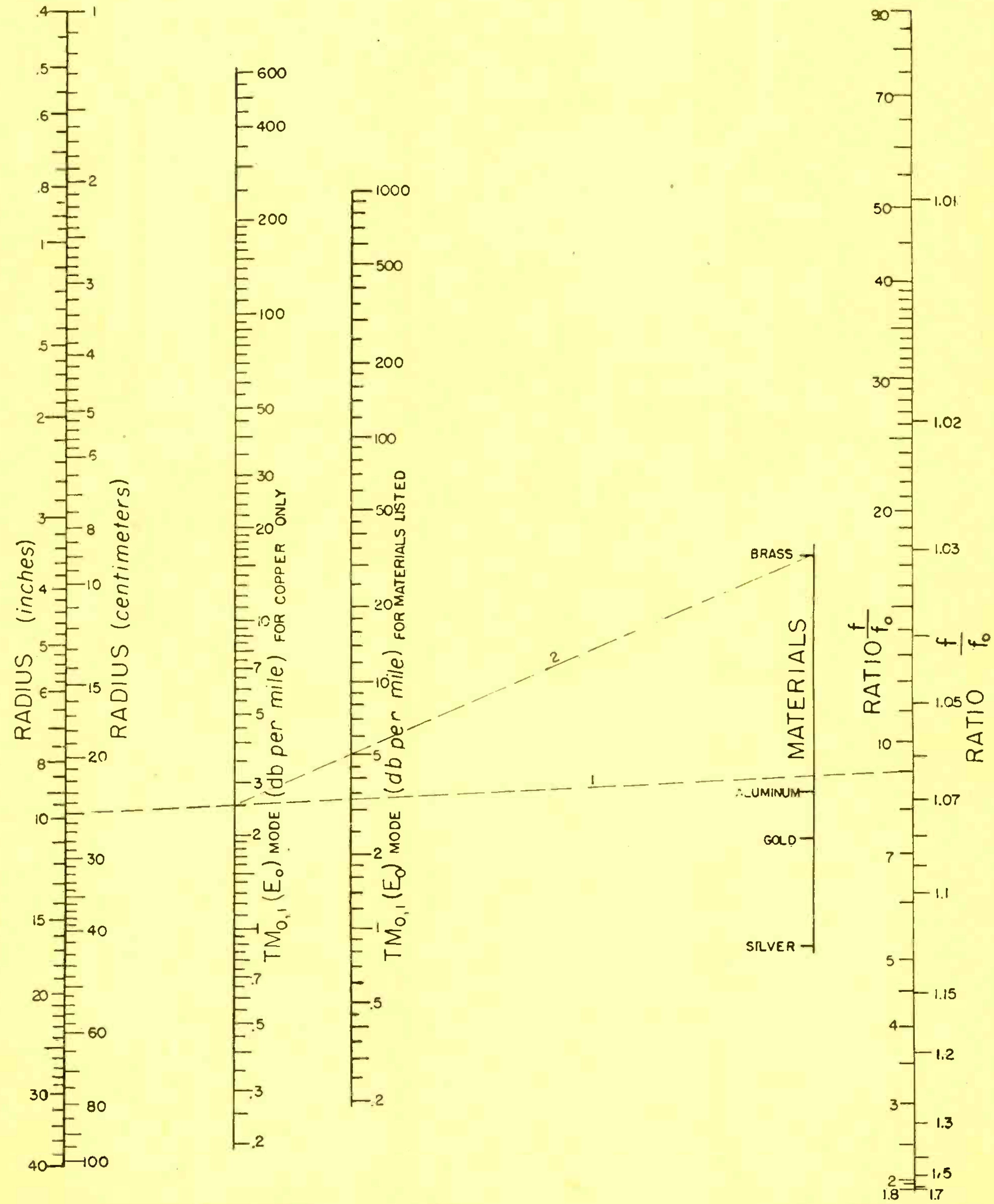
Editor's Note: The article entitled "Surface Wave Transmission Line" by Georg Goubau which appeared in the May issue, page 10, was essentially the text of a paper presented by Dr. Goubau at the 1950 I.R.E. National Convention in New York on March 8.

PHOTO CREDITS

3, 5.....Federal Telecommunication Laboratories
6, 7, 8............Dalmo-Victor Co.
9....National Bureau of Standards
12................General Electric
15....Radio Corporation of America

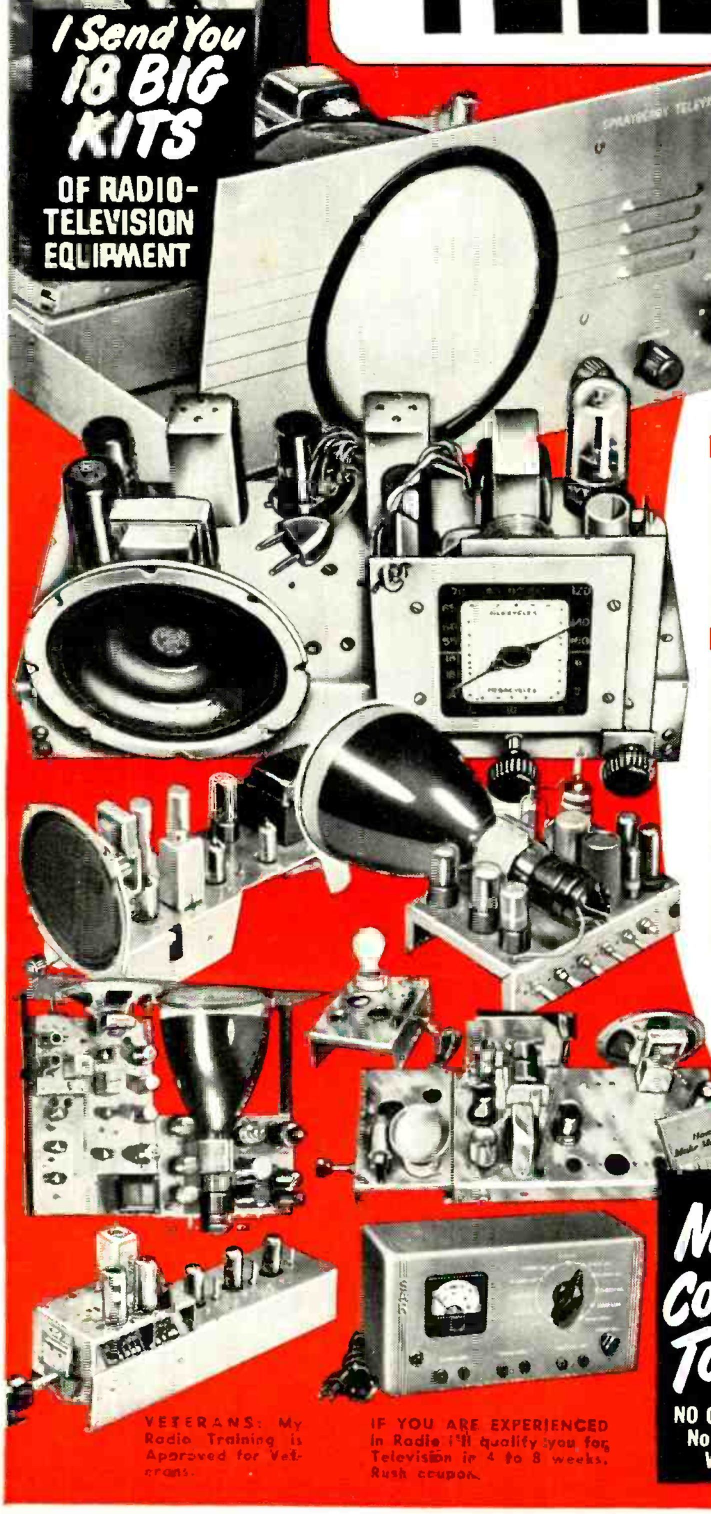
CIRCULAR WAVE GUIDE ATTENUATION

Nomograph for determining circular wave guide attenuation for the $TM_{0,1}$ (E_0) mode for wave guides constructed of various materials such as brass, aluminum, gold, silver, and copper.



Courtesy of Federal Telephone and Radio Corp.

Train at Home in Spare Time for RADIO and TELEVISION



My Famous Training System Prepares You in Double-Quick Time for a Good Job or Your Own Profitable Radio-Television Business

Radio-Television is now America's greatest opportunity field! Trained men are needed to fill good jobs and handle profitable Radio-Television Service work. I have trained hundreds of men for success in Radio-Television—and I stand ready to Train you too, **even if you have no previous experience.** My training is 100% practical—designed to give you the knowledge and experience you need to make money in Radio-Television in the shortest possible time. I Train you with up-to-the-second revised lessons—PLUS many big kits of Radio-Television equipment. You actually do over 300 demonstrations, experiments and construction projects. In addition, you build a powerful 6-tube 2-band radio, a multi-range test meter and a complete Television receiver! All equipment is YOURS TO KEEP.

EASY TO MAKE EXTRA MONEY WHILE YOU LEARN

You do all your training with me AT HOME in spare hours. Keep right on with your present job and income while learning—and earn extra cash besides! The day you enroll I begin sending you plans and ideas for doing profitable spare-time Radio-TV work. Many of my Sprayberry students pay for their entire training this way! You get priceless experience and many plans for making extra money. You build all your own Radio-TV Test Equipment from parts I send you—nothing else to buy. Just one more reason why I believe I offer the ambitious man the biggest value in top notch Radio-TV Training available anywhere in America today.

Be Ready for Top-Paying Radio-Television Jobs

Radio-Television is growing with amazing speed. More than 2000 Radio broadcasting stations PLUS an additional 102 Television stations are now on the air. Radio sets and TV receivers are being made and sold in record-breaking numbers. If you enjoy working with your hands . . . if you like to do interesting and varied work . . . if you really want to make good money and work in an industry that has a future . . . YOU BELONG IN RADIO-TELEVISION. But you MUST have good Training to "cash in" . . . the kind of Training that starts you out with basic fundamentals and carries you right through every circuit and problem of Radio-Television Servicing and Repair. In a word . . . that's Sprayberry Training . . . the course backed by more than 20 years of association with the Radio-Television industry!

FREE 3 BIG RADIO-TELEVISION BOOKS

I want you to have ALL the facts about my complete system of Radio-Television Training! Act now! Rush the coupon for my three big Radio-Television books: "How to Make Money in Radio-Television," PLUS my new illustrated Television Bulletin PLUS an actual sample Sprayberry Lesson—all FREE with my compliments. No obligation and no salesman will call on you. Send the coupon in an envelope or paste on back of post card. I will rush all three books at once!

Sprayberry Academy of Radio, Dept. 25-L
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Mail Coupon Today!
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SPRAYBERRY ACADEMY OF RADIO, Dept. 25-L
111 North Canal St., Chicago 6, Ill.

Please rush to me all information on your Radio-Television Training Plan. I understand this does not obligate me and that no salesman will call upon me.

Name.. Age........

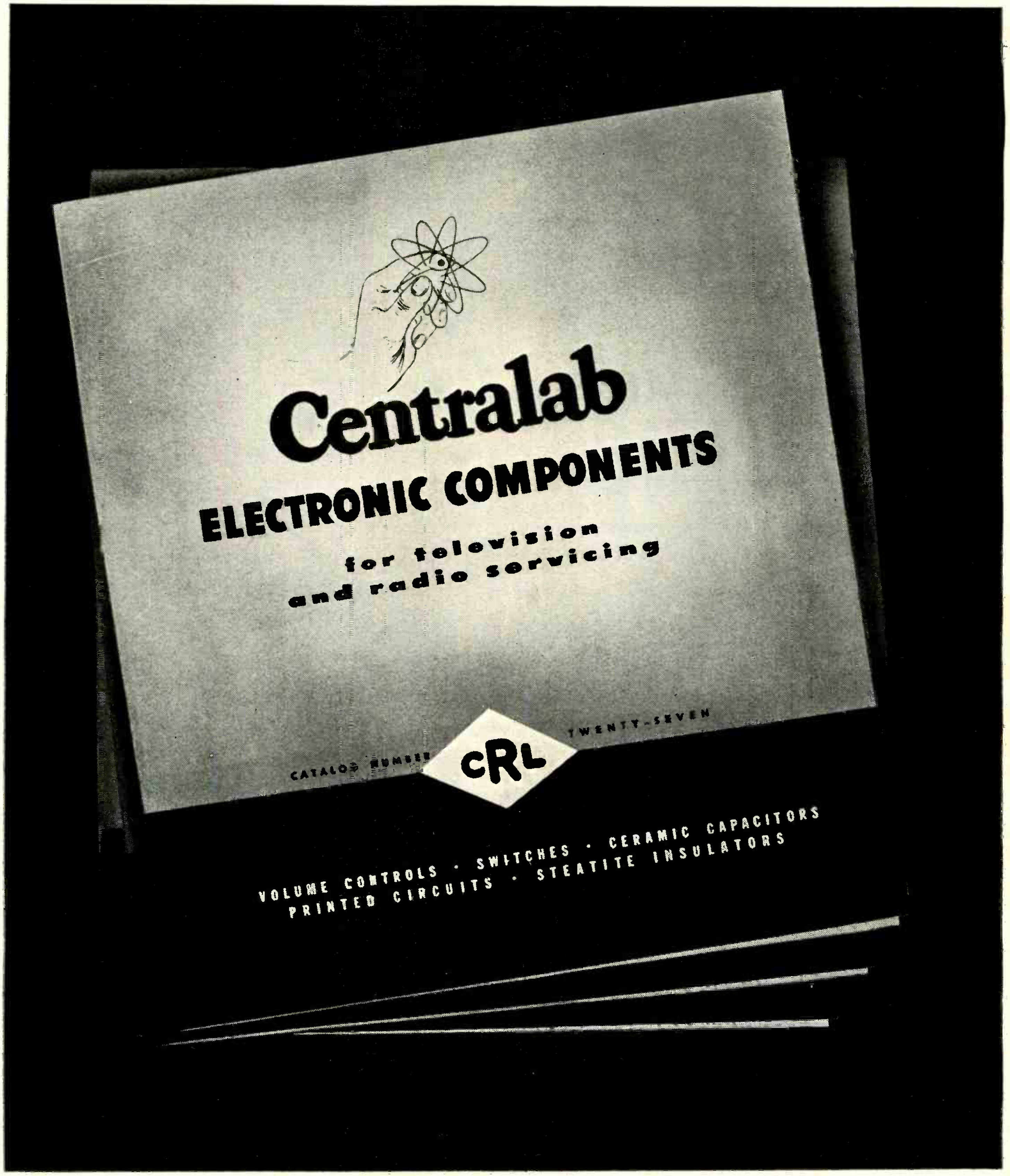
Address ....

City.............................. Zone..... State...........

Please Check Below About Your Experience

☐ Are You Experienced? ☐ No Experience

Your New Centralab



Within the INDUSTRY

WILLIAM T. BEAN, JR., has been named director of the newly-created Technical Service Center of *Industrial Electronics, Inc.* of Detroit.

Mr. Bean, until recently a consulting engineer for several of the leading heavy industries, is a graduate of the University of Oklahoma. He has been associated with *Skelly Oil Company* and *National Supply Company.*

In 1940 he joined the faculty of Purdue University where he taught aircraft engine design and basic mechanical engineering. He returned to industry in 1943 as research engineer in charge of stress analysis for *Continental Aviation and Engineering* in Detroit. He also served as project engineer on air-cooled engine development for Army Ordnance.

In his new position Mr. Bean will continue his activities in stress analysis.

* * *

SCOTT RADIO LABORATORIES, INC., recently named a new slate of directors and two new officers at a special meeting of shareholders.

New directors of the firm are John S. Meck, Leslie Evan Roberts, Russell G. Eggo, and F. W. Adams. Remaining on the five man board is H. S. Darr, former president of the firm.

Mr. Meck was elected president of the firm on April 17th after he purchased large holdings in the company. At the special meeting Mr. Roberts was named vice-president and Paul Schuecking was re-elected comptroller. Other new officers of the firm include Mr. Adams as vice-president and general counsel; Mr. Eggo as secretary, and G. F. Meck as treasurer.

* * *

RADIO CORPORATION OF AMERICA has purchased a new building which will provide an additional 126,000 square feet of space for the expansion of electron tube manufacturing facilities at its Harrison, New Jersey plant . . . **SYLVANIA ELECTRIC PRODUCTS INC.,** has temporarily reopened its radio tube plant in Altoona, Pa. . . . **EAGLE ELECTRIC MFG. CO., INC.,** has moved its Chicago office and warehouse to larger quarters at 311 N. Desplaines Street . . . **SQUARE ROOT MANUFACTURING CORPORATION,** makers of built-in and outside TV antennas, has recently purchased a 30,000 square foot plant at 391 Saw Mill River Road, Yonkers, New York . . . Plans to double radio and television production were recently disclosed by the announcement of **SENTINEL RADIO CORPORATION** that ground has been broken for a new building in Evanston which will add 25,000 square feet of manufacturing space . . . **TELEQUIP RADIO COMPANY** has moved its plant to new quarters at 2559 W. 21st Street, Chicago. The new plant will triple the company's television production capacity . . . **CONCORD RADIO CORPORATION** has centralized its mail order headquarters at 901 W. Jackson Blvd., Chicago 7, Illinois . . . To offset the bottleneck in powdered cores used in horizontal output transformers, deflection yokes, etc. the **HENRY L. CROWLEY COMPANY** has expanded facilities at its West Orange plant and has opened a new plant at Cleveland, Ohio . . . **SYLVANIA ELECTRIC PRODUCTS INC.,** has consolidated its New York offices in a new headquarters at 1740 Broadway . . . **TELE-MATIC INDUSTRIES, INC.,** manufacturers of TV antennas, accessories, and components, has moved to new and larger quarters at 1 Joralemon Street, Brooklyn 2, New York . . . **CREST TRANSFORMER CORPORATION** has taken over the entire building located at 1834 W. North Avenue in Chicago in order to double production facilities . . . The executive and sales offices of **TEL-O-TUBE SALES CORPORATION** have been moved to new and enlarged quarters at 580 Fifth Avenue, New York 18 . . . **SPELLMAN TELEVISION CO., INC.,** has acquired new quarters at 3029 Webster Avenue in the Bronx . . . The **DUO-TONE COMPANY, INC.,** has moved its offices to larger quarters at Locust Street in Keyport, N. J. . . . The Cincinnati District Office of **TINNERMAN PRODUCTS, INC.,** has been moved to the Roselawn Center Building, 1717 Section Rd., Cincinnati 37, Ohio . . . **CALIFORNIA CHASSIS CO.** has moved into its new building at 5410 Tweedy Blvd., South Gate, California . . . **STANDARD COIL PRODUCTS CO., INC.** of Chicago, Los Angeles, and Bangor, Michigan, has opened a new branch sales office at 1616 Walnut Street, Philadelphia 3, Pa. . . . **PHOENIX ELECTRONICS, INC.** has added 3000 square feet of manufacturing area to its plant at Lawrence, Massachusetts . . . **TELREX INC.** of Asbury Park, N. J., has acquired a new testing site on which it is constructing a fully equipped laboratory. The three-acre tract is located in Belmar, New Jersey . . . **NIZE MANUFACTURING CO., INC.,** manufacturers of radio and TV accessories, has moved to new and larger quarters at 550 Westchester Avenue, Bronx 55, New York . . . 78,000 additional square feet of floor space has been acquired by **STARRETT TELEVISION CORP.** in its

Starrett-Lehigh Building. Three new assembly lines will occupy the newly-leased space . . . **ERIE RESISTOR CORPORATION** has purchased a new building for its plastics division which will give that division better than two and a half times the space it now occupies.

* * *

MAX F. BALCOM was elected chairman of the board of *Sylvania Electric Products Inc.*, to succeed the late Walter E. Poor.

In addition to elevating Mr. Balcom, the board of directors also named Frank A. Poor, founder of the company, as vice-chairman of the board. Three new directors were elected at the same meeting: Edward J. Poor, who resigned as chairman in 1943; Richard L. Bowditch, president of *C. H. Sprague & Son Company;* and H. Ward Zimmer, vice-president in charge of operations.

Mr. Balcom has been associated with *Sylvania* since 1918. He has long been active in various radio industry activities. He was president of RMA in 1948 and 1949 and is presently chairman of the Association's television committee.

* * *

NOBLITT-SPARKS INDUSTRIES, INC., which manufactures a full line of home radios and television receivers in addition to electric housewares, car heaters, etc., has changed its corporate name to *Arvin Industries, Inc.*

According to Q. G. Noblitt, chairman of the board and co-founder of the company, the new move is designed to permit the company to capitalize on its brandname to the fullest extent. The company's policies, products, and operations will not be affected by the name change, according to Mr. Noblitt.

The company operates eleven plants in five central Indiana towns with main factories and executive offices in Columbus, Indiana.

* * *

JOHN H. GANZENHUBER, formerly manager of broadcast sales for *Western Electric Company*, has been appointed vice-president in charge of sales and product development for *Standard Electronics Corporation* . . . **ROBERT J. CANNON** has been named president and treasurer of *Cannon Electric Development Company* of Los Angeles, succeeding his father, the late James H. Cannon, former president and founder . . . **CAXTON BROWN** has retired as the chairman of the executive committee of *Weston Electrical Instrument Corporation* but will retain his post on the board of directors and will be available to the corporation as a consultant. He has been with the company since 1901 . . . **CARL E. SCHMITZ**, vice-president and director of engineering of *Crane Packing Company* of Chicago, was recently elected vice-president-at-large of the American Society of Lubrication Engineers . . . **WILLIAM W. STIFLER, JR.** has joined the application engineering staff of the *Sprague Electric Company* of North Adams, Massachusetts . . . **W. F. BARNES, JR.** has been appointed to the post of regional sales manager for the Magnetic Recording Division of *The Brush Development Co.* of Cleveland . . . **SAM NORRIS** has been elected president of *Amperex Electronic Corporation* of Brooklyn. He was formely executive vice-president of the firm . . . **JOSEPH W. CROWNOVER** has been named section chief in charge of the experimental and research electronics laboratory at the *Electrical Reactance Corp.* of Franklinville, New York . . . *Philco Corporation* has promoted **JOHN F. GILLIGAN** to the post of vice-president in charge of advertising, **HENRY T. PAISTE, JR.** as vice-president in charge of service and quality, and **RAYMOND B. GEORGE** as vice-president in charge of merchandising for the television and radio division . . . **A. S. JOHNSON** is the new general manager of the National Carbon Division of *Union Carbide and Carbon Corporation* . . . **G. EDWARD DE NIKE** is the new manager of Teletron Sales for the *Allen B. Du Mont Laboratories* . . . *Electro-Voice, Inc.* of Buchanan, Michigan has named **HOWARD T. SOUTHER** to the post of manager of its new speaker division . . . **JACK PETTERSEN** has been named assistant advertising manager of *Motorola Inc.* . . . **J. E. TEMPLETON**, manager of the Los Angeles branch of *P. R. Mallory & Co., Inc.* has been named to succeed **WALTER HARVEY** who is retiring as manager of the company's wholesale division . . . **W. E. McWHORTER** has been promoted to the post of advertising manager of *Owens-Illinois Glass Company's Kimble Glass Division* . . . **BERT CONWAY** was elected to the new post of executive vice-president by the board of directors of *Aerovox Corporation* . . . The duties of advertising manager of *General Electric Company's Tube Divisions* will be handled by **G. A. BRADFORD** . . . **A. C. LINDQUIST** has been named manager of Sound Products by the *RCA Engineering Products Department* . . . **JOHN P. SHERIDAN** is the new Washington engineering representative of the *Sprague Electric Company* . . . *Westinghouse's* TV-Radio Division in Sunbury, Pa. has named **A. EARLE FISHER** as merchandise manager . . . **ROBERT F. HERPICH** has joined the engineering staff of *Telrex, Inc.* as an industrial engineer . . . **SAM AUERBACK** has been named general manager of the newly-formed Chicago sales branch of *Stewart-Warner Electric*, the radio and TV division of *Stewart-Warner Corporation* . . . **WILLIAM A. MUSSEN** has been appointed supervisor of the electronics laboratory at *Southwest Research Institute* . . . **JAMES C. SMITH** is the new industrial sales manager of *Potter & Brumfield* . . . Appointment of **VINTON K. ULRICH** as manager of the Renewal Tube Sales Division has been revealed by *National Union Radio Corporation.*
—30—

SALES POWER?

"Plenty . . . with the G-E monogram on the job!"

"ANOTHER way to put it is *acceptance.* 'G-E' on my store window, on tube cartons, makes my customers want to buy!" Testimony like this is common when radio-TV servicemen talk shop. They've found — sales have shown them — that it's easy to market a tube product known favorably to millions. Just as *your* income, once you handle General Electric tubes, climbs because your public is pre-sold on G-E quality and value! . . . And you get plenty of help in acquainting prospects with your expert service facilities, as well as with your complete line of G-E tubes. General Electric signs, advertising aids, other attention-getters do an overtime job of bringing business to your door. Your G-E tube distributor will be glad to review for your benefit the folder describing the many colorful, effective, *tested* G-E sales helps, each a signpost along your road to bigger tube profits. See him today! *General Electric Company, Electronics Department, Schenectady 5, New York.*

You can put your confidence in—

GENERAL ELECTRIC

181-JAS

ONE SOURCE for all your tube requirements—metal and glass tubes; miniatures; TV picture tubes in a wide range of sizes and types; also germanium diodes and selenium rectifiers. General Electric's line is complete! G. E.'s list of types includes newest tube designs for new radio-TV receivers! . . . Stock G-E 100-percent, to simplify ordering — to benefit from unit deliveries — to profit from General Electric tube quality and product popularity!

Become an
Electrical Engineer

☆

Major in Electronics

☆

B.S. Degree in 36 Months

Prepare Here for Specific Career-Objectives

Your success in the expanding, fascinating field of Electronics will be influenced materially by the type of educational program you choose.

Important advantages are gained at this Technical Institute and College of Electrical Engineering. For example, you achieve the Technician's occupational certificate upon completion of your first level of study toward a B.S. degree. The *comprehensive* nature of the courses gives you other special advantages in securing positions such as are listed below:

☐ **Major in Electronics**
B. S. Degree
(36 successive months of study which include the 12-month Electronic Technician program)

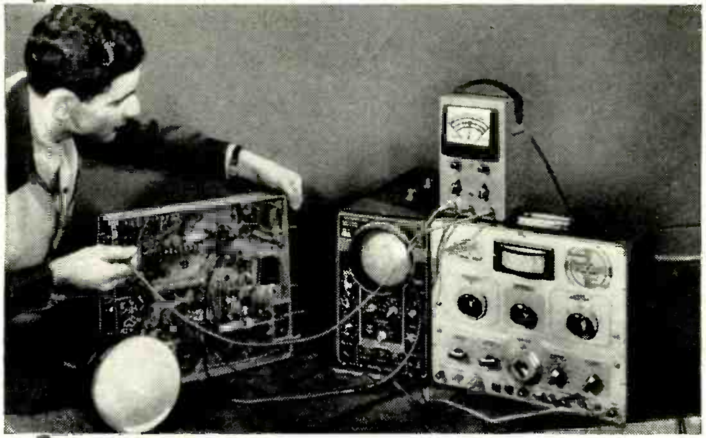
Typical job objectives:
- Design Engineer
- Electronics Research Engineer
- Radio Engineer
- Sound Engineer
- Application Engineer
- Field Engineer
- Patent Attorney (with additional training in law)
- Salesman of Electronic Equipment
- Manufacturing Supervisor
- Communications Engineer
- Industrial Electronics Engineer
- Television Engineer

☐ **Electronic Technician**
(12 months of objective study which also completes a third of the program leading to the B.S. degree)

Typical job objectives:
- Laboratory Technician
- Electrical Tester (radio mfg.)
- Maintenance and Repair Technician
- Contractor
- Manufacturing Supervisor
- Salesman of Electronic Equipment

☐ **Radio-Television Technician**
(18 months of study)

Typical job objectives:
- Radio-Television Serviceman
- Audio, Transmitter or Communication Technician.
- Broadcast Operator (upon passing FCC examinations)



A VALUABLE FEATURE of this educational program is the manner in which LABORATORY experience is woven into *each* successive term to assure a thorough, practical background. You receive electrical practice and technical studies *immediately*. You train with modern equipment such as you will use after graduation.

"HUMAN ENGINEERING" is essential to the full success of tomorrow's technical man. Therefore, courses also include combinations of English, Economics, Engineering Law, Industrial Psychology, Speech and other Humanities.

THIS world-famous course in Electronics presents thorough technical training plus a solid education in the basic sciences, electrical engineering and allied fields. You have an opportunity to save a valuable year by using the option to study the year-round. Thus, you earn your B.S. degree in 36 months.

MILWAUKEE SCHOOL of ENGINEERING
Technical Institute • College of Electrical Engineering

- The 1,555 students enrolled in this 47-year-old school represent 48 states and 23 countries. Over 35,000 alumni. Terms open Oct., Jan., April, July.
- Military, practical or prior academic training will be evaluated for advanced credit. Preparatory and refresher courses are also available.

Write or send coupon today for the helpful 44-page pictorial bulletin, "Your Career," and the 110-page catalog.

MILWAUKEE SCHOOL OF ENGINEERING
Dept. RN750
1020 N. Broadway, Milwaukee, Wis.

Without obligation send the 44-page "Your Career" bulletin and 110-page catalog.

(Check 6 to 36-month courses which interest you)

Electrical Engineering: ☐ Electronics ☐ Electrical Power

☐ Radio-Television ☐ Heating ☐ Refrigeration
☐ Air Conditioning ☐ Electricity ☐ Welding

Name .... Age ....

Address ....

City .... Zone ...... State ....

☐ Check if World War II Veteran

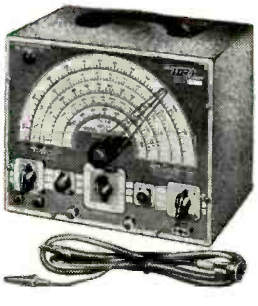
YOU BUILD 'EM IN ONE EVENING BUT...

THEY LAST A LIFETIME!

SAVE 50% WITH LABORATORY PRECISION EICO INSTRUMENTS & KITS

ANYONE CAN BUILD THEM!

SENSATIONAL NEW
EICO Model 360-K TV-FM SWEEP SIGNAL GENERATOR

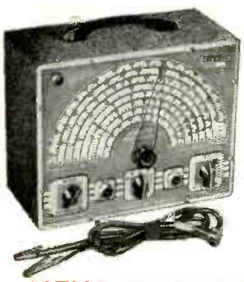


• Crystal marker oscillator with variable amplitude. • Covers all TV and FM alignment frequencies between 500 kc. and 228 mc. • Sweep-width variable from 0-30 mc, with mechanical inductive sweep. • Extremely wide sweepwidth allows gain comparison of adjacent RF TV Channels. • Provides for injection of external signal generator marker. • Phasing control included. • Large, easy-to-read dial is directly calibrated in frequencies. Vernier tuning condenser. Comes complete with all tubes (including new, high-frequency miniature types): 6X5GT, 12AU7, two 6C4's. Crystal not included. 10"x8"x6¾". 5 Mc. Crystals available for above, each \$3.95.

\$29.95

FACTORY-WIRED AND TESTED
Model 360. Ready to use Sweep Signal Generator. \$39.95
See it at your local jobber!

NEW! MODEL 320-K SIGNAL GENERATOR

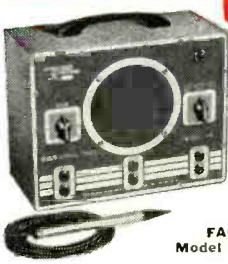


\$19.95

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. Vernier tuning condenser. Use audio oscillator voltage to test distortion in audio equipment, bridge measurements, etc.

FACTORY-WIRED AND TESTED
Model 320. Ready to use..... \$29.95

VERSATILE MULTI-SIGNAL TRACER



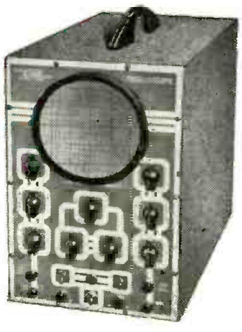
\$18.95

Model 145-K. High gain—high frequency. Self-contained test speaker permits audible signal tracing of RF, IF, FM, audio and video circuits. Provision for visual tracing with VTVM. Response is well over 200 mc. 3-color hammertone panel. 110-125 V. AC. Size: 10"x8"x4¾". Comes complete with tubes and diode probe in kit form.

FACTORY-WIRED AND TESTED
Model 145. Ready to operate....... \$28.95

NEW PUSH-PULL 5" TV OSCILLOSCOPE Model 425-K Kit

\$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"x17"x13" high. Complete with 3—6SN7s, 2—6J5s, 2—5Y3s, and 5BP1 CRT.

FACTORY-BUILT OSCILLOSCOPE
Model 425. Fully wired and tested \$69.95

HIGH PRECISION VACUUM TUBE VOLTMETER Model 221-K

\$23.95

Tops in workbench versatility—15 different ranges! AC and DC ranges: 0/5/10/100/500/1000 volts. Electronic ohmmeter ranges from .2 ohms to 1000 megs in 6 steps. New features include Zero Center for TV discriminator alignment. 26 Meg. DC input impedance. Accurate, 4½" meter cannot burn out. Double triode balanced bridge circuit assures guaranteed performance. Sturdy portable steel base with etched rubproof panel. Will measure up to 30,000 V. and 200 MC. when used with our HVP-1 or P-75 probes. 110-130 V. AC 50-60 cycle. Size: 9 7/16"x6"x5".

FACTORY-WIRED AND TESTED
Model 221. Same, but completely wired, calibrated, and tested.... \$49.95

DELUXE SIGNAL GENERATOR

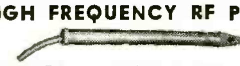
MODEL 315

Completely wired, ready-to-use Signal Generator with 1% accuracy! A wonderful instrument with dozens of expensive features. Frequency range: 75 kc to 150 mc. Has microcycle band-spread vernier tuning for FM, AM, and TV. Voltage regulator. Write for full details. \$59.95

HIGH VOLTAGE PROBE Model HVP-1

Complete top-quality High Voltage Test Probe measures up to 30,000 volts. Special Helical-Wound Ceramic HV Multiplier Resistor adaptable to most VTVM's and 20,000 ohms per volt meters with 1000 or 5000 volt scales. Lucite head, plywood bakelite handle, large flashguards for additional safety. Specify your instrument. Complete ready to use \$6.95

HIGH FREQUENCY RF PROBE



Model P-75K germanium crystal probe for visual RF signal tracing and measurements to over 200 megacycles. Can be used with models 221 or 113A Eico instrument (state which when ordering). 6½" long, ½" O.D., with wire, plugs, and all components.
IN KIT FORM.......... \$3.75
Model P76K same as above, but for oscilloscopes; in kit form.......... \$3.75
Models P75 or P76 similar to above but factory wired, ready to operate. Each... \$7.50

VOLT-OHM MILLIAMMETER Complete Pocket Kit

Model 511-K. A "Must" for every serviceman! Small, handy instrument used a thousand times a day. Large 3" meter, beautifully etched panel. A perfect kit for beginners. Simple to assemble. Ranges: DC-0/5/50/250/500/2500 volts. AC-0/10/100/500/1000 volts. Output—0/10/100/500/1000 v. DC Ma.—0/1/10. DC Amps.—0/1/10. Ohmmeter — 0/500/100,000 ohms/0/1 meg. DB meter —8 to +55 Db.. \$14.95

ASSEMBLED—READY TO USE
Model 511 — Completely wired, tested, and assembled at the factory. Rugged, built for heavy duty...... \$17.95

\$14.95

ASK YOUR LOCAL JOBBER

About EICO's new Tube Tester Kit Model 625K—"The most 'versatile' Tube Tester ever designed!"

Don't settle for a substitute if jobber is out of stock. Insist on EICO, leading name in kits.

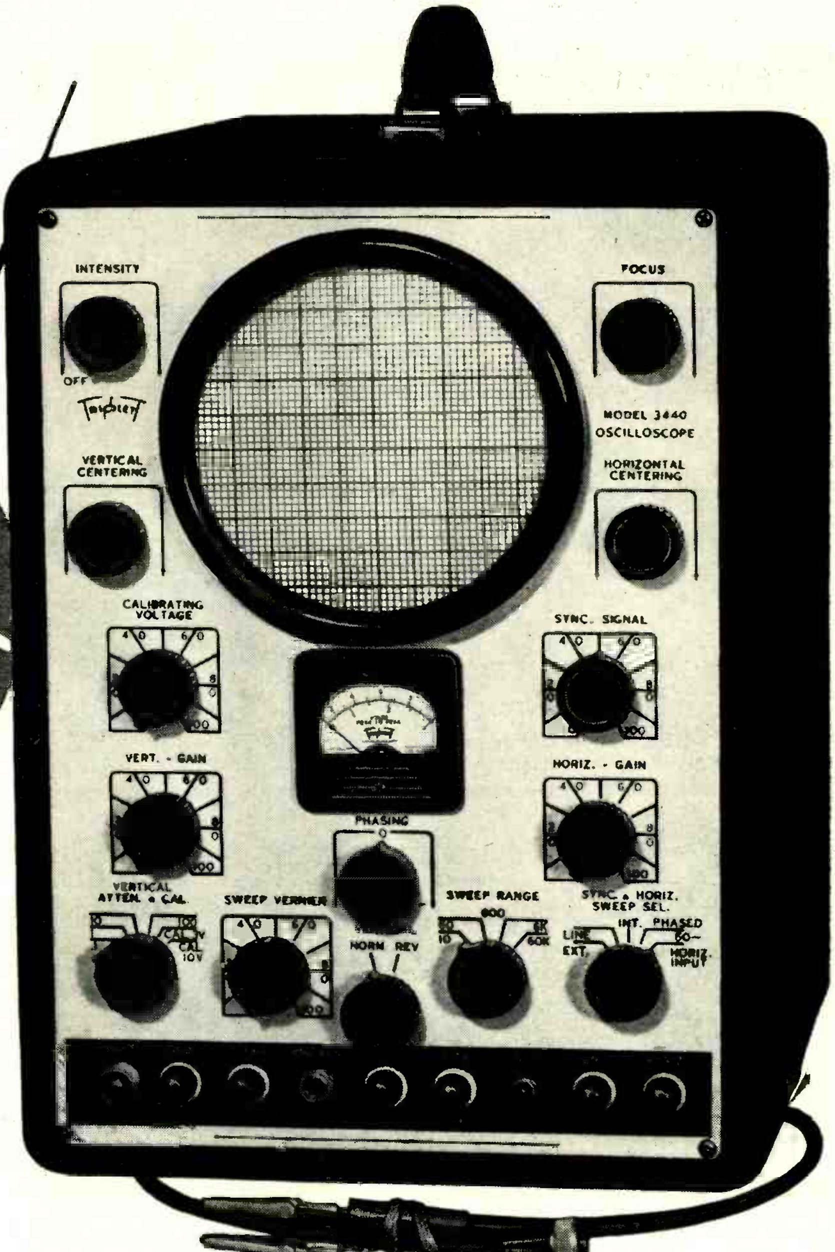
EASY-TO-FOLLOW SCHEMATIC & EICO PICTORIAL DIAGRAMS

Come complete with every EICO Instrument Kit. Each kit fully guaranteed to operate perfectly when assembled according to our simple instructions!
EXCLUSIVE LIFE-TIME REPAIR SERVICE: For a nominal charge, we will repair and service your EICO instrument, regardless of its age!

ELECTRONIC INSTRUMENT CO., INC.
276 Newport Street, Brooklyn 12, N. Y.

Write For New Catalog "R"
Prices Higher on West Coast

TAILORED FOR TV by TRIPLETT



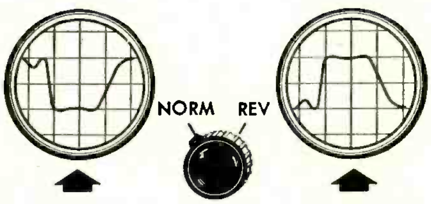
WIDE RANGE 5-INCH

OSCILLOSCOPE

MODEL 3440

- *● **Provision for changing polarity—wave form shows in conventional manner.**
- *● **Calibration Meter—to measure voltage of complex wave forms in TV receivers.**
- *● **Vertical deflection sensitivity—.009 RMS volts/inch.**
- ● **Wide frequency range—20 cycles to 1 MC on Vertical—Services both TV & FM.**
- ● **Return trace eliminator.**
- ● **Internal phase controlled horizontal sweep.**
- ● **Internal sweep oscillator—10 to 60 MC/second linear.**
- ● **Z-axis input for intensity modulation.**
- ● **Copper plated feet for improved grounding.**

* EXCLUSIVE AT THIS PRICE LEVEL



THIS + THIS = THIS

The first oscilloscope which permits changing polarity, thus keeping wave form showing in a conventional manner.

ONLY $189.50 AT YOUR DISTRIBUTORS

FOR THE MAN WHO TAKES PRIDE IN HIS WORK

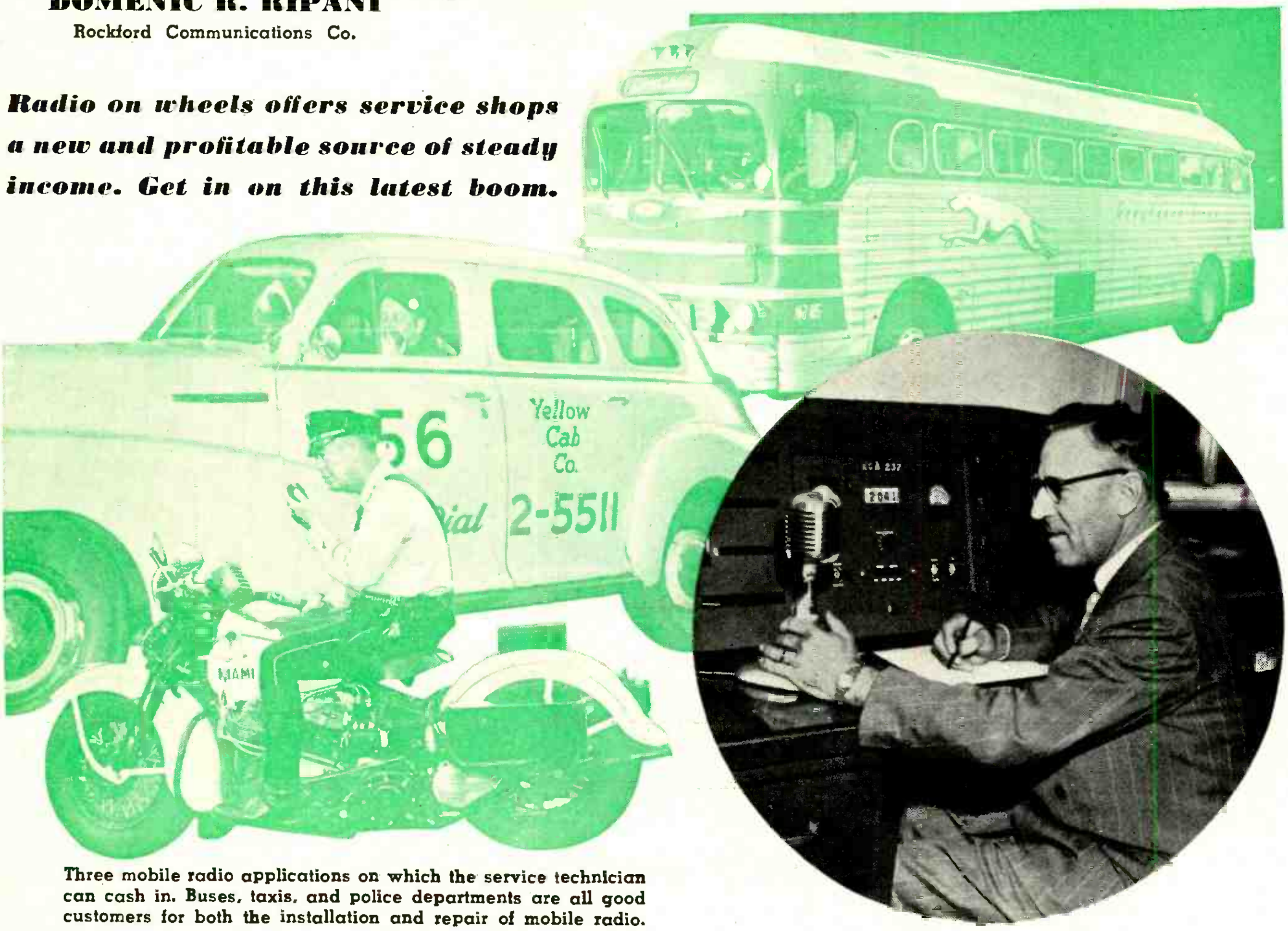
Triplett

TRIPLETT ELECTRICAL INSTRUMENT COMPANY · BLUFFTON, OHIO, U.S.A.

Mobile TWO-WAY RADIO

By
DOMENIC R. RIPANI
Rockford Communications Co.

Radio on wheels offers service shops a new and profitable source of steady income. Get in on this latest boom.



Three mobile radio applications on which the service technician can cash in. Buses, taxis, and police departments are all good customers for both the installation and repair of mobile radio.

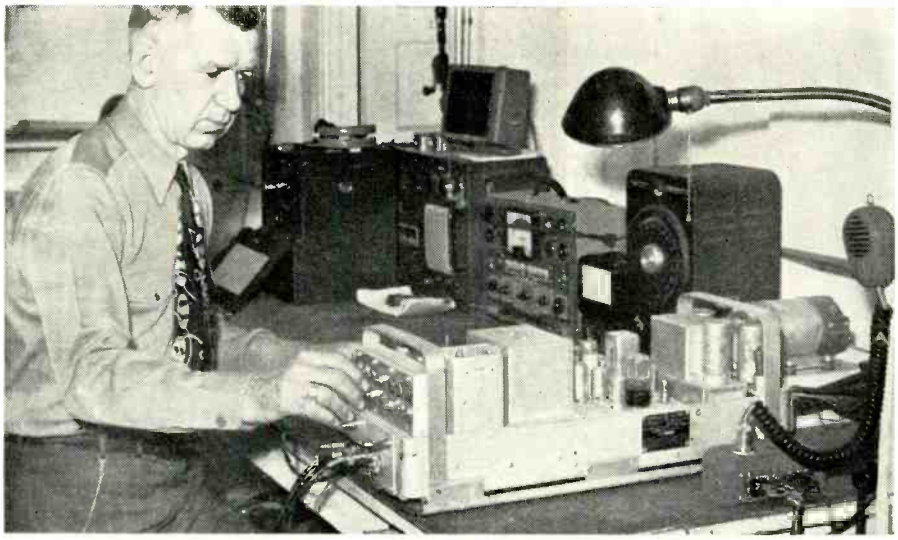
WHEN the FCC lifted the temporary freeze on commercial two-way radio activities last May, it changed many groups from an experimental to a permanent status. While commercial mobile radio operations had expanded considerably since the war, this relaxation of the rules and more liberal issuance of licenses, was like a "shot-in-the-arm" for these groups and spurred them on to further activity.

Prior to the war, two-way radio was considered principally as a necessary tool for the law-enforcement bodies throughout the country. Today we find industry turning more and more to this method of communication as an important addition to their operations. Transportation companies are finding that radio-dispatched vehicles result in more economical operations because the movement of the trucks can be controlled while in transit. Taxicab companies have found that radio-equipped cabs reduce the amount of dead mileage and also reduce customer waiting time. Utilities have discovered that radio-controlled trucks and service cars can be moved more quickly and efficiently during emergencies. An important user of radio, the *Greyhound Bus Line*, has found that not only do radio-controlled buses reduce operating expenses, but customer good-will and sense of security have increased. As Fire Chief Wayne Swanson of the Rockford Fire Department so ably puts it, "FM two-way radio, as used in the fire service, in my opinion, is one of the greatest appliances given to the fire fighter since the change-over from horses to automotive equipment". A. I. Koch, president of one of the first cab fleets to go 100 per-cent radio, the *Rockford Yellow Cab Company*, and former president of the American Taxi-Cab Association, expresses fully the general opinion of the cab industry by stating, "The addition of mobile radio equipment to cab operation has increased revenue by 50 per-cent, decreased operating costs, and has helped to build customer good-will to a high level."

These reasons will give some indication why industry is turning more and more to some type of radio-controlled operation.

Many more specific examples of mobile and portable operation could be cited, but it is sufficient to say that the field, expanding as rapidly as it is, has a great need for many more competent men. Many of the smaller radio-equipped companies "farm out" their radio service on a contract basis and it is to these organizations that the service shop should turn for additional revenue. On the other hand, many of the larger organizations hire their own full time radio technicians and it is with one of these groups that the interested individual should become associated. It is surprising to find that in many communities there are mobile units being maintained by technicians who must come from some other community to service mobile equipment. This, in communities where radio service shops already are established! The owner of a local radio shop, if of a truly progressive nature, will investigate the possibilities of adding this type of service, not only from a monetary point of view but from the standpoint of the greater service he can offer to his community.

Mobile radio equipment, in the ma-



An independent service shop, operated by Bill Wallingford of Rockford, handles mobile radio servicing for small municipalities as well as those for private firms.

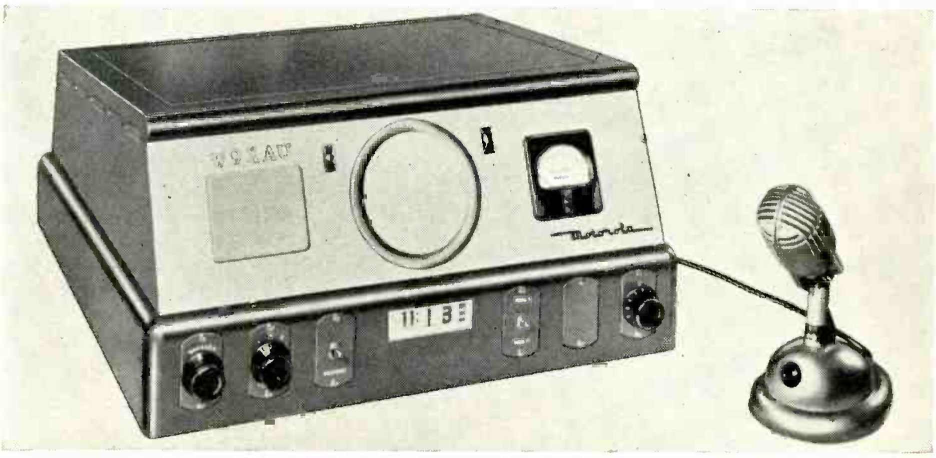
the antenna from "transmit" to "receive" instantaneously.

The receivers are the crystal-controlled, fixed frequency types, possessing a high degree of selectivity. The selectivity is necessary if interference from adjacent channel operations is to be reduced to a minimum. While a few makes of receivers will be found using Magmotors to develop the proper "B" voltages, the majority will be found to contain vibrator supplies.

The actual work of installing mobile radio equipment in cars and trucks will present no problems that are not encountered in the installation of the ordinary car radio. The main difference lies in the fact that the units are installed in the trunk of the car and are connected by means of control cables to the control head mounted on the dashboard. The carbon microphone, containing a push-to-talk switch, is connected to this control head as is the loudspeaker. Depressing the microphone switch actuates the necessary relays in the transmitter for proper operation. The two important things to keep in mind when installing these units are to make certain that all grounding is mechanically and electrically tied securely to the car body and to be sure that all control cables are protected against possible breaks or shorts. Avoid sharp bends in cabling as they will always be the source of trouble.

jority of cases, uses FM today. In the early days of two-way radio, AM was the predominant method of communication, but with the possible exception of a few police AM systems operating around 1700 kc., most installations are now FM. Mobile equipment and the associated land station units are constructed along similar lines by the various manufacturers. The minimum requirements set forth by the FCC, coupled with the specific demands of industry, have resulted in a fairly uniform line of equipment both mechanically and electrically. Transmitters and receivers fall into two broad categories. They are: the low frequency units covering roughly a band of frequencies between 25 and 45 mc. and the high frequency units covering a band between 152 and 162 mc. This is not to be construed as the only available equipment, but only that the majority of operations fall into these two categories. Important users of the low bands include the sheriff networks, and the *Greyhound Bus Lines*. On the high band frequencies, 152-162 mc., will be found a great many types of services such as local police and fire departments, utilities, and the many cab companies.

The typical transmitter starts with a crystal-controlled oscillator, operating generally somewhere between 3 and 9 mc. Proper frequency multiplying in the following stages brings the frequency up to the correct operating band. Modulation is accomplished with a single button carbon microphone. Depending on the range desired and the economical limitations of the installation, transmitters are available with a power output of from ½ watt (the "walkie-talkie" variety) to the 50 watt heavy duty unit. However, the two popular types of transmitters in use today are the 7 watt transmitter using a single 2E26 in the final and the 30 watt mobile unit using either an 807 or push-pull 2E26's in the final. (Some types of 30 watt units use the quick-heating 5516 in the final.)



A local control base station which is manufactured commercially by Motorola Inc.

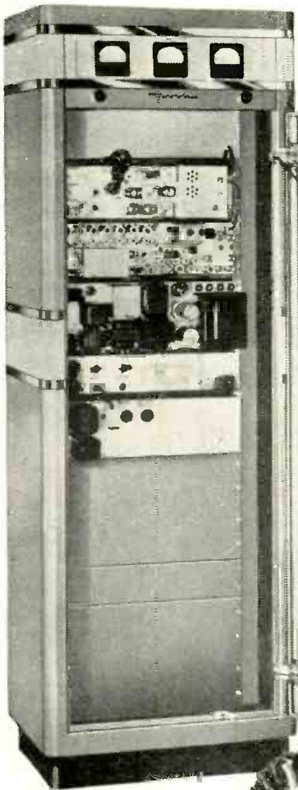
The primary source of power for these units is the car battery. Where a heavy drain of power is needed for proper operation of not only the radio equipment, but the various electrical accessories, many installations use the "a.c.-d.c." method of supplying power instead of the standard "battery-generator" system. In the a.c. system, the vehicle is equipped with a 3-phase alternator, the output of which is rectified by a dry-disc rectifier. The work of the car battery is reduced to that of supplying excitation to the alternator, and also for starting purposes. A further advantage of this system is that full output may be obtained even when the car engine is idling. The high voltage is generally developed by a vibrator in the case of a low power transmitter, while a dynamotor produces the necessary power for the larger type units. The antenna found to be most efficient and the type widely used is the quarter-wave, end-loaded type. A 52 ohm shielded line feeds the power from the transmitter to the antenna. This coaxial line connects to a coax relay at the transmitter, thus making it possible to switch

The basic circuits of the land base stations do not differ greatly from that of the mobile units. The differences lie primarily in the power supply systems used, a little difference in the relay control circuits, and possibly in the fact that a little more power output is obtained. The equipment of some manufacturers is such that there is hardly any difference in mobile units and land stations. One company produces a 30 watt station transmitter which is identical to its 30 watt mobile unit. This simplifies maintenance and reduces the amount of replacement items a radio shop must have on hand. This same manufacturer goes further and supplies a ¼ kw. final which may be driven to full output with this same 30 watt exciter without any changes to the equipment.

Installation of base stations is not a difficult job. With the equipment is included detailed instructions and all necessary notations to enable the service technician to install the gear properly. As further protection, a quick call to the manufacturer's field representative in case of trouble will bring him immediately to help in the solution of any specific problems. The only really difficult phase of the installation is in the erection of the tower, if a tower supported antenna is included in the plans. Many technicians do not bother with this part of the job, but turn it over immediately to some firm equipped to do the work. However, in most cases, particularly small taxi-cab companies, the antenna desired will be a ground-plane or turnstile mounted on a small mast at some point near the transmitter site. Incidentally, an ideal and popular site for the antenna, if available, is a water tower. The first consideration in any installation is to determine where the point of operations is to be located—with due regard given to accessibility to power lines and antenna cable routing. If the selected site is in the vicinity of the operating room, then the transmitter-receiver console can be installed directly in this room. However, due to noise level conditions at the point of operation or if greater range is desired, in many cases the transmittter proper is located outside the city limits, the equipment being installed in a "dog house" or weatherproof cabinet at the selected site. A telephone line is then connected between these units and a small preamplifier installed at the point of operations. The preamplifier amplifies the incoming signals from the receiver and on "transmit" sends a small current down this line which actuates the necessary relays for transmitter operation. When the transmitter is to be controlled at two or more locations, then several of these remote preamplifiers are connected in parallel. In this case though, the FCC regulations require that *one* operating location be designated as the control point. This control point must not only be able to monitor all activities of the station, but must be able to make the transmitter inoperative at will.

Maintenance of two-way radio equipment is not as difficult as it might seem at first glance. In general, the units found in the field are well constructed and can withstand a considerable amount of abuse. Component parts work with a large margin of safety and seldom give trouble. In fact, it will be found that about 90 per-cent of the troubles are directly caused by defective tubes and vibrators. The technician, however, will be wise if he sets up a preventative maintenance program. This will reduce to a minimum the number of breakdowns on equipment and also keep the "out-of-service" time of the vehicles low. An extremely helpful tool, incorporated in practically all equipment nowadays, is the metering system. It is because of this systemized metering arrangement that the service technician can quickly locate a faulty stage. In fact, with this method, the trouble in a mobile unit can be located and repaired more rapidly than most home radios. As a specific example, one popular manufacturer provides a jack on his transmitters into which is inserted a 50 microampere meter. Located near this jack is a meter switch with a number of positions. Each switch position reads the grid current of a specific tube. A separate jack is provided for reading the plate current of the final amplifier. A quick check of all meter positions will show which stage is defective. The receiving equipment contains a similar arrangement permitting a rapid check of the over-all receiver performance. However, a fortunate condition exists in the maintenance of mobile gear in general. It will be found, after a little experience, that most troubles fall into very definite categories and may be located very quickly upon visual inspection.

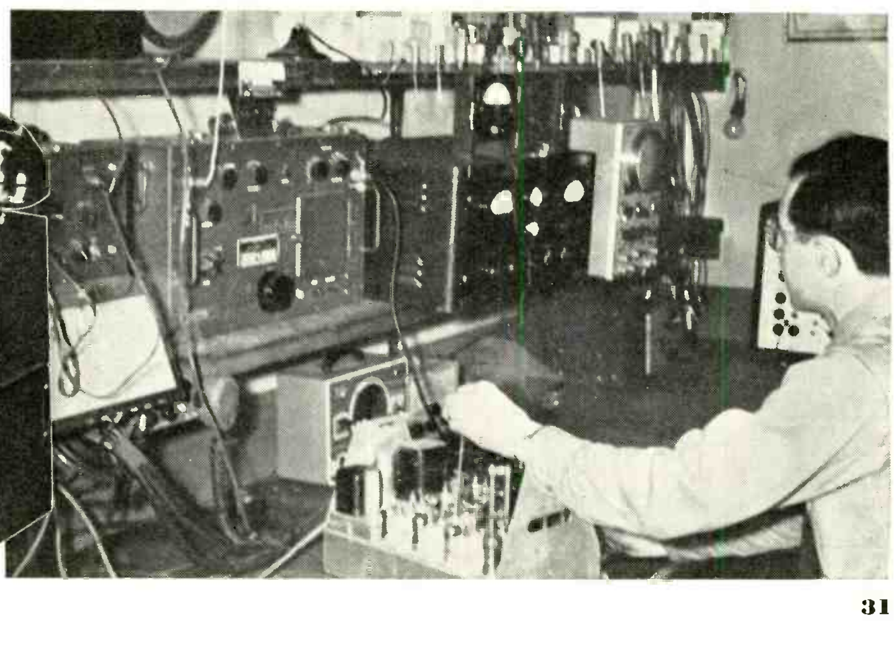
It was mentioned earlier that a preventative maintenance program was advisable. This program is necessary not only from the standpoint of reducing the number of breakdowns, but also to conform with certain specific regulations of the FCC. These rules call for a check, every six months, of the transmitter frequency of both the land station and

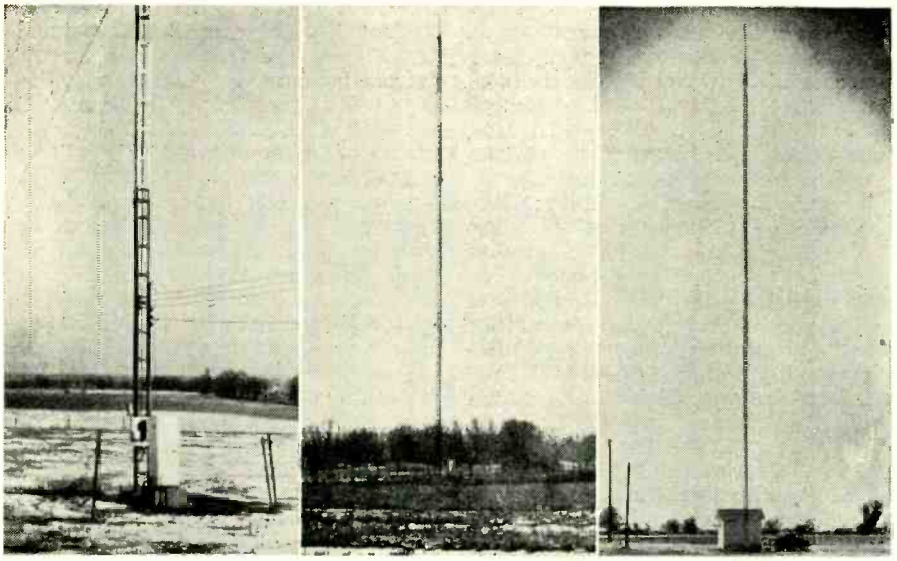


← A modern cabinet unit. Top section is a 30-watt transmitter with receiver immediately below it. The other three shelves contain the power and control equipment.

↓ A typical low-power unit of about ½ watt output which has proven popular in the construction field for use at the building site.

↓ The author's service shop. To the left of the oscilloscope is a Doolittle frequency monitor. To the left of the monitor is the I-122 high-frequency generator and to the left of that is the BC-221 which is used for low-frequency work.





Remote transmitter installation (left) with equipment housed in a weatherproof cabinet. Tower lights are automatically turned on and off by means of a photoelectric cell located on left side of tower. (Center) Where extended range is an important consideration the antenna must be mounted as high as possible. In this case the tower is 150 feet high on top of which is mounted a ground plane antenna. Transmitter is connected to control point by telephone lines. (Right) Remote installation with equipment located in a small "dog house." Tower is 150 feet high on which is mounted a Motorola triple-skirt colinear coaxial antenna. This is an REA installation near Hayti, Mo.

the mobile units, the power input to the final stage (the product of the plate voltage and total plate current is acceptable) and the total modulation deviation (in the case of FM). To properly handle these requirements both legally and ethically, the service technician should periodically remove the units from the vehicles and check them completely on the work bench. In this way they can be checked for legal requirements and also be given a systematic cleaning, adjustment, etc. Obviously, certain

A combination receiver and 30-watt transmitter for mobile installations. Complete unit may be removed in one simple motion.

pieces of test equipment will be required to maintain this gear. The test equipment found in the average shop can still be put to good use, such as the v.t.v.m., tube checker, and signal generator. In addition, however, there should be available a stable low frequency generator and a stable high frequency generator. For low frequency work, the BC-221 is good and for high frequencies, the I-122 is satisfactory. The FCC requires that a stable monitor be available to measure the transmitter frequency within the tolerable limits and also an accurate device for measuring the modulation. Perhaps the most stringent regulation set down by the FCC is that a license of the grade of 2nd class radiotelephone, or higher, is required by personnel making repairs or adjustments to a transmitter which might affect the frequency of operation. Under the law, however, a non-licensed man may make repairs and adjustments *under the direct supervision* of a duly licensed operator of the proper grade.

The service technicians considering the possibility of entering this field should have no fear of the examination for FCC qualifications. On the market are several good manuals written specifically as a guide for this examination.

The radio technician who has had car radio experience, in addition to experience on home AM and FM receivers, will find that the knowledge acquired will provide most of the "know-how" needed to satisfactorily install and maintain mobile radio gear and their associated land stations. Most manufacturers of mobile radio equipment, anxious to have their equipment serviced properly in the field, authorize competent service shops in the various territories throughout the country to handle the work on their equipment. The radio shop owner would be wise in contacting the various companies to arrange for official recognition by one of these radio concerns. Advantages such as complete technical data on new gear, factory assistance when needed, and consideration on receiving the new installations as they are sold in the territory, become available when the shop becomes affiliated.

The ham will find that the experience he has gained through his association with home built ham gear, will provide him with most of the knowledge needed to handle this work, as the tuning and adjustment of these units is not unlike the average ham rig. Experience gained through operation of portable mobile equipment will also prove of great value in this line of work.

It is with groups such as the state or local police, or large utilities engaging full time radio help that the ham, possessing a commercial ticket, can take his place and handle the complete radio maintenance with little, if any, additional training.

Whether you contemplate seeking a position with some firm engaged in two-way radio work, or whether you operate your own independent service shop and are looking for additional steady business, you will find this work interesting and varied. You will experience the deep satisfaction that comes when the "big switch" is thrown and you've put a station and its private network on the air. So pause now and consider the many opportunities in this progressive field and begin making plans to take your place in its ranks.

A careful study of the field in general and the possibilities in your own locality will uncover numerous applications where two-way radio can perform a real service. With two-way radio's impressive record it is not too difficult to sell prospective users on such an installation—and when the equipment is in use it will follow quite naturally that the job of servicing and maintenance will be yours without question.

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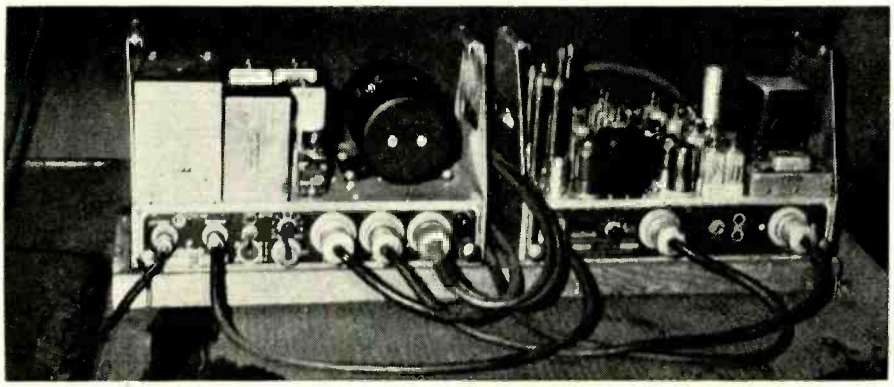
Interior view of taxi trunk. The 30-watt transmitter is at left and receiver is at right. Cabs operate in the 152-162 mc. band. Notice the switches mentioned in text.



OSCILLOSCOPE for R.F.

By GUY DEXTER

Only basic scope is used. Test instrument is ideal for checking transmitters.

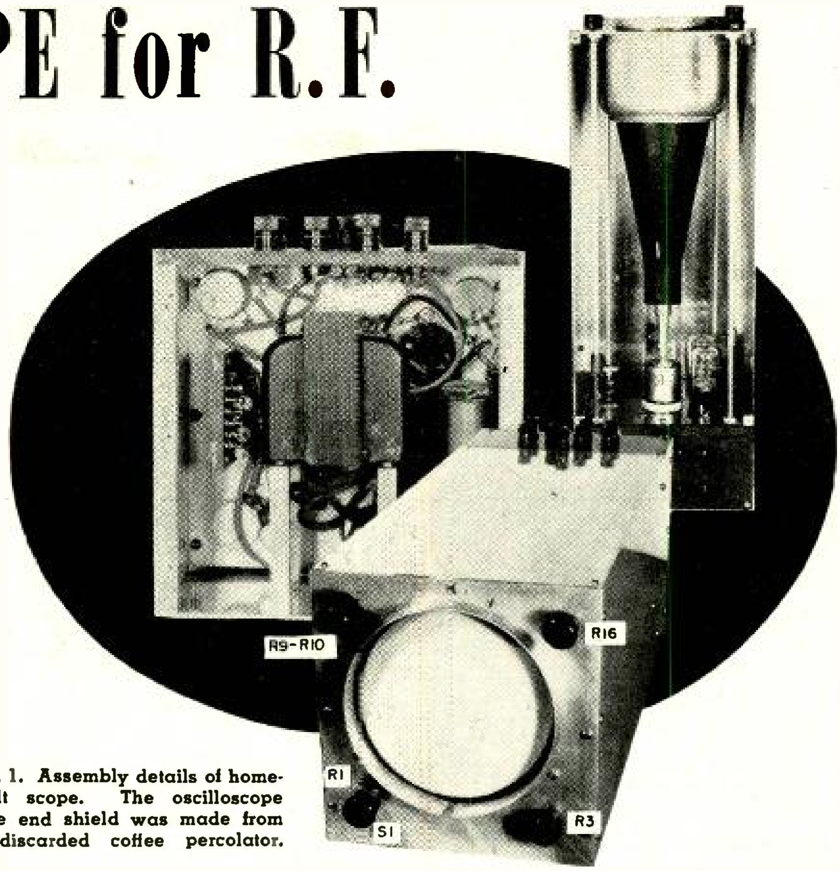


Fig. 1. Assembly details of home-built scope. The oscilloscope tube end shield was made from a discarded coffee percolator.

AN OSCILLOSCOPE for transmitter checking need not be expensive or complicated. A basic scope, minus amplifiers and sweep oscillator, is all that is required. An instrument of this type can be built easily with junk-box parts and one of the "cheapie" surplus 5-inch cathode-ray tubes. Using direct input to the deflecting plates, the basic scope is well suited to r.f. operation. Vertical and horizontal amplifiers and a sweep oscillator can be added externally if and when the scope is to be used later for other purposes.

The oscilloscope shown in the accompanying illustration is unique in that it is just a little larger than the 5BP1 tube itself. It is built in an aluminum case 19" long, 7¼" wide, and 7¼" high. A 3½-inch-deep compartment in the rear portion of the case holds and shields the circuit components. The controls are adjusted by means of long brass shafts which extend from the front-panel knobs to the potentiometers on the compartment partition. In order to conserve panel space, the beam centering controls (R_9 and R_{10}) are combined (*I.R.C. Concentrikit*) and operated from twin knobs and a concentric shaft.

The circuit is unusual in its use of a common replacement-type receiver power transformer. Any small transformer with a 350-0-350 v. secondary rated at 40 ma. or higher will do. The entire secondary winding is used in a voltage doubler circuit comprised of two 6X5GT tubes and two 0.15 μfd. tubular condensers (C_2 and C_3 in Fig. 2). The rectifier tube filaments are operated from the 5-volt winding of the transformer. A prolonged test run of the instrument revealed no trouble as a result of operating the tubes at this reduced voltage.

The deflecting plates are connected to binding posts *A, B, C,* and *D*. In addition, a signal voltage divider, connected to binding posts *E, F, G,* and *H*, is provided for audio voltage attenuation in modulation measurements.

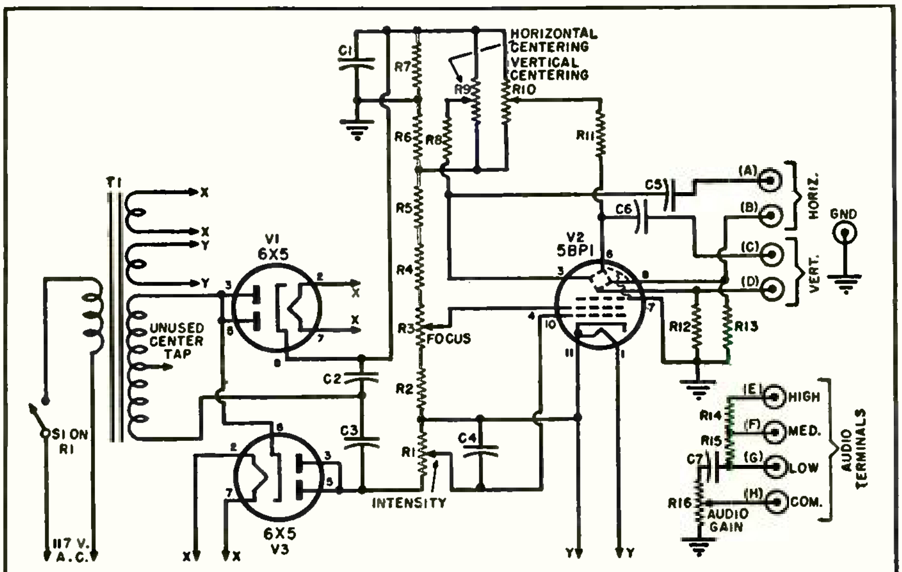
R.F. Applications

Use of the basic scope for modulation checking by means of trapezoidal patterns has been covered completely in previous articles and is described in detail in the amateur handbooks. Therefore, no space will be devoted here to an explanation of the method. To set the instrument up for modulation checking: (1) Connect an r.f. pickup loop to terminals *C* and *D*. (2) Connect *C* to *"GND."* (3) Connect audio output from modulator through suitable coupling condensers to *E, F,* or *G* (depending upon whether audio voltage is high, low, or medium). (4) Connect *H* to *B*. (5) Connect *A* to *"GND."*

One important use of the basic scope, almost completely overlooked by radio amateurs, is frequency multiplier

(*Continued on page* 106)

Fig. 2. Complete circuit diagram of oscilloscope. Only basic circuits are required.



R_1—1 megohm pot. (with S_1)
R_2, R_4—1 megohm, 1 w. res.
R_3—2 megohm pot.
R_5, R_{14}—5 megohm, 1 w. res.
R_6, R_7, R_{15}—2 megohm, 1 w. res.
R_8, R_{11}, R_{12}, R_{13}—2 megohm, ½ w. res.
R_9, R_{10}—2 megohm concentric control pot.
R_{16}—1 megohm pot.
C_1, C_4—.25 μfd., 200 v. cond.
C_2, C_3—.15 μfd., 1000 v. cond.
C_5, C_6—.05 μfd., 1000 v. cond.
C_7—.01 μfd., 2500 v. mica cond.
S_1—S.p.s.t. sw. (on pot. R_1)
T_1—Replacement-type rec. trans. 350-0-350 v. @ 40 ma. (or higher); 6.3 v. @ 2 amps; 5 v. @ 2 amps
V_1, V_8—6X5GT tube
V_2—5BP1 tube

Model N Geiger unit made by Western Radiation Lab.

Beckman Model MX8 produced by Nat. Tech. Labs.

The Model 106 Geiger counter built by Precision Radiation.

Nuclear Instrument Corp.'s radioactivity "Sniffer" model.

THE ERA OF GEIGER COUNTERS

A review of commercially-built instruments for the detection of radioactive materials.

Technical Associates' custom-built No. F3-B.

By

LESLIE M. NORMAN

Pres., Precision Radiation Instruments, Inc.

A NEW vocabulary has found its place in our everyday conversation. Words like Geiger counter, atoms, nuclear physics, uranium, plutonium, chain reaction, radioactivity, cyclotron, beta and gamma rays have become commonplace since Hiroshima.

Uranium was first discovered in 1789 by M. H. Klaproth and named for the planet Uranus. Most of its properties have been well known for half a century. It was not, however, until 1939 that experiments in Western Europe definitely proved that uranium could provide a chain reaction, releasing a hitherto undreamed of and fantastic amount of power. This discovery started a scientific race unparalleled in the history of mankind and culminated in the atomic bomb.

It is rumored that a single gram of the priceless U-235 used in the atomic bomb requires the mining and processing of no less than one million pounds of uranium bearing ore. A gram is not enough material to fill an ordinary sewing thimble.

The need for uranium is so enormous that the Atomic Energy Commission has offered a cash bonus of $10,000 for each new discovery of suitable content plus a ten year guarantee price of $3.50 for each pound of uranium oxide recovered. Furthermore, one or more other valuable minerals such as radium, silver, vanadium, lead, and thorium always accompany a uranium deposit. These facts have started a stampede of an army of prospectors armed with Geiger counters on the search for uranium. The stampede overshadows even the Gold Rush of '49.

The richness of the reward explains the strange texture of this army. People from all walks of life have joined the search. They include professors, vacationers, physicists, campers, geologists, Boy Scouts, prospectors, retired businessmen, salesmen, doctors, engineers, cooks, and what have you. The search extends not only to every state in the union but to every corner of the world. The extent of the movement can best be understood when it is known that sales of Geiger counters have already soared into the tens of thousands in the United States alone.

One of the principal characteristics of uranium is its property of radioactivity. The radiations emitted cannot be seen, heard, or felt and can only be detected by means of a special instrument such as a Geiger counter. There are other means of detection besides Geiger counters but all are either unreliable or impractical for the prospector.

One such method is the photographic test. This makes use of the fact that radioactivity will blacken an unexposed photographic film in the same manner as sunlight. In order to employ this test it is necessary to exclude all light and leave the ore sample on the film for a period of days or weeks depending on the quality of the ore. The limitations of this method are evident.

Another method is the ultraviolet light or "mineralite" which makes use of the principle that fluorescent minerals will glow when exposed to ultraviolet light. The use of fluorescence is extremely limited since only one or two important uranium minerals, chiefly autunite, are always fluorescent. Pitchblende, carnotite, and uraninite, the three most important uranium minerals never fluoresce. Many minerals which contain no uranium do fluoresce. Furthermore a mineralite should be used in darkness for best results. Thus the mineralite has little value in the search for uranium.

The scintillation test can be used because a screen coated with zinc sulphide powder, when struck by a radioactive ray, will produce bright flashes of light known as "scintillations." The scintilloscope can only be used in a dark place and will only detect surface radioactivity. The instrument does not indicate radium that is below the surface of the sample and is very fragile. This rules out its use by serious prospectors.

The electroscope makes use of the fact that two very thin metal strips, usually gold, when electrically charged will separate and stand erect. Radioactive rays will discharge the instrument, causing the strips to fall. This instrument is extremely fragile and has no practical use outside of the laboratory.

The most accurate method is chemi-

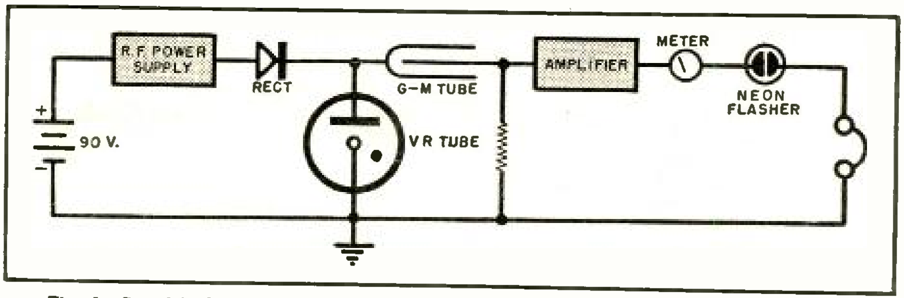


Fig. 1. Simplified block diagram of Precision Radiation Instruments' Model 106 unit.

cal analysis which is, of course, limited to the laboratory.

The Geiger counter is a rugged, reliable instrument. It works under all conditions and is extremely sensitive. It will detect even very minute amounts of radium. It is small, lightweight, and portable. Thus it is the only practical field instrument. Furthermore no laboratory is complete without one.

This is significant to the enterprising radio technician since a Geiger counter is an electronic device which can best be sold and serviced by a radio dealer. It is similar, in a general way, to a small battery-operated portable radio. The circuits employed in these instruments can be easily understood by any radioman. The heart of the Geiger counter is the Geiger Mueller tube. The principle employed in this tube is relatively simple. It contains an anode and a cathode separated by a gas which may be ionized. A high voltage is applied between the anode and cathode of a value just below that necessary to ionize the gas in the tube. The voltage used is generally around nine hundred volts but is sometimes as low as two hundred volts. When even a single radioactive ray strikes the tube it causes the gas to ionize momentarily, causing a very minute amount of current to flow. The current passes through a resistor of high value causing a momentary voltage drop.

This pulse is usually amplified and then indicated by one or more of several methods. The amplifier circuits will not be discussed here because they follow the same principles employed in radio circuits which are well known to radiomen. The simplest types of Geiger counters use an earphone as the only means of indication. The user counts the number of clicks per minute he hears in the phone. More elaborate instruments have earphones and a neon bulb which flashes with each impulse. The best types have, in addition to the phones and flasher, an indicating meter with three ranges and detect beta as well as gamma rays. Geiger counters with a thick wall Geiger tube detect gamma rays only.

One of the primary considerations in building a Geiger counter is the high voltage supply used to operate the Geiger tube. This problem has been solved in many different ways by various manufacturers. Each method has its own advantages and disadvantages.

The simplest method is that used in the Model N made by *Western Radiation Laboratories,* 1107 W. 24th Street, Los Angeles 7, California. In this instrument (Fig. 4) a small one hundred and eighty volt Geiger tube is used with six 30 volt hearing aid batteries in series. Since no amplifier is employed the unit has a long battery life and is compact. This instrument employs earphones only and weighs about one pound. It does not detect betas.

In the model F3-B (Fig. 3) made by *Technical Associates,* 3730 San Fernando Road, Glendale 4, California, a nine hundred volt Geiger tube is used with three 300 volt batteries in series. This provides stable operation and long battery life. The F3-B has earphones and a three range indicating meter and weighs ten and a half pounds. It detects both betas and gammas.

The *Beckman* Model MX8 (Fig. 2) made by *National Technical Laboratories,* South Pasadena, California, employs a unique method. A nine hundred volt Geiger tube is used with a single three hundred volt battery. The battery is placed alternately in parallel and in series with two condensers by flipping a spring action switch. This charges the condensers to 300 volts each and then places them in series with the battery to provide 900 volts. The advantages are simplicity, long battery life, and light weight. The MX8 has earphones as the only means of indication and weighs three and a quarter pounds. It detects both betas and gammas.

The "Sniffer" made by *Nuclear Instrument and Chemical Corporation,* 223 W. Erie Street, Chicago 10, Illinois, employs a mechanical vibrator power supply for the high voltage. Two 1½ volt batteries in series supply the three volts needed to operate the vibrator which changes the d.c. voltage into a.c. The a.c. voltage is then applied to a transformer which develops the high voltage. This voltage is then rectified by a rectifier tube and filtered to provide the high d.c. voltage. Five neon bulbs in series are used to regulate the voltage which is then applied to the Geiger tube. The advantage of this method is the light weight and low battery cost. The mechanical vibrator requires power to operate it and, therefore, the batteries are rated by the manufacturer at forty hours life. This instrument weighs only two pounds.

The Model 106 made by *Precision Radiation Instruments, Inc.,* 5478 Wilshire Blvd., Los Angeles 36, California, (Fig. 1) employs an r.f. power supply. In this method two small 45 volt batteries are placed in series to provide 90 volts which is applied through an *RC* circuit to a neon bulb. This sets the neon bulb into oscillation providing a source of a.c. The a.c. is then amplified by a miniature tube and applied to a high impedance choke coil. A high voltage is then obtained across the choke coil and is rectified and filtered. An electronic voltage regulator circuit is used to keep the voltage con-

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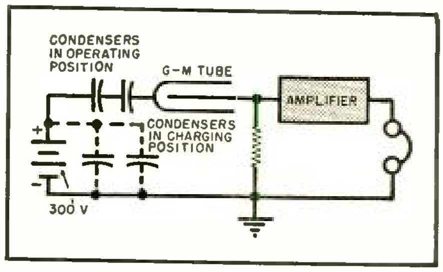


Fig. 2. Block diagram of Model MX8.

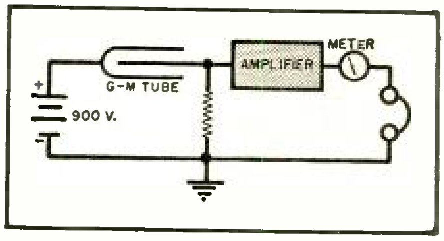


Fig. 3. Simplified circuit of Model F3-B.

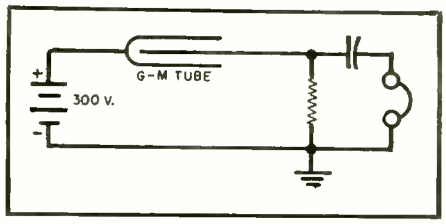
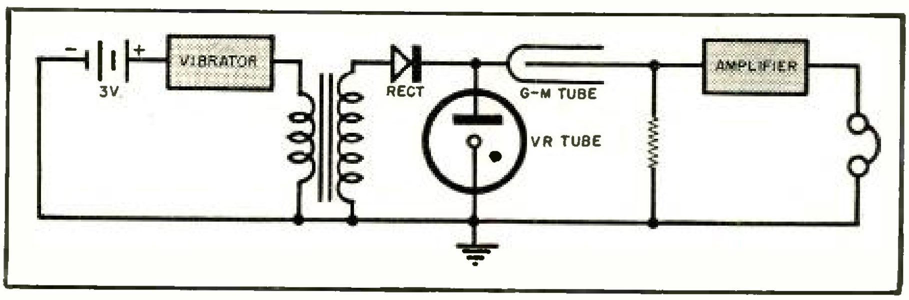


Fig. 4. The basic circuit of Model N.

Fig. 5. Simplified block diagram of Nuclear Instrument Corporation's "Sniffer" model.



Details of a preamp incorporating a variable equalizer to compensate for variations in phono pickups and recordings.

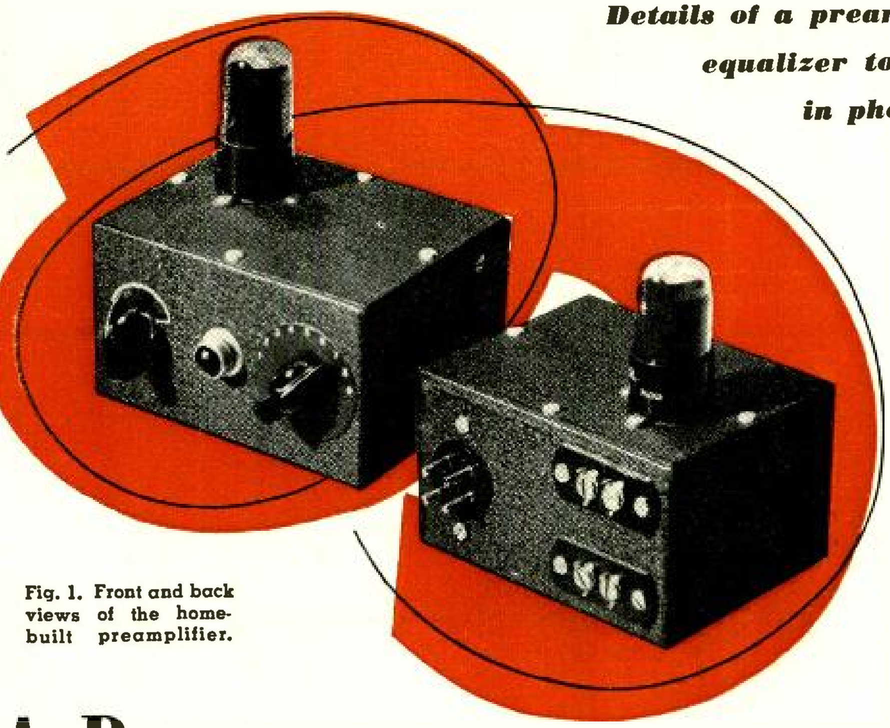


Fig. 1. Front and back views of the home-built preamplifier.

By
CHARLES BOEGLI
Cincinnati Research Company

A Preamp for MAGNETIC and CRYSTAL PICKUPS

ALTHOUGH in fairly common use with microphones, so-called "preamplifiers" were relatively unknown in connection with phonograph pickups until the marketing of the *Caltron, General Electric,* and a few other popularly-priced magnetic cartridges of very low output made them necessary. The "phono" input of most amplifiers prior to this time required about 0.5 volt to drive the power stages fully, and these new cartridges produced a signal at best only a fiftieth that great.

Various more recent magnetic cartridges furnish substantially higher outputs and can often be connected directly to the low-gain input of the amplifier but the introduction of equalization, so necessary to compensate for the multitude of recording characteristics in existence, invariably reduces the pickup output again to too low a value for most older amplifiers. There are three solutions to this problem; first, the equalized pickup signal can be fed into the "microphone," *i.e.,* high gain, channel of the amplifier; second, a special "magnetic phono" input can be provided with subsequent equalization, as in many modern amplifiers; and third, a combined preamplifier-equalizer separate from the main amplifier can amplify the signal to the proper value for the low-gain input.

The first arrangement has many disadvantages. Equalizer design is not only apt to be dependent upon the cartridges in question, but particularly in the case of low-output cartridges the level of the equalized signal will be so low that hum pickup in the connecting cables and tube noise in the first amplifier stage will reach an objectionable level. It is always desirable to keep weak signals at their maximum possible levels in order to increase their magnitude in relation to hum pickup and tube noise, and this requirement indicates that the equalizer should be located at some later point in the amplifier where its attenuation will be of little consequence. The second alternative mentioned accomplishes this objective satisfactorily, but it, too, suffers from several shortcomings. The amplifier is often located at some distance from the pickup and it is then usually impossible to arrange a convenient means for inserting various equalizers. Most amplifiers equipped with a magnetic cartridge input therefore have only a single equalizer, and from what will be said later about recording characteristics it will become manifest that such an arrangement is absolutely insufficient.

The last alternative, the separate equalizer-preamplifier, has none of these drawbacks. Means are easily provided right at the turntable for switching various equalizers into the circuit. At the same time these equalizers can be located at a point where signal strength is many times the tube noise level. The full cartridge output is fed through a short cable into the first grid, and the preamplifier output is sufficiently great that hum pickup even in fairly long high-impedance lines is easily eliminated. The sole disadvantage of the preamplifier is the necessity either for a separate power supply or for obtaining supply voltages from the main amplifier via a cable. The latter is generally the better arrangement by virtue of the superior filtering economically available, but this power-supply cable is seldom a cause of much inconvenience. The separate preamplifier is the only satisfactory means of utilizing older amplifiers with the new magnetic pickups.

The equalizer-preamplifier to be described was originally intended for use with a high-output magnetic pickup; it has a gain of 30 at 1000 c.p.s. and therefore supplies a signal of 3 volts with an input of 100 millivolts. Even with a 10-millivolt input the output will be sufficient for most amplifiers. It was also first desired to provide a separate equalizer specifically tailored to each make of commercial pressing now on the market, the proper equalizer to be selected by means of a switch. Further study has shown the impossibility of attaining the latter ambition and the crying necessity for some sort of standardization in commercial recording characteristics. It has nevertheless been found possible with eight or nine equalizers to compensate very well for most modern pressings and satisfactorily for a great many older recordings. The final unit is believed to have advantages in convenience and fidelity over most other amplifiers now available, and its circuit and construction are consequently described in detail.

Although originally intended for use with magnetic pickups, the preamplifier to be described can also be employed to great advantage with crystal cartridges. For this purpose the crystal unit it made velocity-responsive by loading it with a very low resistance, which simultaneously reduces the output voltage to the proper magnitude and effects a remarkable improvement in the quality of reproduction, as will be described later.

The preamplifier itself consists simply of two conventional high-mu triodes in cascade. The 6SL7GT is admirably suited to the purpose and is used here. As with all high-mu triodes, certain precautions must be taken to prevent high-frequency attenuation from the Miller-effect capacitance. Particularly in the case of the 6SL7GT, when operating at a gain of 30, the input capacitance is in the order of 100 $\mu\mu$fd., which means that a resistive source impedance no greater than 75,000 ohms can be tolerated if response is to be down 3 db. at 20 kc. This offers little difficulty in the first stage because both magnetic and crystal cartridges will be loaded with lower resistances than this, but the input to the second stage is more critical. In this preamplifier the equalizers are located between the first and second stages and the input resistance to the second stage can thus be reduced to the required level. This location of the equalizers has the further beneficial effect of reducing the signal input to the second stage to the point where it is easily handled without noticeable distortion.

The equalizers described later all have an amplification of about 0.022 at 1000 c.p.s.; even at 20 c.p.s. the amplification is generally only 0.32 so that at this low frequency, a -2 volt bias on the second stage will easily permit a signal input of 0.1 volt to the first stage. This is considered adequate for the entire range of available magnetic pickups and is also suitable for crystal pickups if they are properly loaded. The minimum input voltage is of course determined by the required output signal but a 0.01-volt signal provides a 0.3-volt output at 1000 c.p.s., which is sufficient for most amplifiers.

The completed preamplifier is shown in Fig. 1 and Fig. 3 gives the circuit diagram. The cathodes are heavily bypassed to prevent loss in gain and to reduce hum introduced by the heaters. This, coupled with the low grid-current impedances, reduces noise to a very low value. The main requirement is for a well-filtered "B+" supply, which must be adequately decoupled from the remainder of the amplifier to prevent motorboating. The plate current requirement is about 5 ma. so if desired this decoupling can be carried out with a high-inductance audio coupling choke and a high-value electrolytic condenser. The circuit components were chosen for a 320-volt "B+" supply after decoupling; for a 250-volt supply the same values can be used but the permissible input is somewhat reduced.

The entire unit is compactly housed

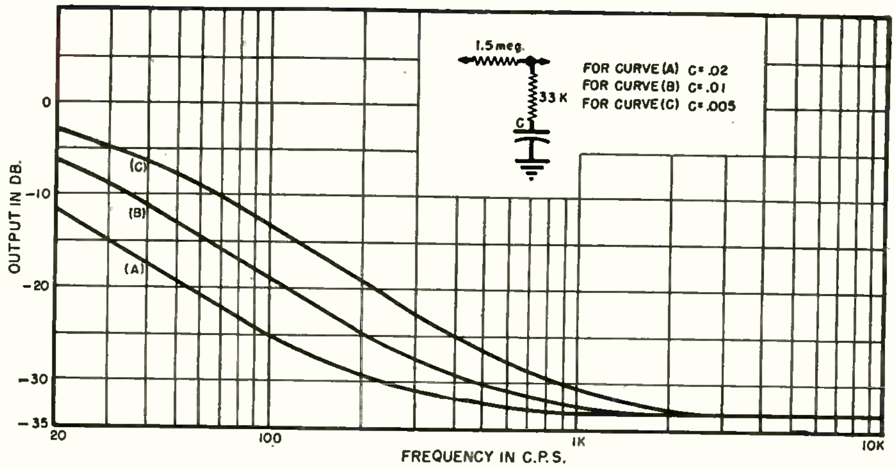


Fig. 2. (A) Equalizer for flat recordings with 250 c.p.s. turnover. (B) Equalizer for flat recordings with 500 c.p.s. turnover. (C) Unit for flat recordings with 1000 c.p.s. turnover.

in a small steel utility cabinet with the "on-off" switch, pilot light, and equalizer switch brought out on the front. Ordinary screw-terminal strips are provided on the back for the input and output connections because the preamplifier is intended to be located in the same cabinet with the pickup and turntable. Following the accepted practice, power connections are made to a 4-prong male plug on the chassis. It is important to float the tube socket on rubber to reduce microphonics; even with this precaution some makes of tubes will be found much freer from microphonics than others.

Magnetic cartridges are connected directly to the grid of the first tube, which is loaded with the resistance *R*, of proper size for the pickup in question. This resistance is usually specified by the maker of the cartridge with a view toward reduction of needle scratch and high-frequency drop. Crystal cartridges should be loaded with sufficiently low resistance to bring the 1000-c.p.s. response to no more than 0.1 volt; for a 0.001-μfd. cartridge with an open-circuit output of 1.0 volt *R* is about 16,000 ohms. This resistance is usually low enough to insure constant-velocity response

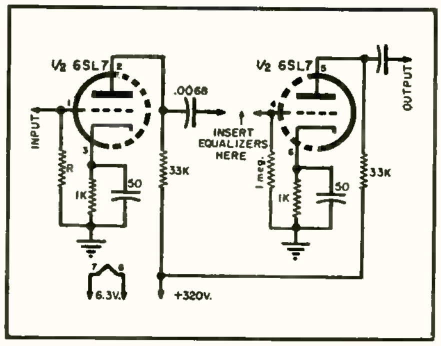
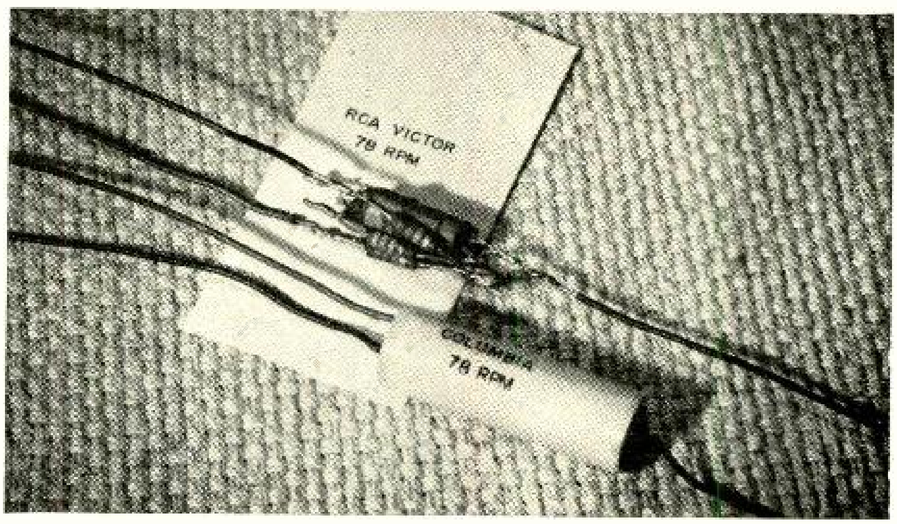


Fig. 3. Circuit diagram of preamplifier.

over the entire audible range. With some pickups this resistance can be chosen so as to eliminate, to a large degree, the high-frequency peak arising from needle resonance; the load resistance then equals the impedance of the cartridge at the point where treble response is up 3 db. from needle resonance. This low load resistance improves the damping of the input circuit and results in markedly reduced needle scratch and cleanness of reproduction. It should be remembered, however, that most crystal pickups have a response that is far from smooth and in general they cannot be

Fig. 4. Equalizers used in preamplifier for RCA Victor and Columbia 78 r.p.m. records.



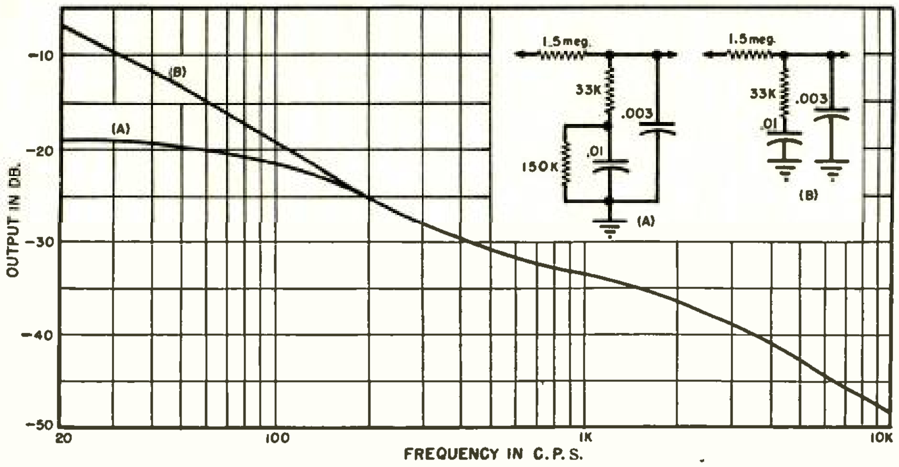


Fig. 5. (A) Equalizer for Columbia Microgroove recordings and its frequency response curve. (B) Equalizer and response curve for the NAB Standard recordings.

expected to yield as good results as the magnetic units.

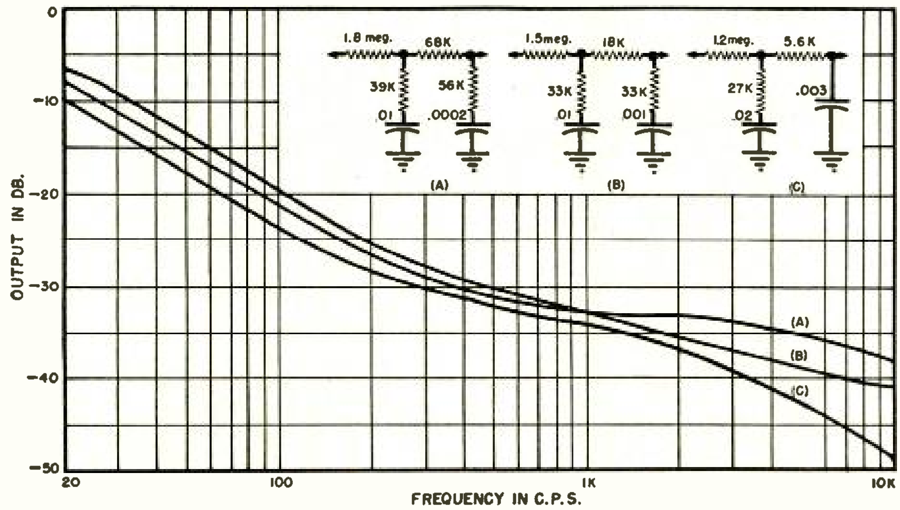
Equalizer Design

The equalizers are the heart of the preamplifier. Really satisfactory reproduction of records is possible only when the recording characteristics are perfectly compensated by means of properly-designed equalizers. It is true that the ear can accomodate itself, in a way, to imperfect frequency response, but although a system with poor response may sound all right by itself, it will pale considerably when compared directly to a much more perfect amplifier. For this reason there is simply no use in providing a single equalizer for the diversity of recording characteristics now in use. Even versatile bass and treble tone controls cannot be relied upon to supply the additional correction necessary with some discs, and even if they could, this would constitute a misuse of those controls, which are more properly intended to compensate for room acoustics and playback level.

A variable equalizer allowing control over turnover frequency and degree of bass emphasis is still insufficient. Many modern records have considerable treble pre-emphasis which remains uncorrected by such an arrangement. Some recent discs also have additional bass emphasis which again is overlooked by any such simple circuit. Even if a versatile equalizing system were available by which any part of the audio-frequency spectrum could be accentuated or attenuated to any degree, it would not be enough unless the recording characteristics of each pressing were known and the proper settings of the equalizer controls had been calculated. As has been mentioned, unless the original sound source or a high-fidelity reproduction are present for comparison, the ear would not be able to tell in what way the response was defective; even sensitive persons can at times only declare a reproduction to be unsatisfactory without being able to state what is wrong with it.

The only solution seems to be a separate equalizer tailored to each commercial recording characteristic, but the diversity of such characteristics makes this ideal all but unattainable. Nevertheless the great preponderance of pressings can be perfectly compensated by means of only a few equalizers, and when sufficient circuits for this purpose are provided, the remaining records generally sound pretty good with at least one of the available equalizers. For use with the preamplifier described, therefore, sufficient equalizers to correct the major modern pressings and the predominant older ones have been designed and are described in what follows. These equalizers are inserted in the preamplifier at the point indicated in Fig. 3. Electrically the only requirement is that the input impedance be high enough to avoid loading the first tube excessively, and the output impedance be sufficiently low to avoid high-frequency drop from the Miller-effect capacitance of the second tube. In addition to this, the attenuation of all the equalizers should be the same at, say, 1000 c.p.s. to avoid the necessity of adjusting the amplifier gain substantially when the equalizers are changed.

Fig. 6. (A) Equalizer and its response for Decca FFRR records. (B) Frequency response and equalizer for Victor 78 r.p.m. records. (C) Equalizer and response for Columbia 78 r.p.m. records.



Flat, 250 c.p.s. turnover. The equalizer to correct for records with a turnover at 250 c.p.s. and a flat treble characteristic is shown in Fig. 2A, together with its response curve. This equalizer is used with *British H.M.V.* and a number of other European pressings.[1] It should also be tried with any American pressings that have been recorded in Europe.

Flat, 500 c.p.s. turnover. Fig. 2B shows the equalizer for a simple 500 c.p.s turnover characteristic. This circuit is employed for a good many American pressings of older vintage.

Flat, 1000 c.p.s. turnover. For a 1000 c.p.s. turnover the equalizer given in Fig. 2C is very good, but there is slightly greater bass drop than with the two previous circuits. This equalizer will rarely be used but the characteristic is followed on some European recordings.

If the minimum number of equalizers is desired, those for 250 c.p.s. and 1000 c.p.s. turnover can be omitted. There is only a slight audible difference between the three when playing a given disc.

NAB characteristic. The NAB curve is followed in *Artist, Capitol, M.G.M.,* and many other American pressings. It is characterized by a low frequency turnover at 500 c.p.s. and a treble pre-emphasis of 6 db. per octave commencing at 1590 c.p.s. The equalizer of Fig. 2B is easily modified for this purpose by shunting the output with a condenser as shown in Fig. 5B. Although this simple addition results in a slight deviation from the ideal in the vicinity of 1590 c.p.s. the variation has been found by measurement to be exceedingly small and this simple circuit gives excellent results.

Columbia Microgroove characteristic. The recording curve for *Columbia* Microgroove records differs from the NAB curve in that extra bass emphasis is provided, amounting to 3 db. at 100 c.p.s.[2] This is corrected simply by adding another resistor to the NAB equalizer as indicated in Fig. 5A.

Columbia 78 r.p.m. characteristic.

(*Continued on page* 120)

Discount THOSE MATERIAL BILLS

By HAROLD J. ASHE

Judicious borrowing or advanced planning enables shop owners to save real money on stock purchases.

IF THE radio and television service shop owner were obliged to pay his banker from 18% to 60% interest a year on a loan, he would be warranted in complaining bitterly about usurious rates. Such rates of interest would lay such a heavy burden upon the shop that, very likely, its owner would be forced out of business.

Yet, paradoxically, many shop owners pay the equivalent of such interest rates year after year without a murmur of protest. They do this in a left-handed manner, due to their failure to take all cash and quantity discounts made available to them by their suppliers. Any available funds that a shop owner has can earn for him vastly greater returns in taking such discounts than these funds can earn in outside investments. Nevertheless, many service shop owners persist in channeling savings into savings accounts paying 2% interest a year, and other low-return investments, while bypassing the high-earning possibilities offered them in their own business.

Terms of 1 per-cent in 10 days or net in 30 days may sound trivial to the reader who, at the same time, considers a 6 per-cent bank loan a burden to carry. However, letting the discount period pass on a bill offering such returns will result in paying 18 per-cent annually to the supplier for the use of the latter's money, assuming the bill is paid at the end of the 30-day period. And it had better be, if the shop owner doesn't want to wreck his credit standing with all supply houses. That is, he is paying (because he is losing) 1 per-cent of the bill for a 20-day extension of time, or at the rate of better than 18% a year. This is about the most expensive type of loan that can be negotiated. And it is a loan, even though it is not put on that legalistic basis

Cash discounts, alone, can go far toward constituting a large share of the *net* profits of a service shop—depending only upon the amount and kind of discount opportunities offered by supply houses. These vary in different sections of the country.

In weighing the importance of cash discounts as a possible source of additional shop net revenue, consider the annual earning rates of various discount terms shown in Table 1.

These earning rates of discounts are based on the elapsed time from the end of the discount date to the end of the net date after which the bill becomes delinquent.

If the shop owner is unable to discount all bills at the outset, he should nevertheless constantly refer to the given earnings table and apply whatever funds are available to taking the cash discount on those bills earning the most. Example: A bill offering a cash discount of 2% in 10 days or net 30 days (36% a year earnings) should have precedence over another offering 1% in 10 days or net 30 days (18% a year earnings). If these discount earnings are allowed to accumulate, the shop owner should eventually acquire enough funds with which to discount all bills.

Bills should be filed for payment according to the dates when discounts expire so that those bills about to become net will show up first for payment before discounts are lost. In small shops an ordinary clip board, obtainable at any stationer, will suffice. Bills should be clipped to the board in the order of their discount due date, those approaching payment date being on top. A quick tally periodically will reveal the amount of cash that must be available to meet bills and when. Sometimes, by being forewarned, the shop owner can so maneuver as to make more funds available for discounting than would be the case if he does not plan in advance for these dates.

Table 1. Annual earning rates of the various discount terms offered shop owners.

½% in 10 days, net 30 days	9% a year
1% in 10 days, net 30 days	18% a year
1½% in 10 days, net 30 days	27% a year
2% in 10 days, net 30 days	36% a year
2% in 10 days, net 60 days	14% a year
2% in 30 days, net 60 days	24% a year
2% in 30 days, net 90 days	12% a year
2% in 30 days, net 120 days	8% a year
3% in 10 days, net 60 days	21% a year
3% in 10 days, net 90 days	13½% a year
3% in 30 days, net 60 days	36% a year
3% in 30 days, net 90 days	18% a year

Sometimes, the shop owner may be able to persuade his banker to advance a small loan for the express purpose of discounting bills. This loan objective makes good sense to bankers. This may put the shop owner on a full discount basis sooner and, at normal bank interest rates, he should make a profit on the transaction. However, the loan should be scaled to an amount that can be used every month, so that the revolving fund can work every month of the year. The loan should be for an amount equal to the minimum monthly material purchases having discounts—not on the basis of a peak month of the year. Otherwise, if a maximum loan is obtained, the borrower will be paying interest on part of the loan which may have discount opportunities only one or two months of the year. Example: Experience shows the minimum monthly purchases having discounts available are $500, the maximum is $1200. The loan should be for no more than $500, even less if the borrower can supply part of the funds himself. The borrower should resolutely refuse to di-

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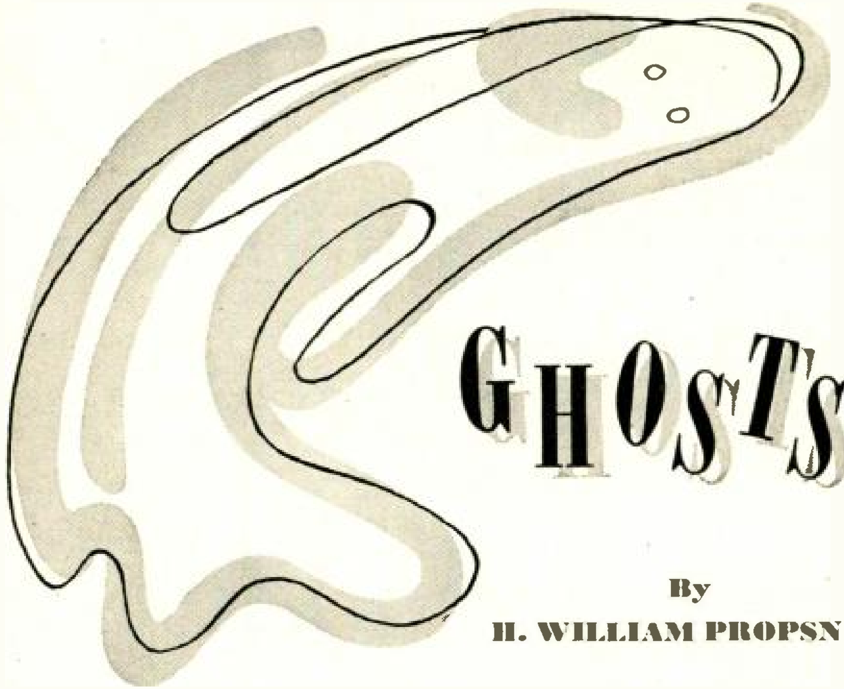


GHOSTS

By

H. WILLIAM PROPSNER

How to subdue annoying video ghosts with a minimum of special antennas and hardware.

NOTHING plagues the television technician more or sours a sale for a dealer faster than reflections which a customer won't tolerate.

Mathematicians and engineers have spent considerable time calculating the source of the reflections on the television screen. Radar theory has them bouncing every which way as water does from a fire hose played on a car.

Even the layman knows that "ghosts are a phenomenon created by successive signals arriving later than the original video frequency and manifesting themselves directly in superimposed pictures or reflections on the television screen."

Unfortunately there is no single solution to the problem of reflected pictures. Every situation is different. Similar problems occur in the same area, but the solutions will vary. The old process of cut and try and experiment will inevitably produce results. An article such as this can only become a guide and provide background data for further experimentation. It is understood that the basic principles of antennas and their use are common knowledge. Certainly there is sufficient literature available. Much of this article may be a recapitulation of information already known. However, since it is based on day in and day out experience in all kinds of weather, it can save time and money.

The only definite statement anyone can make concerning the proper installation of a television antenna where ghosts abound is that it requires honest work. What works perfectly for one installation can be disappointing or impossible for another.

The author is selling nothing but the idea that ghosts can be reduced or made less objectionable by the TV set owner himself. Inexpensively.

Generally where there is a ghost, the transmitter is close and the gain is high at the receiver. However, ghosts can occur anywhere, although they are much less of a problem outside a 20-mile radius of the station. Out where the signal is clean or perhaps flecked with a little snow, antenna work follows electrical and mechanical practice. Just put up the necessary skyhook so it won't fall down, orient it by the sun or neighboring antennas, and run a wire to the set. An airplane may cause a fluttering ghost now and then, but its reflecting surface is happily transient.

There are *wide* reflections, so wide that the left-hand edge of the raster makes a disconcerting vertical bar or two near the middle of the picture. There are ghosts which put extra teams on the field during ball games which are more distinct than the home team. There are ghosts that just make the picture fuzzy. Some affect the best sync circuits so that the picture rolls vertically at every spark or noise. Some ghosts can be tolerated and show up badly only on advertisements or where straight lines are shown. Others may pass as minor on a test pattern when the antenna is installed, but cause cross-eyed actors and maddening outlines on programs.

High-gain, narrow-bandpass receivers tend to accentuate the reflection problem, even picking up ghosts from passing cars. No one receiver is necessarily better than another in a ghost-haunted regions. With careful antenna work your set will work as well as the next. The antenna is more important than the set.

Initially, a transmission line to match the set, usually 300-ohm line, is preferred. Brown or black polyethylene cracks and deteriorates less in sunlight than the lighter colors. Where a strong signal is known to be present, good shielded line is all right, provided thought is given to the possibility of moisture entering the tubing. If it can be done at all, a well-routed unshielded line and an antenna, particularly a stacked array, located and oriented to minimize interference are better than the results achieved by installing coax or Twin-X.

The simplest of electrical tools and television antenna materials are all that are necessary to clean up most pictures. A complicated antenna for high power gain, installed at much expense and effort as high as practicable, does better as a balloon trap than as a device to cut down reflections.

An adjustable V-type or bug antenna is an ideal type in ghost-elimination work since it can be oriented in every possible position by hand with angles between 0° and 180°. The dipole lengths can be adjusted as shown in the diagrams, and it can be very easily moved about by hand, or on a pole if necessary. Unbalanced arrangements of angles and dipole lengths and odd orientations can be tried right at the set, providing there is sufficient signal strength. Of course, few people want an antenna stuck in some odd place in the same room with the set, but an idea of the best arrangement for a dipole can sometimes be secured before work is done elsewhere. Unfortunately, it is only an idea, for ghosts are nasty and don't play fair.

In an apartment building an indoor antenna may be necessary, and here the reflections may be of the worst possible type. For many such installations a booster is necessary or a genuine aid.

Begin with the V-antenna and a piece of lead-in connected to the set, nothing else. Perhaps a vertical orientation with an angle of 120° produces a satisfactory picture, though minimum gain is secured this way. Often the location of the antenna in relation to hidden wires and pipes is critical. Transmission-line antennas have been installed in the cellar and have, under certain conditions, given pictures superior to the best roof-top arrays. However, with many sets and with inside installations where the signal is critical, furniture movement or lights and appliances turned on or off may affect the pictures. The movement of people within the room is often responsible for the presence or absence of ghosts.

The answer is experimentation. Check on how an indoor antenna works in that ghost-free location you have found. If the antenna must be moved for different channels, separate antennas are advisable, with independent leads and a switch, rotary or toggle.

A V-antenna, quite naturally, is excellent for surveying. Here is where the helper comes in. If personnel is easily secured, someone can operate the set and watch the ghosts, preferably test patterns in all work of this kind. Another individual can survey with the antenna. A third person can act as the liaison man.

In any survey work, the more information given the man on the roof, the more he can accomplish. There should be a continual flow of messages to tell him what's happening at the set. Instruments can show him the orientation for strongest signals, but only a confederate can tell him whether he's doing any good with the ghost problem.

A normal horizontal position of the antenna should be maintained in all search work. Incidentally, guys or ground wires for lightning have a decided effect on reflections. Avoid metal guys by substituting plastic-covered clothesline or waterproof rope on short masts if no other means of mounting is feasible.

Spot checks should be tried close to roof flashing, thus incorporating the effects of this metalwork as a director or reflector in your antenna. It goes without saying that a location may be discovered halfway up the side of the house in front of a window with metal sash or screening. Or the antenna may work well just over the front door or under the rain gutter, then that is where it belongs.

When the antenna is installed and oriented for the best picture, a little gimmick (see Fig. 1) may do more to help you than all the manufactured antennas on the market today. A simple aluminum rod or plated metal-tubing dipole six or eight feet long is phased in as illustrated and moved up or down the mast, independently of the existing antenna for best pictures. The desired vertical spacing from the fixed antenna is achieved when a half-turn of the dipole gives the maximum variation in gain between two positions 180° apart. The signal on this phasing dipole is emphasizing or de-emphasizing the signal on the other antenna, depending on whether the antenna is in or out of phase.

When this height is found, the phasing antenna can be slowly turned to minimize the ghost. This method has cancelled reflections in the worst possible receiving areas. Conveniently, too, it may be added, with little difficulty, to most existing installations. A suitable outdoor lightning arrester may be used at the junction of the two antennas thus making soldering unnecessary. All leads are secured.

Whether an antenna matches is usually of little consequence. Trifilars and line transformers are fancy gadgets. The diagrams, Fig. 3, show designs to overcome the wide lobes in the receiving patterns of elementary antennas and the means of making one dipole work for both high and low frequency. The phasing or ghost-control antenna does just this—regulates the directivity.

A dipole can be used as a parasitic and adjusted for minimum ghosts on the same mast with *no* electrical connection whatsoever to the existing antenna. It is best to try a V-antenna first, with 180° angle and maximum length. Then adjust its angle and length. If it works, a dipole may be cut and formed for a parasitic, *being careful your own body isn't indispensable to the receiving set-up.*

Rotors have become an imposing aid in subduing ghosts. Installed with proper considerations for the problems at hand, they can overcome the effects of changing conditions in the immediate area. For a good picture one day can gradually get worse with the weather, until it becomes a snake pit of confusion. A little turn of the antenna, even though a ghost persists, can clear it up until the weather is dry again.

Mechanical means of remotely orienting the antenna may correct a changed receiving condition which develops when another antenna joins the joyful throng on the rooftops, or a new water tower goes up on the pretzel plant. It can swing the antenna to cut ignition or motor noise picked up directly.

Two antennas stacked the proper distance and correctly phased can be divided—one fixed and the other turned from the armchair by a rotor. You can thus alter the pattern of the receiving antenna to suit many conditions. Its orientation, too, may have a wide range, provided it has the leads and switching arrangements.

A word of caution, however. Although a rotor serves in many situations, it cannot satisfy every person. A problem at any particular location can be quite complex. Thus the application of a rotor can easily be the most disappointing investment of all. It is often purchased as a fascinating cure for a disease that only the conscientious labor of surveying and experimental work can treat.

The lead-in length is very important in certain installations. This can be checked by splicing in temporarily several lengths of wire up to ten feet. A few trials will demonstrate whether any real significance can be attached to the effects of standing waves on the line.

Should more than one lead-in arrive at the back of a set, it's a good idea to ascertain if there is any cross-

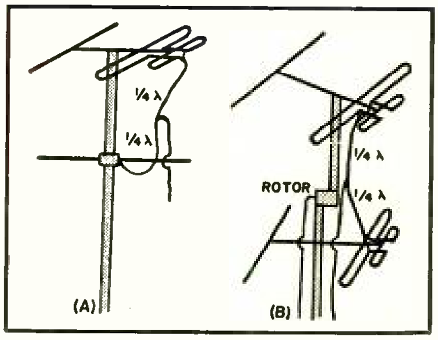


Fig. 1. (A) A 6 to 8 foot dipole phased to existing antenna. The antenna may be of any type. The quarter-wave sections of lead-in are equal and cut to frequency desired. The antennas are oriented independently for minimum ghosts. (B) A rotor turns one antenna of a stacked array, thus varying the receiving field pattern. Conical antennas may be used, but the simpler units are preferable. The rotor may also be used to turn the phase-control dipole.

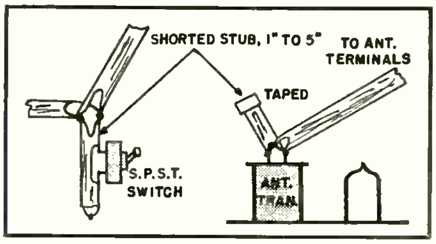


Fig. 2. How the line can be tuned for close-in ghosts, 1/8" or less, with a shorted stub a few inches long. The length is found experimentally with a razor blade. The stub may be installed at the antenna transformer or socket by baring 3/8" leads on the stub, inserting them in socket holes, and pushing transmission line plug in on top.

over of signals. A 250-ohm *carbon* resistor, switched across the end of the suspected lead, can act as a terminating load. A *shorted* quarter-wave stub, tuned to the desired frequency, performs best. This trap is *shorted* at the junction.

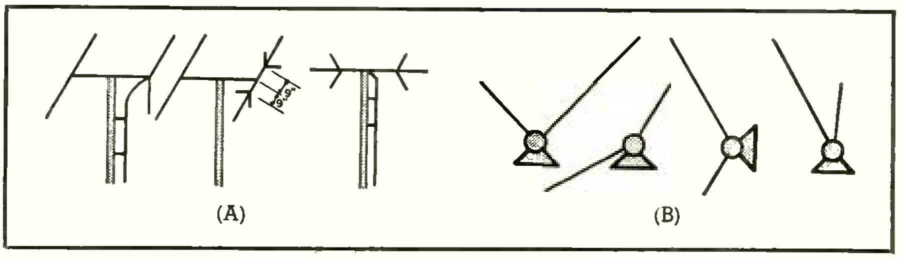
Twisting the lead-in has little effect in the reduction of interference or ghosts. It provides a little symmetry to the run, makes for a slightly more taut line, and that's all.

The first thing to do in any antenna troubleshooting is the substitution of an entirely new temporary lead-in, run as far as possible from the existing transmission line, yet without undue length.

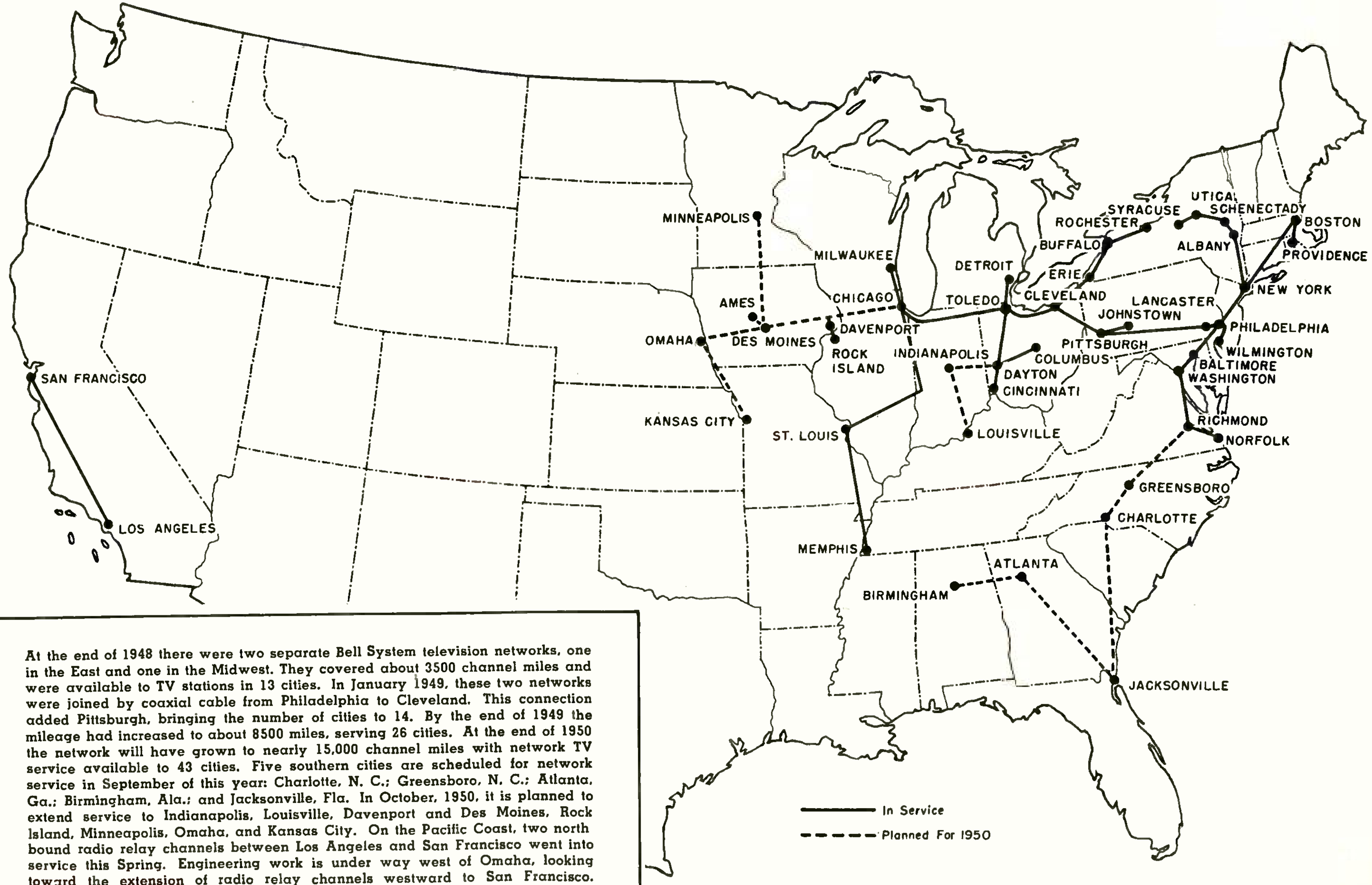
Sometimes a well-chosen folded-di-

(*Continued on page* 85)

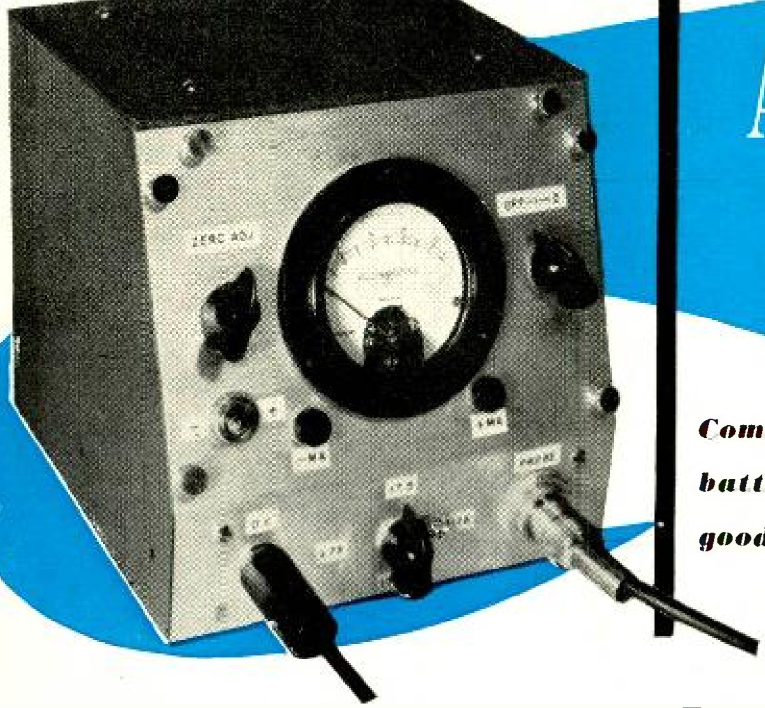
Fig. 3. (A) Means of controlling the lobes in the antenna field pattern. The "wings" are commercially-available RCA type. Each is usually spaced nine inches from the lead-in connection but may tune the antenna better if adjusted individually on dipole arms (B) Several arrangements of an indoor "V"-type antenna which can sometimes be used.



BELL SYSTEM TELEVISION NETWORK ROUTES



At the end of 1948 there were two separate Bell System television networks, one in the East and one in the Midwest. They covered about 3500 channel miles and were available to TV stations in 13 cities. In January 1949, these two networks were joined by coaxial cable from Philadelphia to Cleveland. This connection added Pittsburgh, bringing the number of cities to 14. By the end of 1949 the mileage had increased to about 8500 miles, serving 26 cities. At the end of 1950 the network will have grown to nearly 15,000 channel miles with network TV service available to 43 cities. Five southern cities are scheduled for network service in September of this year: Charlotte, N. C.; Greensboro, N. C.; Atlanta, Ga.; Birmingham, Ala.; and Jacksonville, Fla. In October, 1950, it is planned to extend service to Indianapolis, Louisville, Davenport and Des Moines, Rock Island, Minneapolis, Omaha, and Kansas City. On the Pacific Coast, two north bound radio relay channels between Los Angeles and San Francisco went into service this Spring. Engineering work is under way west of Omaha, looking toward the extension of radio relay channels westward to San Francisco.



A V.T.V.M. For a.c.-d.c.-r.f.

Complete construction details for a battery-operated v.t.v.m. It is of good design and inexpensive to build.

Fig. 1. Front panel view of the home-built v.t.v.m. All batteries are self-contained.

By
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IN MANY electronic tests not of a prolonged nature, a battery-operated vacuum-tube voltmeter is desirable, and often required. This is especially true when measurements are to be made between circuit points above ground, when there is a possibility that power-line hum may be transmitted by an a.c.-operated instrument into the system under test, when undesirable coupling might take place between the instrument and the system, and when measurements must be made at some distance from the nearest power outlet. In its own right, the battery-operated v.t. voltmeter is an essential instrument in the well-equipped laboratory or shop.

The usefulness of the battery-operated instrument is not questioned by well-informed laboratory technicians. However, it is the misguided opinion of some experimenters that little care need be exercised in the design and construction of this device. No notion could be more erroneous. Merely separating the electronic voltmeter circuit from the conventional a.c. power supply does not in any way eliminate the need for good design and construction procedures.

The battery-operated v.t. voltmeter described in this article was designed for maximum utility and minimum initial and maintenance costs. It may be duplicated by any engineer, laboratory or service technician having access to common tools. And this instrument will be equally useful to the engineer and amateur.

Features

Basically, the instrument described is an electronic d.c. voltmeter. An external tube-type probe enables measurement of alternating voltages in both audio and radio-frequency ranges. Voltage ranges provided are 0-1.75, 0-17.5, 0-175, and 0-1750 d.c.; and 0-1.75, 0-17.5, and 0-175 a.c. Continuous use of the probe above about 150 volts is not recommended, although intermittent use is permissible between 150 and 175 volts. The d.c. input resistance of the instrument is 10.11 megohms for all voltage ranges. The a.c. input impedance with the diode probe is correspondingly high, but is a function of the frequency of the measured voltage. The input capacitance of the probe is approximately 5 $\mu\mu$fd., and the resonant frequency of the high-frequency diode tube employed in the probe is approximately 2000 megacycles.

Two inputs are provided. These are (1) a phone-type jack for a shielded d.c. test prod, and (2) a 5-terminal male chassis receptacle for the a.c.-r.f. probe. Panel knobs control the 4-position range switch, zero adjustment rheostat, and "On-Off" battery switch. A calibration control rheostat, connected in the filament-return circuit of the 1G4/GT-G voltmeter tube, is mounted inside the instrument, since this component needs to be reset only when the tube is replaced or the calibration verified.

An additional pair of tip jacks, mounted on the front panel, allows the 0-1 d.c. milliammeter to be used in external circuits.

Desirable features of the instrument are its excellent stability, complete, single-package portability, polarity switching, low battery drain, single zero adjustment which is effective automatically on all ranges when set on any one, and its freedom from false deflections which ordinarily arise in v.t. voltmeters when measuring across circuits of various impedance values.

This v.t. voltmeter is reasonably small in size and is built in a sloping front cabinet. All batteries are self-contained. Fig. 1 is an external view of the completed instrument.

Circuit

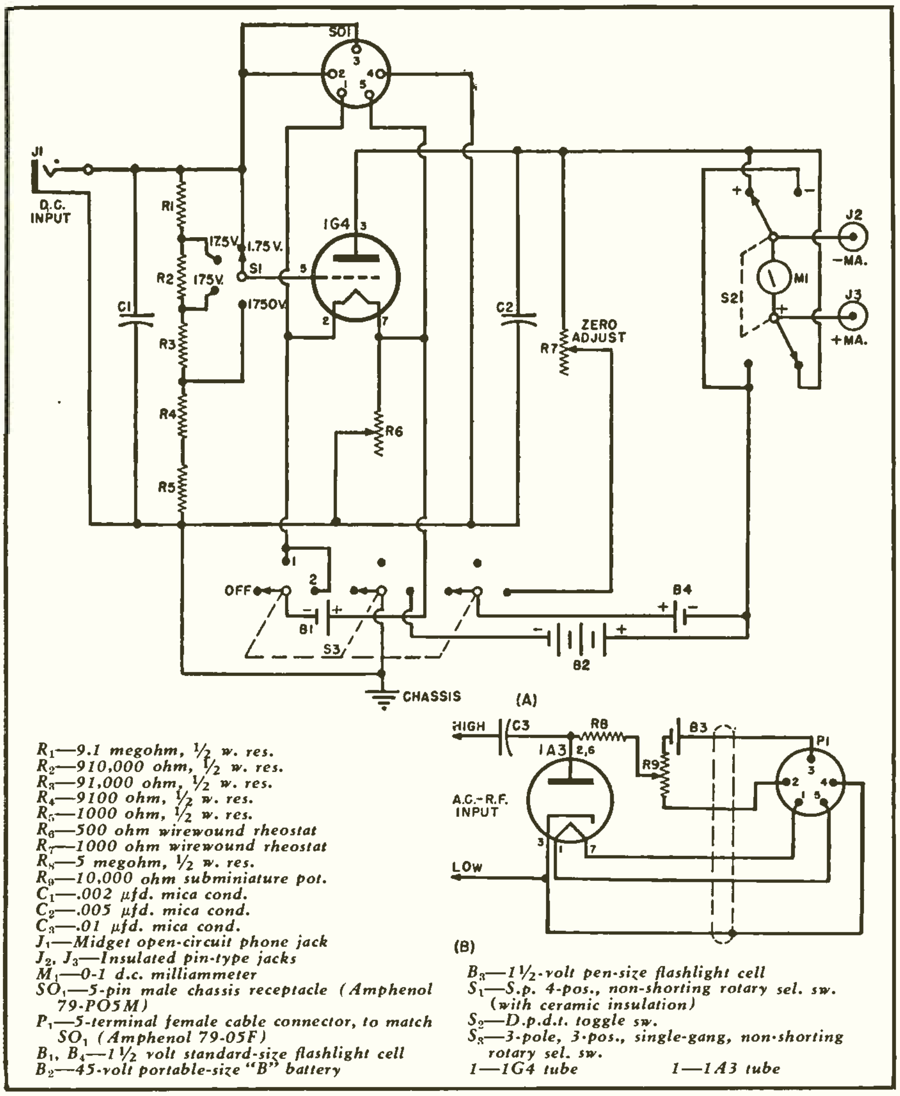
The complete circuit schematic is given in Fig. 2. The circuit for the a.c.-r.f. probe also appears in this drawing.

With the connections shown, a maximum potential of 1.75 volts d.c. is applied to the 1G4/GT-G grid. This is true regardless of the setting of the range switch, S_1. For voltage range selection, resistors R_1 to R_5 inclusive form an input voltage divider. It will be noted from the parts list that these resistors have been selected to have the new fractional values which have come into use.

The d.c. test voltages are applied through jack J_1. The d.c. test probe is provided with a shielded cable terminated by a standard phone plug. The shield braid is connected to the outer sleeve of the plug. The d.c. probe does not contain a resistor of any value.

When the calibration control rheostat, R_6, has been set properly, a 1.75-volt d.c. signal at the triode grid will deflect the milliammeter, M_1, exactly to full scale. Adjustment of this control will be described later in this article. Rheostat R_7 serves as the zero adjustment.

The filaments of both the 1G4/GT-G meter tube and the 1A3 diode probe tube are heated by a single 1½-volt flashlight cell, B_1. Triode plate voltage is supplied by the 45-volt battery, B_2. A second 1½-volt flashlight cell, B_4, furnishes a bucking voltage for setting the milliammeter initially to zero against 1G4/GT-G plate current. This arrangement was chosen in preference



R_1—9.1 megohm, ½ w. res.
R_2—910,000 ohm, ½ w. res.
R_3—91,000 ohm, ½ w. res.
R_4—9100 ohm, ½ w. res.
R_5—1000 ohm, ½ w. res.
R_6—500 ohm wirewound rheostat
R_7—1000 ohm wirewound rheostat
R_8—5 megohm, ½ w. res.
R_9—10,000 ohm subminiature pot.
C_1—.002 μfd. mica cond.
C_2—.005 μfd. mica cond.
C_3—.01 μfd. mica cond.
J_1—Midget open-circuit phone jack
J_2, J_3—Insulated pin-type jacks
M_1—0-1 d.c. milliammeter
SO_1—5-pin male chassis receptacle (Amphenol 79-PO5M)
P_1—5-terminal female cable connector, to match SO_1 (Amphenol 79-05F)
B_1, B_4—1½ volt standard-size flashlight cell
B_2—45-volt portable-size "B" battery
B_3—1½-volt pen-size flashlight cell
S_1—S.p. 4-pos., non-shorting rotary sel. sw. (with ceramic insulation)
S_2—D.p.d.t. toggle sw.
S_3—3-pole, 3-pos., single-gang, non-shorting rotary sel. sw.
1—1G4 tube
1—1A3 tube

Fig. 2. (A) Circuit diagram of v.t.v.m. (B) Diagram of external a.c.-r.f. probe.

to the usual well-known resistor-bridge balancing network, since the former permits somewhat better instrument sensitivity.

The "On-Off" battery switch will appear unconventional to most readers. This is the 3-pole, 3-position rotary selector switch, S_3. Offhand, it might appear that only the filament and zero-adjuster circuits need be opened in order to switch the instrument off, and that two switch poles could do this job simultaneously. But with that simpler arrangement, the milliammeter is "slammed" on both starting and stopping the instrument. This is because the tube filament does not come up to full electron emission immediately after the filament cell is switched on, nor does it cease emitting electrons immediately after the filament circuit is interrupted. Consequently, when the filament circuit first is closed, the meter will be deflected backward by the zero adjuster cell—and when the filament circuit is interrupted (the zero adjuster cell now also being cut out of the circuit), the meter will be deflected off the top end of its scale by the slowly decaying plate current.

The 3-pole "On-Off" switch shown in Fig. 2 protects the meter from damage. When all poles are in the "off" position, all batteries are disconnected. In position 1, the 1G4/GT-G filament alone is connected, and the switch is left in this position for a few seconds to enable the filament to come up to its normal operating point. In position 2, the plate battery and zero adjuster cell both are switched on at the same instant. When shutting the instrument down, switch S_3 moves from position 2 to 1, removing both plate and zero adjuster batteries before opening the filament circuit into the "off" position.

The indicating meter is a standard 0-1 d.c. milliammeter. The resistance of this meter is not critical in the circuit, and any of the presently available models (33 ohms, 66 ohms, 105 ohms, etc.) accordingly may be used. Two panel pin-type jacks, J_2 and J_3, allow the milliammeter to be used externally. The double-pole, double-throw toggle switch, S_2, allows the milliammeter to be "turned around" in the circuit, thereby rendering unnecessary the shifting of test leads in d.c. measurements.

The plug P_1, terminating the cable of the a.c.-r.f. probe, is plugged into the chassis receptacle, SO_1, when a.c. measurements are to be made, and the alternating voltage is applied to the probe input terminals. Terminals 2 and 3 of SO_1 are connected together to complete the circuit between the contact potential bucking cell, B_3 (in the probe shield) and potentiometer R_9 when P_1 is inserted. The bucking circuit is necessary to counteract the diode contact potential which otherwise would deflect the milliammeter in absence of a signal. When a.c. or r.f. measurements are completed, P_1 must always be removed from SO_1. This automatically opens the bucking cell circuit, as well as removing voltage from the 1A3 filament.

The a.c.-r.f. probe is of the standard shunt-diode design well-known to radio experimenters. This normally is a peak reading device, but the builder may prepare a special r.m.s. scale for the milliammeter. The 1A3 tube has the advantage that its high self-resonant frequency permits operation well into the u.h.f. region.

The accuracy of the voltmeter at the various settings of the range selector switch, S_1, depends largely upon the accuracy of resistors R_1 to R_5. These components must be hand-picked. While it is desirable that each resistor have the *exact* value specified in Fig. 2, they may deviate from specified resistance values without affecting the instrument accuracy, as long as *each* resistor is in error by the same percentage and in the same direction.

It is possible to measure these resistors with an accurate ohmmeter or resistance bridge. However, a microammeter check will be desirable in most cases. Using a sensitive d.c. microammeter; R_1 must be checked at 100 volts d.c., R_2 at 10 volts, and R_3 and R_4R_5 at 1 volt. For correct resistances; R_1, R_2, and R_3 will give a reading of 11.1 microamperes, and R_4 R_5 (10,100 ohms) 111 microamperes.

Resistors R_1 to R_5 are soldered directly to the terminals of the voltage range switch, S_1, as shown in the photograph, Fig. 3.

Construction

It is convenient that no inflexible layout is required in the construction of this v.t. voltmeter. Any satisfactory instrument which the builder may have on hand may be used. Various styles of portable construction will suggest themselves to individual builders and will be entirely satisfactory. It is not imperative that the sloping panel metal case be employed.

The author's instrument is housed in a cabinet 7 inches wide, 6¾ inches high, 7 inches deep at the base, and 5½ inches deep at the top. The chassis is 7" x 7" x 2" in size.

The arrangement of controls on the front panel is shown in the over-all photograph (Fig. 1). Arrangement of components is shown in Fig. 5.

The 45-volt battery is secured in place by means of a plastic rod mounted horizontally across the top of the battery and held tightly in place by means of long threaded rods extending through the chassis. Connections are made to this battery by means of a standard 3-pin battery plug (one pin unused). To remove the battery, it is necessary only to remove the thumb nuts holding the plastic rod, lift the rod clear of the screws, and then to lift the battery from between the threaded rods.

The two 1½-volt flashlight cells are held side by side under the chassis by a similar arrangement of yoke and long screw, and may be seen in Fig. 5. Leads are soldered directly to the brass caps and to the bottoms of the cans of these cells. While this procedure does not appear to be the best for quick replacement, it is justified by the fact that these cells need to be replaced only infrequently.

Insulated wire leads from the milliammeter, switches, jacks, and rheostat mounted on the front panel above the chassis pass through the chassis through grommet-lined holes.

Rheostat R_6 is mounted below chassis, as shown in Fig. 5, with a slot sawed in the end of its shortened shaft to permit screwdriver adjustment.

By mounting d.c. input jacks J_1, voltage range switch S_1, and a.c.-r.f. probe input receptacle SO_1 side by side along the lower edge of the front panel (see Fig. 1), short leads are insured between these associated components and the 1G4/GT-G tube.

The author kept the regular 0-1 milliampere card on the meter, in order to preserve this scale when using the milliammeter externally through jacks J_2 and J_3. Some time after the photograph (Fig. 1) was made, the voltages were inscribed on the same card just below the milliampere scale. If the reader prefers, he may replace the milliampere card with a specially-drawn voltage scale. The scale points may be obtained as will be described later under *Testing and Calibration,* and will follow the sample voltage calibration curve illustrated in Fig. 4.

Wiring of the instrument is simple and straightforward. Employ regular stranded hookup wire throughout. It is very important to observe the battery and meter polarities indicated in Fig. 2, and also to follow the tube socket wiring indicated. The latter applies particularly to the filament terminals of the 1G4/GT-G tube. Do not interchange terminals 2 and 7.

Testing and Calibration

After all wiring has been completed and inspected, the instrument may be checked and calibrated as follows:

(1) With no plugs inserted in either J_1, J_2, J_3, or SO_1, set switch S_3 to "Off," switch S_1 to 1.75 v., and switch S_2 to "Positive." (2) Set rheostat R_6 at about mid-range. (3) Switch S_3 to position 1 and allow 2 to 3 seconds for the 1G4/GT-G filament to come up to full emission. (4) Switch S_3 to position 2. (5) Set zero adjuster rheostat R_7 to bring pointer of milliammeter to zero. (6) Touch wire jumper to both terminals of jack J_1, watching milliammeter. If meter is deflected in either direction from zero, advance rheostat R_6 slightly and reset R_7 for zero (with jumper removed from J_1). Touch jumper again to J_1. When R_6 is set correctly, short-circuiting terminals of J_1 will not cause milliammeter to deflect from zero. If resistance setting of R_6 is too low, milliammeter will kick upward; if too high, meter will kick downward. It will be necessary to jockey back and forth between R_6 and R_7, while intermittently short-circuiting the terminals of J_1, until the short circuit does not upset the zero setting of the meter. (7) Connect variable d.c. voltage source (0-2 volts) to jack J_1, with negative terminal of voltage source connected to jack frame (instrument chassis). (8) With aid of standard d.c. voltmeter of known accuracy, set voltage source at various voltage steps between 0.1 volt and 1.75 volts, noting deflection of milliammeter for each step. This will yield calibration curve similar to that shown in Fig. 4.

Some 1G4/GT-G tubes have E_p-I_g characteristic curves of such shape that the instrument calibration will not be exactly the same if the polarity of the input d.c. voltage is reversed.

(*Continued on page* 98)

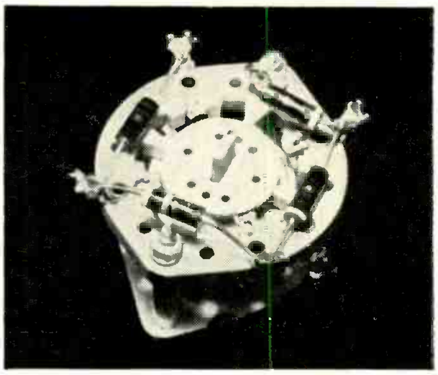


Fig. 3. Method of mounting resistors (R_1 to R_5) to switch, S_1. As in this case, a single resistor may be used for R_4 and R_5 if the exact value, 10,100, is obtained.

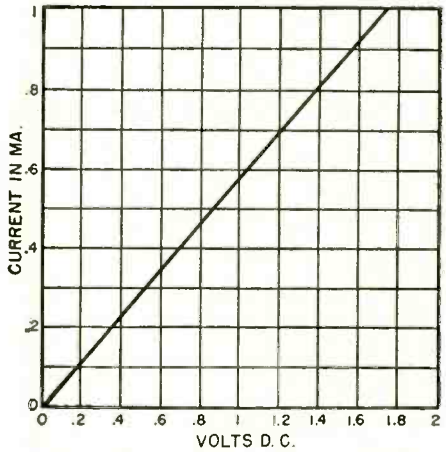
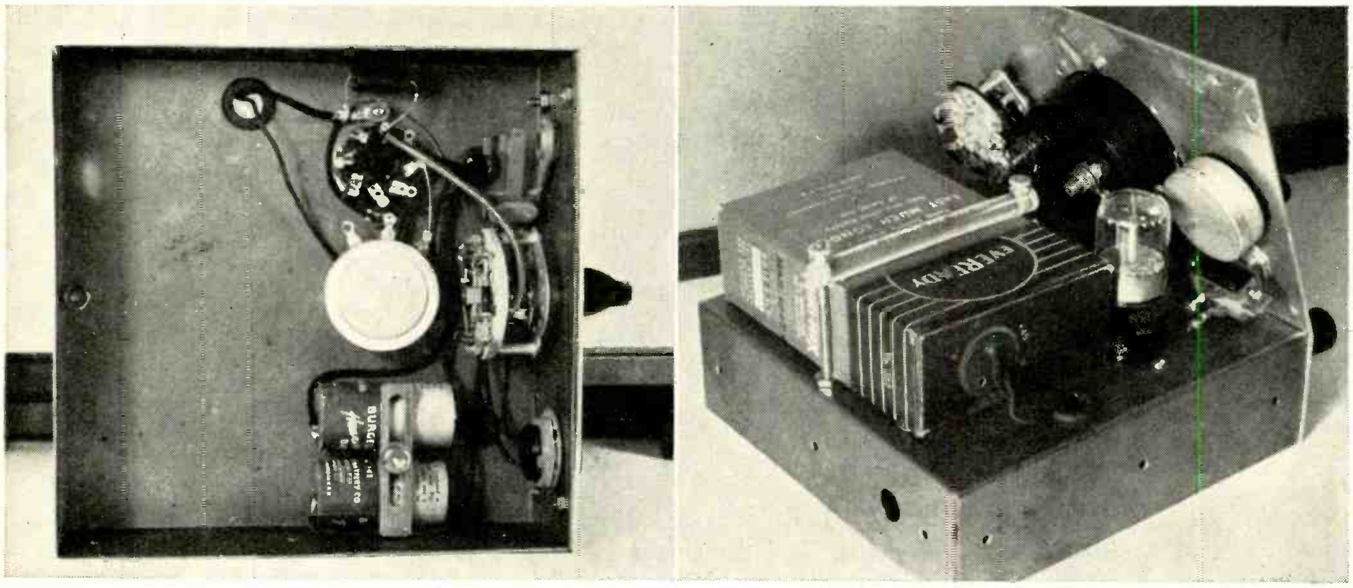
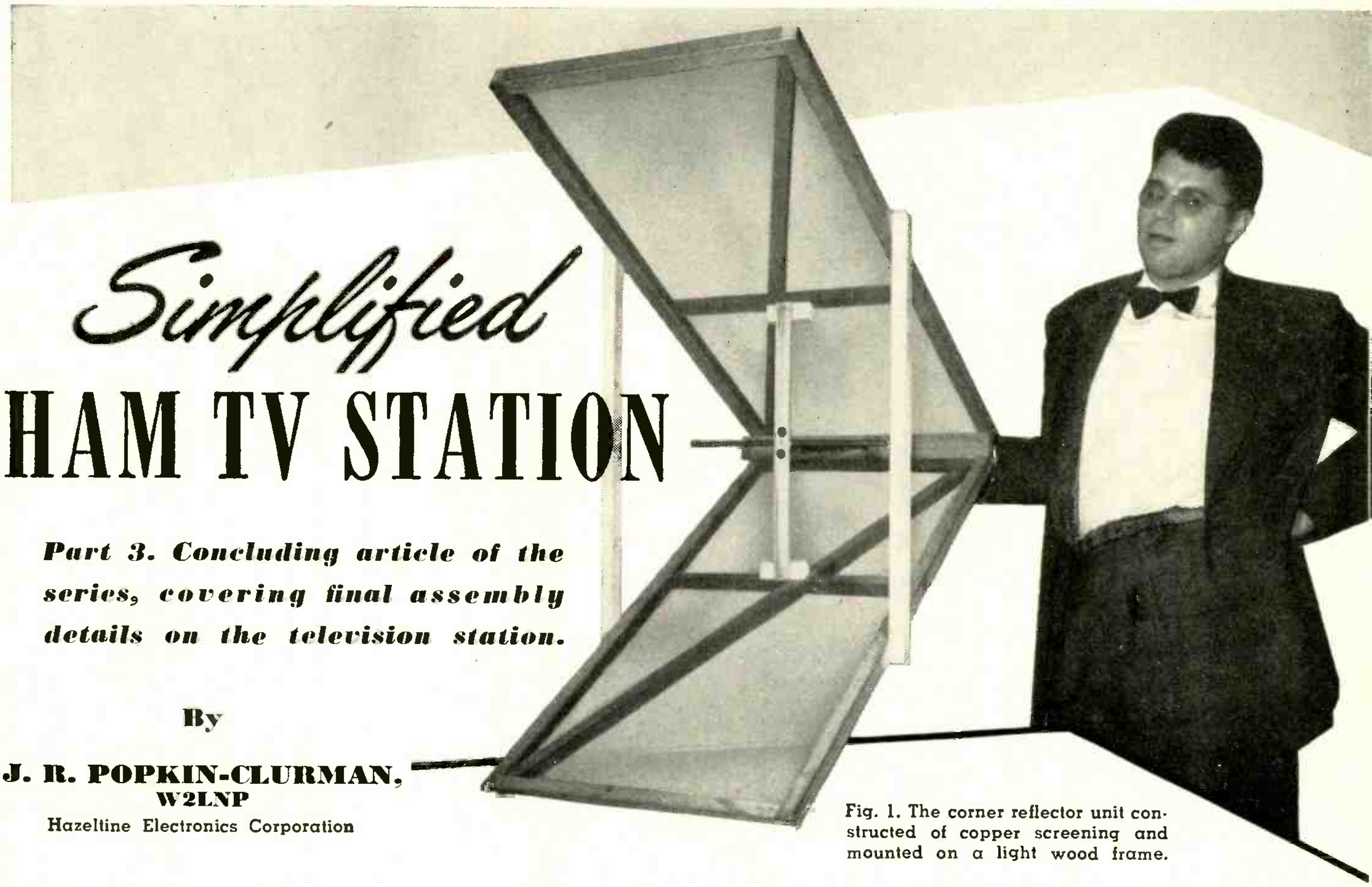


Fig. 4. Voltage calibration curve taken with switch, S_1, in the 1.75 v. position.

Fig. 5. Top and bottom views of the home-built v.t.v.m. See Fig. 1 for identification of all panel-mounted components.





Simplified HAM TV STATION

Part 3. Concluding article of the series, covering final assembly details on the television station.

By

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Fig. 1. The corner reflector unit constructed of copper screening and mounted on a light wood frame.

THE functioning of the complete amateur television system was described in the May issue while details of the picture maker, together with the blanking generator, were given in the June issue. The present article, which is the last, gives details on making the sound, mixing it with the sync and blanked video, feeding the composite signal into the modulator, and then transmitting this on the 420-megacycle band. In addition, design data is given on the transmitting and receiving antennas, which are of the high-gain, corner-reflector type. Details are given on the converter, used at the receiving end, which transfers the 420-megacycle signal to one of the unused television channels on a standard television receiver. No change is made in the television receiver for reception of these signals, because the picture as sent should conform in most respects to that received from a standard television broadcast station.

FM Sound Generator

The 4.5 mc. FM sound generator, which is Item No. 9 in the block diagram in Part 1, is shown in Fig. 2. It is a stable Hartley oscillator which is frequency-modulated by a reactance modulator. The FM deviation of this generator is at least ±35 kc. at 4.5 megacycles. The reactance tube functions as a variable inductive shunt across the oscillator tank circuit. The choice of 4.5 mc. was made so that when this generator is fed into a modulator it produces sidebands 4.5 megacycles away from a picture carrier and acts in every respect as if it were a separate transmitter. At this frequency this sideband is then frequency-modulated and has no effect upon the picture carrier at the receiving end. A television receiver does not know the difference between this received-sideband FM signal and the sound channel produced by a separate FM sound transmitter; in fact, they are identical, the only difference being the methods by which they were produced. The construction of this unit is straightforward. The only difficulty that might be encountered is getting the proper center frequency. The center frequency control is in the cathode of the 6AC7 which should be set to mid-resistance. The trimmer across the 4.5-megacycle tank should then be adjusted for 4.5 megacycles. More or less capacitance should be added to this trimmer if the frequency is not correct. The center frequency of the oscillator should be checked by listening to it on a communications receiver.

The deviation of the generator may be checked in several ways. One way is simply to apply 60-cycle modulation (6.3 volts is adequate) to the audio input jack J_1. The frequency "spread" of the buzz in the receiver as the gain control is varied will then give an indication of the deviation. An alternate way is to remove the .1-μfd. blocking condenser C_{15} from the audio input and substitute a 4.5-volt battery. By varying the gain control, the frequency shift of the oscillator may be followed as a function of the d.c. applied voltage on the grid of the reactance tube, as measured with a meter at the variable arm of the gain control R_{17}. The battery and meter are then reversed and the frequency shift in the opposite direction is followed. It will then be possible to plot a graph of deviation vs. d.c. volts input. The bias is then set at the most linear operating point. As a final check, the 4.5-megacycle generator may be used to modulate an oscillator whose frequency is in the television band and thus check the FM sound by listening to the television receiver's sound. One of the troubles that may be encountered while testing this unit is AM or FM hum. The FM hum may be the result of heater-to-cathode leakage in the 6AC7, or 60-cycle pickup on the audio input grid. The audio input leads should be well shielded as a protection against hum pickup. The 200,000 ohm resistor R_{16} (used as an r.f. choke) should be mounted directly at the grid of the 6AC7. It is suggested that the experimenter try several 6AC7 tubes and pick the one with the least hum. If AM hum is present, check the 6C4 oscillator tube and also see if there is any ripple on the "B+" feed. If the 6AC7 modulator is not on the most linear portion of its modulator characteristic, as determined by the plot of deviation vs. d.c. voltage, then the center frequency control R_{13} should be changed (using the trimmer condenser C_7 across the tank to reset to 4.5 megacycles) until the most linear operating point is reached.

To obtain the sound level required and provide for losses in the shielded lead from the generator output to the mixer, the ratio of the 4700 to 500 ohm divider R_8, R_9 may be changed until sufficient 4.5-megacycle output at the mixer is obtained. For those not wishing to send the sound with the picture or desiring to use some other communication channel, the sound generator may be eliminated.

Mixer and Modulator

If the TV receiver is to be used to furnish the sync pulses, positive as well as negative pulses are required from the receiver. The positive pulses are fed into the 12AU7 mixer tube, V_1 in Fig. 3, while the negative pulses go to the sweep generator as shown in the June issue, Fig. 2.

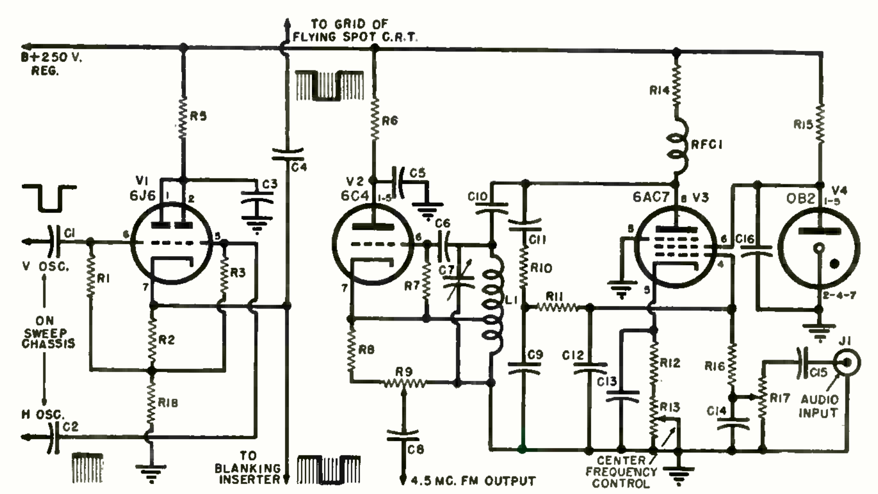
The positive pulses may be taken from the plate of the same tube which furnishes the negative pulses, as described last month.

The purpose of the mixer tube V_1 in Fig. 3 is to add together and combine the FM sound with the composite sync and the blanked video. There are several different methods of accomplishing this, only one of which is shown. The mixer circuit should be wired with the same care as was devoted to the video amplifier. The purpose of the sync delay control C_3 is to have the sync follow the start of the blanking period. The time between the starting edge of the blanking and the leading edge of the sync is called the "front porch." One purpose of the "front porch" is to obtain immunity of the sync to video pulses, occurring just before the blanking period, which might trigger the sweeps prematurely. This delay time is not critical and may be adjusted over a wide range. As a preliminary adjustment, the delay condenser should be set to half value.

EDITOR'S NOTE: *The mixer tube was added to the modulator chassis after the photograph (Fig. 9, page 57 June issue) was taken. It is placed directly to the rear of the 12AU7 shown (at left) which is the blanking inserter and clipper. If internal sync is used, the bypass condenser (C_3 in Fig. 2) is removed and a lead taken from the plates of the 6J6 blanking generator is fed to the combined positive horizontal and vertical blanking input, Fig. 3.*

Injection of the FM sound is not critical either. It may be mixed at any place in the modulator, following the sync injection, the later, the better, since there is less possibility of overloading of the amplifiers. Of course, this implies that the 4.5-megacycle signal amplitude input must be correspondingly increased. The relative levels of the various signals to be mixed are as follows: Sound—50%; Picture—35%; Sync—15%.

If the sound is being received at ample strength in the receiver, then its amplitude may be reduced and the picture and sync proportions increased correspondingly. These various levels should preferably be set up by using an oscilloscope. The scope vertical deflection plates may be directly connected to the modulator output or to any of the high-level stages, such as in the



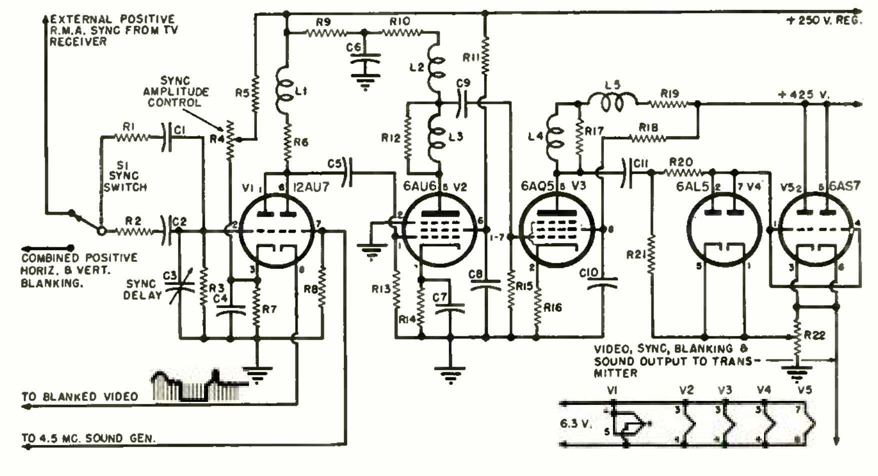
R_1—1 megohm, ½ w. res.
R_2—51 ohm, ½ w. res.
R_3—100,000 ohm, ½ w. res.
R_5, R_{14}—3000 ohm, 2 w. res.
R_6—8200 ohm, 1 w. res.
R_7—50,000 ohm, ½ w. res.
R_8—4700 ohm, ½ w. res.
R_9, R_{13}—500 ohm pot.
R_{10}, R_{11}—3000 ohm, ½ w. res.
R_{12}—500 ohm, ½ w. res.
R_{15}—10,000 ohm, 10 w. res.
R_{16}—200,000 ohm, ½ w. res.
R_{17}—500,000 ohm pot.
R_{18}—2000 ohm, 2 w. res.
C_1—.1 μfd., 600 v. paper cond.
C_2—.006 μfd., 500 v. mica cond.
C_3—120 μfd., 250 v. elec. cond.
C_4, C_{13}, C_{15}—.1 μfd. 400 v. paper cond.
C_5, C_8, C_{16}—.01 μfd., 400 v. paper cond.
C_6—50 μμfd., 500 v. mica cond.
C_7—12-125 μμfd. ceramic trimmer
C_9, C_{12}—5 μμfd. ceramic cond.
C_{10}—500 μμfd., 500 v. mica cond.
C_{11}—100 μμfd., 500 v. mica cond.
C_{14}—100 μμfd., 500 v. mica cond.
L_1—40 t. #28 s.s.e. closewound on 7/16" diam. form. Tapped 8½ t. from bottom
RFC_1—2.5 mhy. r.f. choke
J_1—Input jack

Fig. 2. Schematic diagram of blanking generator for negative input pulses and the FM sound generator unit. Operation of the 6J6 was described last month.

plate circuit of the 6AU6 driver stage V_2. The 6AQ5 tube V_3 may sometimes flash over at the base pins. Its input video voltages should be kept at a level which prevents this flashover.

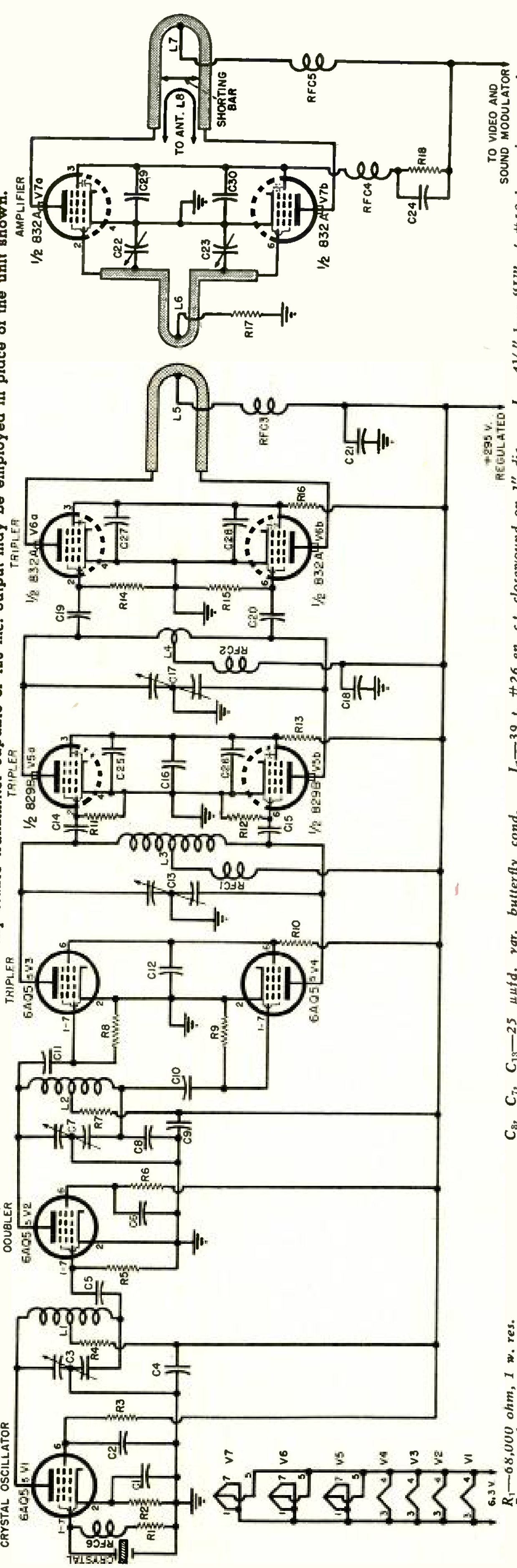
The cathode-follower 6AS7G may be replaced by three 6L6 tubes or two 807's in triode connection. The adjustment of the grid return for the 6AS7 determines the resting voltage for the transmitter carrier. The 6AL5 in the grid circuit of the cathode follower acts as a d.c. restorer. This adjustment will vary for different transmit-

Fig. 3. Schematic diagram of the mixer for video and blanking signals, FM sound, d.c. restorer, and the 6AS7 cathode modulator for the 420 megacycle transmitter.



R_1—100,000 ohm, ½ w. res.
R_2—33,000 ohm, ½ w. res.
R_3—150,000 ohm, ½ w. res.
R_4—50,000 ohm wirewound pot
R_5—22,000 ohm, 2 w. res.
R_6—1000 ohm, 2 w. res.
R_7—470 ohm, 1 w. res.
R_8, R_{14}—1000 ohm, ½ w. res.
R_9—68,000 ohm, 1 w. res.
R_{10}—3300 ohm, 1 w. res.
R_{11}—82,000 ohm, 1 w. res.
R_{12}—15,000 ohm, ½ w. res.
R_{13}, R_{15}, R_{21}—2.2 megohm, ½ w. res.
R_{16}—510 ohm, 1 w. res.
R_{17}—20,000 ohm, ½ w. res.
R_{18}—47,000 ohm, 2 w. res.
R_{19}—4000 ohm, 10 w. res.
R_{20}—33 ohm, ½ w. res.
R_{22}—10,000 ohm, 25 w. adj. res.
C_1—.001 μfd., 500 v. mica or ceramic cond.
C_2—47 μμfd., 500 v. mica or ceramic cond.
C_3—15-100 μμfd. var. ceramic, mica, or air cond.
C_4—.1 μfd., 200 v. paper cond.
C_5 C_9—.5 μfd., 400 v. paper cond.
C_6—30 μfd., 300 v. elec. cond.
C_7—500 μμfd. mica or ceramic cond.
C_8—10 μfd., 300 v. elec. cond.
C_{10}—20 μfd., 450 v. elec. cond.
C_{11}—.5 μfd., 600 v. paper cond.
L_1—40 μh. peaking coil
L_2—85 μh. peaking coil
L_3, L_4—110 μh. peaking coil
L_5—95 μh. peaking coil
S_1—S.p.d.t. sync switch

Fig. 4. Schematic diagram of the 420 mc. transmitter. Any stable transmitter capable of 420 mc. output may be employed in place of the unit shown.



R_1—68,000 ohm, 1 w. res.
R_2—390 ohm, 1 w. res.
R_3—47,000 ohm, 2 w. res.
R_4, R_7—560 ohm, 1 w. res.
R_5, R_8, R_9, R_{11}, R_{12}, R_{14}, R_{15}—82,000 ohm, 1 w. res.
R_6—8200 ohm, 1 w. res.
R_{10}—3300 ohm, 2 w. res.
R_{13}—7500 ohm, 10 w. res.
R_{16}—12,000 ohm, 10 w. res.
R_{17}—33,000 ohm, 2 w. res.
R_{18}—200 ohm, 2 w. res.
C_1, C_2, C_4, C_6, C_9, C_{12}—.01 μfd., 500 v. mica or ceramic cond.
C_3, C_7, C_{13}—25 μμfd. var. butterfly cond. (Hammarlund BFC25)
C_5, C_{10}, C_{11}, C_{14}, C_{15}, C_{19}, C_{20}—50 μμfd., 500 v. mica cond.
C_8—7 μμfd. ceramic cond.
C_{16}—.005 μfd., 500 v. mica or ceramic cond.
C_{17}—15 μμfd. var. butterfly cond. (Hammarlund BFC15)
C_{18}, C_{21}, C_{24}—.001 μfd., 500 v. mica or ceramic cond.
C_{22}, C_{23}—1-7 μμfd. ceramic trimmer cond.
C_{25}, C_{26}, C_{27}, C_{28}, C_{29}, C_{30}—Mica bypasses (built into socket)
L_1—39 t. #26 en. c.t. closewound on 1" dia. form
L_2—16 t. #20 en. c.t. closewound on 1" dia. form
L_3—10 t. #16 en. c.t. airwound ½" o.d. spaced dia. of wire
L_4—2 t. #10 bare, 1" dia. spaced ½" between turns
L_5—1¼" long "U" of 3/16" copper tubing, spaced approx. ⅞" to fit plate pins of 832A
L_6—4½" long "U" of #10 bare wire, C_{22}, C_{23} across line to ground 3" from center-tap
L_7—4½" long "U" of #10 bare wire, spaced approx. ⅞" to fit plate pins of 832A. Shorting bar ¾" wide copper strap
L_8—5" long "U" of #10 bare wire coupled to L_7
RFC_1, RFC_2, RFC_3, RFC_4, RFC_5—R.f. choke (Ohmite Z50)
RFC_6—2.5 mhy r.f. choke
4—6AQ5 tubes
1—829B tube
2—832A tubes

ters. The performance of the video-sound modulator may be checked in the same manner as an additional video amplifier stage, and may be fed into the grid of a cathode-ray monitor tube through a resistance divider network of about ten to one (27,000 to 3000 ohms is satisfactory).

Transmitter

Any stable 420-megacycle transmitter may be used. If crystal control is provided, then frequent retuning of the transmitter becomes unnecessary. The transmitter should be constructed so that all connecting leads to the r.f. circuit are as short as possible. In fact, the final amplifier and the preceding tripler have nothing but the leads themselves for the r.f. circuit. The frequency multipliers should be built so that they are easily shielded in order to prevent radiation from any stages other than the final. The type of construction shown in the photographs lends itself very well to shielding. The sockets used for 829B's and 832A's have built-in bypasses and are available in the surplus market. The use of sockets with this bypass feature is necessary in order to get proper operation in the 420-megacycle region.

The diagram of a power supply suitable for the transmitter is shown in Fig. 8. The power transformer used was an *RCA* replacement type. The unused 5.0 volt winding is connected in series with the primary so that it opposes the primary flux, resulting in a slightly higher output voltage.

The 832A tripler plate circuit is tuned by sliding the tank along the plate leads of the 832A tube. Set screws then clamp the tank to the leads at the proper position. The grid circuit of the 832A amplifier is loaded by condensers so that it is effectively ¾ wavelength long. It is inductively coupled to the plate tank of the tripler. At 420 megacycles the final tank is tuned by a shorting bar which is moved along the tank bars. A hairpin link is used to couple inductively from the tank bars to the coax cable. The losses in the final amplifier are so great that neutralization will probably be unnecessary when the transmitter is coupled to a load or the antenna. Five out of seven 832A's tried did not need to be neutralized. The other two were neutralized by inductive link neutralization. This consists of coupling a small portion of the output energy back to the input circuit in reverse phase. Capacitance neutralizing upset the tuning and could not be satisfactorily used. The low-frequency stages of the transmitter are tuned in the same manner as for normal transmitters. Each stage is peaked to give the maximum output as observed by a pilot lamp (pink bead bulb) wired to a single-turn loop and coupled in turn to each circuit. Care should be taken in tuning the 420-megacycle circuits as the proximity effect of a single-turn loop will greatly change the resonant frequency of the circuit. The tuning procedure should be done at reduced plate voltage as the transmitter shown has no bias except for grid bias produced by r.f. drive. These tubes run very hot and a fan blowing on them is desirable—even with the fan on they run pretty warm. Let the fan run for awhile after turning off the power before attempting to change tubes, etc.

It is not necessary to construct the complete transmitter if a transmitter of the SCR-522 type is available. This may be used in its original form to drive a tripler stage with output on the 420 mc. band. The tripler stage may be an 832A such as the one in the transmitter shown in Fig. 4 or a pair of 2C43 tubes as shown in the circuit of Fig. 7. No specifications are given for coils in this tripler due to the difficulty of specifying coils for these frequencies. In general, the coils L_1 and L_2 will be similar to the output stage of the 144 mc. exciter. L_3 and L_4 will be similar to the output circuit L_7 and L_8 of the transmitter shown in Fig. 4.

If the 2C43 or equivalent lighthouse tubes are used as triplers, a simple way to mount them for effective 420-megacycle operation is to punch holes for octal sockets in the chassis, and then clamp the lighthouse tubes in place by inserting them in the socket holes from *underneath* the chassis. Put the sockets on the tubes and then draw up the sockets tight by screws from the top of the chassis. This makes a very good low-inductance ground connection for the lighthouse tubes, as the tubes have built-in cathode bypasses. A pair of 2C43's as triplers will deliver about 7 watts average power, if driven by 10 watts at 144 megacycles. The construction of such a tripler is very simple. Because of the low plate capacitance existing in these tubes, the cathode-follower type of modulator is not necessary. The tripler stage may be directly plate modulated by a pair of 807's or 6L6's.

The transmitter with its modulator may be easily tested by feeding into the modulator a composite video source, such as derived from the output of a television receiver which is tuned to a local program. The output of the transmitter should be coupled to a dummy load consisting of a number of pilot lights in parallel. If a converter is not available, a small portion of the transmitter output can be rectified by a crystal and fed into the video stages of another standard television receiver, which can be used as a monitor. The bias on the modulator tube and the video input to the modulator should be adjusted to the level which gives the best picture on the monitor. This will not necessarily correspond to the best video level when the 4.5-megacycle sound subcarrier is added, but will check the over-all picture quality available. When the sound is added the levels will have to be reset.

Antenna

Since an antenna feed line has high losses at 420 megacycles, the length of the feed line should be kept as short as possible. A length of 100 feet of RG8/U gives a 4.5 db. loss, while RG59/U gives almost double this loss. A compromise between the antenna height and the feed-cable length should be selected. The antenna for 420 megacycles should be located high and as much in the clear as possible. Absorption by houses, trees, hills, and bridges is far greater at these frequencies than at 2 meters. The antenna itself should be made of heavy copper tubing ⅜" or ½" in diameter. The end of the coax cable feeding the antenna should have a bazooka on it 19¾" long (see ARRL or any antenna handbook). The corner reflector, shown in the photograph Fig. 1, is constructed with a wooden frame. The reflector's surface is made out of chicken wire (any size holes) or screening. The chicken wire is preferred, because it has the least wind

(*Continued on page* 71)

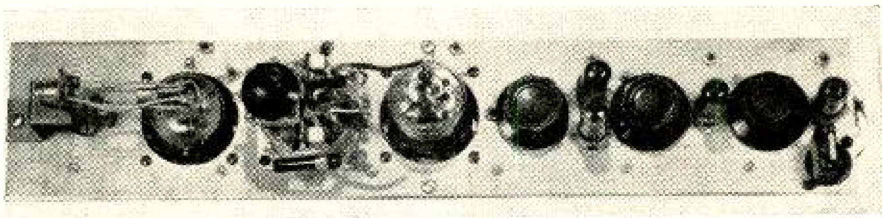


Fig. 5. Top view of transmitter. 832A tubes are used as tripler and output amplifier.

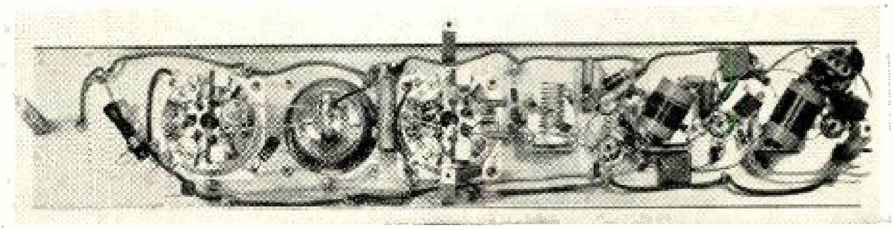
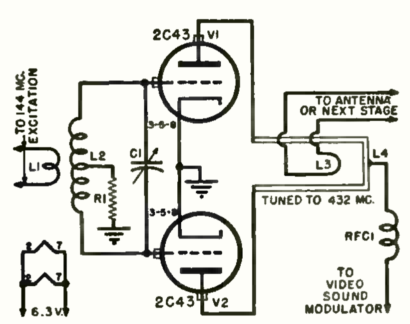


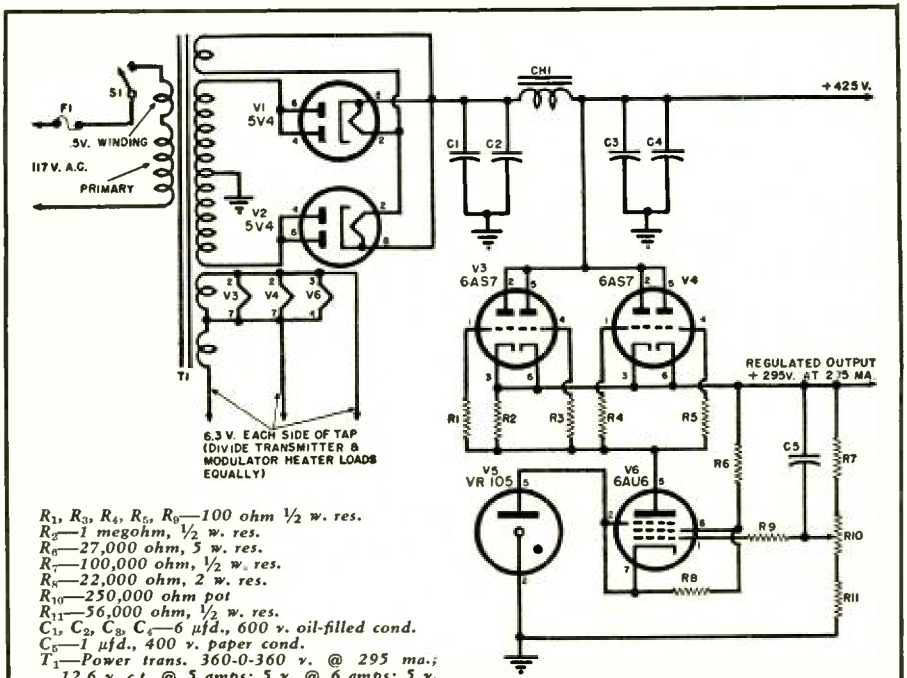
Fig. 6. Bottom view of transmitter. Sockets with built-in bypasses are used with 832A's.



R_1—10,000 ohm, 2 w. res.
C_1—See text
RFC_1—R.f. choke (Ohmite Z-460 or equiv.)
L_1, L_2, L_3, L_4—See text
V_1, V_2—2C43 tube

Fig. 7. A tripler stage, driven by a 144 mc. exciter, which may be used alternatively.

Fig. 8. Power supply capable of supplying entire transmitter, shown in Figs. 4, 5, and 6.



R_1, R_3, R_4, R_5, R_9—100 ohm ½ w. res.
R_2—1 megohm, ½ w. res.
R_6—27,000 ohm, 5 w. res.
R_7—100,000 ohm, ½ w. res.
R_8—22,000 ohm, 2 w. res.
R_{10}—250,000 ohm pot
R_{11}—56,000 ohm, ½ w. res.
C_1, C_2, C_3, C_4—6 µfd., 600 v. oil-filled cond.
C_5—1 µfd., 400 v. paper cond.
T_1—Power trans. 360-0-360 v. @ 295 ma.; 12.6 v. c.t. @ 5 amps; 5 v. @ 6 amps; 5 v. @ 2 amps (see text for data on this winding) (RCA 201T6 or equiv.)
CH_1—6 hy. @ 350 ma. filter choke, 90 ohm d.c. res.
S_1—S.p.s.t. toggle sw.
F_1—5 amp fuse

V_1, V_2—5V4 tube
V_3, V_4—6AS7 tube
V_5—VR105 tube
V_6—6AU6 tube

A High-Quality VOLUME EXPANDER

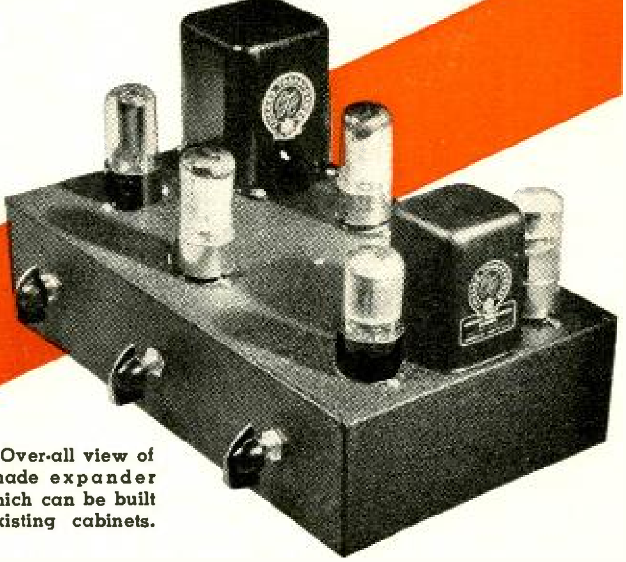


Fig. 1. Over-all view of home-made expander unit which can be built into existing cabinets.

By GLEN SOUTHWORTH

An easily-built unit which features push-pull, low distortion, and variable attack and release times.

ALTHOUGH volume expanders have been of perennial interest for years, many of the designs published have been inadequate for high quality service, and often only a limited understanding of advantages and drawbacks of these devices exists.

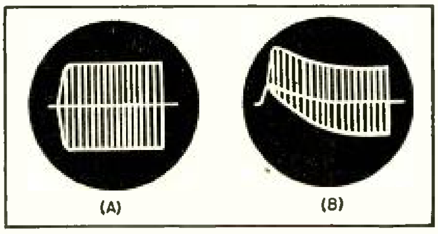
The inception of the volume expander dates back to the early thirties, a time at which poor signal-to-noise ratios in reproduction meant that a very limited dynamic range could be handled by phonograph recordings and radio broadcasts. The result of this limited range was a form of distortion disagreeable to listeners accustomed to the wide changes of dynamic intensity found in live orchestral music. As a consequence, the innovation of volume expansion was hailed with considerable enthusiasm at its first demonstration.

Since that time, two factors have tended to dim public interest in volume expansion. One of these is, of course, the vastly improved signal-to-noise ratios brought about by advances in the audio art. A second factor of probably almost as great importance is the fact that large sections of the listening public have become as accustomed to limited dynamics as to limited frequency response. Nevertheless, due to the revived interest in high quality, the expander should be considered as a potentially desirable device, especially by those who may own a considerable collection of the older 78 r.p.m. recordings.

A number of different methods may be used to secure volume expansion, or conversely compression, but in general the most widely used method is to rectify and filter a portion of the input signal and apply the resulting d.c. voltage to one of the elements of a variable mu tube, consequently changing the gain of the system in accordance with the level of the input signal. Most of the circuits of this nature are single-ended, resistance-capacitance coupled devices and suffer from a number of inherent defects. One of the chief disadvantages is the fact that the time constants of the expansion must usually be of such a nature that it takes a considerable amount of time, possibly several seconds, to build up to full expansion. This effect is particularly objectionable on passages containing sudden orchestral peaks and can entirely alter the dynamic effects of the music. Likewise, single-ended operation may mean appreciable second harmonic distortion, due to the nonlinear characteristic of the variable mu tube, and introduce thumps or blocking when used with an amplifier with superior low frequency response.

The push-pull expander circuit, shown in Fig. 3, overcomes nearly all of the objections previously mentioned, and is patterned in large part after the commercial limiting amplifiers used to produce the initial volume compression. A number of factors were considered in the design shown, first of which was the ability to achieve relatively great amounts of expansion, a range of twenty decibels or better being easily obtainable. Secondly, that harmonic and other distortion products such as "thumps" should be as low as practicable for use with associated high quality equipment, and, third, that a very low attack time should be available as well as provision for variable attack and decay rates.

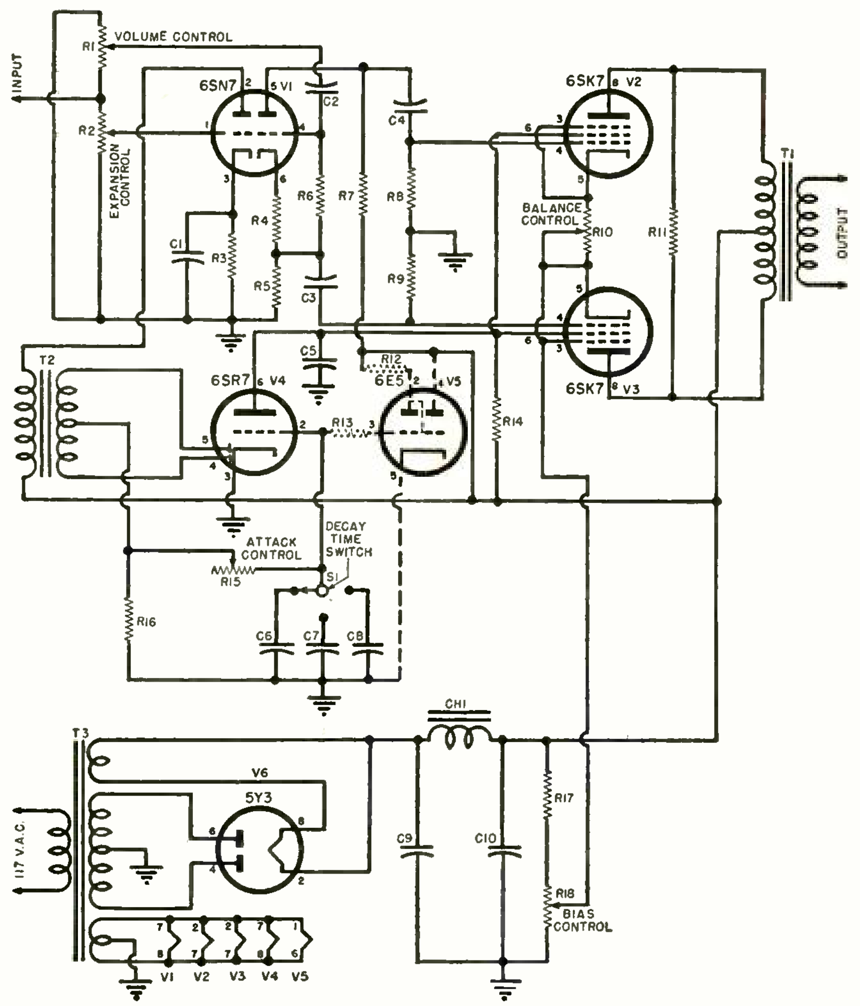
Fig. 2. Oscilloscope traces showing the correct (A) and incorrect (B) balancing of expander output stages. A tone burst obtained by keying an audio oscillator is used in making circuit adjustments.



The time constants of the expander circuit are determined by the values of the rectifier load resistor, the filter condenser, and the impedance of the rectifier as well as the audio transformer and power source. The attack time of the expander will be dependent upon value of the filter condensers, C_6, C_7, C_8, and the series charging resistance. The release time will be controlled by the value of these filter condensers and the value of the load resistor R_{16}. In general, these values should be chosen for a release time of several seconds to prevent "choppiness" in the reproduction. For certain types of music, such as band, a shorter period of decay seems satisfactory and unusual effects can be produced, such as the apparent effect of very dead acoustics due to the rapid decrease in gain effected. As mentioned previously, the attack time will be dependent upon the values of C_6, C_7, C_8 and the series charging resistance. With the circuit shown, a minimum attack time of approximately one two hundredth second may be achieved when C_7 equals .25 μfd. This attack time may be greatly lowered, if desired, by decreasing the impedance of the charging circuit. One well-known commercial limiting amplifier achieves a very low attack time by use of push-pull 6Y6 tubes driving a 6X5 rectifier. Extremely low attack times are, however, of questionable value in an expander, particularly where vinylite records are being reproduced, due to the fact that ticks or pops in the recording may initiate expansion with corresponding undesirable variations in level. Similarly, with some recordings it may be desirable to introduce a relatively long attack time to reduce the effect of sudden peaks of short duration. The schematic shows provision for varying both attack and decay rates.

In many expanders, expansion is achieved by applying a positive voltage to the control grid of the variable mu tube. This has the disadvantage that the grid may be driven positive by peaks, and as a result, in the design shown, the control voltage is applied to the screen grids of the variable mu tubes and the circuit set up in such a way that the screen voltage will not increase beyond a certain point no matter how hard the circuit is driven. This has the further advantage that only fixed amount of expansion can be obtained, the amount of expansion being determined by the voltage applied to the cathodes of the two 6SK7 tubes. If very little grid bias is generated, then little or no expansion will occur, however, with grid bias near the cutoff point, twenty to thirty db. expansion may be achieved. Although it is a temptation to bypass the cathode resistor with an electrolytic condenser in order to reduce possible hum and achieve increased gain, this is not necessarily desirable as it may cause overexpansion on sudden peaks, due to the change in cathode current being momentarily retarded. A similar effect is sometimes found in commercial compressors, in which the initial portion of a sudden high level passage is overcompressed. This, of course, produces a dynamic distortion which even a very fast acting expander can not be expected to correct entirely.

A second factor of importance is that the two variable mu tubes in the expander be adequately balanced. Failure to do this may result in increased distortion and thump as well as possible poor frequency response. Although in most commercial instruments, tube balancing is achieved by adjusting the plate currents to identical values under steady state conditions, a more satisfactory method seems to be through the use of an oscilloscope and an interrupted sine wave source. As shown by the accompanying oscilloscope patterns, Fig. 2, the expansion caused by a sudden tone burst may result in a strong d.c. component and harmonic distortion during the initial portions of the expanded signal in an unbalanced system (B). The pattern (A) shows the system balanced to provide symmetrical output. The circuit diagram illustrates the balancing arrangement used by the author, in which a five thousand ohm variable resistor, R_{10}, is inserted in the cathode lead of one of the tubes. Adjustment of this control provides additional grid bias and introduces some degeneration, but as it controls only one side of the circuit, the locations of



R_1, R_2—500,000 ohm pot.
R_3—1000 ohm, ½ w. res.
R_4—1500 ohm, ½ w. res.
R_5, R_7—100,000 ohm, ½ w. res.
R_6, R_8, R_9, R_{14}—500,000 ohm, ½ w. res.
R_{10}—5000 ohm, 10 w. wirewound var. res.
R_{11}—50,000 ohm, 1 w. res.
R_{12}—1 megohm, ½ w. res.
R_{13}—2 megohm, ½ w. res.
R_{15}—1 megohm pot.
R_{16}—3 megohm, ½ w. res.
R_{17}—10,000 ohm, 5 w. wirewound res.
R_{18}—5000 ohm, 10 w. wirewound var. res.
C_1—25 µfd., 25 v. elec. cond.
C_2, C_5—.01 µfd., 400 v. cond.
C_3, C_4—.02 µfd., 400 v. cond.
C_6—.1 µfd., 200 v. cond.
C_7—.25 µfd., 200 v. cond.
C_8—.5 µfd., 100 v. cond.
C_9, C_{10}—12 µfd., 450 v. elec. cond.
CH_1—10 hy., 40 ma. d.c. filter choke
S_1—S.p.3-pos. rotary sw.
T_1—Interstage trans., 20,000 ohms c.t. into 50,000 ohms (Chicago Transformer BI-6 or equiv.)
T_2—Interstage trans. 1:1 ratio (Chicago Transformer IN-16 or equiv.)
T_3—Power trans. 225-0-225 v. @ 40 ma.; 5 v. @ 2 amps.; 6.3 v. c.t. @ 2 amps. (Chicago Transformer PCC-40 or equiv.)
V_1—6SN7 tube
V_2, V_3—6SK7 tube
V_4—6SR7 tube
V_5—6E5 tube
V_6—5Y3 tube

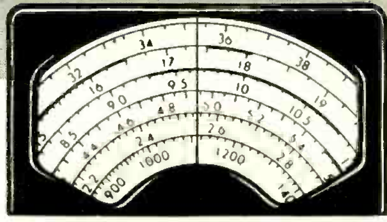
Fig. 3. Diagram of expander featuring push-pull operation and variable attack and decay rates.

the two 6SK7 tubes may need to be reversed in order to achieve correct balance. In the event that a scope is unavailable, the point of balance may be roughly determined by playing a piece of music with the expansion control on but with no signal applied to the grids of the 6SK7's. The balancing control may then be adjusted for minimum noise or thump introduced by the expander action.

As it may be desired to adapt this general circuit to other requirements, or to incorporate it in new equipment, a number of other considerations might be mentioned. In general, the factors that are of importance in an expander, such as balanced circuits, attack and decay rates, etc., hold true when designing a good volume compressor for communications or recording work. In fact, if desired, the circuit shown may be easily modified for use as a compressor by reconnecting the audio rectifier section so that a positive voltage is applied to the grid of the 6SR7 tube, although this will require a separate rectifier. Another method is to take the negative d.c. potential already available and apply it to the control grids of the 6SK7 tubes. For best results in this case, the screen grid voltages should be well regulated and proper adjustments made in the cathode bias. If desired, the 6SK7's may be triode connected although it will probably require a higher compression voltage. To secure a delay in order that compression does not occur until a certain level is reached, a negative voltage may be inserted in series with the output of the audio rectifier. In the expander design as shown, some delay voltage is

(*Continued on page* 96)

International SHORT-WAVE



***Compiled by* KENNETH R. BOORD**

MSF is a *new* frequency check station established at Rugby, England, to improve calibration facilities and provide frequency checks in the European areas. Is still experimental and is restricted in operations due to possible mutual interference with WWV, Bureau of Standards station in Washington, D.C., USA. MSF operates on 60 kc. at 0529-0545; on 5.000 at 0044-0115, and on 10.000 at 0129-0200. Reports are requested to the Director, National Physical Laboratory, Teddington, Middlesex, England. Technical responsibility has been assumed by the G.P.O. Constant monitoring is maintained at the National Physical Laboratory. (Patrick, England, Radio Australia, others)

* * *

IMS Report

Edgar W. Parmenter, general manager, International Monitoring Service, San Carlos, California, writes: "The IMS would like to acknowledge and thank the many hundreds of applicants who have offered their services to IMS's organization. The office of the coordinator is working day and night to attempt to make the utmost practical use of every applicant who has filed a formal application. We would like to announce that it will take up to 30 days after receipt of application before action can be taken upon the volunteer. We are still awaiting further applications from the U.S. territories or other possessions—particularly from the Territory of Hawaii."

* * *

Swedish DX Sessions

Summer schedule for *"Sweden Calling DX-ers"* is 0215-0230, 6.065, 15.155; 1015-1030, 10.780, 15.155; 2015-2030, 10.780, 15.155, *all on Saturday only.* (Skoog, Sweden)

* * *

This Month's Schedules

(*NOTE:* At the time this was compiled, some stations had not yet gone on Summer Time; in such cases you may find schedules by now have been *advanced by one hour.*—KRB)

Angola—*Radio Diamang,* CR6RG, 8.242, noted 1355 to sign-off 1430; heard another day signing on 1330; severe CWQRM in England. (Pearce) At the time this was compiled, Boice, Conn., reported *Radio Clube do Huambo,* 11.925, still good signal around 1330 to 1530 sign-off; some CWQRM at times.

Australia — VL13, 9.500, Sydney, noted 0100 with BBC news relay. (Leary, Ind.)

Arne Skoog, DX Editor of "Radio Sweden," tunes the short-wave bands while at the microphone of the Swedish Broadcasting Corporation. According to Arne, he feels that it is good business for DX-ing to tell the listeners on the domestic network what is to be heard on s.w. by means of "sweeps" at the open mike.

Austria—Blue Danube Network, approx. 9.533, noted in Britain 0400 with news; later on is buried by HER4, 9.535, Berne. (Pearce)

Azores—Ponta Delgada is now on 11.094, 1400-1500; 4.845, 1600-1800. (Pearce, England)

Bechuanaland—The N.Z. DX Times says Nafeking is heard on approx. 8.240 to sign-off 1430; believed to come on air 1200.

Brazil—PRL5, 11.950, Rio de Janeiro, heard 0545; news in Portuguese 0600. (Cushen, N.Z.)

Canary Islands—EA8AB, 7.518 (approx.), noted signing on with orchestral music 1700; news in Spanish 1750; off 1800 with "Viva Franco! Arriba Espana!" and music. (Pearce, England)

China—Dilg, Calif., writes: "The Communist-Chinese outlets made many changes recently; I believe that 10.260 and 15.068 which announce as 'Radio Peking' are used in the Overseas Service while the others may be in the Home Service; have noted after the *English* (around 0830-0850) they use what seems to be Thai at 0900-0930; at 0930-1000 a language unknown, but 1000-1030 seem to use Burmese, with sign-off 1030. At 0800-0830, most of the Communist-Chinese channels take the same Chinese program (talk); even Shanghai, 5.985, takes this program which is a relay of 10.260. There is a Chinese station on approximately 5.910 which also takes this 0800-0830 Chinese session, but I am inclined to believe it is a Manchurian outlet, probably Mukden formerly on 3.500; just above this—around 5.920—is an unknown, very weak with bad QRM, has a Russian flavor, but is too weak to copy; not confused with 5.940 which is a strong Russian in California." (While the 15.068 outlet says "Radio Peking," I believe this may be Chungking or Nanking with a relay from Peking.—KRB)

Colombia—Stark, Texas, believes the Colombian outlet on approximately

(*Continued on page* 122)

(Note: Unless otherwise indicated, all time is expressed in American EST; add 5 hours for GCT. "News" refers to newcasts 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.

The "Sumodget" TRANSMITTER

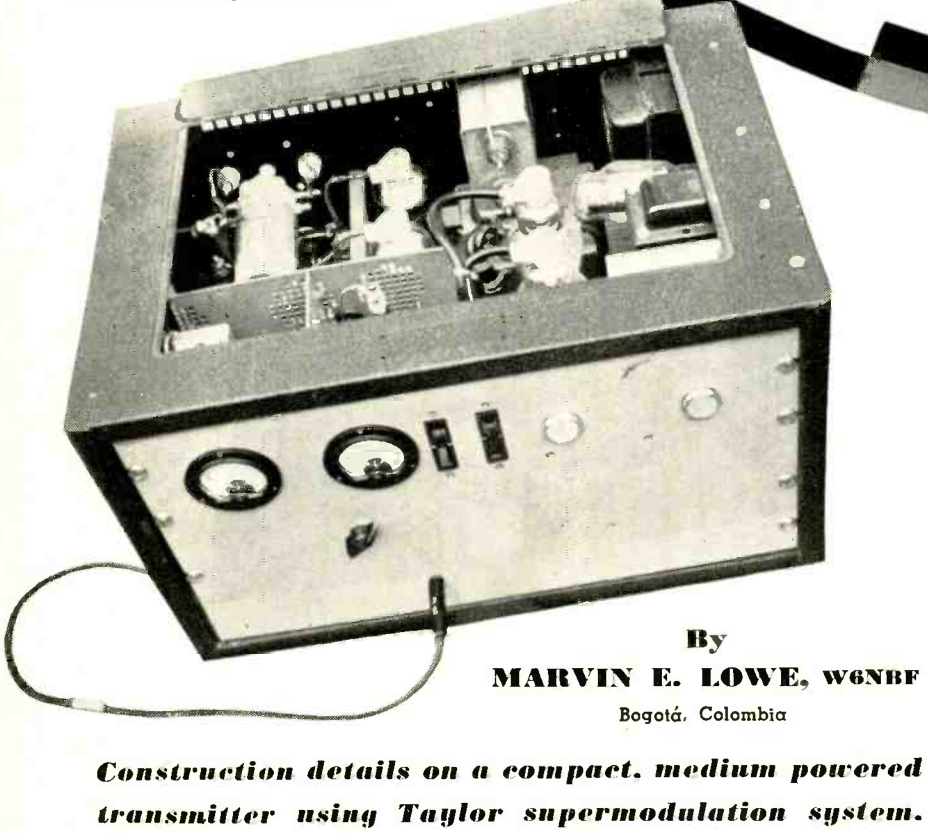


Fig. 1. A receiver-type cabinet houses the complete transmitter.

By
MARVIN E. LOWE, W6NBF
Bogotá, Colombia

Construction details on a compact, medium powered transmitter using Taylor supermodulation system.

"QUALITY items come in small packages" is an old saying, which the author feels adequately covers the transmitter to be described here.

Supermodulation has been used by the writer in two transmitters during the last several months and the results have been almost phenomenal. During hundreds of QSO's over HK3ME the fellows on the "other end" have been very enthusiastic and flattering in their reports on the signal and a great majority of them have shown great interest in the supermodulation system. Most of them have asked a great many questions regarding it. Many had read the two articles written by the inventor and patent owner, R. E. (Bob) Taylor, in the September and October, 1948, issues of RADIO & TELEVISION NEWS but, although intrigued, most found them to be "way over their heads." It appears that fewer had read Rufus Turner's article in the June, 1949, issue principally because it described a transmitter of very low power while most were interested in transmitters in the medium power range, 250 to 500 watts input. It was with this in mind that the transmitter shown in Fig. 1 was designed and built.

The first of the two transmitters to be built by the author is believed to be the first in amateur service in any part of the world outside of the U. S. and Canada to use supermodulation. This transmitter was first constructed to use conventional high-level plate modulation, later changed to NBFM and screen-grid modulation. From that set-up it was then modified to supermodulation. The author is an inveterate experimenter.

A great reduction of size and equipment is possible when a transmitter is designed and built to use the supermodulation system and the author feels that this is the most practical advancement to come to ham radio in many years. Just note some of the advantages of this system as listed below:

1. Substantial (up to 50%) reduction of components for more power output as compared to conventional plate, or high-level modulation, while still retaining all of the advantages of AM.

2. About four times the audio or sideband power, as compared with conventional plate modulated transmitters, with no over-modulation or peak clipping. See Taylor's articles, mentioned before, for full explanation.

3. Virtual elimination of BCI and TVI because of absence of audio splatter, shot-effect, or negative peak clipping.

4. No audio power is developed thus eliminating the extra-heavy duty power supply or extra power supply necessary for the conventional audio power tubes.

5. Only positive audio is generated and the carrier is automatically suppressed, or compressed, during modulation, resulting in greatly decreased receiver noise and practical elimination of heterodynes at the receiving station. This makes for more 100% QSO's regardless of power.

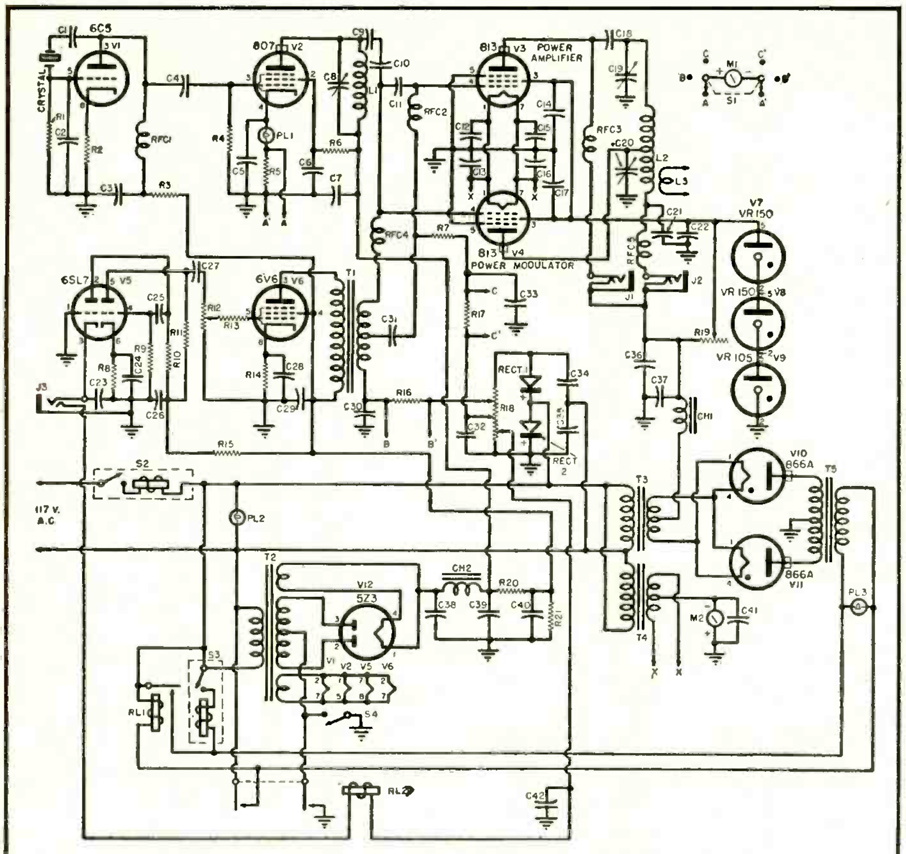
6. Unlike the single-sideband-suppressed-carrier no additional tubes, filters, phasing networks, etc., are necessary to accomplish carrier suppression, nor is any special receiver, modification thereof, or handling necessary to receive a supermodulated signal.

7. Like narrow-band frequency modulation, very little audio voltage is necessary to accomplish supermodulation but, unlike NBFM, the signal is tuned in on a conventional receiver in a normal manner and without any type of adapter or "gadget."

8. Final tubes, the power amplifier (PA) and the positive modulator, may be operated at their full c.w. ratings because no audio voltage is added to the final tank circuit or applied to the final tubes.

9. Only one high-voltage power supply is needed, having a current rating capable of handling the two tubes in the final at their c.w. ratings. This eliminates the high-voltage, high-power, power supply or the additional higher current rating normally necessary for high-level modulated finals using audio power modulator tubes.

10. Supermodulated signals occupy only about one third as much of the frequency spectrum as does a conventional AM transmitter. HK3ME has been checked here in Bogotá, Colombia by HK3AB, and others, while being 100% modulated by a 3000 cycle sine wave and the signal measured 4 kilocycles wide, with the signal pinning the needle on the receivers. All conscientious amateurs should be interested in this feature as it will allow almost three times as many phone stations to occupy our crowded bands if all were using similar equipment.



R_1—50,000 ohm, 1 w. res.
R_2, R_8—1000 ohm, 1 w. res.
R_3, R_4, R_{15}—20,000 ohm, 1 w. res.
R_5—10 ohm, 1 w. res.
R_6—25,000 ohm, 10 w. wirewound res.
R_7—5000 ohm, 20 w. wirewound res.
R_9—220,000 ohm, 1 w. res.
R_{10}, R_{11}—180,000 ohm, 1 w. res.
R_{12}—250,000 ohm pot.
R_{13}—10,000 ohm, 1 w. res.
R_{14}—470 ohm, 2 w. res.
R_{16}, R_{17}—20 ohm, ½ w. res.
R_{18}—15,000 ohm, 100 w. wirewound res. (with 3 sliders)
R_{19}—20,000 ohm, 200 w. wirewound res. (with slider)
R_{20}—3000 ohm, 100 w. wirewound res.
R_{21}—15,000 ohm, 25 w. wirewound res.
C_1, C_3, C_6, C_7, C_{12}, C_{13}, C_{15}, C_{16}, C_{25}, C_{27}, C_{36}, C_{41}—.01 μfd., 500 v. mica cond.
C_2, C_{11}—100 μμfd., 500 v. mica cond.
C_4—50 μμfd., 500 v. mica cond.
C_5—10 μfd., 150 v. elec. cond.
C_8—100 μμfd. double-spaced var. cond.
C_9, C_{10}—250 μμfd., 5000 v. mica cond.
C_{14}, C_{17}—.001 μfd., 1000 v. mica cond.
C_{18}—.002 μfd., 2500 v. mica cond.
C_{19}, C_{20}—150 μμfd., 6000 v. var. cond.
C_{21}—.002 μfd., 12,500 v. mica cond. (5 amps r.f.)
C_{22}, C_{38}, C_{39}—8 μfd., 600 v. elec. cond.
C_{23}, C_{29}, C_{33}—.001 μfd., 500 v. mica cond.
C_{24}, C_{28}—10 μfd., 50 v. elec. cond.
C_{26}—.5 μfd., 600 v. cond.
C_{30}, C_{31}—2 μfd., 400 v. cond.
C_{32}—4 μfd., 400 v. paper cond.
C_{34}, C_{35}, C_{40}—10 μfd., 450 v. elec. cond.
C_{37}—4 μfd., 2500 v. oil-filled cond.
C_{42}—20 μfd., 150 v. elec. cond.
RFC_1, RFC_2, RFC_4—2.5 mhy., 125 ma. r.f. choke
RFC_3—2.5 mhy., 500 ma. r.f. choke
RFC_5—All-band, 800 ma. r.f. choke
T_1—Universal 10 w. driver trans., pentode plate to class B grids
T_2—Power trans., 550-0-550 v. @ 200 ma.; 6.3 v. @ 5 amps.; 5 v. @ 3 amps
T_3—Fil. trans., 2.5 v. c.t. @ 10 amps.
T_4—Fil. trans., 10 v. c.t. @ 11 amps.
T_5—Plate power trans., 1775-0-1775 v. @ 400 ma.
CH_1—10 hy., 400 ma. filter choke
CH_2—10 hy., 200 ma. filter choke
RL_1—S.p.s.t. relay, 117 v. a.c. @ 30 amps.
RL_2—D.p.s.t. relay, 30 v. d.c. @ 20 ma.
S_1—D.p.3-pos. rotary sw.
S_2, S_3—117 v. a.c. @ 15 amps. circuit breaker
S_4—S.p.s.t. toggle sw.
L_1, L_2, L_3—See text
J_1, J_2—Closed circuit jack
J_3—3-circuit jack
Rect.$_1$, Rect.$_2$—100 ma. selenium rectifier
PL_1—120 v., 15 w. Mazda lamp
PL_2, PL_3—120 v. candelabra lamp
Crystal—For operating band (see text)
M_1—0-50 ma. d.c. meter
M_2—0-500 ma. d.c. meter
V_1—6C5 tube
V_2—807 tube
V_3, V_4—813 tube
V_5—6SL7 tube
V_6—6V6 tube
V_7, V_8—VR150 tube
V_9—VR105 tube
V_{10}, V_{11}—866A tube
V_{12}—5Z3 tube

Fig. 2. Schematic diagram of the complete transmitter including power supplies.

Two other factors, strictly local, prompted the building the above mentioned transmitters (others are being planned). Bogotá is located at 9000 feet above sea-level and the relatively rarified air places modulation transformers under a definite handicap due to the fact that they are normally designed for more "normal" altitudes. The transmitters are also used down in the steaming hot jungles where ambient temperatures are very high, as is the humidity. In both cases the modulation transformers in conventional AM transmitters are the main source of trouble due to burnouts resulting from high surges of audio power. Supermodulation eliminates this transformer along with the inherent losses present in this piece of apparatus and the losses always present when transferring the audio power from the modulation transformer to the r.f. load.

In the interest of brevity the author especially recommends a careful rereading of the previous articles, mentioned before, for most of the answers to the theoretical questions which may come to his mind. This article will be confined generally to explaining those parts of the circuit and answering the questions on the operational characteristics most frequently asked.

The Circuit

The circuit of the transmitter to be described is shown in Fig. 2. This transmitter is operated on 40 meter phone *(Editor's Note: The 40 meter band is not open to phone operation in U.S.A. and possessions.)* but, as may be seen, the exciter up through the plate tank circuit of the 807 stage is conventional, except PL_1 in the cathode circuit (to be explained later), and any suitable exciter with the same output could be used, terminating at the frequency on which it is desired to operate the final. The original transmitter built by the author operates on 10, 11, and 20 meter phone using a 6F6 Clapp e.c.o., 6F6 doubler, 807 driver amplifier and 813's in the PA and positive modulation stages.

PL_1 is a 15 watt tungsten filament lamp of the 110-120 volt variety and has been used by the writer in all 807 r.f. stages constructed in the past few years. It is a very versatile item as it gives absolute protection to the 807 tube in case of failure of excitation or off-resonance tuning because of tungsten's characteristic of increasing resistance with an increase in current, thus, if the plate current soars for any reason the bias on the tube also increases and holds the plate current within safe limits. Unlike a fixed cathode resistor, very little net plate voltage is subtracted from the plate supply when the plate circuit is in resonance. Also it has never been found necessary to use any parasitic suppressors with an 807 when using this lamp. Apparently the inductance of the lamp has some effective suppression action.

C_9 looks superfluous but it was found that more than sufficient excitation was available from the 807 stage and this condenser served to reduce the excitation. Originally C_{10} and C_{11} were 100 μμfd. variables but these were later replaced by fixed mica condensers.

Two separate variable condensers are not necessary in the final tank circuit and a split-stator condenser could have been used but considerable "cut and try" was found necessary in the first transmitter in order to find the proper point to connect the positive modulation circuit, therefore, two single-section condensers were employed in this transmitter in order to use a center-tapped coil and dip each tube separately. Some interaction is present between the two circuits but adjustment is simple.

It is important that the screen-grid supply for the 813's be regulated or be a completely separate supply with good regulation. Erratic operation will result if this is neglected.

The two-tube speech section, consisting of the 6SL7 and 6V6 tubes, is conventional and is designed for use with a T17-B surplus single-button carbon microphone with push-to-talk operation. Any speech amplifier with comparable output will be satisfactory.

Switches S_3 and S_4 are test switches and will be left open for push-to-talk operation. It will be noted that the bias will be changed slightly on the final tubes when push-to-talk operation is compared to "test" operation. This change will be slight, however, and will not materially affect operation. The entire control system may be changed for that matter because the entire transmitter is conventional except for the grid and plate circuits of the final.

The bias supply shown provides 200 volts. With this type of circuit it is not possible to connect the transmitter to an earth ground and the constructor may desire to use another type. Any supply of the same rating may be used in its place.

The 0-500 ma. meter in the secondary center-tap of T_4 reads the combined currents of both 813's. Jack J_1 is provided for insertion of a 0-300 ma. meter to read the plate current of the PA tube, while J_2 is for the same purpose with the positive modulation tube. The jacks are used only during the initial tune-up operation and subsequent periodical checking. The common meter (0-500 ma.) serves adequately for regular operational indication.

While T_5 furnishes only 1500 volts to the plates of the PA and positive modulation tubes it is entirely possible, and permissible, to use 2000 volts on 813's in this system of phone transmission, thereby increasing the input to the final to approximately 750 watts. No changes need be made except to increase the value of R_{19} and the available bias voltage.

C.W. Operation

Although not used in this particular transmitter, c.w. operation may be accomplished by very simple means. It is only necessary to connect a d.p.d.t. switch or relay so that the bias tap for the positive modulation tube is switched to another tap on the bias supply bleeder to reduce the bias voltage to a value just slightly more than that furnished the PA tubes. The other set of contacts should switch the 6V6 grid directly to ground.

This is another great advantage of the supermodulation system. Only two or three small low-level audio tubes, depending on the individual speech-amplifier used, are standing idle during c.w. operation. *Not* about half of the equipment as is the case with conventional AM transmitters.

Your own preferred method of keying may be used.

Construction

The photographs of the transmitter clearly show many of the construction details although it is felt that most readers will have their own pet ideas which will be just as good, therefore, little will be said regarding this feature. Also the author believes that any person having the experience necessary to build and operate a transmitter of this power rating will be capable of working out all details. After all, the same rules apply here as in any other transmitter.

The usual precautions for beam power tubes should be observed in this transmitter. Isolation of grid and plate circuits, leads as short as possible, and adequate bypassing are basic points to watch.

It is advisable to check for oscillation and parasitics before attempting any of the operating adjustments.

Several articles covering the taming of beam tubes have been published.

L_1, the 807 plate tank coil, is entirely conventional and will be the same as normally used with C_8 to resonate at the desired frequency. Data may be obtained from any radio handbook or commercially manufactured coils may be used.

L_2, the final tank coil, is definitely unconventional as to its inductance and no available coil tables will suffice in its direct calculation. Roughly speaking it may be said that a coil designed to resonate at twice the frequency desired, with the variable condensers used, will be OK. The coil shown in this particular transmitter is a 500 watt surplus coil designed to operate at 9-10 megacycles with a 200 $\mu\mu$fd. single-section condenser in a parallel-tuned circuit.

If a split-stator condenser is used in the final tank circuit it will be necessary to find the proper point to connect the stator of the condenser and the plate of the positive modulation tube by the "cuss and try" method. This connection must be made on the coil at a point where the plate current of each tube, as measured in jacks J_1 and J_2, dips at the same setting of the tank condenser.

In the original transmitter a split-stator tank condenser having two 50 $\mu\mu$fd. sections is used. For twenty meters the tank coil has 6 turns, 2½ inches in diameter, 6 inches long, constructed from ¼ inch copper tubing and tapped at 2½ turns from the d.c. or power supply end. The ten meter coil, also ¼ inch copper tubing, has 3 turns, 2 inches in diameter, 6 inches long and tapped at 1¼ turns. As in practically all cases, individual layouts may change these dimensions somewhat.

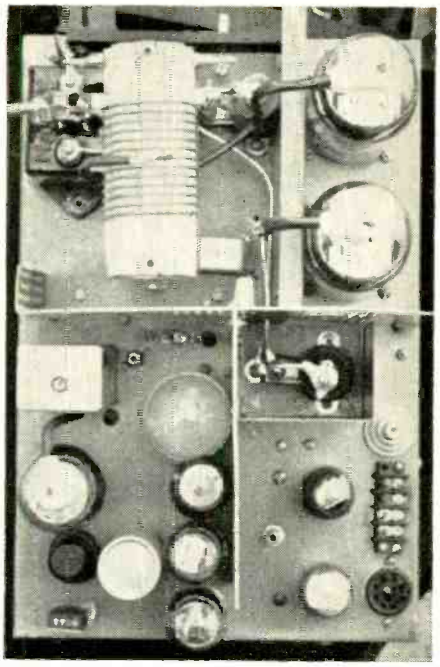
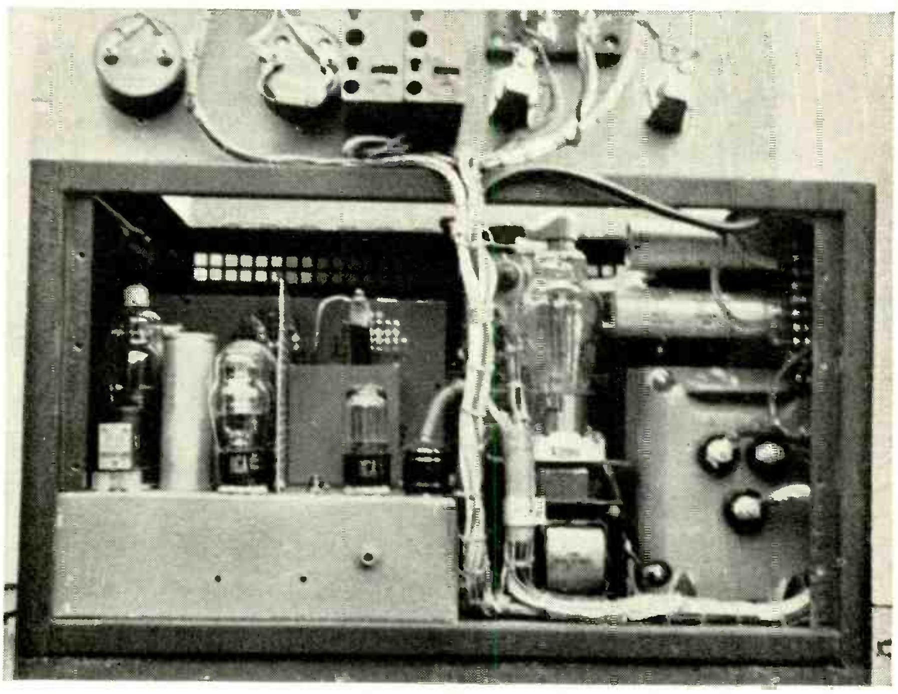


Fig. 3. Top view of r.f. and modulator section.

Adjustment and Operation

After double-checking all connections for correctness you are now ready to close S_2. After sufficient warm-up time has been allowed for the filaments (3 minutes is always desirable where mercury-vapor tubes are used), close S_4 and, with S_1 on position A, adjust C_8 to resonance as indicated

Fig. 4. Front view of the transmitter with panel removed to show the parts layout.



by a dip in the reading on the 0-50 ma. meter.

Plug the microphone into J_3 and test the speech amplifier by any conventional means. A pair of headphones connected through a .01 μfd., 500 volt condenser from the 6V6 plate to ground will do. A small PM speaker connected in the same manner will also serve. Open S_4.

Next adjust the bias bleeder (R_{18}) approximately as follows: Upper tap to about 150 volts; center tap to about 90 volts; and the lower tap to about 15 volts.

Close S_4, then S_3 and with a 0-300 ma. meter plugged into J_1 bring the PA circuit into resonance, then transfer the 0-300 ma. meter to J_2 and do the same to the positive modulation circuit. Open S_3 and S_4.

Connecting the antenna or antenna coupling network, as the case may be, and proceeding to load the final is apparently the point where most amateurs run into trouble with supermodulation.

The writer has found that very few new or recently licensed hams know anything about grid modulation and most of the "old-timers" have forgotten most of its characteristics. Supermodulation is a form of grid modulation but don't let what they say in textbooks about grid modulation (critical adjustments, poor stability, low efficiency, etc.) worry you because none of these bugaboos are present in this system. However, some of its characteristics are present and must be observed.

First is the excitation requirement, which is approximately halfway between the minimum required for c.w. and the minimum required for conventional AM phone.

Second is the loading requirement in order to obtain upward modulation. L_3 must be proportioned and placed so that the antenna will fully load the final tank circuit. In both transmitters L_3 contains 4 turns of number 12 wire closewound and placed inside the d.c. end of the tank coil.

Now come the adjustments for proper modulation. Connect a dummy antenna for the initial adjustments, in accordance with FCC regulations. This may be two 200 watt lamps in series and paralleled by a 200 μμfd. variable condenser. Fire up the rig, set S_1 to C position and "juggle" the antenna coupling until approximately the following meter readings are obtained, with *no modulation*, always keeping C_{19} and C_{20} at resonance: PA grid—5 ma.; PA plate (J_1)—200 ma.; positive modulation plate (J_2)—30 ma.

With suitable audio or visual phone monitoring equipment set up, introduce modulation by whistling a steady tone, or by using an audio oscillator, and again go through the previous "juggling" procedure until good quality upward modulation is obtained at the 100% level. This is one system in which you can 100% modulate without splatter creeping in at the 85% point. Slight adjustments to the bias voltages may be found necessary but once set they will be permanent. Meter readings at *full* modulation should be approximately as follows: PA grid—2 ma.; PA plate (J_1)—140 ma.; positive modulation plate (J_2)—150 ma.

From the above it will be observed that during modulation approximately the following takes place on modulation peaks: PA grid decreases from 5 ma. to 2 ma.; PA plate decreases from 200 ma. to 140 ma.; positive modulation plate increases from 30 ma. to 150 ma.

With S_1 at position B the meter will indicate approximately 2 ma. in the positive modulation grid circuit on modulation peaks. An antenna current meter will indicate the customary 22½% increase in antenna current at 100% modulation.

In short, if you will spend a little time and energy building a supermodulated transmitter you will benefit by the following:

1. Reduce the power consumption from the a.c. mains by approximately 30%.
2. Practically eliminate BCI and TVI originating from audio.
3. Have better audio quality, all things being equal, because you will have no high-level audio transformer to add distortion to your signal.
4. Have a more easily copied phone signal because of the added "talk power" and the reduced heterodyne generating carrier in the crowded phone bands.
5. Have an extra measure of pride in your signal, realizing that you are making room in the band for more signals due to the inherent narrowness of your own signal.
6. Increase the power of your phone transmitter, with the same tubes, by approximately 30% and have practically none of your equipment standing idle if you want to work c.w.
7. Greatly increase the power, readability, and effectiveness of your NBFM transmitter with practically the same equipment now in the rig, if you are using push-pull tetrodes or pentodes in the final stage.

Go to it, fellow, it's not nearly as difficult or complicated as all these words make it sound.

The author wishes to express his thanks and appreciation to Mario Estrada (HK3ME) and Luis A. Rocha who did practically all of the actual construction work on the transmitter described herein. The author did little more than design the unit, give advice, and suggestions, and do the "heavy looking-on."

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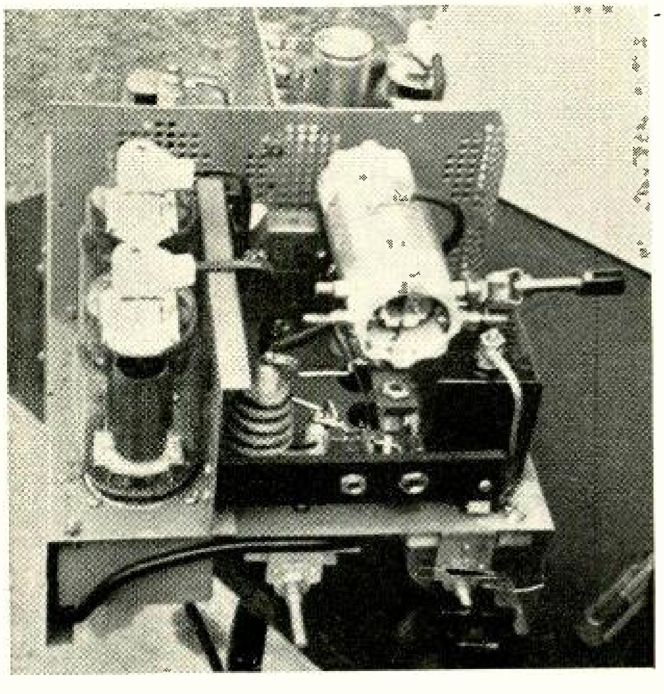

Fig. 5. Rear view of r.f. section showing shielded partitions.

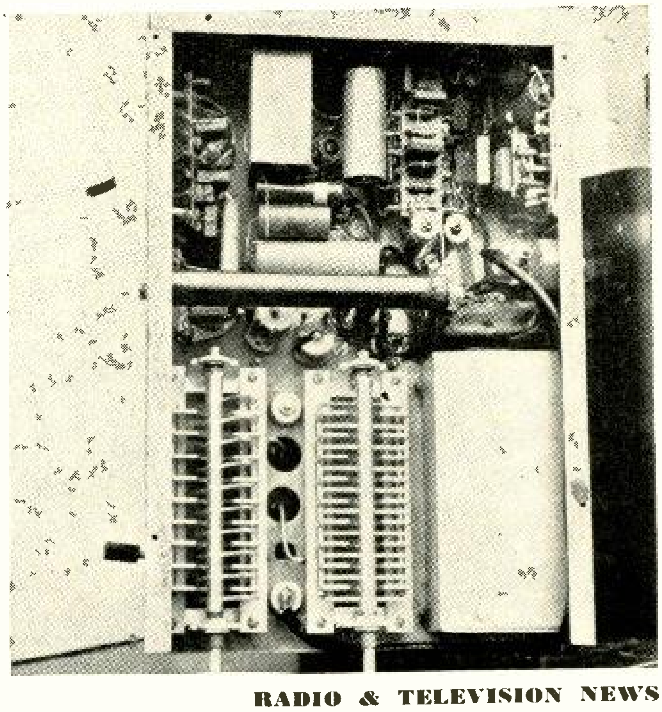

Fig. 6. Bottom view. Final condensers, C_{19} and C_{20}, are shown.

An Inexpensive GRID-DIP OSCILLATOR

By
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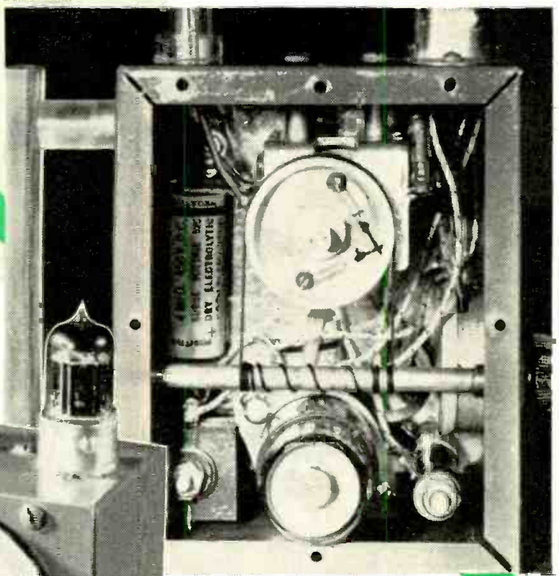


Fig. 1. (Top) Front view of the home-built grid-dip oscillator with the front panel removed. (Left) The overall view of the completed unit showing the dial plate, the Lucite handle, and standoff coil socket.

A stable, compact test unit for the ham that uses plug-in coils and a self-contained power supply.

ALTHOUGH inexpensive, accurate, and reliable instruments are available for the measurement of voltage, current, and resistance, no such devices have appeared commercially for the determination of inductance and the resonant frequency of an LC circuit. While bridge methods are ideal for the measurement of large inductances, the accurate measurement of small inductances such as used in communications equipment is difficult, because the stray inductances of the leads and bridge wiring may not be negligible compared to the inductance being measured. The effect of bridge conditions may be minimized by the substitution method, but the fact remains that the inductance bridge is relatively costly and finds its widest application in the laboratory.

Fortunately, another method is available. The series resonant frequency of an LC circuit is given by:

$$\frac{1}{2\pi\sqrt{LC}}$$

If the frequency and capacity are known, the inductance can be calculated. It has been found that a vacuum tube oscillator using L and C for frequency control will oscillate at a frequency which is very nearly the series resonant frequency of the LC circuit. It has also been established that maximum power transfer between two coupled LC circuits occurs when the circuits are resonant at the same frequency. If the LC circuit of a calibrated oscillator were coupled to a circuit whose resonant frequency was not known, this frequency could be determined by noting the frequency at which maximum power transfer occurred. This could be done by inserting an r.f. milliammeter in series with the circuit under test, but this method is neither convenient nor desirable, since the insertion of a meter might change the circuit capacity and therefore the resonant frequency. A better method takes note of conditions within the oscillator.

As external load is coupled to an oscillator, several reactions take place. The plate circuit impedance decreases, tending to raise the minimum plate voltage, which in turn causes the plate current to increase and the grid current to decrease. When the coefficient of coupling is less than critical, the maximum effect on the oscillator occurs at the resonant frequency of the external circuit.

Using this principle, the "grid-dip" meter has found considerable application among radio experimenters, with poor-to-excellent results. The author has sought to devise a grid-dip meter which would cover the entire range of communication frequencies, which would give uniformly excellent results, yet would be less expensive to duplicate than any similar device previously described in the literature. The instrument should be compact, self-contained, and convenient to operate.

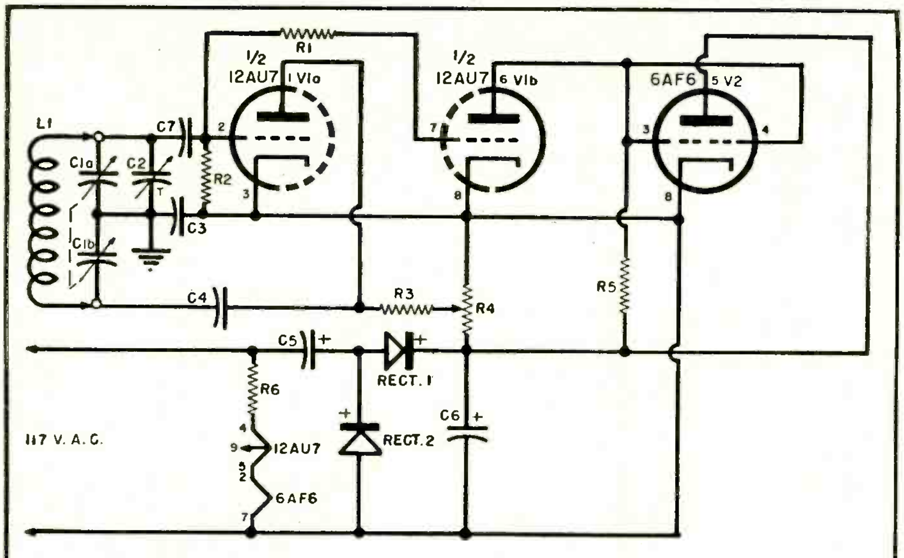
Design Considerations

Before proceeding with the design, a review of some of the limitations of grid-dip meters in general is in order.

1. Grid current, read on a milliammeter, varies with frequency from one arbitrary value to another.
2. Grid current may change erratically with frequency, giving spurious indications.
3. A separate power supply is required.
4. Plug-in coils are used.
5. The instrument is awkward to operate.

In the meter to be described, all objections except the use of plug-in coils have been eliminated. Although it would be desirable to use bandswitching, the mechanical and electrical design becomes difficult if the efficiency is to compare with plug-in coils.

As is well-known to most radio experimenters, the grid current of an oscillator is apt to vary with frequency, increasing with frequency in condenser-tuned circuits. In the Colpitts oscillator, Fig. 3, the ratio of r.f. grid voltage to plate voltage is determined by the ratio of C_p to C_g. If this ratio could be made to vary at the proper rate to compensate for the us-



R_1, R_5—1 megohm, ½ w. res.
R_2—100,000 ohm, ½ w. res.
R_3—27,000 ohm, 2 w. res.
R_4—50.000 ohm, 4 w. wirewound pot. (Mallory M50MP)
R_6—650 ohm, 20 w. wirewound res.
C_1—Modified b.c. cond. (Allied Radio Corp. Cat. #61-008) (See text)
C_2—30 μμfd. trimmer (part of C_1)
C_3, C_4—.001 μfd., 600 v. ceramic cond. Centralab Hi-Kap)
C_5—4 μfd., 150 v. elec. cond.
C_6—8 μfd., 350 v. elec. cond.
C_7—40 μμfd. mica cond.
$Rect._1$, $Rect._2$—75 ma. selenium rectifier

COIL DATA (L_1)

Freq. Range (mc.)	Wire Size	Turns	Winding Length
1-2	36	210	Closewound
2-4	32	95	Closewound
4-8	26	40	Closewound
8-16	22	24	1"
16-32	18	8½	Closewound
32-64	18	3½	½"

All coils wound on Amphenol ¾" forms with enamelled wire.

Fig. 2. Complete circuit diagram, parts list, and coil data for the grid-dip oscillator.

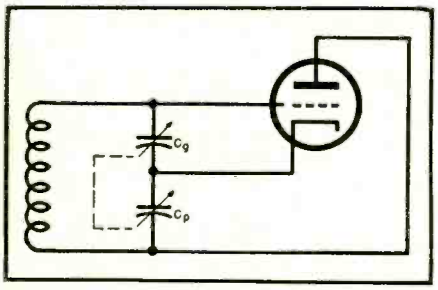


Fig. 3. Condenser-tuned Colpitts oscillator.

ual change in grid current with frequency, the grid current would remain constant. Experiment shows that, when the frequency range is not excessive, grid current can be stabilized satisfactorily by adding a fixed condenser in parallel with the grid section of the tuning condenser. With the proper choice of values, the variation of grid current can be made less than 10% over a 2-to-1 frequency range. Without compensation, the variation is from 35 to 45%.

Having assured a nearly constant grid current, the problem of visual indication next arises. The most obvious device is a grid milliammeter, which is ordinarily used in grid-dip meters. However, milliammeters are relatively expensive and bulky compared with the 6AF6 indicator tube, which consists of two independent sections, each requiring a d.c. amplifier. For our purposes, the two sections can be paralleled.

For compactness and electrical efficiency, the logical choice for the oscillator and d.c. amplifier is the 12AU7 medium-mu twin-triode. The use of selenium rectifiers in a voltage-doubler is the only possible alternative for the power supply.

Since individual tuning ranges of 2-to-1 allow coverage of 1 to 64 megacycles in only 6 ranges, as well as for convenience of dial calibration, this range was selected. It was found that a tuning condenser of 140 μμfd. per section permitted a slight overlap between ranges.

With a 6AF6 target voltage of 300 volts, approximately −15 volts is required at the grid of the d.c. amplifier to just close the "eye." Since the indication is the most sensitive at this position, the oscillator grid bias, which supplies the d.c. amplifier with control voltage, could not be allowed to exceed −15 volts and should be adjustable to exactly close the eye. With an oscillator plate supply of 300 volts, the grid bias will range from over −50 volts on the lowest frequency range to less than −15 volts on the highest range. It is necessary, therefore, to provide adjustment of the oscillator plate supply voltage. A potentiometer connected across the high voltage is the simplest and most effective method.

Since the grid-dip meter contains all of the essentials of an absorption frequency meter, it may be converted by removing the oscillator plate voltage. The eye is then normally open, closing at resonance with a source of r.f. energy.

To eliminate shock hazard, the cabinet should not be grounded directly to the negative high voltage, but should be placed at r.f. ground by a small bypass condenser.

Construction Details

After a "bread-board" model was tested, the actual work of construction was begun. The meter was to be compact without crowding of parts, so a standard 3" x 4" x 5" cabinet was chosen.

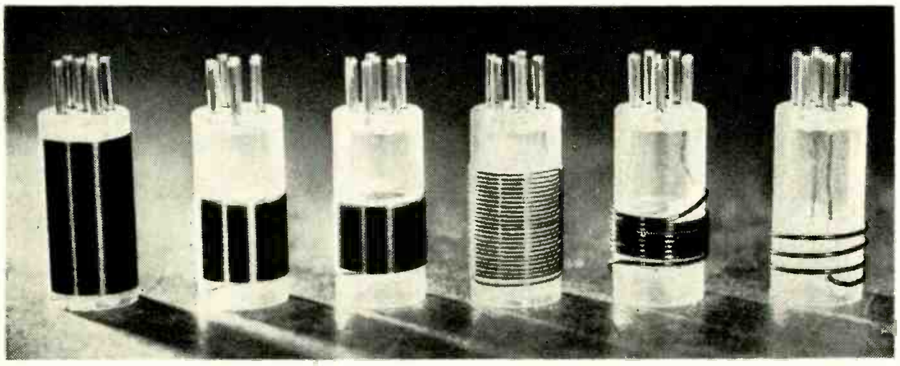
The largest single component is the tuning condenser. No miniature condenser which meets the electrical specifications was available, so a midget broadcast superhet condenser, rated at 420 μμfd. and 162 μμfd. per section, was modified by removing 6 rotor plates and the trimmers from the 420 μμfd. section.

The dial drive mechanism gives a reduction of 6-to-1. A 1½" drum on the tuning condenser shaft is linked with a ¼" drive shaft, which is a standard panel bearing assembly. Bearings are required at both ends, so the end opposite the tuning knob was drilled to engage a screw bearing inserted through the side of the cabinet. Details are shown in the photograph.

The dial plate consists of a 2¾" disc attached to a bushing which is secured by a set screw to the condenser shaft. Three ranges were calibrated on each half of the dial, the exact frequency being indicated by a vertical hairline on the Lucite dial cover. The dial markings were impressed photographically, although a paper dial marked in ink should prove satisfactory.

After the working model had been in use a few minutes, it became obvious that the handle is a more important part than it might at first seem. It must enable the meter to be held firmly in the left hand without turning. The original round metal handle was discarded in favor of Lucite, which is

Fig. 4. The set of plug-in coils used with the home-built grid-dip oscillator unit.



light, strong, and has a pleasant feel. A 5" x ¾" x ⅜" strip was cemented to two 1" long ½" diameter rods tapped for 8-32 screws which secure the handle from the inside of the cabinet.

The standoff coil socket mounting enables the instrument to be used in any accessible place. The 5-pin polystyrene coil socket was cemented in the top of a 4" length of ¾" o.d. polystyrene tubing, which is fastened to the top of the cabinet by means of a plastic disc cemented into the end of the tubing, tapped for mounting by a 8-32 screw, and drilled to pass the two leads from the coil socket.

The power supply components, consisting of the two electrolytic condensers, the selenium rectifiers, and the heater-voltage dropping resistor, are mounted on the rear panel, along with the 6AF6 socket.

Adjustments and Calibration

With the 4-8 megacycle coil in place, and the tuning condenser at maximum capacity, the oscillator plate voltage control is adjusted to exactly close the eye. With the tuning condenser at minimum capacity, the trimmer condenser is adjusted to exactly close the eye. This setting of the trimmer is permanent. Calibration can be accomplished by tuning in the signal from the meter on a communications receiver or by the use of an absorption frequency meter. Due to low circuit impedances, the eye does not entirely close on the 32-64 megacycle range. This does not impair the usefulness of the meter on this range however.

Operating Instructions

1. To find the resonant frequency of an *LC* circuit, place the meter coil a few inches from the circuit coil on the same axis. As the resonant frequency is approached, the eye will open, the amount of deflection depending on the *"Q"* of the circuit and the coupling.

2. To find the resonant frequency of an antenna connect a coupling coil of several turns across the transmission line or antenna terminals. This coil should be of larger diameter than the meter coil, so that the meter coil may be placed inside the coupling coil if necessary. The resonant frequency is found in the same manner as for an *LC* circuit. Note: Harmonics, as well as the fundamental frequency, will be indicated.

3. To find the inductance of a coil, connect a known condenser across the coil and measure the resonant frequency. The inductance can be calculated from reactance charts or the formula:

$$L = \frac{1}{39.6\, f^2 C}$$

where L is in microhenrys, f in megacycles and C in microfarads. For best results, the procedure should be repeated, using several different values of condenser.

In conclusion, the author wishes to acknowledge the invaluable assistance of James Takemoto, who designed and constructed the dial drive system. —30—

Mac's RADIO SERVICE SHOP

By JOHN T. FRYE

BARNEY IS "HOUSEBROKEN"

MAC had been awakened that hot and sticky July morning by the low rumble of distant thunder; but when he opened up his radio shop two hours later the storm still had not broken. Black clouds hovered over the town, and every few minutes the ground shook with the deep growl of the brooding storm, but no more than a few huge scattering drops of rain fell.

It was such a gloomy morning that Mac rather looked forward to the arrival of his red-headed, cheerful assistant, Barney; but when that worthy arrived, he looked even worse than the weather. His wide mouth was turned down like a croquet wicket, and his countenance was screwed up in a half-scowl that looked as out of place on his freckled face as a mustache on a kewpie doll.

"Greetings, Little Sunshine!" Mac saluted him. "Why the cheerful countenance and the general air of reckless gaiety you have about you this morning? Did Margie finally get smart and break the lease you seemed to have on her front porch swing?"

"Naw," Barney answered listlessly, "it's not that. I never have any trouble with my women. But I've just decided I'm a prize dope."

"You can't get an argument out of me on that subject," Mac said in cheerful agreement, "but what made you see the light?"

"Well, you know how I have been working on that tube tester idea of mine that uses a punched card shoved into a slot in the tester to set it up for a test. I have been going right along with the model. In fact, I worked until midnight last night putting on the finishing touches so I could bring it down and show it to you this morning. Then, before going to bed, I kicked on the ten meter rig to have just one QSO before hitting the sack.

"A PY down in Rio answered my CQ, and while we were chewing about this and that I mentioned that I was working on a new kind of tube checker. He came back and told me about a tube tester called the 'Cartomatic' made by the *Philips Company* that was very popular down there. It developed that this tester used a punched card that was shoved into a slot to set up the instrument for testing a particular tube! Can you beat it? All the time I was slaving away 'inventing' a tester, there was already one on the market."

"I was afraid of that," Mac told him consolingly; "but don't let it throw you. Since you had never heard of this *Philips* instrument, you really did 'invent' the tester. While you can't cash in on your brain child, no one can take away from you the really important thing: You did think up, all by yourself, a really good idea."

"Maybe you're right," Barney said more cheerfully. "I've got plenty on the ball; all I need is a little more speed."

"And to cheer you up further," Mac went on, "I have decided that it is about time you were housebroken."

"Housebroken!" Barney exclaimed. "Hey, what do you mean? I never—"

"I mean that you have worked in the shop long enough so that I feel you are ready to start making house calls."

"Fine!" Barney said with mounting enthusiasm. "I have been wanting to meet the public—and let the public meet me."

(*Continued on page* 115)

THE "SIGNAL SNATCHER"

By
LOUIS E. GARNER, JR.

A handy and easily-built gadget for television, AM-FM servicing, and general experimental work.

A SIMPLE yet effective piece of equipment that most service technicians will find valuable in their work is a handy little instrument known as a "Signal Snatcher." Although designed for use in servicing television receivers, this unit is equally useful in all servicing and experimental work.

It may be made simply by attaching a shielded lead to an ordinary .01 or .02 µfd., 600 volt paper condenser. Alligator clips are attached to the central conductor and to the shield of the lead.

If desired, a more professional instrument may be made by using a small condenser such as the *Solar* "Solite" and mounting it in a conventional test probe as shown in Fig. 1.

Essentially, the "Signal Snatcher" is used either as a signal tracer, "snatching" the signal from one section of the set and feeding it into another, or as a signal injector—again doing approximately the same job. The condenser is used only as a d.c. block, so that the probe may be used in plate and grid circuits without danger of shorting "B plus" or grid bias. The shielded lead prevents the feeding of the signal into other stages.

There are two basic ways in which the instrument may be connected to a television receiver. The most popular way is illustrated in Fig. 2. Here, the "Signal Snatcher" is used as a signal tracing probe for the TV receiver audio amplifier. The "hot" lead is connected to the high side of the volume control, and the shield connected to ground. When this connection is used, the first audio i.f. amplifier tube is removed.

In its other use, as a signal injector, the sound appearing in the plate circuit of the last audio amplifier tube is used as a test signal, and the instrument is connected as shown in Fig. 3.

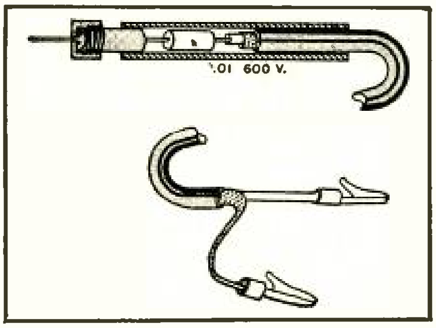
Let's demonstrate the use of the "Signal Snatcher" in a typical TV receiver. A partial schematic diagram of the *RCA* 630TS television receiver is given in Fig. 4. The audio stages, video 2nd detector, video amplifier, d.c. restorer, sync circuits, and vertical deflection circuits are shown.

Suppose that the complaint is any one of the following: sound, no picture; sound, picture, but not synced; sound, but no vertical deflection; picture, no sound; no sound or picture, but raster; etc. The "Signal Snatcher" may be used to service a set with any of these complaints (and others). It is used to take a signal from any stage known to be working and injecting that signal, stage-by-stage, into the sections that are dead.

As an example, if there were no picture, the "hot" lead of the "Signal Snatcher" would be connected to the top of volume control R_{222}. The shield is connected to ground or set chassis, and the first audio i.f. amplifier tube (not shown) is removed.

Next, the probe is touched to the top of the video 2nd detector load, the junction of C_{138}, L_{188}, R_{136}, and L_{187}. If the characteristic video signal buzz is heard in the loudspeaker (you will soon get to recognize this signal), you know that the video i.f. and 2nd detector stages are operating properly. In making this test, we assume that sound is received, indicating that the front end and audio stages are operating, and that a station is on the air.

Fig. 1. Assembly details of "Signal Snatcher."



To check condenser C_{138}, simply transfer the probe to pin 1 of the 6AU6 1st video amplifier. Use the volume control to set the sound at a comfortable level.

The operation of the 1st video amplifier may now be checked by transferring the probe to pin 5 of this tube. The signal should be appreciably louder as heard in the loudspeaker. A check on coupling condenser C_{140} may be made by simply transferring the probe to pin 5 of the 6K6 2nd video amplifier.

If a louder signal is heard when we transfer the probe to pin 3 of the 2nd video amplifier, we know that this stage is operating. The signal may even be checked directly at the grid of the picture tube by transferring the probe to the junction of C_{141}, R_{148} and the green lead from the 10BP4 tube socket. This is a check on the condition of C_{141}.

In this particular receiver, the sync pulses are taken from the d.c. restorer. Since this signal tracing technique may be used to follow the sync pulses as well as the video signal (a characteristic buzz being produced in the loudspeaker), we may now transfer the test probe to the junction of R_{149} and R_{150} (pin 2 of the d.c. restorer tube V_{114-B}). The sync pulse buzz should be heard in the loudspeaker. Next, the sync signal can be followed throughout the sync amplifier and separator stages by simply touching the probe, in order, to each of the following points: pin 4 of the 1st sync amplifier V_{118} (6SK7); pin 8 of V_{118}; pin 4 of sync separator V_{119} (6SH7); pin 8 of V_{119}; pin 1 of 2nd sync amplifier V_{120-A} (6SN7GT); pin 2 of V_{120-A}; junction of R_{162}, R_{163}, and C_{149}; and, finally, junction of R_{165}, C_{153}, and the yellow lead from the vertical blocking oscillator transformer T_{106}.

By following the sync pulses through the sync amplifier and separator stages in this manner, an inoperative stage is instantly detected. But, in addition, the condition of the coupling condensers between stages is also indicated. As an example, if a strong buzz is heard when the probe is touched to pin 8 of V_{119} (6SH7), but little or no signal is heard when pin 1 of V_{120-A} is touched, we can be pretty sure that C_{118} is open.

The signal tracing procedure can now be followed through the vertical deflection circuit, thus checking the operation of this section of the set. The operation of the vertical oscillator V_{121} is checked by placing the probe on pin 5 of the 6K6GT vertical output tube V_{122}. If the low frequency vertical sweep signal is heard, the probe is transferred to pin 3 of V_{122}. A stronger signal should be heard at this point. If not, we know that the 6K6GT stage has not amplified the signal.

The vertical output transformer and deflection yoke can be checked by transferring the probe to the junction of the green lead from vertical output transformer T_{107} and the lead running to the vertical deflection coils in the yoke. If a signal is heard here, but no vertical deflection is obtained, the chances are that either the yoke or the centering control is open. A quick ohmmeter check will indicate which.

On the other hand, if no signal is heard when the secondary of the vertical output transformer is checked in this manner, but a signal was heard when the probe was touched to pin 3 of the 6K6, we know that the vertical output transformer is defective.

This signal tracing technique cannot generally be used in the horizontal deflection circuits of a TV receiver —simply because the audio amplifiers in most TV sets are not capable of effectively reproducing the high frequency (15,750 c.p.s.) horizontal sweep signal. Even if the system were capable of reproducing a signal at this frequency; many people are unable to hear signals at this high a pitch.

In addition to the general signal tracing procedure described, the "Signal Snatcher" may be used in several other ways. As an example, if a strong interference signal is received on a TV set, it is often worthwhile to be able to identify this signal, so that the length of the tuned stub or frequency of the wave trap employed for interference elimination may be determined.

Sometimes an interfering signal can be identified by using the "Signal Snatcher" to listen to the video signal at the video 2nd detector load. The leads are connected across the volume control in the usual manner and the probe touched to the "hot" side of the 2nd detector load resistor, just as at the start of the signal tracing test. If the interfering signal is exceptionally strong with respect to the video signal, it may be possible to identify it even when a TV station is being received. In most cases, however, the strong video signal buzz will drown out the audio signal from the interfering station, and it becomes necessary to check the interfering signal while the TV station is off the air.

Many TV stations, when transmitting a test pattern, also transmit an audio tone modulation on the sound channel at the same time. When this is the case, and in sets with a separate audio i.f. channel, the audio signal may be used for test purposes in cases where the complaint is "sound, raster, but no picture."

The "Signal Snatcher" is used for signal injection rather than for signal tracing purposes in this case and the 1st sound i.f. tube is left in place. The leads are connected as in Fig. 3. The audio signal appearing here is sufficient to drive the grid of the picture tube, and its level may be easily changed (when checking back from stage-to-stage) by adjusting the volume control.

Since a signal injection technique is to be employed, the probe is first touched to the grid of the picture tube. Characteristic horizontal "sound bars" will appear across the face of the CRT if this tube is in good condition, and if proper d.c. operating voltages and sweep voltages are applied.

If the sound bars are obtained, the probe is transferred next to the plate of the last video amplifier tube. If sound bars are again obtained, the probe is transferred to the grid of this stage. Then to the plate of the first video amplifier tube, next to its grid, and, finally, placed across the 2nd detector load. It is necessary to reduce the audio level (using the volume control) as the probe is transferred back from stage to stage in the video amplifier circuit to avoid overdriving the picture tube.

A similar technique may be employed where the complaint is "picture, no sound," but the video signal appearing at the plate of the video output tube is used for test purposes, and the probe used in the audio amplifier section.

Although the "Signal Snatcher" is extremely valuable as a servicing tool for signal tracing and signal injection, almost allowing a TV receiver to "service itself," its use is not limited to these applications. Often, a service technician will find it desirable to use a paper condenser in some particular application, either as a blocking condenser, or as a test bypass condenser. Here, the "Signal Snatcher" may again be used.

When using it as a test bypass condenser, for example, both of the test clips can be connected to the set chassis. The probe can then be touched to the "hot" side of suspected condensers, effectively shunting them. If oscillation or regeneration is cleared up as a particular bypass condenser is shunted with the "Signal Snatcher," you can be pretty sure that that condenser should be replaced.

Probably the only limits on the uses to which the "Signal Snatcher" may be put in servicing are the ingenuity and imagination of the technician using it. —30—

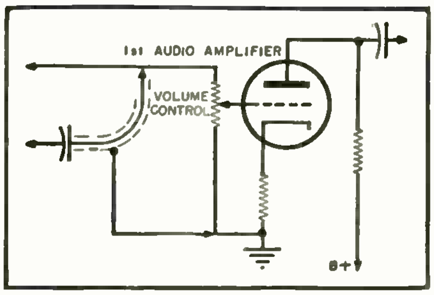


Fig. 2. Unit used as TV signal tracing probe.

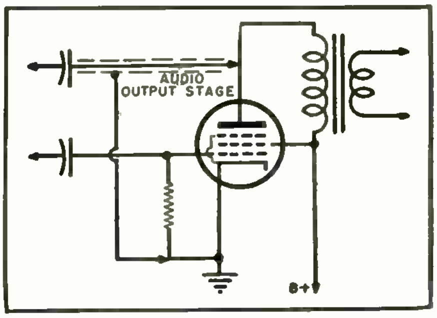


Fig. 3. The probe used as a signal injector.

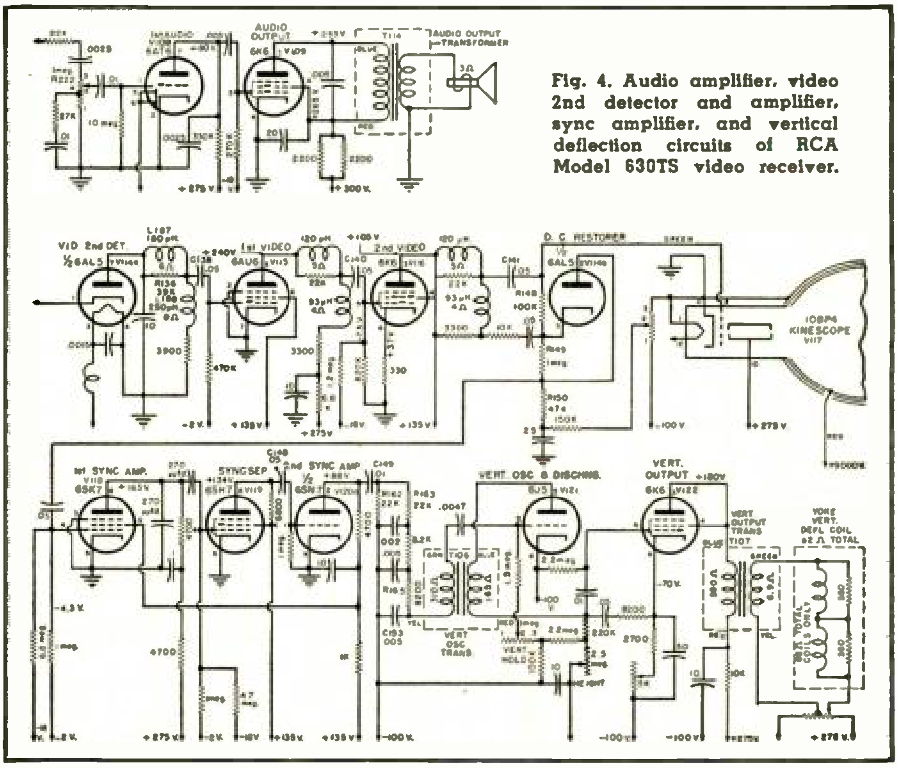
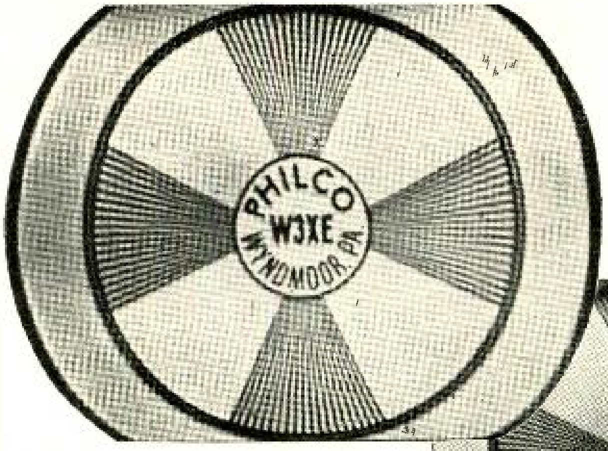
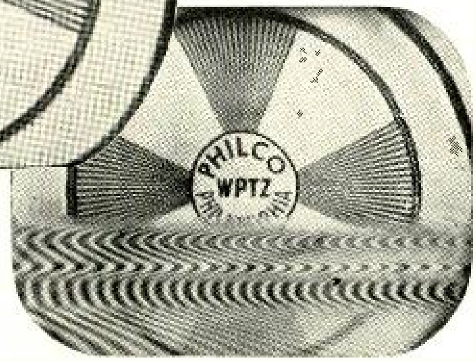


Fig. 4. Audio amplifier, video 2nd detector and amplifier, sync amplifier, and vertical deflection circuits of RCA Model 630TS video receiver.

TV INTERFERENCE PROBLEMS



Beat frequency interference as evidenced by fine vertical bars.



Diathermy interference indicated by familiar herringbone.

By DANIEL LERNER

TV Field Service Engr.
Philco Corporation

Methods for identifying and eliminating several common causes of television receiver interference.

WITH the recent increase in television receiver sensitivity, the problems of television interference have become more acute. In addition, the increase in the number of operating television stations is contributing new problems for the technician. Not only television stations but local short-wave, amateur, and FM broadcast stations as well as diathermy equipment may prove to be possible sources of interference to good reception.

Power line interference, due to any type of electrical equipment with breaking contacts on the line, can cause interference, which will appear on the screen as bursts of jagged white or black lines which may or may not cause the receiver to lose vertical synchronization. Equipment such as cash registers, electric shavers, and adding machines can cause this particular kind of interference. Isolating the trouble in this case becomes a matter of shutting off one piece of electrical equipment at a time until the offender is found. This type of interference may be minimized considerably by the use of power line filters, which usually take the form of low pass filters, that is, with the chokes as series elements and the condensers as parallel elements. In some cases merely putting a condenser of approximately .1 μfd capacity across the contacts of the offending equipment will cure the trouble.

Cases of interference caused by actual radiation from the discriminator section in a receiver are common.. In most cases this type of radiation can be effectively combated by a careful redressing of the leads in this section, and in some cases by using grounded shields over the discriminator components.

Much more drastic methods involve actually detuning the sound i.f. of the offending sound section so that the radiation falls at a frequency outside the desired channel. For example, if the third harmonic of the i.f. falls at 66.2 mc. and causes a beat pattern on Channel 4, detuning the sound i.f. just .15 mc. will move the radiation away from this channel to 65.75 mc. This type of interference which causes a fine pattern to appear on the screen, can be easily isolated by removing the discriminator and sound i.f. tubes and noticing if the offending beat disappears. Video detectors, which are essentially non-linear devices, can produce harmonics which also cause interference patterns. Both detector and discriminator radiation effects are increased considerably when a built-in antenna is used. Also in fringe areas this radiation will be more apparent.

In some isolated cases, in installations close to high powered transmitters, interfering signals may be picked up by the receiver chassis or leads in the receiver. This effect can be minimized by using a bottom copper screen shield on the chassis and running a good ground to this screen. If this doesn't help, screening the entire inside of the receiver cabinet may be required.

Since either the fundamental or harmonics of the fundamental interfering frequency may cause trouble, there are numerous forms that this interference may take in the television receiver. Harmful effects may occur in the video or audio sections of any channel, and some method must be used in order to identify and track down the particular interfering signal or signals. The following methods are just a few means of tracking down interference:

1. If the interference is audible so that it interferes with the TV sound, the interference may be identified by hearing the call letters of the interfering station. If the interference is of an FM nature it will be amplified and detected in the sound system of the receiver. This does not mean that only a frequency modulated signal will cause interference for an amplitude modulated signal although limited to some degree by the first and second sound i.f. amplifiers, still has sidebands which can be considered as frequency changes. These changes are detected and, in turn, passed on to the sound amplifiers by the FM detector.

Sharp bursts of noise, such as ignition interference, although amplitude modulated in nature, contain a high amount of energy which lasts for very short periods. These noise pulses are not of one particular frequency, and are rich in harmonics. They cause the FM detector to reproduce short bursts of audio which are heard in the speaker.

2. If the interference appears on the

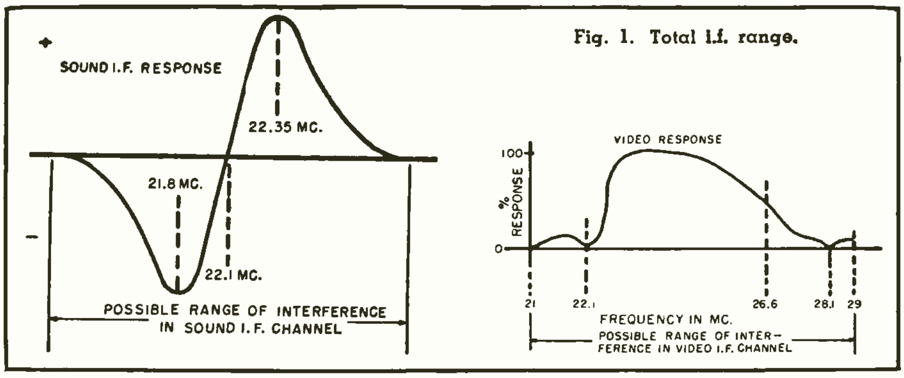


Fig. 1. Total i.f. range.

picture tube screen, the receiver local oscillator may be tuned lower in frequency so that the video i.f. signal is passed through the sound channel and may also be identified by listening to the station call letters. How easily the interfering signal can be heard will depend, to a great extent, on the strength of the signal since as the oscillator is detuned, the low frequency video and sync signals will be heard strongly in the speaker. An accurately calibrated signal generator may be used to provide a heterodyning signal so that an audible beat indication may be obtained, and the interfering frequency recorded from the generator frequency or log scale.

There are numerous ways in which interference occurs in television reception. A TV service technician should familiarize himself with the possible harmonic combinations of these interfering signals because this knowledge greatly simplifies the identification and subsequent removal of such interference. The principal possibilities of interference combinations are about eight in number. To make this explanation more simple, a specific channel (Channel 3) is chosen as an example, and the actual arithmetic involved in interference calculation is recorded. In these calculations a television receiver with a sound i.f. of 22.1 mc. and a picture i.f. of 26.6 mc. is used as an example. If a receiver with different i.f. is used, the figures for oscillator frequencies and harmonics must, naturally, be modified.

Channel 3 occupies the portion in the low TV band from 60-66 mc. Its video carrier occurs 1.25 mc. above the low limit of the frequency range or 61.25 mc. Its audio carrier occurs 5.75 mc. above the low limit of the frequency range or at 65.75 mc. Its oscillator frequency occurs 26.6 mc. above the video carrier or 87.85 mc.

The video i.f. response of the television receiver occurs in a range from approximately 22-29 mc., these figures being extreme ranges. In addition, the sound i.f. system will pass and amplify a signal of 21 mc., so that the interference limits in the television receiver can be said to occur from 21-29 mc. See Fig. 1.

A 28.1 mc. beat forms from the next lower channel's audio carrier, in this case Channel 2 (59.75 mc.), and the oscillator frequency of Channel 3 (87.85 mc.), but in the video i.f. section of the receiver a trap is tuned to 28.1 mc. and thus this possible interference frequency is eliminated.

1. Since the interference limits occur from 21 mc. to 29 mc., the radio frequency signal required to produce these beats is: 87.85 — 21.00 = 66.85 mc. and 87.85 — 29.00 = 58.85 mc. Thus any interfering signal in the band from 58.85 to 66.85 mc. will form a beat in the i.f. range (21 mc. to 29 mc.).

2. Any radio frequency signal whose second harmonic falls in the range of 58.85 to 66.85 mc., in this case 29.42 to 33.42 mc., will cause serious interference.

3. In case 2 the second harmonic was considered but harmonics up to the eighth harmonic should be considered where a strong local transmitter is operating. In this event 58.85 to 66.85 may be divided by any whole number up to eight to find the interfering frequency limits.

4. In the event of a strong local transmitter whose fundamental or harmonics fall in the range of 21 to 29 mc. (i.f. range), interference will occur.

5. Any radio frequency which is an image frequency, that is, the local oscillator frequency (87.85) plus the lower limit of the i.f. range (21 mc.), or the upper limit of the i.f. range (29 mc.) will cause interference. This interference will then occur from 108.85 to 116.85 mc.

6. Any radio frequency whose harmonic or harmonics fall in the image range (108.85 to 116.85 mc.) will cause interference.

7. Any radio frequency that is about 8.0 mc. above or below the oscillator frequency (87.85 mc.) in a range from 79.85 to 95.85 mc. will cause interference. This interference occurs because the undesired radio frequency signal will beat with the desired station carrier producing a beat within the limits of the i.f. range (21 mc. to 29 mc.).

8. Any radio frequency that is 21 to 29 mc. above or below the local oscillator second harmonic, 175.70 mc., will cause interference. This will occur from 175.7 + 21 = 196.7 mc. to 175.7 + 29 = 204.7 mc. or from 196.7 mc. to 204.7 mc. Also, it will occur from 175.7 — 29 = 146.7 mc. to 175.7 — 21 = 154.7 mc. or from 146.7 mc. to 154.7 mc.

The chart in Fig. 2 is tabulated for interference possibilities on Channel

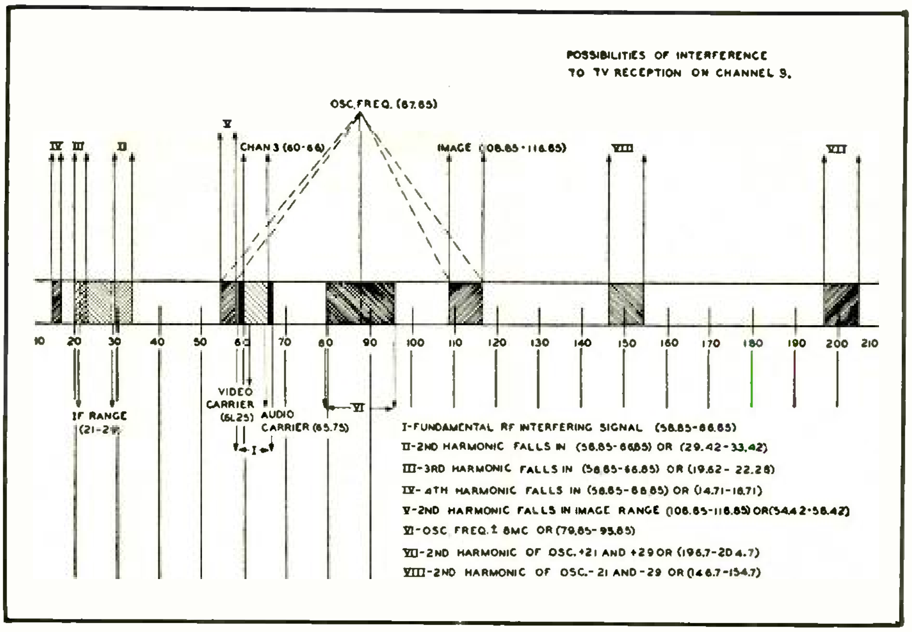
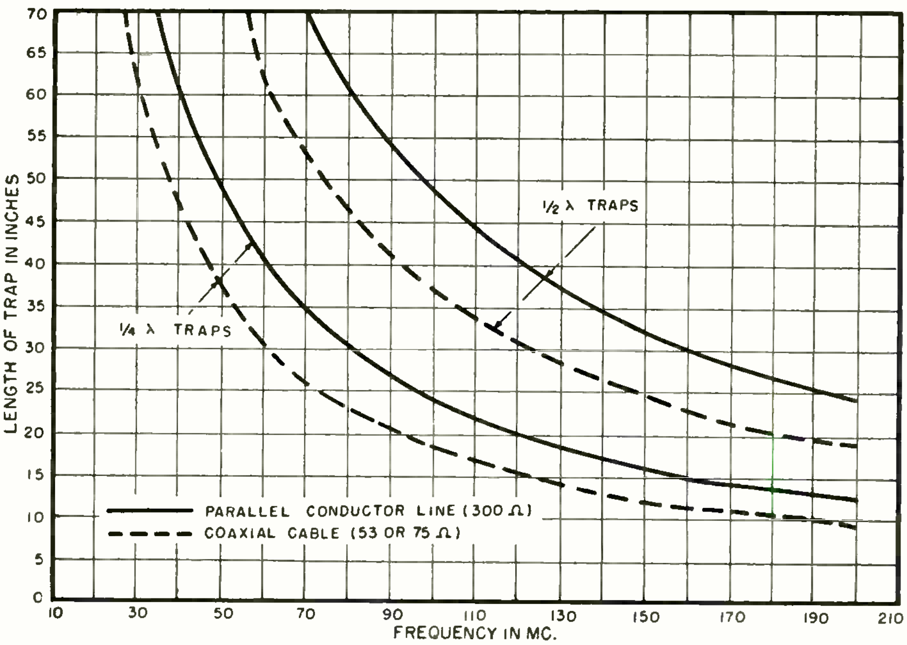


Fig. 2. Interference possibilities occurring in any conventional TV receiver tuned to Channel 3. Similar charts can be compiled for other channels, as explained in text.

Fig. 3. The graph which may be used to determine approximate length of a wave trap.



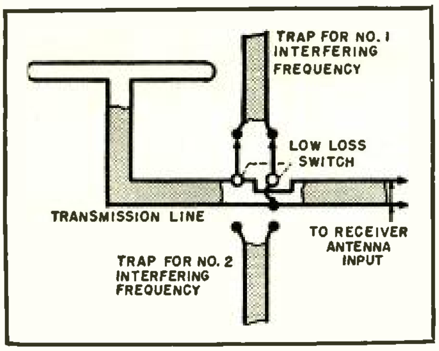


Fig. 4. Method used to switch wave traps.

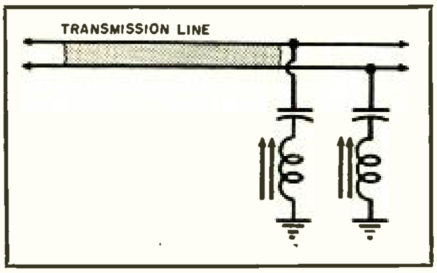


Fig. 5. Series traps for eliminating the interfering signals which fall in the sound and video i.f. frequency range.

3, but a similar chart can be made for any television channel by use of the mathematics and principles as outlined in the preceding discussion of Channel 3. If the video and audio carriers are known, the oscillator frequency can be found. With these three frequencies the chart can be made for any channel by using the examples for Channel 3 described in the preceding steps 1 to 8.

Eliminating Interference

In most cases, interference picked up by the antenna system can be greatly reduced or completely eliminated without seriously affecting the television signal. This may be accomplished by installing a wave trap across the antenna terminals of the receiver. The wave trap circuit should have an extremely low impedance to a signal of the interfering frequency and a high impedance to the frequency of the desired television signal. With such a circuit, the unwanted signal is effectively shorted across the line before it reaches the receiver, but the desired signal is practically unaffected by the presence of the wave trap circuit across the antenna.

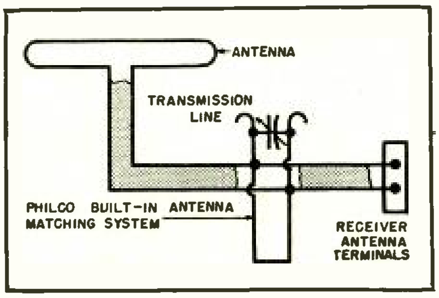
A half wavelength of transmission line, shorted at one end, offers a low impedance at the other end to the frequency at which it is resonant. This half-wave section makes an effective wave trap. However, at the lower TV frequencies, a half wavelength of line may prove to be too long to be practical. In this case, a similar effect may be produced by using a quarter wavelength of line with open ends. The approximate length of the trap may be obtained from the graph given in Fig. 3.

It should be noted that with receivers using a common high and low band antenna input, and most receivers are of this type, the use of a trap across the antenna terminals becomes a problem in certain locations. In installations where the trap attenuates the desired signal on other channels besides doing its intended job, some sort of switching arrangement is required. Fig. 4 shows such a switch connected into the antenna input circuit. The switch used should be of a type having relatively low r.f. losses. A coaxial type switch is widely used and is recommended, but installations have worked properly with everything from a miniature to a large type knife switch. Of course, it should be noted that an antenna installation shouldn't resemble a power station!

For interference at the sound or video i.f. frequencies, a series-resonant circuit of lump reactances is recommended for shorting out the unwanted signal. The *"Q"* of this series-resonant trap should be high so that only slight attenuation of the television signal is obtained. This trap is connected from each side of the line to ground. In many cases, however, one is sufficient. It is connected to the lead that runs closest to the r.f. grid. Actually this means the lead that is physically closer on the coil. It is suggested that these parts be mounted as close to the antenna input socket as possible. The diagram Fig. 5 shows such a trap arrangement.

Another method of minimizing interference is to tune the receiving transmission line, using the matching and tuning section from a *Philco* built-in antenna, as shown in Fig. 6. To accomplish this reduction of interference, the incoming transmission line from the antenna is attached to the matching section's principal inductive loop. The matching section can be mounted on or in the rear of the TV cabinet, keeping it away from any metal parts.

Fig. 6. How to use Philco's built-in antenna matching section to tune out interference.



If the receiver is a *Philco* model containing the built-in aerial, then the two foil antenna sections mounted inside the cabinet are merely disconnected from the matching section. Then the matching section and the lead-in from the outdoor antenna are both connected to the antenna terminals of the receiver; and the effect is the same as described above and as shown in the alternate arrangement in Fig. 6.

Tuning the system for each channel not only reduces interference, but by matching the line and thus reducing standing waves, a greater signal is delivered to the receiver's antenna terminals. It should be noted that the system requires retuning whenever the channel selector switch is moved to another station. This matching system in most cases will not decrease the bandwidth of the system. Thus no harmful attenuation of useful picture or sound signal is encountered, and interference is reduced.

To show typical problems that are found in the field and how they are solved, the following case histories are presented:

Case History No. 1 (Bound Brook, N. J.): Interference was reported by a customer in this city. The interference source was identified as a Government transmitter which operated at 21.6 and 21.7 megacycles. Since these frequencies fell within the limits of the audio i.f. bandpass of the television receiver, the interference blocked out the accompanying sound on all television channels.

In solving this problem two series traps were used, one placed from each side of the antenna-input terminals to ground. The traps used were of the type employed as accompanying-sound traps (22.1 mc.) in *Philco* receiver Model 49-1075. These traps were found to have broad enough tuning to provide adequate attenuation of both 21.6 mc. and 21.7 mc. In addition, a bottom chassis shield made of copper screen, grounded at several points to the chassis, was used to give further shielding and thus better protection against the interference.

Case History No. 2 (Detroit, Mich.): On a television receiver tuned to Channel 4, beat interference was reported at a customer's home. Upon investigation it was found that the second harmonic of the Channel 2 audio carrier (119.5 mc.) was beating with the Channel 4 oscillator (93.85) mc.), to form a beat frequency of 25.65 mc., which was in the video i.f. bandpass of the television receiver. The interference was serious only within a radius of approximately two miles from the Channel 2 transmitter.

To correct this condition a quarter-wave, open-ended stub made of 300-ohm transmission line and cut to resonate at 59.75 mc. (Channel 2 audio carrier) was attached to the antenna-input terminals. The stub was first cut to a length which was a few inches longer than a quarter wavelength. After the stub had been attached the line was shortened by clipping very short lengths from the open end of the line. The clippings were made small enough so that the point of resonance was slowly reached, and at each clipped point the quality of the signal, for both sound and picture, was noted. When the length producing best quality signals had been determined, another piece of 300-ohm line of the exact length was permanently installed. Other channels on the same band as that for which the stub was provided were checked for possible attenuation due to the presence of the stub.

—30—

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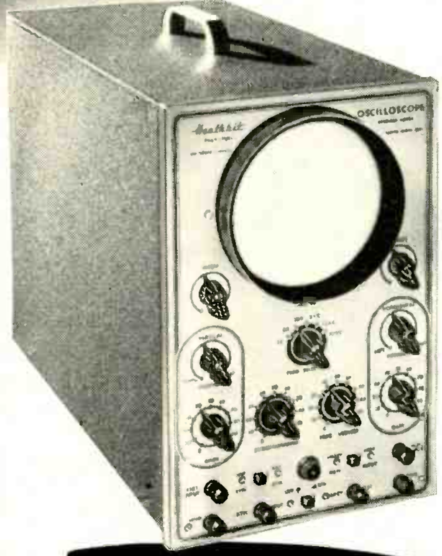

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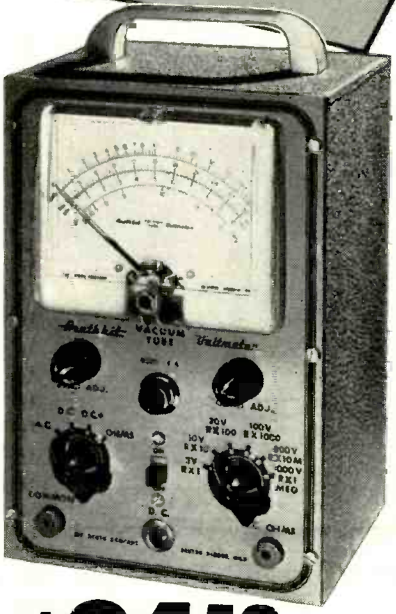

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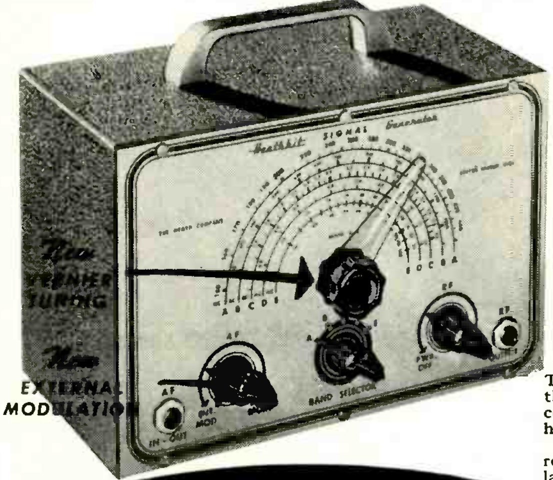

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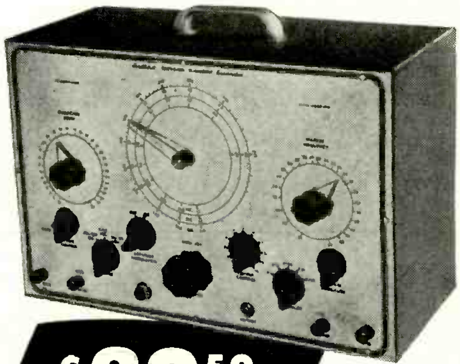

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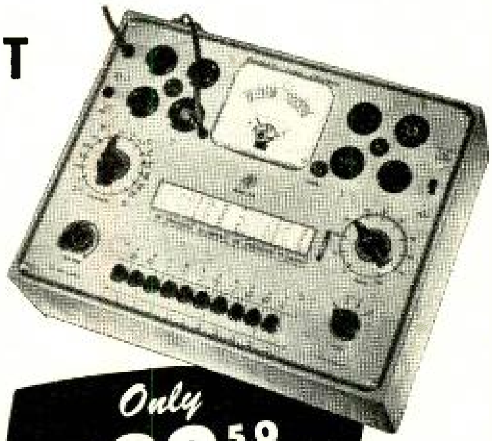
Complete with detail instructions — all parts — cabinet — roller chart — ready to wire up and operate. Shipping Wt., 15 lbs.



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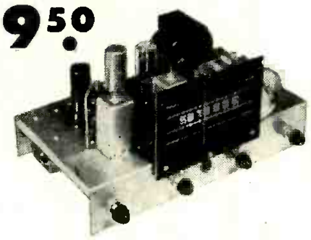

Ideal AC operated superheterodyne receiver for home use or replacement in console cabinet. Comes complete with attractive metal panel for cabinet mounting. Modern circuit uses 12K8 converter, 12SH7 input IF stage, 12C8 output IF stage and first audio 12A6 beam power output stage, 5Y3 rectifier. Excellent 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**

3 BAND MODEL AR-1
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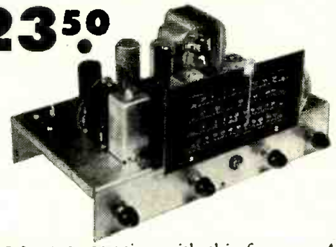

Enjoy the thrill of world wide short wave reception with this fine new AC operated Heathkit 3 band superheterodyne — amazing sensitivity 15 microvolt or better on all bands. Continuous coverage 550 Kc. to over 20 Mc. Easy to build with complete step-by-step instructions and pictorial diagram. Attractive accurately calibrated six inch slide rule dial for easy tuning. Six tubes with one dual purpose tube gives seven tube performance. Beam power output tube gives over 3 watts output.

Separately assembled coil turret with band switch eliminates difficult construction. Conservatively rated 110 V. power transformer supplies full operating voltages to all tubes for maximum reception. Has band switch, tuning, volume, tone and phono-radio controls. Chassis size 2¼" x 7" x 12½" — supplied complete — punched chassis — tubes — controls — transformers (quality output to 3.4 ohm voice coil) — all small parts — hardware and instructions (less speaker). Shipping Wt., 10 lbs. No. AR-1 Receiver $23.50.

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Ham TV Station
(Continued from page 49)

resistance. Alternatively, rods may be used for the reflector, spaced less than 1/10 wavelength apart. The length of the antenna is 13½ inches allowing for 1" space at center for feeding both halves of the dipole. The width of the reflector screen is 18". The length along the reflector from the vertex to the ends of the reflector is 36". The spacing of the antenna away from the corner depends upon the impedance of the cable used to feed the antenna. The spacing used for RG8/U was 14½". Higher-impedance cables will bring the antenna farther away from the corner. The enclosed angle between the corners of the reflector is 60°. Horizontal or vertical polarization of the antenna may be used (but be sure the same polarization is used at the receiving end, or very little signal will be obtained). A similar antenna is used for receiving. The same considerations as for building and siting the transmitting antenna apply equally well to the receiving antenna.

Receiver Converter

The diagram of the receiver converter is given in Fig. 9. The construction should follow the details shown in the photograph.

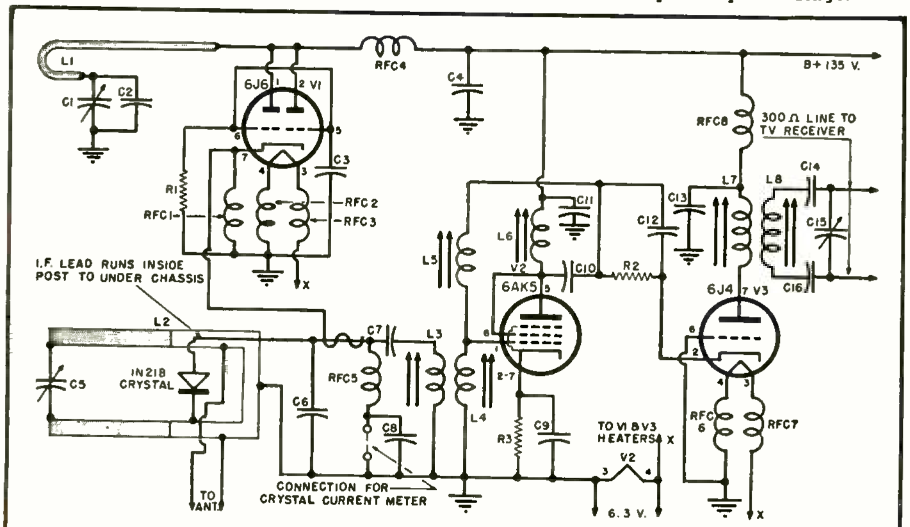
Miniature i.f. transformer cans and forms were used for the coils L_3-L_4, L_6, and L_7-L_8. The original forms in these cans were iron cored units measuring .280" diameter. Many of the small i.f. transformers are of these dimensions. In the event that such forms can not be obtained, the ¼" diameter iron core forms made by both *Millen* and *Cambridge Thermionic* should prove satisfactory. If these are used it may be necessary to add a turn or two to the coils specified to compensate for the reduced form diameter.

The tune-up of the converter is as follows.

The converter input circuit is *loosely* coupled to the transmitter output. Be careful not to couple too tightly to the transmitter as the mixer crystal might burn out. The converter mixer circuit may then be aligned by tuning the condenser C_5 across the ends of the lines, using a lucite or polystyrene screwdriver, until the crystal current, as read on a one ma meter, goes to maximum. The oscillator tube V_1 should be pulled out during this tuning up.

The converter is then connected to a television receiver. The local oscillator tube is reinserted. The television receiver is tuned, for example, to Channel three. The local oscillator tuning condenser C_1 of the converter is tuned until a signal is received on the television receiver. The transmitter is then shut off and the mixer crystal current from the local oscillator is read. The local oscillator coupling is obtained by a wire attached to the local oscillator cathode and wrapped around an insulated lead coming from the crystal to the i.f. input. This wrapping is ad-

Fig. 9. Schematic diagram of the receiver converter. A 6AK5 "cascode" amplifier is used, followed by a grounded-grid 6J4 used as the output amplifier stage.



R_1—2700 ohm, ½ w. res.
R_2—100 ohm, ½ w. res.
R_3—82 ohm, ½ w. res.
C_1—3-45 μμfd. midget var. cond.
C_2—10 μμfd., 500 v. silver mica cond.
C_3—15 μμfd., 500 v. ceramic cond.
C_4, C_8, C_9, C_{11}, C_{13}—.005 μfd., 500 v. ceramic cond.
C_5—1-7 μμfd. ceramic trimmer cond.
C_6—1 μμfd., 500 v. ceramic cond.
C_7—6.8 μμfd., 500 v. ceramic cond.
C_{10}, C_{12}—.002 μfd., 500 v. ceramic cond.
C_{14}, C_{16}—15 μμfd., 500 v. ceramic cond.
C_{15}—7-45 μμfd. ceramic trimmer cond.
L_1—2½" #14 bare in hairpin loop, ¾" wide
L_2—Two ⅜" wide brass straps, 5" long, 1" between centers, mounted on ⅜" square brass posts 1⅛" high. Crystal mounted by drilling through posts ⅞" from chassis. Hot lead from pin end of crystal runs through hole drilled length of post
L_3—10 t. #24 en. wound on .280" dia. form (see text)
L_4—8 t. #24 en. wound on .280" dia. form, spaced from L_3 by 3/32" (see text)
L_5—Approx. 22 t. #32 en. wound on ¼" dia. iron-cored form
L_6—6 t. #24 en. wound on .280" dia. form (see text)
L_7—10 t. #24 en., wound on .280" dia. form (see text)
L_8—10 t. #24 en. wound on .280" dia. form, spaced from L_7 by 3/32" (see text)
RFC_1, RFC_2, RFC_3—8" #26 wire airwound on ¼" dia. form, spread about ⅜"
RFC_4, RFC_5, RFC_6, RFC_7, RFC_8—48 t. #32 en. on .225" dia., 2 megohm res.

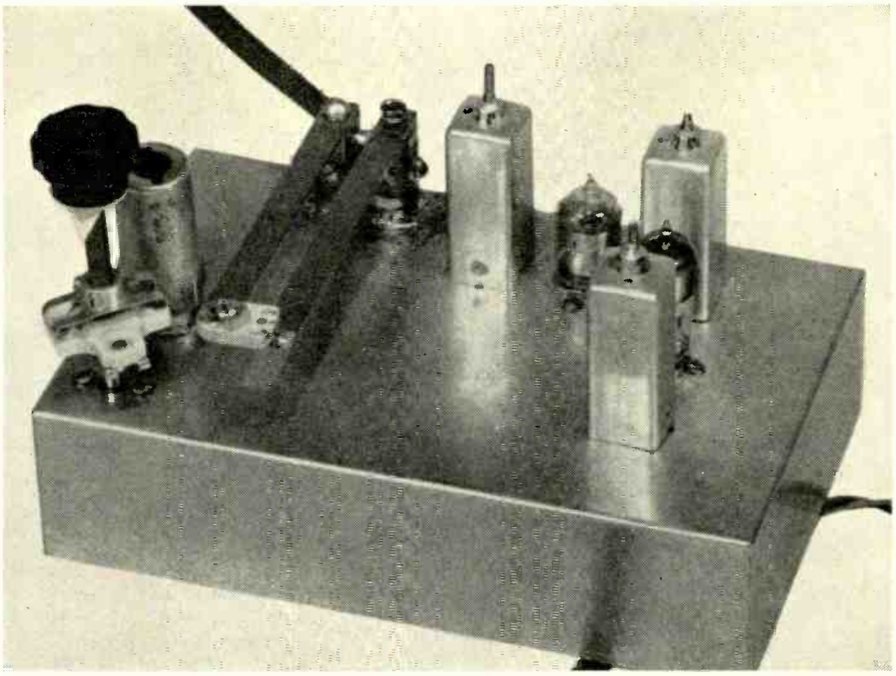


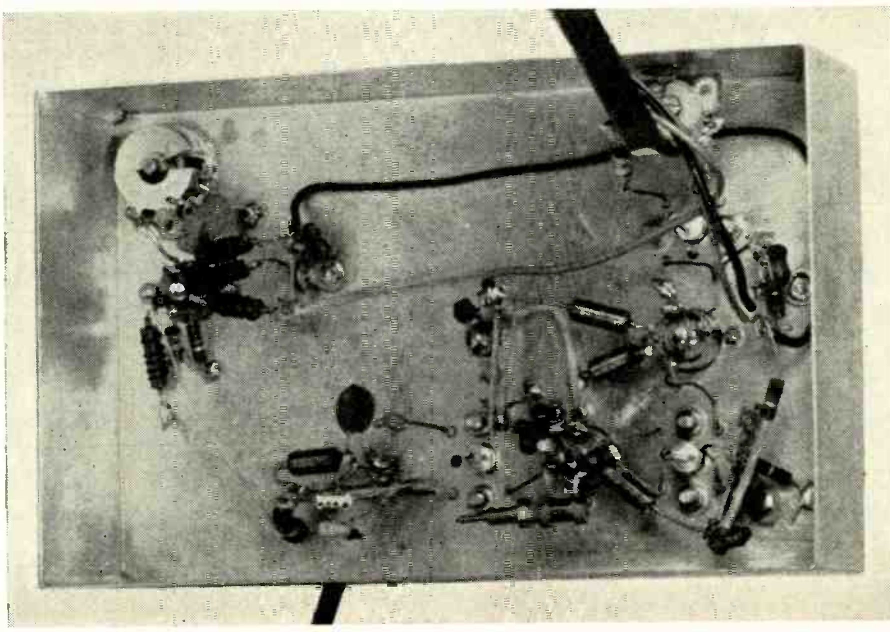
Fig. 10. Top view of the 420 megacycle converter for use with a standard TV receiver.

justed so that the crystal current in the mixer, due to the local oscillator signal, reads between .25 to 1 milliampere. If the meter is disconnected, connect a jumper in its place in the circuit. The "cascode" 6AK5 is neutralized by disconnecting its heater voltage and adjusting L_5, the neutralizer coil, until *minimum* output is obtained. The 6AK5 heater is then turned on again and the rest of the circuits are aligned in the same manner as for normal television i.f. circuits, with a signal generator or wobbulator. The variable condenser C_{15} in the converter output circuit, together with the iron slug in the output coil L_6, are adjusted simultaneously after the 300-ohm twin lead has been connected to the television set's input. The bandwidth of the converter i.f. is approximately 6 megacycles. Half of a 6J6 may be used instead of a 6J4.

It is realized that these notes can only help in a general way to get started. Since this system follows standard television procedures, the reader is advised to study the standard television textbooks such as: "Principles of Television Engineering" by Donald G. Fink (*McGraw-Hill*); "Television Simplified" by Milton S. Kiver (*Van Nostrand*); "Photofact Television Course" edited by B. V. K. French (*Howard W. Sams*); and "Television—How It Works" (*John F. Rider*).

Various ways not given here will naturally occur to the constructor in simplifying the processes involved. None of the circuit descriptions herein should be considered the only, or necessarily best, way of doing the job. —30—

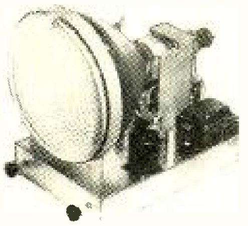
Fig. 11. Bottom view of converter unit. Oscillator tuning condenser, C_1, is at upper left.



McGEE ANNOUNCES ITS NEW 1950 TELEVISION KIT

BUILD A 16" DELUXE TELEVISION KIT FOR ONLY $49.90 Less Tubes

COMPLETE 16" T.V. KIT WITH ALL TUBES INCLUDING 16" PICTURE TUBE $82.95. COMPLETE 12" KIT WITH ALL TUBES $77.95.



16" FG-19 T.V. DUPLICATOR KIT $29.95 **LV-13 13 CHANNEL VIDEO RECEIVER KIT $19.95**

★ BUY BOTH FG-19 AND LV-13 TOGETHER YOU HAVE A 16" T.V. SET FOR $49.90 Kit Less Tubes

COMPLETE 16" T.V. KIT $49.90

Complete Television Kit; includes the FG-19 reproducer and the LV-13 Video Receiver. With these two kits you can wire your own television chassis for any size picture tube, 10, 12 or 16". Stock No. LV-13FG, less all tubes. Net **$49.90.** Complete kit of all 23 tubes, less picture tube. Net **$13.90.** The chassis sizes of both reproducer and receiver are small and compact, however they were not intended to be installed in the same cabinet. Complete Television Kit, LV-13FG, with all tubes, including 12" picture tube, nothing else to buy. Net **$77.95.** Complete Television Kit, LV-13FG, with all tubes, including 16" picture tube, nothing else to buy. Net **$82.95.**

BUILD A T.V. DUPLICATOR-TUNER OR A COMPLETE T.V. RECEIVER

This paragraph introduces our new versatile TV Kit. For the purpose of simplified construction and wiring, McGee has designed a television kit as two distinct units. One chassis is the reproducer (sometimes known as a slave or remote TV duplicator), which holds the picture tube, power supply, sweep circuits and audio. The other chassis is for video reception and we call it a video tuner. It has the 13 channel Sarkes-Tarzain front end and all video and sound I.F. stages. If you purchase both the picture reproducer and the tuner you can build a complete TV set, less all tubes for only **$49.90**, or with all tubes including a 12" picture tube, you can buy the complete TV kit deal for only **$77.95**; with a 16" picture tube your cost is **$82.95**. Get started building your own TV set today. Of course you can order the duplicator this month and buy the video receiver kit later, thus keeping your investment low.

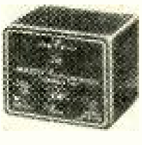
16" DUPLICATOR KIT Model FG-19 $29.95

A sensational new 1950 Model kit. Every part including a ready punched chassis, to build a television duplicator. (Sometimes called a slave or reproducer unit.) This kit has two definite uses. Build as a TV duplicator or build with the idea of later adding the video tuner stages; to use as an independent TV receiver. A real educational and useful item. After this kit is wired, you simply connect a standard 72 ohm coaxial cable to your present TV set. May be used on any size set: 7, 10, 12 or 16". Connect at the video detector and operate the remote unit up to 100 feet or more away from your TV set. Have a TV duplicator for your recreation room, etc. No special test equipment is needed to align this duplicator. It is in reality about ¾ of a TV set. You could order and build our LV-13 video tuner later on and have a complete TV set. This duplicator has its own controls and power supply circuit. Just hook to any PM speaker. Adjusting the brightness and contrast controls on master TV set does not effect the duplicator unit. We think this duplicator unit offers you a chance to experiment with TV and end up with a piece of equipment that you will benefit from. The complete kit of parts, less tubes and picture tube. Stock No. FG-19. Shipping weight 40 lbs. Net price **$29.95.** Tube kit (except picture tube) 5U4G, 6K6, 3—7N7, (or 6SN7) 6X5, 6AC7, 6BQ6, 1B3 and 6H6. Net price **$7.95** extra. 12" round picture tube, **$14.95** extra. 16" round picture tube, **$19.95** extra. Diagram and photo furnished with the kit. Only those who have an understanding of radio and basic electronics should buy this kit. Chassis size: 15" wide, 17" long, 18" high with 12" tube and 20" high with 16" tube.

VIDEO RECEIVER KIT $19.95

McGee's new 1950 Television Video Receiver Kit, (not intercarrier, has separate sound and picture I.F.'s); designed to be used with our model FG-19 duplicator kit. With the duplicator and receiver kits, for only **$49.90**, you can build a complete television receiver. (Price does not include any tubes.) This video tuner kit is complete. It incorporates a 13 channel, Sarkes-Tarzain TV turret tuner and separate sound and picture I.F. stages. The receiver uses 13 tubes: 6C4 oscillator, 6AG5 mixer, 6BH6 R.F., 4—6AU6 picture I.F.'s, 6AU6 cathode follower, 6AL5 AVC, 2—6AU6 sound I.F.'s, 6AL5 discriminator and 6AT6 1st audio. Sensitivity and brightness controls on front panel. Plate and filament voltages to operate tuner are picked up from the duplicator. This complete TV tuner kit is furnished with a diagram and photos. Priced less tubes. Stock No. LV-13. Net price **$19.95.** Kit of 13 tubes **$5.95** extra. Chassis size: 6¾" wide, 13" long and 6" high.

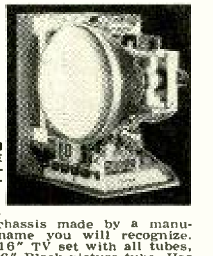
REG. $20.58 MASCO T.V. BOOSTER FOR $13.39



Masco MTB-13X, 13 channel television booster. A regular $20.58 dealers' net item, on sale at McGee for only **$13.39.** Housed in an attractive walnut cabinet. 5½x5x5½". Self powered, operates on 110 volts AC. Priced complete with 2—6AK5 tubes. These boosters are brand new and factory cartoned. Shipping weight 6 lbs. McGee's sale price only **$13.39** each. Two for **$25.00.** The price is good only as long as our supply lasts.

Astatic AT-1 "Channel Chief" TV Booster. Equal to two ordinary boosters. Two tuned circuits. Dual controls tune picture and sound. Attractive wood cabinet. 8½x6½x7¼". Shipping weight 6 lbs. Net price **$29.10.**

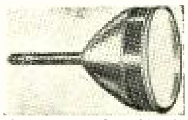
16-INCH Nationally Famous T.V. Chassis Complete $149.95



COMPLETE WITH PICTURE TUBE FULL DESCRIPTION ON REQUEST

A complete television receiver chassis made by a manufacturer whose name you will recognize. Not a kit, but a 16" TV set with all tubes, 8" speaker and 16" Black picture tube. Has 19 tubes, plus three rectifiers. Supplied with wood frame for wall or cabinet mounting. Size 19½x23" wide and 21¼" deep. Price was **$259.00.** Now at McGee for **$149.95.** Stock No. 520EX. Shipping weight 80 lbs.

TERRIFIC T.V. PICTURE TUBE SALE



16JP4 BLACK FACE $24.95
16JP4 NEUTRAL FACE $19.95
12LP4 NEUTRAL FACE $14.95

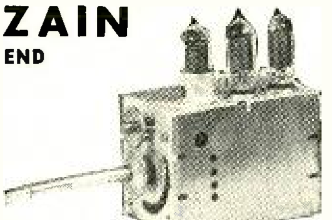
★Every Tube Guaranteed to You for 90 days ★ Limited Quantity ★ Best Value in America

Factory changes in tube specifications make this picture tube sale possible. Quality of these tubes is number one. All are guaranteed by us for 90 days. You must be satisfied. The 16JP4 equivalent, a direct replacement for any 16" all Glass picture tube, is available with new style black face. Specify "Black Face" when ordering. Shipping weight 25 lbs. Net price **$24.95.**
16JP4 equivalent is also furnished with a neutral or standard face, at **$19.95.** Specify "Neutral Face" when ordering.
12LP4 equivalent is furnished with neutral face at the scoop price of **$14.95.** Shipping weight 19 lbs.
All above tubes are not seconds and pass RMA standards. Guaranteed for 90 days by us. Name of famous maker has been withheld and does not appear on the tubes for obvious reasons. When ordering include ample postage.

SARKES-TARZAIN

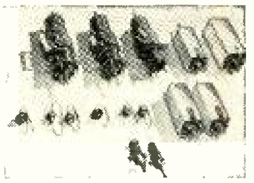
13-CHANNEL T.V. FRONT END

WITH TUBES AND DIAGRAM $7.95



This popular Sarkes-Tarzain television front end is widely used to-day. **The 13 channel** rotary switch type with individually tuned coils. Price includes a schematic diagram and 3 tubes, 6C4 osc, 6BH6 RF and 6AG5 mixer. Regular factory cost is twice our price. Each tuner and its own tube sockets are wired, ready to hook up to a video and sound IF strip. May be used with either 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**
Sarkes-Tarzain Type 3 tuner and 205-XX coil kit both for........................**$16.95**

TELEVISION VIDEO COIL KIT—20 MATCHED COILS FOR PICTURE AND SEPARATE SOUND I.F. $7.95



Order with a Sarkes-Tarzain Front End and Save

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?

Buy this 10" streamlined mahogany television cabinet at ¼ actual cost of manufacturing. Originally intended for use in the Farnsworth factory. All brand new in factory cartons. Heavy construction with removable bottom base. Weight packed is 33 lbs. Size 13x19x17". Stock No. RY-10. Offered at the close out price of only **$2.95.** Buy both the RY-10 cabinet and the partially wired GVZ-60 Farnsworth TV chassis for only **$4.95.** This chassis has tube sockets, installed and over 100 parts, resistors, condensers, etc. However, no coils are included. RY-10 cabinet and GVZ-60 chassis. Shipping weight 40 lbs. Combination price **$4.95.** 1948 Supreme Television Manual, which includes a diagram of the GVZ-60, **$3.00** extra.

$19.95 BUYS A NEW St. George Wire Recording Mechanism ONLY 200 TO SELL

McGee offers you a terrific saving, the St. George Series 1100, wire recording mechanism. Brand new and factory cartoned. This unit will record and playback from a standard recording wire, up to 1 hour. The wire take-up reel turns at 78 RPM and will play and record from a 78 RPM phono record. The base is punched for a phono pickup. Space required, 9x13x3½". Shipped with a diagram of how to connect and also how to wire a 3 tube converter to enable the wire recorder to be used in conjunction with any radio or amplifier. St. George wire recording mechanism, Series 1100. Shipping weight 15 lbs. Net price **$19.95** each. Crystal phono pickup arm and cartridge **$1.95** extra. Recording wire 15 minute spool. Net price **$1.19.** 30 minute spool. Net price **$1.79.** 1 hour spool. Net price **$2.79.** Crystal mike and desk stand **$4.95** extra.

Regular $25.00 Television Magnifier SALE PRICE $7.95

Stock No. HA-22

FOR 7-10-12 INCH TUBES

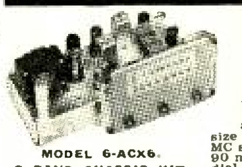
Stock No. HA-22 12x17 in. television magnifier. Made of crystal-clear plastic and oil-filled. Magnifies your present 7-, 10-, or 12-inch television picture up to four times. We offer you these new factory cartoned magnifiers, you provide your own means of mounting to your set. Edge of magnifier may be 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.

Wire Recorder Converter FOR ANY WIRE RECORDER MECHANISM $12.95

Wire recorder converter **$12.95.** With this 3 tube converter you can adapt the St. George, Air King, or Webster Chicago wire recorder mechanism to any radio or amplifier. Only 3 connections necessary. Just plug in to the phono input of your amplifier and connect to plate of output tube. AC transformer construction, gain for mike, 3 position switch for quickly changing from record to playback. Priced ready wired and tested with instructions and tubes: 12AT7 preamplifier, 6AQ oscillator erase and 6X4. Stock No. RR-Y.

BUY YOUR RADIO KITS AT McGEE FOR LESS

6 TUBE AC SUPERHET KIT BROADCAST AND SHORTWAVE MATCHED PARTS $11.95



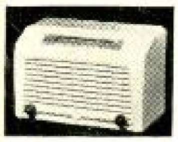
MODEL 6-ACX6.
2 BAND CHASSIS KIT

A complete kit of parts, tubes and ready punched chassis to build a fine 6 tube, 2 band AC power transformer type radio chassis. (No cabinet.) We furnish all pieces as well as a printed diagram and photograph. Chassis size 14x7½x7". Receives standard broadcast and 6 to 18 MC shortwave. 3 gang tuning condenser used on both bands. 90 mil power transformer and 6V6 output tube. The chassis, dial mechanism, gang and coils used in this kit were manufactured for use in a high quality Detrola radio. The heavy plate glass dial has etched-in numerals. This is a complete 2 band AC chassis kit, with tubes. The output transformer is furnished but the speaker is not. Use any standard PM speaker.
Stock No. 6-ACX6. Net price **$11.95.** 8" Heavy duty PM speaker, **$2.95** extra.
10" Heavy duty PM speaker, **$3.95** extra. 12" Heavy duty PM speaker, **4.95** extra.

2-BAND DETROLA—SCOOP COILS, GANG, DIAL, PAN $3.95

Genuine Detrola Chassis pan with 6 octal sockets. Heavy glass slide rule dial, 3 Gang Tuning condenser. All RF and IF coils and band switch for standard broadcast and foreign short wave. Buy these parts for less than the coil value alone. These parts all fit the chassis properly. Only material pictured and listed above is offered with diagram. It is not a complete kit. You supply your own tubes, speaker, resistors, condensers, etc. Stock No. DET-2. Shipping weight 9 lbs. Net **$3.95**

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.**

McGEE RADIO COMPANY

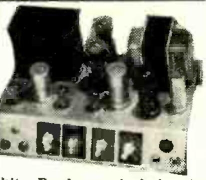
Prices F.O.B. K.C. Send 25% Deposit with Order, Balance Sent C.O.D. With Parcel Post Orders, Include Postage

TELEPHONE VICTOR 9045. WRITE FOR FLYER
1422 GRAND AVE., KANSAS CITY, MISSOURI

WIDE RANGE AMP KITS COST LESS AT McGEE

34 WATT WIDE RANGE AMP KIT $29.95

- RESPONSE 20 TO 20,000 C.P.S.
- TWIN ELECTRONIC TONE CONTROLS



It's the newest thing in audio amplifiers. McGee's wide range, 34 watt amplifier kit with inputs for crystal or dynamic mikes and any crystal phono cartridge, as well as the new G.E. variable reluctance cartridge. Output transformer is wax impregnated, weighs 6 lbs. Voice coil taps 4-8-15-250 and 500 ohms. Push-pull 6L6 output tubes. Separate electronic base and treble boost. Inverse feedback. Input tube filament is DC heated to reduce hum level to nil. Frequency response from 20 to 20,000 cps. Easy to follow diagram and photos for easy assembly of this kit. Ready punched chassis. Every part furnished, including tubes: 2—6L6, 5V4, 3—12AX7. Shipping weight 25 lbs.
Stock No. XX-34, net $29.95
XX-34 WT (wired and tested) **$12.50** extra. Crystal mike and desk stand **$4.95** extra.

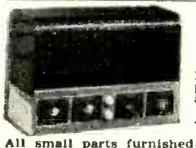
NEW 15 WATT UTILITY AMP KIT

- INPUT FOR VARIABLE REL. PICK UP
- MIKE INPUT
- TONE CONTROL
- FADER CONTROL
- COMPLETE KIT

$12.95

Kit Model TM-15, push-pull wide-range 15 watt amplifier kit. Ideal for a high quality record player, as a P. A. system or recording amplifier. Matched component parts, ready punched chassis. One control fades from phono to mike. Input compensation for G.E. variable reluctance, pickup, fully shielded. Output matches 8 ohm voice coil. 100 mil power transformer. Complete with tubes, photos and diagram. 2—6V6, 2—12AX7 and rectifier. Variable tone control. Model TM-15. Weight 10 lbs.
Net $12.95

MODEL ZZ-30—30-WATT $19.95



Commercial Quality Amp Kit
"Build an Amp Like You Would Buy"

A complete kit of parts to build a factory quality 30 watt public address amplifier. Servicemen, you can wire this amplifier and have a commercial looking unit. Pan and cover are ready punched and grey splatter finished. Size 5½x12". Inputs for two mikes and one phono. Base boost tone control. 4-8-16-250 and 500 ohm shielded output. With tubes: 2—12AX7, 6SN7, 2—6L6 and 5U4. Full size power transformer. All small parts furnished, nothing else to buy. **Printed diagram furnished.** Shipping weight 25 lbs. Stock No. ZZ-30. Net price $19.95
Wide range Capehart (regular $7.95) Output transformer **$5.00 extra.** Crystal mike and desk stand **$4.95** extra.

New 1950 Music Lover—Radio, P.A.—Music System Kit

18 Watt Super High Fidelity Home Music System Amp. Kit. Resp. 20-20,000 CPS $19.95

5-Tube Self Powered AM Broadcast Tuner Kit $9.95

Buy Both Kits and Have a Fine Music System $28.95

This kit when wired will make a 20 to 20,000 CPS, wide range, all purpose 18 watt, music appreciation amplifier. Inputs for a radio tuner, crystal or dynamic mike and crystal phono pickup, also has preamplifier for G.E. variable Reluctance pickup. Nothing but the finest quality material is furnished with this kit. A heavy 200 mil power transformer, super wide range broadcast quality shielded output transformer, that may be connected to any 4 or 8 ohm PM speaker. Chassis size 9¼"x9¼"x6" high. Tube line up is 3—7F7 and 2—7C5, plus rectifier. The circuit has very low resistance, well regulated power supply. Separate base and treble boost controls and fader circuit. Designed with controls on 30" shielded leads, so that you may install them on any panel and put the amplifier in a convenient location. Photos and schematic furnished with this kit, will build the finest all purpose amplifier we know of today. One well worth 3 times the kit cost. Super wide range amplifier kit complete with tubes (no speaker). Model S-2020. Shipping weight 16 lbs. Net price **$19.95**. Crystal mike and desk stand **$4.95** extra. Why not order one of our wide range speakers with this kit, especially our P-158 or CU-13X

A self powered, 3 gang superhet tuner kit, with R.F. stage. When wired according to our diagram will make the best possible broadcast tuner, (550 to 1650 KC), for use with any amplifier. Has a 6" lighted, slide rule dial. Don't class this with ordinary tuners, this has its own transformer. The complete kit is furnished with diagram and photo, with tubes; 6SK7, R.F. 6SA7 converter, 6SK7 I.F., 6H6 detector, 6X4 rectifier. Chassis size 9¼x8½x4⅜" high. Shipping weight 8 lbs. Broadcast Tuner, Model BT-38, Net price $9.95

If you buy both the S-2020, 18 watt music appreciation amplifier kit and the BT-38 tuner, you can build yourself a fine custom radio-amplifier combination. Offered both for **$28.95**. Crystal mike and desk stand **$4.95** extra. CU-13X, 12" coaxial PM speaker, **$9.95** extra.

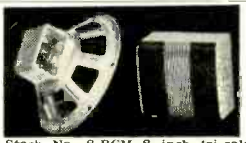
WESTERN ELECTRIC SPEAKERS

NOT SURPLUS
NEW 1950 SPEAKERS

Western Electric 728-B, 12" 30 watt, Alnico V high fidelity PM speaker. Increased production makes this speaker available now, at a new low price. Do not confuse this with surplus, it's brand new production. 12" Alnico V PM with a 4 ohm voice coil and treated cone. Response, 60 to 10,000 CPS. Shipping weight 18 lbs.
Net price $31.20

Western Electric 755-A, 8" 8 watt Alnico V, high fidelity PM speaker. Response 70 to 13,000 CPS. 4 ohm voice coil. A very fine speaker. Shipping weight 6 lbs. Net price **$22.35**

SCOOP!



8" Speaker $2.95
8" Baffle $1.95

Stock SE-8X 8 inch heavy duty 6.8 oz. Alnico V PM with 1" 8 ohm voice coil. (as illustrated) **$2.95** each 10 for **$27.50**.

Stock No. 8-RCM 8 inch tri-color, plastic front wall Baffle. Very popular with music box operators. Sale price **$1.95** each, 10 for **$17.50**.
8 inch 6.8 oz. Alnico V PM speaker made by Jensen for Bell and Howell. A terrific bargain. Stock No. JEN-8. Net **$2.95**, 10 for **$27.50**.

McGee's Super High Fidelity

OUTPUT TRANS. 20-20,000 CPS. $6.95 Best Value in U.S.A.

Model A-403 High fidelity output transformer. Why pay $20 or $30 for an output, when our A-403 is available at $6.95? Impedance, 6600 ohms plate to plate, (for PP 6L6 or 6V6), 10% feed-back winding, 4-8-15-250 and 500 ohm secondary. Housed in a potted case. Net weight 6 lbs. Recommended for all amplifiers up to 34 watts. Size 3⅞x4½x3". Suggested diagram furnished. Shipping weight 8 lbs. Net Price A-403 **$6.95**.

BROADCAST QUALITY TRANSFORMER KIT

Response 18 to 22000 C.P.S. The Same Quality as Used in the Finest Quality Audio Amplifiers

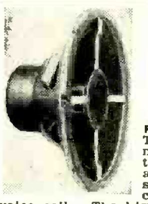
Why Pay More **Sale Price $12.95**

Here is the hottest transformer kit we have ever offered. Originally intended for use in the high priced Lear recorder amplifier. Made of the best possible material to give broadcast station frequency response: 18 to 22,000 CPS. A suggested diagram is furnished to build your own amplifier; with inputs for G.E. variable reluctance phono pickup, crystal phono pickup or radio tuner. Here are the transformer specifications: The output is a compound filled case, 3 x 2½ x 3½" high, weight 2¼ lbs., response 18 to 22,000 CPS, matches 2—6V6 in push-pull (15-watts), output taps match 4 or 8 ohm speaker. The power transformer is a fully shielded upright model, 3½ x 4½ x 4½" tall, weight 8¼ lbs. This transformer is utilized in a full wave selenium rectifier bridge, (easy to hook up, full details included), which delivers 300 volts at 200 mils, with the best possible voltage regulation. Also has a 6.3 volt 5 amp. filament winding. The selenium rectifiers come with this kit. The choke weighs 2¼ lbs. and is the same size as the output. You get full description of the kit, including a suggested schematic. You supply the other parts. We furnish the power transformer, choke, output and rectifiers. Shipping weight 15 lbs.
Stock. No. TD-1822. Net price $12.95

AMERICAS BEST VALUES IN

WIDE RANGE PM SPEAKERS

"THEY WOOF AS THEY TWEET"



MODEL P15-8
15 INCH "COAXIAL" P.M. SPEAKER

- NEW 1950 MODEL
- REGULAR $62.50 LIST

$19.95

"IT WOOFS AS IT TWEETS"

REPRODUCES ALL MUSIC AND SPEECH WITH NATURAL CLARITY
This 15", 35 watt peak coaxial PM speaker is not surplus. It is manufactured by a leading speaker company, to our own specifications. We buy them by the hundreds in order to offer them to you at this low $19.95 price. They are comparable to any $62.50 list speaker on the market. The 15" woofer will reproduce down to 20 cycles. It has a 22 oz. Alnico V magnet and molded cone with 1½" voice coil. The high frequency tweeter is coaxially built in, with a special cone that will produce notes up to 17,500 cycles. The input impedance of both reproducers combined, is 8 ohms. Matching network is concealed under the pot cover. Just hook this up like any other 8 ohm speaker and hear the difference. Shipping wt. 14 lbs.
Stock No. P15-8. Sale price, **$19.95; 2 for** $38.00

MODEL CU-13X
12 INCH "COAXIAL" P.M. SPEAKER

- New Aluminum Voice Coil Model
- Wide Range, 40 to 17,500 CPS.
- Reg. $32.50 List at McGee for

$9.95

REPRODUCES ALL MUSIC AND SPEECH WITH NATURAL CLARITY
McGee announces its new 1950 Model 12" coaxial PM speaker. A regular $32.50 list speaker, but mass production enables a new low price of $9.95. Made especially for McGee by a famous speaker manufacturer, to our own specifications. It's a new 1950 model. The sale of 10,000 coaxial speakers assures you that this speaker is a smart choice. The speaker consists of a 12" Alnico V PM with coaxially suspended 3" hard cone tweeter. The 12" portion has a 6.8 oz. Alnico V magnet with 1" voice coil and heavy one piece ribbed cone. This responds to the lower register of the audio spectrum. The tweeter has its own separate 2.15 oz. Alnico V magnet. A high pass filter is concealed under the pot cover. This prevents low frequency from reaching the tweeter. The 3" tweeter has a very stiff cone and responds only to the upper register of the audio spectrum. With all this the speaker is still just as simple to connect as any ordinary PM. Only two wires to connect. Input impedance is 8 ohms. Designed especially for the critical music listener with a keen ear for the higher audio register. Response is from 40 to 17,000 cps. 18 watts. This speaker is ideal for the home music system. Generally used in only $400 to $800 radio installations. The high piano, cymbal and violin notes will reproduce clearly with our new 12" coaxial speaker. Model CU-13X. Shipping weight 8 lbs.
Net price, **$9.95; 2 for** $19.00

MODEL 15-LS
15 INCH 40 WATT P.M. SPEAKER

- A Super Heavy Duty Deluxe P.M.
- 21.5 Oz. Alnico V Magnet

$15.95

A regular $45.00 list 15" molded cone Alnico V PM speaker. 21½ oz. Alnico V magnet, with molded cone and 1½", 8 ohm voice coil. Truly a super heavy duty speaker that will take 35 watts with ease, up to a 50 watt peak. The King Juke PM. Response down to 20 cps and up to 12,000 cps. Shipping weight 14 lbs. Model 15-LS, Net price, **$15.95; 2 for** $30.00
Model 15-KR, standard juke box PM. 15" with 8 ohm voice coil and 12 oz. Alnico V magnet. Shipping weight 10 lbs.
Net price, **$9.95; 2 for** $19.00

MODEL A-50
12 INCH 40 WATT P.M. SPEAKER

- FOR RUGGED P. A. USE

$13.95

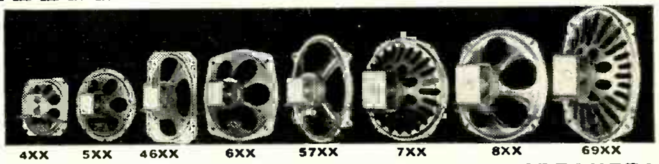
Model A-50, 12" 40 watt super heavy duty permanent magnet speaker. Has 1½", 8 ohm treated voice coil and one piece molded cone. Heavy half inch machined pot, with bolt secured 21 oz. Alnico V magnet. Frame is of heavy construction with metal pot cover. Finished in silver-grey enamel. This speaker is the best possible value today. Efficiency is two or three that of ordinary speaker. Especially recommended for all public address systems and high quality home audio systems. Will handle 35 watts with ease and 50 watts peak for short lengths of time. Its retail value is $50.00. Wt. 8 lbs. But, by our large purchase, we are able to offer it to you for only .. $13.95
TWO FOR $26.00

MODEL 1202-X
12 INCH WIDE RANGE P.M. SPEAKER

RESPONSE 35 TO 12,500 CRS.

$9.95

Why pay more? McGee's new 1950 model 1202-X Music Lovers' Reproducer. A full heavy duty 14½ oz. Alnico magnet PM speaker. Full 1¼", 8 ohm voice coil. One piece molded curvelinear cone forms a trumpet for the high note distribution. An ideal speaker for high fidelity music system and P.A. work. The rugged construction of this speaker enables handling of low notes down to 35 cps; 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



4XX 5XX 46XX 6XX 57XX 7XX 8XX 69XX

ALUMINUM VOICE COIL REPLACEMENT SPEAKERS

Radio Servicemen—These Are 1950 Production—In Cartons

Best Prices in America—ALUMINUM VOICE COIL SPEAKERS

McGee's Double X (XX) replacement speaker line is unconditionally guaranteed. All in individual cartons. Manufactured this year, by a renowned speaker builder, to our order. Newest Aluminum voice coil, Alnico V magnets, standard RMA 3.2 ohm voice coil. Why pay more? These speakers are second to none. We want your speaker business. We carry 50,000 speakers in stock, for you to pick from. Buy from McGee and save.

Double X Aluminum Voice Coil, Alnico V Magnet, RMA 3.2 ohm V.C.

Stock No.				
4XX	4" square	1 Oz. Mag.	$1.09 ea.	10 for $10.00
5XX	5" round	1 Oz. Mag.	1.09 ea.	10 for 10.00
6XX	6" pincushion	1.47 Oz. Mag.	1.69 ea.	10 for 14.95
6XX2	6" pincushion	2.15 Oz. Mag.	1.95 ea.	10 for 17.95
46XX	4x6"	1 Oz. Mag.	1.49 ea.	10 for 13.95
57XX	5x7" oval	1.47 Oz. Mag.	1.95 ea.	10 for 17.95
7XX	7" pincushion (Auto set)	3.15 Oz. Mag.	2.79 ea.	10 for 24.95
8XX	8" pincushion	3.16 Oz. Mag.	2.95 ea.	10 for 27.95
69XX	6x9" oval	3.16 Oz. Mag.	2.95 ea.	10 for 27.95

Universal replacement output transformers for any push-pull or single plate 2500 to 13,000 ohms from 2 to 16 ohms voice coil. Standard size strap mounting with long leads and lugs for voice coil connections.

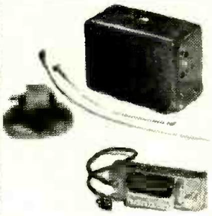
U- 5	5 watt universal output	$ .79 each	10 for $ 7.50
U- 8	8 watt universal output	.99 each	10 for 9.50
U-15	15 watt universal output	1.19 each	10 for 11.00
U-20	20 watt universal output	1.49 each	10 for 13.95

JJ- 4 Single universal output. Any plate to 3.2 ohm voice coil. 4 watt, small size. **49c** each, 10 for $4.50

McGEE RADIO COMPANY Prices F.O.B. K.C. Send 25% Deposit with Order, Balance Sent C.O.D. With Parcel Post Orders, Include Postage **TELEPHONE VICTOR 9045. WRITE FOR FLYER 1422 GRAND AVE., KANSAS CITY, MISSOURI**

BRAND NEW—OVER $80.00 LIST

MOTOROLA 8-TUBE



MODEL 708-T6

AUTO RADIO With Speaker and Cables $39.95

Universal Under Dash Control $1.49 Extra
FITS MOST CARS AND TRUCKS
Push Pull 6K6 Audio 8-Watts Output

Priced less remote control. For all trucks and cars, order our 2A1 universal underdash control, or pick custom controls from our limited selection listed below. Of course you may buy a custom control from your Motorola jobber. World famous 8 tube Motorola auto set. Merchandised by Tucker but branded Motorola. A real distance getter with high fidelity audio. Tone control and push buttons. Fits most cars and trucks. Compact size, 9⅞x5¼x6⅝". Everything furnished, including 6" PM speaker, cables, hardware, etc. You furnish any push button custom control or buy our 2A1 universal underdash control at **$1.49** extra. Shipping weight 17 lbs. List price over **$80.00**. Motorola 708-T6 complete, less remote control. **Net $39.95**. 2A1 underdash remote control **$1.49** extra. (Will supply 7", 6x9", or 8" PM speaker in place of the 6" for **$1.49** extra.)
Note: Pick a custom control from our limited list below for **$1.49** extra.

REG. $6.95 DCF-3 FENDER or COWL ANT. $2.49

Regular $6.95, 3 section top cowl or fender mounting antenna. 3 section 56"—only 3½ inches exposed when collapsed. A universal mounting design. May be ordered with your Motorola set or purchased extra for **$2.49**. Stock No. DCF-3. Weight 2 lbs. **$2.29** each in lots of 12.

10 Assorted Motorola Remote Control Heads $9.95

A RED HOT ITEM FOR THE AUTO RADIO SERVICE DEALER

10 assorted genuine Motorola remote control heads with knobs, pilot light, etc. 5 of each type, manual and automatic. Automatic heads: 42 Hudson, 46-47 Packard, 40 Hudson, 46-47 Hudson, 42-46 Cadillac, 42 Oldsmobile, 41 Nash, 41 Packard, 40 Pontiac, 40 Lincoln Zephyr, 40 Nash, 42-46 Lincoln Zephyr. Manual Heads: 42 Cadillac, 42 Hudson, 46-47 Hudson, 40 Nash, 42 Oldsmobile, 46 Packard, 42-46 Lincoln, 40 LaSalle, 42-46 Cadillac, 40 Hudson, 41 Lincoln Zephyr. **$1.49** each; 10 for **$9.95**.

1950 MODEL PORTABLE TAPE RECORDER $99.50

Our brand new 1950 model portable tape recorder. Response, 60 to 8,000 CPS. With this you make and playback top quality tape recordings. Tape speed, 7½ feet per second. New mechanism records 1 hour on 1200 ft. reel of tape. Fast rewind. Record 30 minutes, turn spool over and record second 30 minutes on 1200 ft. reel. Has an AC transformer type amplifier with 6" speaker. Inputs for mike and radio. External speaker jack. Price includes 30 minute reel of tape and mike. Hinged lid is removable. Case is attractive leatherette covered. Size 10x13x14". Shipping weight 29 lbs. **Stock No. PLT-3.** Net price **$99.50**. Extra reels of recording tape. Latest type recording tape, plastic with red oxide coating. 5" reel **$2.10** each. 7" reel **$3.30** each.
Latest type Kraft base, red oxide coating. 5" reel **$1.35** each. 7" reel **$2.10** each.

RECORD PLAYER KIT $9.95

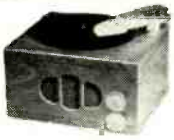
Complete record player kit, for 78 RPM records. All parts, tubes and diagram for building a 70L7 type amplifier. Attractive ready cut walnut base (speaker cutout on top). Ballentine phono motor and Astatic pickup with permanent needle. Shipping weight 10 lbs. Model No. MD-78. Net price **$9.95**.
Three-speed model No. D-3378, same as above only has 3 speed motor and Webster flip-over pickup and twin needles. Net price **$14.95**.

3-SPEED AUTOMATIC PLAYER KIT $39.95

Walnut cabinet, automatic 3 speed record player kit. Attractive cabinet with hinged lid. Two tube amplifier kit of parts including diagram, tubes and Alnico V PM speaker. Latest 3 speed automatic record changer that intermixes records of the same speed, 33⅓, 78 and 45 RPM changer Model VM-406, with twin needles. A complete easy to assemble kit with instructions. Shipping weight 20 lbs. Stock No. LL-374. Net price **$39.95**.
Model LB-23 same as above only with 78 RPM changer, **$24.95**.

WEBSTER 356-1 $24.95

Brand new in original factory cartons. Only 50 to sell. Webster 3 speed automatic record changers with crystal cartridge and tandem tip permanent needle. Webster-Chicago Model 356-1. Shipping weight 16 lbs. Sale price **$24.95** each while 50 last.



RADIO AND RECORD PLAYER $14.95

For your children's room. Buy this superhet radio and record player. Here is what you get: A full 5 tube superhet broadcast chassis all wired and tested. Walnut cabinet, 78 RPM phono motor and crystal pickup. All you do, when you receive your set is drill mounting holes in cabinet. We are offering you this radio-phonograph at the price of an ordinary record player. Shipping weight 15 lbs. **Stock No. JA-70.** Net price **$14.95**. **Stock No. AUT-JO.** Same radio chassis and cabinet as above, but furnished with a 78 RPM automatic record changer. Shipping weight 25 lbs. Net price **$24.95**.

Our Leader Changer Scoop $10.95, 2 for $20.90

Our leader, automatic changer scoop. Base size 13 x 13". Plays 10 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. Shpg. Wt. 17 lbs. Scoop price **$10.95** each; 2 for **$20.90**.

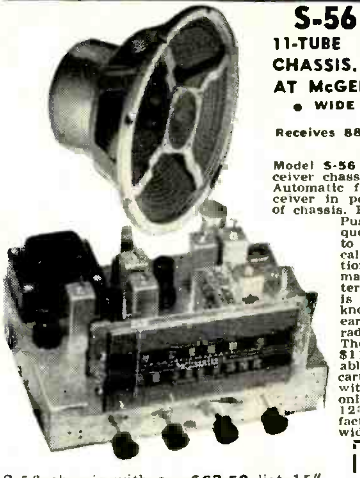
50 PLASTIC 600 VOLT COND. $4.79

50 Molded Plastic By-Pass condensers. All 600 volt. All by the same factory. Not surplus. Regular dealers' net would be 2½ times our sale price. You will chuckle when you look these over.
5—.001 600 v., 5—.002 600 v., 10—.005 600 v., 10—.02 600 v., 5—.05 600 v. and 5—.1 600 v. Shpg. wt. 1 lb. Plastic 600 v. Deal No. 102. Net price **$4.79**.

SCOOP ON CARTRIDGES

Astatic N1-J Nylon 1 volt output cartridge with needle. Response to 8,000 cps. Net. **$2.79**.
MLP-1 Astatic cart. with needle. Net, **$1.19**.
Astatic L-72 or Webster equal, 3 volt output. Net. **$1.79**.
Astatic L-70 or Webster equal, 1 volt output. Net. **$1.79**.
Flip-over cart. with twin needles. Net $2.98.

BUY YOUR S56 HALLICRAFTERS WITH A 15 INCH COAXIAL $77.95



S-56 HALLICRAFTERS

11-TUBE FM-AM CUSTOM CHASSIS. A $110.00 VALUE AT McGEE FOR ONLY . . . $59.95

• WIDE RANGE • AUTOMATIC FREQUENCY CONTROL ON F.M.

Receives 88 to 108 MC F.M. and Broadcast 550 to 1650 K.C.
Fine for Custom Installation

Model **S-56 Hallicrafters**, 11 tube AM-FM radio receiver chassis for broadcast and FM 88 to 108 mc. Automatic frequency control on FM, holds the receiver in perfect tune. Phono connection on rear of chassis. Full range tone control with bass boost. Push-pull 6K6 tubes in audio system. Frequency response essentially flat, from 50 to 14,000 CPS. Wide vision accurately calibrated slide rule dial, with pre-selection on broadcast band. Output transformer matches any 8 ohm speaker. 4 antenna terminals, two for AM and two for FM. This is the finest type of home radio that we know of today. Better get your order in early. Designed to be used in commercial radio selling in the $400 to $600 class. The regular dealers' net on this chassis is $110.00. However, a lucky purchase enables us to offer these brand new, factory cartoned S-56 Hallicrafters chassis, complete with tubes and operating instructions, at only **$59.95** less speaker. Chassis size 12¾x10x7¾". Weight 25 lbs. Brand new factory cartoned. Buy your S-56 with a wide range PM speaker.

S-56 chassis with our **$62.50** list 15" coaxial (P15-8) PM speaker, on sale for **$77.95.**
S-56 chassis with our **$32.50** list 12" coaxial (CU-13X) PM speaker, both for **$69.50.**
S-56 chassis with our new 12" curvilinear cone (1202-X) PM speaker, both for **$67.95.**
VM-950 Tri-O-Matic, 3 speed changer **$28.35.**
VM-950-GE, 3 speed changer with new GE RPX-050 V.R. cartridge **$31.20.**

Pre-amplifier for S-56 $3.95

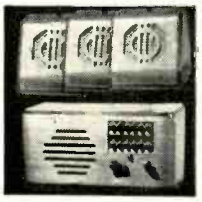
Dual purpose preamplifier for either S-56. Only 4 wires to connect (instructions furnished). With this you can convert set to operate either a G.E. variable reluctance pick-up or a crystal or dynamic mike, making your S-56 a home P.A. system. Preamp Model SS-69. Size 3½x4x3". Shipping weight 2 lbs. Net price, **$3.95**. Crystal mike and desk stand. **$4.95** extra.

BUY YOUR S-56 WITH A CHANGER AND CABINET

(A) Arm Chair Cab. $29.95 **(B) VM-950 3-Speed $28.35** **(C) Furniture Baffle $29.95** **(D) Radio Changer Compartment $29.95**

(A) Armchair radio-phono combination cabinet. Specify when ordering whether you want the radio panel cut for the S-56 or blank. Size, 24" high, 27" long and 16½" wide. Will hold a changer up to 14" square. Changer panel is uncut. For any speaker up to 12". Radio chassis area is 14" long, 9" high and 10" deep. Top quality furniture construction and finish. Walnut armchair cabinet, cut for S-56 or blank, net price **$29.95.** Mahogany armchair cabinet, cut for S-56 or blank, net price **$29.95.** Blond armchair cabinet, cut for S-56 or blank, net price **$34.95.** Shipping weight 40 lbs.
(B) The new VM model 950 Tri-O-Matic automatically plays all records, all sizes and all speeds now on the market. Protective features: records are lowered, not dropped, no wobbling down the spindle, no slip or scrape, no possibility of the tiny microgrooves on the new type records being damaged. Plays 12 10", 33⅓ or 78 RPM, 10 12", 33⅓ or 78 RPM, any 10 or 12" records of the same type intermixed, 12 7" 33⅓ RPM and 12 7" 45 RPM records. Automatically shuts off on the last record, base size 13 13/16x12¼", 7¼" high overall. Equipped with crystal cartridge and needle. Stock No. VM-950. Shipping weight 12 lbs. Net price **$28.35.** New 1950 Model VM-950 with All-in-one General Electric Variable Reluctance Cartridge and Twin Needles. Specify VM-950-GE. Add **$2.85** to above cost.
(C) A fine furniture quality speaker baffle, made of ¾" brown mahogany. Will hold either a 12 or 15" speaker. (Specify size speaker you intend using when ordering.) You may buy this baffle by itself or for use with our radio and changer compartment. The two pieces are a matched pair. Set the radio cabinet by your chairside and the speaker baffle elsewhere. You may extend the speaker leads up to 50 feet on your S-56 or any other radio. This baffle is of high quality, non-rattle construction. Stock No. LS-4. Shipping weight 40 lbs. Net price **$29.95.**
(D) Radio chassis and changer compartment (no space for speaker). Intended for use with the speaker baffle on the left, or may be purchased separately if you have some place to put your speaker. Cabinet is made of ¾" brown mahogany and is of furniture quality. It is 25" high, 18¼x17¼". Consists of two drawers, one for the record changer 14¼x14¼x6¼ above the motor board; the other drawer has space for radio chassis up to 15" long, 9½" front to back and 8½" tall. We can supply with the radio panel cut for the S-56, the 7B-22 utility chassis, or blank. Specify which when ordering. Stock No. UR-2. Shipping weight 38 lbs. Net price **$29.95.**

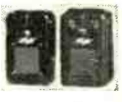
TERRIFIC INTERCOM SALE



10 STATION MASTER $19.95
SUBS, $3.95 EACH

Super heavy duty, 10 station intercom master, designed for continuous service. A powerful AC transformer type with 80 rectifier, 6V6 output and 6SJ7 driver. 5" speaker with 2.15 oz. Alnico V magnet. Housed in a walnut cabinet 14" long, 6½" deep and 7½" high. Designed to install as a 3 wire system. 10 push button station selecter on front, with separate all station call switch. Talk-listen switch has silent position. Made to sell for a much higher price. McGee made a fortunate purchase and passes the bargain on to you. Shipping weight 12 lbs. **Stock No. 2520.** Net **$19.95** each. Remote station with call back switch, for use with the above master, **$3.95** each, 10 for **$35.00.**

McGrade Intercoms



Master and Sub $14.95

McGrade Intercom. Master and sub-station. housed in small matching walnut plastic cabinets, 5½x7x3½ inches. Sloping front for desk or wall installations. Furnished with 50 feet of interconnecting wire. Sub-station may be used up to 1000 feet from master station. These units are new and factory cartoned. Complete with tubes. Made to retail at $29.95. A lucky purchase enables us to offer these to you for only **$14.95.** Include postage for 8 lbs. **Stock No. MB-35.**

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.**

BOES MODEL 103 REG. $7.77 SIGNAL TRACER PROBE WHILE OUR STOCK LASTS $2.95

Boes signal tracer probe, with instructions. Made to sell to you for $7.77. McGee's sale price only **$2.95**. You get this: a heavy bakelite probe containing a 6F5GT tube. (The end of the probe is secured by three screws and may be taken apart easily.) A 5 foot lead with 3 circuit amphenol plugs and receptacle and Mueller peewee clip. You can connect this probe to any AC amplifier and have a signal tracer or you may buy this just for the parts to build a HV multiplier or HF probe for VTVM use. Usable inside space for building purposes is 1¼ x 4". Overall length is 5". Price includes 6F5GT tube. A red hot special. Stock No. 103. Shipping weight 1 lb. Net, **$2.95**; 2 for **$4.95.**

Build Your Own Phono-Mike Oscillator

Kit Model DE-6X $6.95

Kit Model DE-6X. With this simple kit, you can build a 4 tube phono oscillator that also has a mike input. Will broadcast over any radio, within your home, (about 75 feet) from 800 to 1500 kc. Inputs for crystal mike or crystal phono pickup. Fader control fades from mike to record. Ideal for a home P.A. system, baby listener and home entertainment. A complete kit of parts including tubes. Kit Model DE-6X. Net price, **$6.95.** DE-6XWT, wired and tested. Net price, **$8.95.** Crystal mike and desk stand, **$4.95** extra. Concealed microphone unit, only 1" in diameter and ¼" thick. Specify hidden mike when ordering. Stock No. T-001. Net, **$3.95** extra.

McGEE RADIO COMPANY Prices F.O.B. K.C. Send 25% Deposit with Order, Balance Sent C.O.D. With Parcel Post Orders, Include Postage **TELEPHONE VICTOR 9045. WRITE FOR FLYER 1422 GRAND AVE., KANSAS CITY, MISSOURI**

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.

NEW HAM ANTENNA

The development of a new circular antenna for two meter ham operation has been announced by *Circle-X Antenna Corporation* of Perth Amboy, New Jersey.

Known as the "Circle X 2M," the new unit has a low standing wave ratio, a constant 300 ohm impedance, vertical polarization, and high loading qualities.

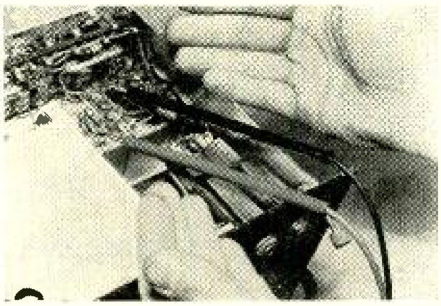
Priced in the moderate class, the new antenna is light weight, of simple construction, and easy to rotate.

UNIQUE TEST PROD

Of interest to television and radio technicians is the recently-announced "Klipzon" self-holding test prod being manufactured by *United Technical Laboratories*, Morristown, New Jersey.

The patented point on the prod has a jaw with an opposed steel needle which, when pressed against wire, lug, or terminal, slides on and grips it until pulled off. The slenderized design adds a minimum of capacity to high frequency circuits and facilitates contact with hard-to-reach points in the equipment under test.

The points fit pin jacks, tube sockets, and binding posts, and will grip all wires from the finest to #12 B & S gauge. Points are made of non-magnetic alloy steel and are needle sharp for ease in piercing insulation, wrappings, fungus, etc. Red and black Synthane handles provide good insulation against relatively high voltages. Four foot red and black leads which will not curl or kink are supplied with the prod.

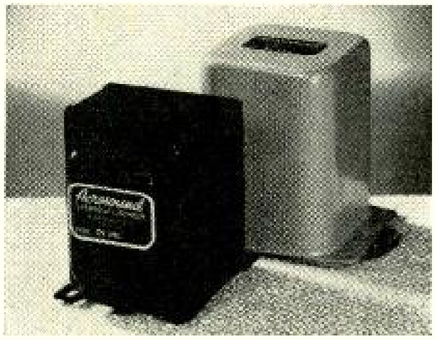


OUTPUT TRANSFORMERS

A new line of high fidelity output transformers is being introduced by *Acro Products Company* of 5328-30 Baltimore Avenue, Philadelphia 43, Pa., for use in original equipment or as replacement units.

The transformers are available in six models for the most popular tube combinations, including a special unit for use with triode-connected 807's as used in the Williamson circuit.

Frequency response is plus or minus one db. from 10 c.p.s. to 40,000 c.p.s. The units deliver full-rated power at 20 c.p.s. and will handle twice the nominal power rating over the useful audio spectrum. A newly designed symmetric coil structure with accurate reactive balance, in conjunction with high permeability core material, is responsible for the extremely wide range response with negligible harmonic and intermodulation content at high power levels.



Full descriptive information and suggested circuit arrangements for high fidelity use are available from the company.

FM RELAY RECEIVER

Radio Engineering Laboratories, 36-40 37th Street, Long Island City, New York is in production on a new FM relay receiver, the Model 722, for the 88 to 108 mc. band.

The Model 722 is a rack mounted, single frequency, crystal-controlled double i.f. superheterodyne of excellent performance, distortion 50 to 15,000 cycles less than ½%; sensitivity noise factor better than 6 db., sputter point less than 2 microvolts, intelligibility with less than 1 microvolt.

The new receiver supersedes the company's *REL* 670 receiver.

"RECORD-LIFE"

The Chemical Division of *The Minnesota Electronics Corporation*, 97 East Fifth Street, St. Paul 1, Minnesota, has developed and is currently marketing a new liquid which is designed to prolong record life.

Tradenamed "Record-Life," the new product combines the functions of a cleaner and anti-static agent. The cleaning agent is formulated to disperse solids in the form of dust and to emulsify surface oils and greases that form mechanical bonds for dust and dirt. The new liquid contains no wax, alcohols, or other solvents and is free from hygroscopic agents and humectants which might leave sticky or hard deposits of solids in the high frequency grooves.

"Record-Life" may be applied to all types of records by means of a foam rubber sponge which is supplied with the liquid.

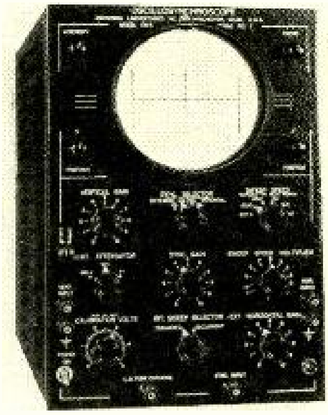
OSCILLOSYNCHROSCOPE

Designed to provide wide-band amplifier and versatile sweep facilities in a single portable unit, the new oscillosynchroscope announced by *Browning Laboratories, Inc.* of Winchester, Massachusetts, has been designated the Model ON-5.

The new unit is particularly well adapted to the study of pulse and transient phenomena as well as being useful in all conventional oscillographic applications. The vertical amplifier response is flat within 3 db. from 5 cycles to 5 megacycles. The horizontal amplifier is direct-coupled with the high frequency response extending to 500 kc.

The sweep generator may be triggered or recurrent with direct reading writing rate calibration for any internal sweep condition. Triggered sweep speeds from 1 microsecond per inch to 25,000 microseconds per inch and recurrent sweeps of 10 to 100 kc. are available.

An adjustable calibration voltage may be used for determination of vertical deflection voltage amplitudes. Either d.c. or a.c. connection may be made to all deflection electrodes. Also provided is a panel connection to the cathode-ray tube cathode for external beam modulation.



GAMMA DETECTOR

A miniature unit for the detection and measurement of gamma radiation has been announced by The Instrument Division, *The Kelley-Koett Mfg. Co.*, Covington, Ky.

(*Continued on page 82*)

GUARANTEE?	MONEY BACK?	THE UNITS OFFERED ON THIS PAGE ARE COMPLETE INSTRUMENTS, NOT KITS! EVERY MODEL IS FACTORY-WIRED, CALIBRATED AND READY TO OPERATE.
Every unit sold by us is covered by a one year guarantee.	Every unit we advertise is offered on a strict "money-back-if-not-satisfied-basis." No if's—no but's—no maybe's. If you are not completely satisfied after a 10 day trial—return for complete refund. No explanation—you are the sole judge. Plain enough?	

THE NEW MODEL 200

AM and FM SIGNAL GENERATOR

SPECIFICATIONS

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

★ **MODULATING FREQUENCY:** 400 Cycles. May be used for modulating the R.F. signal. Also available separately.

★ **ATTENUATION:** The constant impedance attenuator is isolated from the oscillating circuit by the buffer tube. Output impedance of this model is only 100 ohms. This low impedance reduces losses in the output cable.

★ **OSCILLATORY CIRCUIT:** Hartley oscillator with cathode follower buffer tube. Frequency stability is assured by modulating the buffer tube.

★ **ACCURACY:** Use of High-Q permeability tuned coils adjusted against 1/10th of 1% standards assures an accuracy of 1% on all ranges from 100 Kilocycles to 10 Megacycles and an accuracy of 2% on the higher frequencies.

★ **TUBES USED:** 12AU7—One section is used as oscillator and the second is modulated cathode follower. T-2 is used as modulator. 6C4 is used as rectifier.

The Model 200 operates on 110 Volts A.C. Comes complete with output cable and operating instructions.

$18.85 NET

Superior's new model 770

AN ACCURATE POCKET-SIZE VOLT-OHM MILLIAMMETER

(SENSITIVITY: 1000 OHMS PER VOLT)

FEATURES: Compact—measures 3⅛" x 5⅞" x 2¼". Uses latest design 2% accurate 1 Mil. D'Arsonval type meter. Same zero adjustment holds for both resistance ranges. It is not necessary to readjust when switching from one resistance range to another. This is an important time-saving feature never before included in a V.O.M. in this price range. Housed in round-cornered, molded case. Beautiful black etched panel. Depressed letters filled with permanent white, insures long-life even with constant use.

SPECIFICATIONS: 6 A.C. VOLTAGE RANGES: 0—15/30/150/300/1500/3000 VOLTS. **6 D.C. VOLTAGE RANGES:** 0—7.5/15/75/150/750/1500 VOLTS. **4 D.C. CURRENT RANGES:** 0—1.5/15/150 MA. 0—1.5 AMPS. **2 RESISTANCE RANGES:** 0—500 OHMS 0—1 MEGOHM.

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

$13.90 NET

SUPERIOR'S NEW MODEL TV-10

TUBE TESTER

SPECIFICATIONS

★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing Aid, Thyratron, Miniatures, Sub-Miniatures, Novals, etc. Will also test Pilot Lights.

★ Tests by the well-established emission method for tube quality, directly read on the scale of the meter.

★ Tests for "shorts" and "leakages" up to 5 Megohms.

★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-10 as any of the pins may be placed in the neutral position when necessary.

★ The Model TV-10 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

★ Free-moving built-in roll chart provides complete data for all tubes.

★ Newly designed Line Voltage Control compensates for variation of any line voltage between 105 Volts and 130 Volts.

The Model TV-10 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

$39.50 NET

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

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.)

OLSON AKRAD

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

IT'S DIFFERENT—IT'S AMAZING—IT'S GREAT

IT'S NEW!

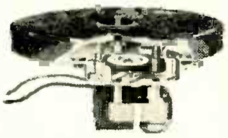
The OLSON LOUDMOUTH

RA-43 Complete with tubes and Electro-Voice Microphone. OLSON'S Special Price, only . . . . . **$29.99 EACH**

ONLY AT OLSON'S

A complete sound system • Inputs for both microphone and phonograph • Electro-Voice Microphone included • Underwriters Laboratories approved components

An entire sound system capable of delivering 6 watts (8 watts peak) at less than 5% harmonic distortion. Has input jacks for microphone and phono. Two controls, one for volume and one for tone. 8" heavy duty built in PM speaker, safety fused circuit. Hum free operation. Indicating pilot light. Suitable for use by musicians, singers, lecturers, lodges, clubs and any other entertainment application. The dual-channel input permits mixing of singing with the playing of phonograph. Frequency response, ± 2DB 100 to 8,000 cps. Power gain 105DB. Tubes 6SL7gt, 6V6gt and 6X5gt. Hum level 60DB below output level of 6 watts. Power consumption 30 watts at 117 volts, 60 cycles. Dimensions, 11¾x8½x13" high. Genuine leather carrying handle, beautiful two tone grey and blue carrying case with sloping control panel. Completely assembled ready to operate. Shpg. wt. 15 lbs.



Rim Drive Phono Motors

Famous Makes! Real bargains at these low prices. Self-starting; complete with turntable. All parts included Shpg. wt. 4 lbs. **OLSON'S SPECIAL.**

M-52, 78 rpm for 115 volts AC . . . $2.75
M-63, 3-speed, 33⅓, 45 and 78 rpm 4.95

Only **$7.95** Model 19

GE LONG-PLAY RECORD PLAYER

A close-out worth much more. Attractive streamlined cabinet contains quiet 33⅓ RPM motor, on-off switch and handsome pick-up with genuine GE variable reluctance phono cartridge and permanent needle. Brand new factory sealed cartons. Can be used on any set with pre-amp. Operates on 115 volts AC. Regular price $19.95. Shpg. wt. 5 lbs. **Special Price at OLSON'S.**

12" COAXIAL SPEAKER

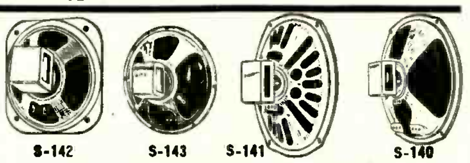
12"

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

40 to 17,000 CPS response

SINGLE EACH **$9.95**

If you've wanted a real high-fidelity co-axial speaker here is your chance to get a brand new 18 watt 1950 model. The 12" woofer section is driven by a heavy Alnico 5 6.8 oz. magnet and this part delivers the base notes. The 3" tweeter which is built into the center of the speaker is driven by a 2.15 oz. Alnico 5 magnet and delivers the treble notes. The high pass filter is built into the speaker and the entire combination gives you tone you never dreamed possible. There are only two wires to connect to any radio or amplifier and the speaker is ready to play for you. Voice coil impedance is 8 ohms. This high quality speaker should not be confused with inferior makeshift units. Olson sells these speakers on an iron clad money back guarantee if you are not 100% satisfied. Order today. Shpg. wt. 8 lbs. **OLSON'S BARGAIN.**



S-142 S-143 S-141 S-140

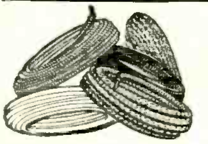
PRICES SLASHED ON GENUINE MAGNAVOX PM SPEAKERS

"The Oldest Name in Radio"

Latest designs to come from the Magnavox laboratory. Super Alnico 5 magnets employed. Voice coils built to utilize every bit of input power and to deliver volume and fidelity you never dreamed possible. Each speaker individually packed in an attractive carton. The name Magnavox on each speaker is your guarantee of the best. Voice coil impedance 3.2 ohms on all speakers except 12" which is 8 ohms.

Stock No.	Size	Watts	Olson's Price	
S-142	4"	3	$1.29	OLSON'S
S-143	5"	4	1.29	SPECIAL
S-141	6 x 9"	6	2.79	BARGAINS
S-140	12"	9	4.95	

HOOK-UP WIRE KIT



How can we give you so much high grade wire for so little? Olson bought all the wire in sight and is passing the bargain on to you. Kit contains 5 rolls, each 100 ft. . .total 500 ft. Various colors, push back, plastic and rubber insulation; solid and stranded copper. Shpg. wt. 3 lbs. **Special at OLSON'S**
AS-19, 500 feet $2.50

2 BAND RADIO CHASSIS

$6.95 RA-49

A 2-Band chassis which is partially assembled. Designed to be a 6-tube set but only 4 of the tubes are included: 1—12SQ7gt, 2—12SK7gt, 1—14Q7. The output and rectifier tubes are not included. Includes a 3-gang condenser, 3-section filter condenser, 6 sockets, 4 tubes, set of shielded RF, Antenna, Oscillator and 2 IF transformers, band switch, volume control, by-pass condensers, mica condensers, resistors and trimmer. Circuit diagrams are not available. Shpg. wt. 10 lbs.

NEW INTERCOM

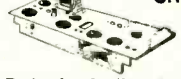
A real high quality Intercom ideal for home, office, nursery or sickroom. Quickly installed without tools. Remote stations may be placed as far away as 2,000 feet. Beautifully designed plastic cabinets with sloping front. Alnico 5 PM speakers deliver ample volume. Has on-off switch, push-to-talk switch and volume control. Master station uses 12SJ7, 50L6 and 35Z5 tubes. Size of cabinets 5½"x8½"x 4". One or more substations may be used with the master station. **RA-40.** Master Station with tubes and 50 ft. of 2 conductor cable **$9.99**
RA-41 Substations, each **$3.99**

$9.99 RA-40 OLSON'S BARGAIN

ASTATIC MICROPHONE

Universal high output crystal for public address, home recording and communications. Equipped with handle and desk base. 7 ft. shielded cable. A beauty, too, for this price. Shpg. wt. 5 lbs. **SPECIAL AT OLSON'S**
M-67, each $4.95

RADIO CHASSIS



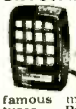
79¢ each X-228

Real value for the experimenter. Each chassis contains at least 5 sockets, and one output transformer to match single tube to 3.2 ohm voice coil. Approximate dimensions 4 x 10 x 1½". Transformer alone is worth 79c, but Olson's price is 79c for everything.

MUSICAL INSTRUMENT MIKE

Famous quality! Sells for twice our sale price. Easily attached. Delivers brilliant tone from string instruments. With 4' shielded cable and volume control.
M-61—OLSON'S PRICE $5.95

CRYSTAL MIKE



Olson's Special **$4.49** M-70

Hand mike by a famous manufacturer. Beautiful Die Cast case. Equipped with 7' shielded cord. Frequency response 60-7, 500 cps. Output —50 db.

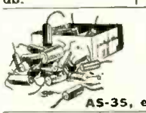
Selenium Rectifiers

Individually boxed, brand new fresh stock. Useful for AC-DC sets, amplifiers and TV sets. Save and buy from OLSON.

Stock No.	MA	Lots of 10, each	Single each
X-184	75	$.59	$.69
X-150	100	.69	.79
X-185	150	.79	.89
X-186	250	1.19	1.29

Rectifiers may be assorted for 10 lot price.

By-Pass Condenser Kit



Assortment of 50 popular values. 200 to 1700 volts, capacities from .0002 to .25 mfd. Quantity limited. Shpg. wt. 2 lbs.
AS-35, ea. OLSON'S BARGAIN $1.59

KIT OF THREE VARIABLE CONDENSERS

A $3.50 value. Perfect for the experimenter. Brand new stock. Quantity limited. Get a kit containing 3 assorted variable condensers. Popular values. 2-gang and 3-gang. Some have trimmers, vernier drives. AM and FM styles.
Olson's Price $1.29
X-226, Carton of 3 asst.

MATCHED PAIR AM-FM CONDENSERS

Beautifully built! 3-gang. Build a tuner or AM-FM set. AM sections are 365 MMFD; FM is 15 MMFD per section. Can be operated by push-buttons, too. Shaft ⅜" dia. Condenser 3"x 1½"x4". Shpg. wt. 3 lbs.
X-201, Only at OLSON'S . . . . 69¢ Pair

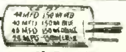
ASTATIC "TURNOVER" PICK-UP ARM

Cartridge turns by means of knob on front. One side plays 33⅓ and 45 RPM records and other side plays 78 RPM. Only 8 grams needle pressure. Employs the famous **ASTATIC** LQD-1 Double-needle cartridge. Die cast curved arm. Equipped with 2 long life needles. Frequency response 50-7000 cps output 1.2 volts. Shpg. wt. 2 lbs. Reg. list price $15.90. **Stock No. M-64, OLSON'S Price, each $4.95**

Genuine Astatic Pickup Arm

With crystal cartridge . . . at less than you'd normally pay for the cartridge alone.
M-58 each $2.19

Cornell-Dubilier Condenser



Lots of 10, each 59c

A truly universal condenser for practically any AC-DC radio. Make any combination from its 4 sections.
40—40—40—20 MFD—150 VOLTS
C-328, single, each 69c

MICA CONDENSER KIT

Contains an assortment of 10 Mica condensers. Popular values. Priced at less than jobbers' cost. Shpg. wt. 1 lb.
SPECIAL AT OLSON'S AS-18, each 69¢

FP CONDENSER KIT

Assortment of 15 popular FP condensers, double and triple sections. Capacities from 10 mfd to 50 mfd: from 25 to 450 volts. Shpg. wt. 3 lbs.
OLSON'S Bargain AS-24, each $2.98

PHONO AMPLIFIER

Easily connected to any phono and speaker . . . or just the thing for a portable. Uses 1 each: 12SQ7, 50L6, 35Z5 tubes. 2 controls: on/off volume and tone. 7"x 3¼"x2" chassis. Shpg. wt. 2 lbs
AT OLSON'S. RA-19 . . . . . . $2.98
AS-22, tubes for above amp. 1.87

3 SPEEDS FOR THE PRICE OF 1

Plays 78—45—33⅓ RPM Discs

Yes, you would expect to pay more for just a single speed player. But Olson made a quick cash deal with a manufacturer and we got 500 of these fine 3-speed record players. This is not a kit. Complete! Ready to play any size record up to 12" and any speed 78, 45, or 33⅓. Carrying case is sturdy, attractive leatherette covered with beautiful hardware and carrying handle. 3-speed motor made by Alliance, astatic tone arm has precious tip needle. Amplifier is scientifically designed. PM speaker is Alnico 5. Equipped with volume control and on-off switch. Operates on 115 volts AC. Shpg. wt. 15 lbs.
RA-34, Single, each . . . . $19.95 **Lots of 3, each $17.97**

4-DRAWER STEEL CABINET GIVEN WITH OLSON'S GIGANTIC, NEW AKRAD KIT

Olson's Price AS-20 $14.95

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

42 "Akrad" By-Pass Condensers!

Qty.	Cap.	Volts	List ea.	Total
2	.001	600	$.25	$.50
2	.002	600	.25	.50
2	.005	600	.25	.50
5	.01	600	.30	1.50
5	.02	600	.30	1.50
10	.05	600	.40	4.00
10	.1	600	.45	4.50
2	.005	1600	.55	1.10
2	.008	1600	.55	1.10
2	.01	1600	.60	1.20

Also 27 "Akrad" Electrolytic Condensers

Qty.	Cap.	Volts	List ea.	Total
2	10	25	$ .75	$1.50
2	25	25	.85	1.70
5	20	150	.95	4.75
5	40	150	1.10	5.50
4	20-20	150	1.30	5.20
5	8	450	.95	4.75
4	16	450	1.35	5.40

69 Value $45.20

X-158 19c

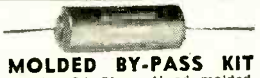
H & H TOGGLE SWITCH

Single pole, single throw, 6 amps, 125 V. Regular 60c.

AC CORDS

Underwriters' Laboratory approved. Use in home and shop. Unbreakable plugs. Cord 6 feet long.
W-43 Zip Cord, single each 19c. Lots of 10, Each **14c**
W-60, Heavy Duty, for motors, etc., single each **29c.** Lots of **10,** each **19c**

MOLDED BY-PASS KIT



Kit contains 34 Olson Akrad molded condensers which retail at $12.80. Will resist heat, cold, vibration, humidity, physical shock, and electrical overloads. Each kit is packed in durable 6-compartment case with snap lock cover. Also included at no charge is a package of snappy tags to attach to radios which you service. Each kit contains the following:

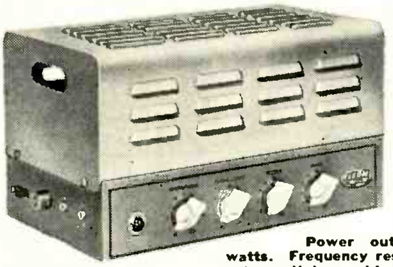
Qnt.	Cap.	Volts	Qnt.	Cap.	Volts
2	.001	600	6	.05	600
2	.002	600	4	.1	600
2	.005	600	2	.005	1600
6	.01	600	2	.008	1600
6	.02	600	2	.01	1600

AS-34, OLSON'S PRICE $4.95

FREE SEND FOR OUR LATEST RADIO AND TELEVISION BARGAIN CATALOG

MONEY BACK GUARANTEE: Everything you order from Olson is guaranteed to be exactly as advertised by us. If, after goods arrive, you are not satisfied, you may return merchandise and get your money back.

Please Minimum Order $3.00



PRICE SLASHED ON LATEST
5-Tube, 12-Watt AMPLIFIER

Inputs for Crystal Mike, Variable Reluctance and Crystal Pickup. Olson's Great Bargain.

It's unbelievable, but Olson has done it again. A full 12 watt beautifully built 5 tube amplifier which has inputs for crystal microphone, variable reluctance phono pickup and crystal phono pickup. In addition this amplifier is equipped with dual tone controls for treble and bass boost, equalized circuits and hum-free wide range response. Engineered by one of the foremost sound experts in the country and licensed by Western Electric, Guaranteed to satisfy. **OLSON'S BARGAIN PRICE**

Power output—12 watts. Peak output—17 watts. Frequency response ±2DB, 40 to 15,000 CPS. Input—switch provides choice of conventional crystal pickup or G.E. Variable Reluctance. Also any crystal, dynamic or ribbon mike. Also any radio tuner. Controls—1 phono or Radio tuner; 1 Mike; 2 bass and treble tone controls. Tubes—2—6SL7gt, 2—6V6gt, 1—5Y3gt. Output impedances—4 and 8 ohms. Voltage—105-125 volts AC, 60 cy.

$27.95 RA-38
Complete with tubes

OLSON AKRAD
THE HOUSE OF RADIO AND TELEVISION BARGAINS

1000 RESISTOR KIT
Color Code Guide Included

Olson's Special Price **$15.95**
Stock No. AS-29

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 8¼x7½x10½". Here's your chance to get a full thousand Insulated Resistors at less than distributors' cost. Your cost is only about 1½c per resistor. Regular price is 9c each or $90.00. Shpg. wt. 12 lbs. Limit: positively only ONE DEAL to a customer. None sold to Jobbers.

INSULATED RESISTOR KIT

OLSON'S Special Price AS-32 **$2.99**

Contains a carefully selected assortment of 100 Insulated resistors. Standard RMA color code. Included are 70—½ watt, 20—1 watt and 10—2 watt resistors. Handsomely packed in a durable pliofilm bag. Regular list price $15.80. Shpg. wt. 1 lb.

OLSON AKRAD CRYSTAL CARTRIDGES

XC-50, Standard Crystal Cartridge, single, each, $1.79. Lots of 10, each. **$1.59**
XC-51, 3-Way cartridge with built-in 2 mil needle for 33⅓, 45, and 78 RPM. Discs single, each, $2.59. Lots of 10, each........ **$2.39**

3-VOLT OUTPUT

The crystal phono cartridge you've been waiting for—and at a price which enables you to use them in your service work profitably. The new Olson Akrad cartridge is interchangeable with any standard cartridge since its mounting centers are ½". Its high output, 3 volts and wide range response of 50-6000 cps are obtained by advanced methods used in driving the crystal element. The cartridge is supplied with pin plug connectors for ease of connecting leads. Each cartridge is individually packed in a handsome red, white, and blue shelf carton. Olson Akrad Cartridges may be assorted to get low 10-lot price.

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.

OLSON'S SPECIAL BARGAIN

Stock No.	Type No.	Price per 100
X-161	47	$4.90
X-174	14	

NEW DESIGN
World's Fastest Automatic Changer for RCA 45 R.P.M. Records
Price slashed by OLSON

$9.95 Each RA-45

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

GENUINE GENERAL ELECTRIC GERMANIUM CRYSTAL DIODES

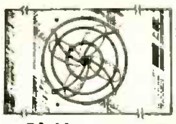
Lots of 10 Choice any type **49c** Each

In the design of modern electronic equipment, Germanium Diodes are becoming very important. Experimenters, servicemen and radio amateurs are now using these diodes to replace such tubes as 6H6 and 6AL5 as well as copper oxide, selenium and silicon rectifiers. Olson has just made a terrific purchase and you can buy them for a fraction of their regular price. Order by GE Type Number. May be assorted in quantities of 10.

GE Type No.	Sylvania Equiv.	Inverse Volts	Regular List Price
IN-51	IN-34	50	$1.35
IN-48	IN-34	85	1.60
IN-52		85	3.35
IN-63	IN-38	125	6.00

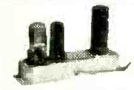
Type IN-48 and IN-51 (Sylvania IN-34) is used for meter rectifiers, or in signal probes, noise limiters and in 1st and second detector circuits of FM and TV. Range up to 200 MC. All above Germanium crystals can be used as highly sensitive crystals in crystal sets. Single unit, each.............. 59c

CHANGE KITCHEN AIR IN 3 MINUTES



RA-44 Olson's Special Price **$7.99**

Powerful 8" exhaust fan designed to run day and night. Reversible—for exhaust or intake. Easily installed. Two adjustable sliding panels permit quick installation in any standard window from 23 to 36 inches wide. Use it in kitchen by day to remove odors. Use it at night in bedrooms to draw in cool air. Equipped with two-pole shaded induction motor, oil-less bearings. Operates on 115 volts 50/60 cycles. Consumes only 26 watts. Motor speed 2300 RPM. Motor is precision-made and is heavy gauge aluminum and fan blades are aluminum and balanced. Has on-off switch and UL approved rubber cord, 6 ft. long with plug attached. Original factory-sealed cartons. Shpg. wt. 7 lbs.



RCA RADIO ELECTRIFIER

Converts Many Types of Portables to AC

Converts RCA Model 25BK, 25BT2, etc., portable battery sets for operation on 115v AC. Plug in and set is electric. Adaptable to other portables. Complete with tubes. Shpg. wt. 2 lbs.

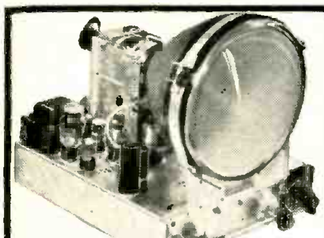
Olson's Price RA-39 .... **$1.95**

RADIO TUBES

Individually boxed GE, Kenrad, Sylvania, etc. Quantities limited. Order early and get your pick. Order by Stock No. as well as Type No.

Stock No.	Type No.	Olson's Price
Z-6	IT4	29c
Z-8	3S4	29c
Z-29	5Y3gt	49c
Z-37	6BE6	29c
Z-33	6SH7	29c
Z-75	12A8gt	49c
Z-13	12BA6	69c
Z-14	12BE6	69c
Z-15	12SA7	69c
Z-16	12SK7	69c
Z-17	12SQ7	69c
Z-23	35W4	49c
Z-25	35Z5gt	49c
Z-26	50B5	89c
Z-27	50L6	69c

OLSON TELEVISION SCOOP!



Never offered before—TV chassis with 12" tube! Not a kit—ready to use! Completely assembled!

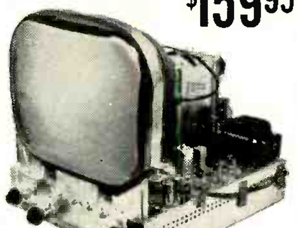
$129.95 RA-33

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 lineup: 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 prealigned 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.

$159.95

16" Rectangular Tube TV Set 170 Sq. In. Picture Not a Kit • Completely assembled with all tubes • OLSON'S Greatest Bargain, RA-50

$159.95



ONLY AT OLSON'S

Made by a leading TV manufacturer who pioneered in TV development. Receiver is pre-aligned and tested at the factory. Only Olson's can bring you such a value. Contains 19 tubes in addition to the Kinescope picture tube. Equipped with standard coil tuner with 300 ohm input, acknowledged to be one of the finest tuners made. All condensers are latest 85° centigrade, insuring long life. Has built-in antenna which is suitable in all major signal areas. Power supply has fused primary and uses voltage doubler circuit producing 13,500 volts. Straight AC circuit. NOT AN AC-DC SET. Power supply equipped with safety cover. Deflection yoke is latest model 70° type. All tubes connected in parallel. All picture adjustments made from front of chassis. No fumbling in the rear to set up picture. PM speaker is supplied. Nothing in the country to compare with this great Olson value. Pictures are large, clear, sharp and steady. A fine set even in fringe areas. You can install this set in your own cabinet. Comes to you in factory sealed cartons including 16" rectangular Kinescope tube, all tubes, speaker, knobs, cable and mounting template. Chassis size 16" wide, 18" deep, 17" high. Operates on 115 volts AC. Shpg. wt. 75 lbs.

TV BOOSTER KIT

R-A-26 **$9.95** Complete

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. **OLSON'S BARGAIN PRICE.**

TV Focus Coil

T-80 **$1.49** Each

Same as RCA Part No. 202D1. Perfect for all RCA 630-type or similar TV sets. Regular list price is $7.50. Shpg. wt. 2 lbs. **OLSON'S BARGAIN PRICE.**

TV Deflection Yoke

T-84 **$2.95** Each

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

TV FLYBACK TRANSFORMER

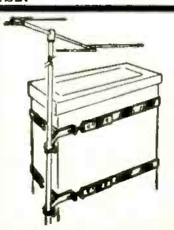
T-82 **$2.79** Each

Same as RCA 211T1. Supplies high voltage to 12" or 10" picture tube. Also has filament winding and feeds horizontal scanning coil of deflection yoke. Sh. wt. 3 lbs.

OLSON Hi-Gain Conical Bay

EACH **$4.49** AU-17

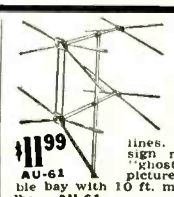
Amazing TV antenna outsells all others. Delivers high gain on all channels. Eliminates ghosts and has excellent signal to noise ratio. Features include silicone-treated insulator, marine type dural elements, and butt seamed tubing. Assembled in a few minutes. Shipped without mast which is available locally. **AU-17** includes universal mounting clamp for attaching to any mast from ¾" to 1¼" diameter.
Special, price lots of 10, each........ **$3.99**



Adjustable Chimney Antenna Mount

Worth Twice Our Price!

Strongly made of heavily plated steel. Makes it easy to attach any antenna mast from ¾" to 1½" diameter to any chimney. Comes complete with strapping and all hardware. U. S. Patent 2482575. The best. Shpg. wt. 5 lbs. Single each, **$1.59.**
X-207, lots of 10 each........ **$1.39**



$11.99 AU-61

TV-FM Antennas

Olson's Finest TV-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**

HOW TO ORDER: Order directly from this ad. State quantity desired, stock number, description and price. You may send remittance with order (include enough for postage on parcel post shipment), or, if you prefer, SEND NO MONEY. Olson will ship C.O.D. and you may pay mail or expressman for merchandise and postage.

OLSON RADIO WAREHOUSE, INC.
73 E. MILL ST. • DEPT. RN750 • AKRON 8, OHIO

MARS Station of the Month

MARS BEAMS WEEKLY BROADCASTS

MARS—Army Headquarters station, WAR, located at the Pentagon Building, Washington, D. C., broadcasts a weekly message each Tuesday at 0100Z and at 0400Z. (This is Monday at 8 p.m. and 11 p.m., Eastern Standard Time; Monday at 7 p.m. and 10 p.m., Central Standard Time; Monday at 6 p.m. and 9 p.m., Mountain Standard Time; and Monday at 5 p.m. and 8 p.m., Pacific Standard Time.)

Simultaneous broadcasts are made on frequencies 3497.5 kc., 6997.5 kc., 14,405 kc., and 20,994 kc. Each message is sent three times, once at 10 words per minute, once at 15 words per minute, and once at a higher rate of speed—usually 20 words per minute.

Designed especially to transmit quasi-official traffic and training information to MARS members, the broadcast offers an excellent opportunity to all amateurs in building up their code proficiency.

HEADQUARTERS U. S. Air Force has selected W2UMB-AF2UMB, operated by 1st Lt. Leo T. Meister, USAFR, of Hillside, New Jersey as "MARS Station of the Month" for his activities in Amateur and MARS affairs and for his further work in public relations.

Leo has worked closely with the Belleville, New Jersey, chapter of the American Red Cross offering the services of his amateur station and aiding in the organization of a mobile disaster communications service which he serves as vice-chairman. He also belongs to the ARRL-sponsored Amateur Emergency Corps.

In the recent Amboy, New Jersey disaster he responded to a call of the Newark, N. J. chapter of ARC and operated his mobile rig handling disaster traffic from 10 p.m. until 3 a.m. May 19 and 20, when he was advised the communications emergency was over.

Leo works 40 and 80 meters from his car as well as MARS frequencies and the 35 minutes it takes him to commute from home to work is spent regularly in local rag chews, with upstate New York being considered as "local DX." Noon hour usually comprises of a junior size ham fest at the *Walter Kidde* plant where Leo works as an industrial engineer. Leo drives W2UMB mobile to a choice clear spot near the guard shack at the *Kidde* plant where all the hams at the plant take turns at the mike for mid-day skeds. This activity has interested a large number of non-amateur *Kidde* employees, many of whom have pursued this interest to the point of obtaining an amateur license.

At home Leo operates on the MARS frequencies on a long wire and on 10 meters using a vertical dipole in the attic. TVI is escaped by working 10 meters early mornings and the 80 meter MARS frequencies at night. One prize item of "home equipment" is young squirtess Helene Donna who serves as a perfect monitor. Brat like, she's up before the rest of the family and if any hot sigs are on the band she zeroes them with the v.f.o. and screams for the Old Man to get out of the sack and flip the transmitter switch for her.

Incidentially Helene has been an avid knob twister since her second birthday and Leo is teaching her the code along with her ABC's. At the rate she has been learning Helene promises to set a record for the youngest ham. She carries on a very good QSO especially if the chap on the other end is interested in dolls and what happened yesterday at kindergarten. When things are a bit dull on the band and Leo's basso profundo doesn't raise any one on a CQ Helene's cheery little peep always does the job. To make it unanimous the XYL is an enthusiast, too, and will be ready to take her ticket exam, soon.

The home installation consists of a *Meck* T-60 transmitter with a *Meissner* Signal Shifter ahead of it to operate on 10, 80 and MARS frequencies. The receiver is an SX-42. The mobile installation is a transmitter-receiver BC 474 using a center loaded whip antenna for 40 and MARS 80 meter frequencies.

As noted above, Leo's day consists of a large portion of amateur radio and when not actually operating or on the job he is selling amateur radio plus MARS operation to the public and doing an excellent job of it.

—30—

Leo T. Meister, 1st Lt. USAFR, W2UMB-AF2UMB, lets Helene Donna have her turn.

CONCORD INTERCOMS. . the finest we've seen at this low price

35-WATT DE LUXE AMPLIFIER Only 32.45

- o Separate bass treble tone controls
- o Frequency response: 30-15,000 cps
- o Heavy-duty components

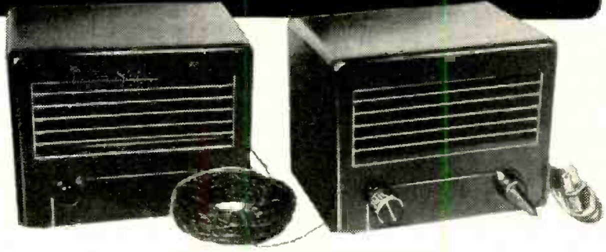
New! Powerful 35-watt Concord Amplifier... your answer to the problem of getting top-notch heavy-duty P.A. at a bargain price. Covers audiences up to 3,000 or more persons.

Peak power output of 50 watts. Normal power output of 35 watts at less than 5% distortion. Frequency response: ± 2 db from 30 to 15,000 cps; ± 1 db from 50 to 10,000 cps. Hum level is 65 db below rated output. Separate bass and treble tone controls work on all channels.

Two high impedance microphone inputs give 125 db gain on each channel. Two phono inputs for crystal or high impedance pick-ups give 75 db gain on each channel. You can mix any 3 of the 4 channels at one time. Big, powerful output xformer--output impedances: 4, 8, 16, 60 and 250 ohms.

Rugged steel cabinet, gray hammerloid finish, 21 x 12-1/2 x 11-1/2 in. high. Power consumption, 135 watts. Heavy duty power xformer for 105-125 volt, 60 cycle AC. Tubes not included.
2-226--Shpg. wt. 43 lbs. **32.45**

Kit of tubes for above. Consists of 4-6V6GT, 1-6SC7, 1-6SQ7, and 1-5U4G.
2-228--Shpg. wt. 3 lbs. **4.95**



2-STATION INTERCOM

Complete two-way inter-communication system. Ideal for homes and offices: especially suitable for nursery or sickroom. Quickly installed without special tools; easily removable for installation at another place. Remote stations may be placed as far away as 2000 feet.

Built-in amplifier uses type 50L6 and 12SJ7 tubes with a 35Z5 rectifier. Handsome molded plastic cabinets. Size 7" x 5" x 5-1/2". Supplied with tubes, cord and plug and 50 feet of intercom wire. Ready for immediate use. For 110 volts, AC or DC.
99-9582--Shipping weight 8 lbs. **12.95**
19-16013--Extra wire. . . . . .Per 100 feet . . . $1.20

5-STATION MASTER

A five station intercom system suitable for use in home, office or factory. Complete, dependable two way communication to any one of five stations. Easily and rapidly installed without the use of special tools. System is complete and ready for use. For 110 volt AC or DC. Complete with one sub station and 50 ft. intercom wire.
99-9585. . . . . **18.95**
19-16148--Extra wire--per foot 1-1/2¢. . . . . . . Per 100 feet, $1.26

EXTRA SUB STATION for master 5-station intercom system.
99-9586--Complete with 50 ft. of 3 wire cable. **3.95**

CONCORD PORTABLE RADIO-PHONOGRAPH

o Powerful superhet radio o 3-speed record player

Plays 33-1/3, 45 and 78 RPM records without needle switching or weight shifting. Gives up to 50 minutes of listening pleasure from one record. Lever controls turntable speeds. Adaptor disc supplied for 45 RPM records.

Latest expertly designed superhet radio uses following tubes: 12BE6, 12BA6, 12AV6, 50B5 and 35W4 rectifier. Built-in loop antenna in cover. Wide-range tone control. Easy-tuning clock-type dial. Handsome case finished in sturdy artificial leather. Matching plastic handle; brass hardware. Size 14-1/2 x 11-3/4 x 6-1/2 in. Complete with tubes. For 105-125 volt, 60 cycle AC.
1-547--Shpg. wt. 14 lbs. **37.50**

PM SPEAKERS

Alnico V magnet gives maximum performance with minimum weight. 3.2 ohm voice coil. Output xformer not included unless stated otherwise.

99-7009--5-in. PM. **1.14**
Lots of 10, each $1.04

99-7016--5-in. PM, 2000 ohm output xformer. . . . **1.59**
Lots of 10, each $1.44

99-7044--5-in. PM, 10000 ohm output xformer. . . . **1.59**
Lots of 10, each $1.44

99-7028--6-in. PM. **1.59**
Lots of 10, each $1.44

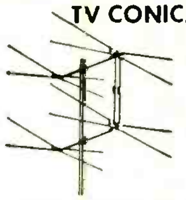
99-7045--8-in. PM. 2.15 oz. Alnico V. **1.98**

99A7046--8-in. PM, 2000 ohm output xformer. . . . **2.48**

99-7019--10-in. PM. 6.8 oz. Alnico V. **2.59**

99-7047--10-in. PM. 3.47 oz. Alnico V. Output xformer for single 6V6GT. **2.98**

RELIANCE ALL BAND TV CONICALS



Gives better reception in fringe areas. High gain on both high and low bands. Conical design cuts down fading, reflections and noise. Has 20° broadside tuning angle. Direct coupling to 72-, 150- or 300-ohm lines made possible by low standing wave ration. Pre-assembled galvanized steel cross arms. Aluminum elements. Mast not included.
28-21861--Two-bay stacked conical with 1/4-wavelength jumper bar. Wt. 13 lbs. Ea **8.45**

28-21860--Single-bay conical. For primary service areas. Wt. 7-1/2 lbs. Ea. **3.95**

STEEL MASTS. 1-1/4 in. dia. Tapered end with locking key so 2 masts can be joined together.
28-21978--5-foot Mast. Ten for $7.38. Each. . . **82c**
28-21968--10-foot Mast. Ten for $14.60. Each. . . **1.62**

HOOK-UP WIRE

No. 22 stranded. Inner yarn wrap. White with red tracer cloth covering.
99-2922--Per 100 feet. **45c**
500 ft. for $1.95 1000 ft. for $3.25

No. 22 stranded. Inner yarn wrap. White with blue tracer cloth covering.
99-2923--Per 100 feet. . . . . 45¢
500 ft. for $1.95 1000 ft. for $3.25

No. 22 stranded. Inner yarn; yellow cloth.
99-2924--Per 100 feet. . . . . 45¢
500 ft. for $1.95 1000 ft. for $3.25

No. 22 solid. Inner yarn; orange cloth.
99-2925--Per 100 feet. . . . . 45¢
500 ft. for $1.95 1000 ft. for $3.25

No. 20 solid. Yellow rubber insulation.
99-2926--Per 100 feet. . . . . 49¢
500 ft. for $2.24 1000 ft. for $3.75

ICA "TENNA BEAM"

The auto antenna that lights up. Quickly installed on fender or cowl of any car. Pilot light in base shines through light transmitting jacket to give a 24-in. shaft of light. Excellent for use as a safety parking light. Two sections extend to 48-in. 48-in. shielded lead-in cable. Chrome-plated Admiralty brass.
27-21914--Wt. 2 lbs. . **4.09**

"VIDI TENNA"

Adds "zip" to appearance of your auto antenna. Gives equivalent of 52 in. of extra aerial for improved reception. Triple chrome-plated Admiralty brass. Size 10 x 3 x 3 in.
27-21913--List $1.95. Wt. 10 oz. . **1.15**

TUBE BARGAINS

Some boxed--some bulk. All famous name brands—GE, RCA, Sylvania, etc. Quantities limited.

Type	Ea.	Type	Ea.
2V3G	59¢	6SR7	69¢
5U4G	59¢	6V6GT	59¢
6AT6	59¢	7C5	59¢
6BA6	69¢	12SA7GT	69¢
6BE6	69¢	12SK7GT	69¢
6F6G	69¢	12SQ7GT	63¢
6H6	49¢	35Z5GT	49¢
6J7	49¢	50B5	69¢
6N7	79¢	50L6GT	69¢

99-2905--OD3/VR150 special purpose tube. (Lots of 10, ea. 39¢) Ea. **44c**

TVI FILTER

Drake Hi-Pass Interference Filter. Improves TV reception by rejecting interference below 50 MC from amateur xmitters, diathermy, etc. Does not reduce strength of TV signal.
5-12525--300 ohms. Ea. **3.50**
5-12506--72 ohms. Ea. . $3.50

DUAL SPST SWITCH

Bat handle. 3 amps, 125V. One side momentary contact, spring return. Other side positive contact.
99-4180--Each. **18c**
10 for $1.65

BARGAIN AUTO ANT.

Side cowl mount. Three sections extend to 66 in. Chrome plated. Adjustable mount fits any car. With 36-in. lead and mtg. hardware
99-9571--Each. **98c**
Lots of 10, each 85¢

EXPORT: Address all export orders and inquiries to Concord Radio EXPORT DIVISION, 901 W. Jackson Blvd., Chicago 7, Ill.

CONCORD RADIO

Mail Order Center and Showroom
901 W. Jackson Blvd., Chicago 7, Ill.
Branch Showroom: 265 Peachtree St., Atlanta 3, Ga.

CONCORD RADIO CORP. Dept. RG-50
901 W. Jackson Blvd., Chicago 7, Ill.

☐ Enclosed $.............................(Include shipping charge. Any excess will be refunded.) Rush me the following equipment:

☐ **Send FREE latest Catalog & Bargain Bulletin.**

Name ....

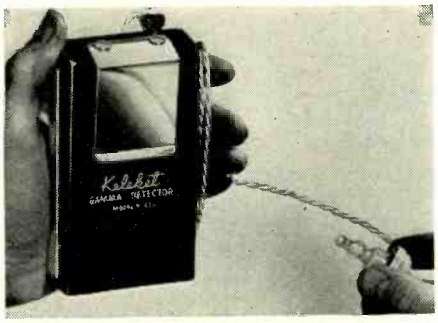
Address ....

City.......................... Zone...... State...........

What's New in Radio

(*Continued from page 76*)

Designated the Model K-550, the new unit measures only 4¾" x 2⅝" x 1⅛" and weighs just ten ounces. The detecting element is a subminiature type, 300 volt Geiger tube. The normal background response of the instrument to cosmic radiation is approximately 12 counts per minute.



The power supply is completely self contained and consists of two types of easily-obtainable batteries. The batteries may be replaced easily and quickly. The instrument itself has only one control, a simple "on-off" switch.

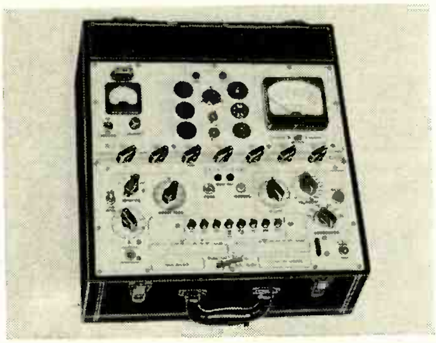
Full details are available on request to the company. Address inquiries to 155 East Sixth Street in Covington.

TUBE TESTER

A new laboratory type instrument, built to test all of the latest subminiature tubes, including television, with professional accuracy has been introduced by *The Hickok Electrical Instrument Company* of 10524 Dupont Avenue, Cleveland 8, Ohio.

Known as the Model 539, the new tube tester is designed for maximum accuracy throughout. The scale reads directly in micromhos. A separate meter permits the accurate adjustment of line voltage while the tube is under test. Provision is made for inserting a plate milliammeter to read plate current of the tube being tested.

The instrument has three a.c. signal voltages, .25, .5, and 2.5 volts in addition to the d.c. grid bias and d.c. plate and screen voltages. Provision is made for self bias and for vernier adjustment of bias for those who prefer it. This feature is accomplished by a 200 ohm rheostat with calibrated dial, bypassed by a 1000 μfd. condenser which can be inserted in the cathode circuit by operating a switch.



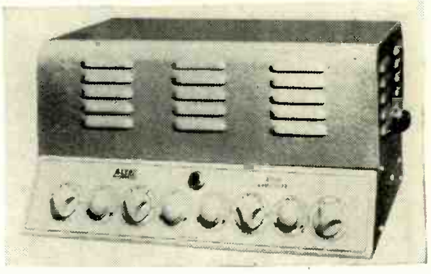
The unit is built into a portable carrying case with leatherette cover. It measures 17" x 18" x 18½" and weighs 31 pounds. It operates on 110-130 volts a.c.

NEW AMPLIFIER LINE

The *Altec Lansing Corporation* of 1161 N. Vine Street, Hollywood 38, California, has made available a new series of amplifiers designed specifically for use with the company's miniature condenser microphone.

By means of newly developed circuits, the new amplifiers eliminate the need for several elements now necessary in microphone amplifier systems. The power for the condenser microphone impedance matching tube is obtained from the amplifier rectifiers. No input transformers or input matching transformers are required.

The first of the new series to be put on the market is the A-332A, an 18 watt portable p.a. unit. Three inputs are provided, two for the *Altec* miniature condenser microphone, and one for a variable reluctance phonograph pickup. Each of the three channels is provided with independent gain and bass controls. A high frequency droop control is provided for all input channels.



NEW SPEAKERS

Permoflux Corp. of 4900 W. Grand Avenue, Chicago 39, Illinois, has recently introduced a new 8" speaker unit which features a blue cone and is said to be capable of covering over 10,000 cycles with unusual sensitivity and fidelity.

A specially treated, slotted cone edge, a new *Permoflux* development, provides extra soft suspension of the cone, thereby increasing the low frequency response. This low frequency response is further aided by an enlarged lower suspension. The curvilinear cone has been throat-treated to extend the high frequency response.

The "Royal Eight," Model 8T-8-1, allows the use of a smaller baffle yet provides performance comparable to that of most 12" speakers, according to the company. An illustrated catalogue on this new speaker is available on request.

AM-FM TUNER

The *Meissner Manufacturing Division, Maguire Industries, Inc.*, of Mt. Carmel, Illinois, has announced the addition of the Model 9A AM-FM tuner to its line of radio equipment.

The new tuner has been designed to be used in original equipment or for

"NIAGARA'S" 4th ANNIVERSARY CELEBRATION

LOW PRICED TUBES AND HIGH PASS FILTERS

BANISH TV INTERFERENCE with NIAGARA'S FAMOUS HI-PASS FILTER!

Positive protection against interference from radar, amateur transmitters, diathermy, and all other devices generating RF interference. Fits any 300 ohm antenna feeder. Absolutely no loss in brightness or clarity. Complete instructions and findings under actual test included.

KIT (all parts included) $1.95
Wired and Tested .. 2.95

Plus 15c postage and handling in U.S.A.

ALL BRAND NEW—STANDARD BRANDS

1B22	$ 3.45
1B23	8.45
1B24	4.49
1B25A	4.95
1B26	4.45
1B27	3.95
1B29	.89
1B32	1.95
1B38	34.50
1B60	4.95
1N21	.89
1N23	.69
1P23	1.95
1P25	14.50
1S21	3.95
2AP1	3.59
2B22	3.95
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	1.25
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
2J34	19.50
2J36	75.00
2J37	12.95
2J38	12.95
2J48	24.50
2J49	19.50
2J50	29.50
2JB51	4.95
2J54B	24.95
2J61	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
3B25	4.80
3B26	1.50
3B27	1.95
3B28	5.95
3BP1	2.50
3C23	2.25
3C24	.35
3C30	.30
3C31	3.50
3C45	12.80
3CP1	1.40
3DP1-A	3.95
3D21A	1.10
3EP1	2.50
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4C35	19.45
4D22	9.95
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5AP1	1.85
5AP4	1.85
5BP1	1.75
5BP4	2.50
5C22	49.50
5CP1	1.50
5CP1A	9.95
5D21	24.50
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5GP1	5.50
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5HP7	3.95
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5J29	12.50
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5JP2	9.50
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6AF6G	.88
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6C21	24.95
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10Y	.39
10SPEC	.69
10BP4	22.45
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12DP7	12.50
12FP7	14.95
12GP7	12.95
12HP7	12.95
12KP4	49.50
12LP4	25.50
15E	1.25
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24G	.35
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45SPEC	.25
53A	24.95
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100TH	11.00
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114A	.69
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211	.40
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28[illegible]A	10.95
287A	9.95
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304B	5.95
304TH	3.50
304TL	1.30
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331A	14.50
338A	3.75
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417A	9.50
434A	2.75
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717A	.58
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730A	9.75
750TL	49.50
800	1.75
801A	.28
802	4.25
803	3.45
804	8.50
805	3.50
807	1.25
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
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923	.75
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1633	.75
1634	.79
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RK34	.25
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RK51	3.95
RK52	4.50
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0A3/VR75	.98
0A4G	.94
0B2	1.74
0B3/VR90	.64
0C3/VR105	.78
0D3/VR150	.54
0Y4	.88
0Z4	.56
0Z4G	.56
01A	.24
1A3	.43
1A4	1.08
1A4P	.96
1A5GT	.48
1A6	.78
1A7GT	.66
1B3GT	1.49
1B4	1.18
1B5/25S	.88
1B7GT	1.06
1C5GT	.66
1C6	.88
1C7G	.88
1D5GP	.96
1D7G	.88
1D8GT	.94
1E5GT	1.38
1E7G	1.56
1F4	.74
1F5G	.74
1F6	1.56
1F7G	1.56
1G4GT	.68
1G6GT	.68
1H4G	.68
1H5GT	.53
1H6G	.86
1H6GT	.86
1J6GT	.86
1L4	.54
1LA4	.78
1LA6	.88
1LB4	.88
1LC5	.78
1LC6	.86
1LD5	.78
1LE3	.88
1LG5	.88
1LH4	.64
1LN5	.66
1N5GT	.58
1P5GT	.66
1Q5GT	.66
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
5JP1	24.50
5R4GY	1.09
5T4	.88
5U4G	.56
5V4G	.88
5W4	.78
5W4GT	.66
5X4G	.58
5Y3GT	.40
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	0.76
6AD6	.88
6AD7G	1.28
6AF6G	.78
6AG5	.76
6AG7	.97
6AH6	1.28
6AJ5	.78
6AK5	.84
6AK6	.78
6AL5	.64
6AL7GT	1.06
6AQ5	.58
6AQ6	.58
6AQ7GT	.88
6AR5	.66
6AS7G	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	.16
6D8G	.87
6E5	.68
6E6	1.06
6F5	.46
6F5GT	.46
6F6	.64
6F6GT	.66
6F7	.84
6F8G	.86
6G6G	.88
6G8G	.68
6H6	.46
6H6GT	.46
6J5	.48
6J5GT	.48
6J6	.76
6J7	.66
6J7GT	.66
6J8G	1.28
6K5GT	.96
6K6GT	.54
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	.79
7W7	.88
7X7/XXFM	.88
7Y4	.56
7Z4	.56
10	.69
12A	.56
12A6	.18
12A6GT	.18
12A7	.97
12A8GT	.58
12AH7GT	.84
12AL5	.80
12AT6	.44
12AT7	1.16
12AU6	.66
12AU7	.78
12BA6	.56
12BE6	.48
12C8	.48
12F5GT	.57
12H6	.26
12J5GT	.26
12J7G	.80
12J7GT	.80
12K7GT	.53
12K8	.58
12K8GT	.66
12Q7GT	.48
12SA7	.56
12SA7GT	.56
12SC7	.56
12SF5	.56
12SF5GT	.56
12SF7	.56
12SF7GT	.56
12SG7	.56
12SH7	.34
12SJ7	.48
12SJ7GT	.48
12SK7	.56
12SK7GT	.56
12SL7GT	.58
12SN7GT	.51
12SQ7	.48
12SQ7GT	.48
12SR7	.48
12SR7GT	.48
12Z3	.78
12X3	.98
14A7/12B7	.68
14AF7/XXD	.88
14B6	.68
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	.40
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	.54
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
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9003	.32
9004	.36
9005	1.90
9006	.23

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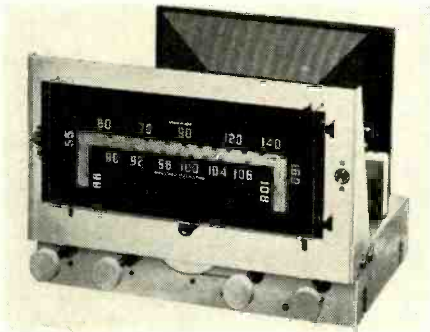

fidelity, and heavily oversized components. In addition, there is temperature compensation on FM, full tone control, built-in phono switching and power outlet for a phono motor. All controls are on the front panel and are also operative on phono.

SERVICE OSCILLOSCOPE

A new portable service-type oscilloscope which will sell in the moderate price class has been introduced by the Test and Measuring Equipment Section of *Radio Corporation of America*, Camden, New Jersey.

According to the company, the Type WO-57A is versatile enough for use in every phase of radio and television servicing. For television servicing the unit has the required high sensitivity and wide frequency range which is equally useful in the shop, laboratory, or factory, for viewing and measuring square waves, pulses, and TV sync signals.

The deflection sensitivity of the instrument is better than 30 millivolts per inch. The frequency response of the vertical amplifier is flat within 2.3 decibels from zero to 500 kc. down only 6.8 db. at 1 megacycle, and useful beyond 2 megacycles.

The outstanding design feature of the new unit is the direct-coupled ver-

tical amplifier which is used to provide flat low-frequency response. High-frequency square wave response up to 100 kc. enables the WO-57A to reproduce blanking and sync pulse wave shapes with fidelity formerly not available in oscilloscopes selling in this price range.

Full details are available from all *RCA* test equipment distributors.

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Ghosts

(*Continued from page* 41)

pole antenna will work wonders with a selected length of temporary 300-ohm lead-in. Different lengths are tried once the best position and orientation of the antenna are located. Loose wire can be coiled and arranged at the set while watching the reflections.

An improperly placed stand-off or lightning arrester may introduce reflected wave energy into the line. For having once found the place where a search antenna with temporary run gives good pictures, one must naturally exercise care at every point in the securing or routing of the lead-in from antenna to set.

All one has to do is experiment with a half-wave open stub at the set's antenna terminals, and it is forever impressed on his mind how sensitive certain points along a transmission line can become. This is especially true of a set without automatic gain control on the picture circuits. With due regard for metal window sash, drainpipes, roof flashing, phone and power lines, and anything at all electrically conductive, he will end up with a transmission line routed with all possible separation from these things. Generally speaking, a few inches is sufficient and all that one can attain. Where there isn't high signal strength, a half-inch will suffice.

Incidentally, television leads have been cut by telephone maintenance men where they passed within six inches of the telephone company's wires.

Close-in ghosts should always be checked with a piece of transmission line attached at the set and tuned experimentally with a razor blade. Beginning six inches from the terminals of the set, the stub is shorted in half-inch steps. Here a mirror or an interested, willing helper becomes a must, particularly with the consoles and large-screen sets of today. Frequently an improvement in gain will be noticed. Certain lengths of shorted stub may make the reflections stronger. If anything is unbalanced, poorly soldered, or even open-circuited in the antenna system, this method of tuning can make you look like a magician. It has often shown spectacular results. It may prevent the expense and nuisance of repair or replacement of a whole antenna and line run. A closed stub of only a few inches, adjusted critically, will improve reception in many instances. Tuned correctly to aid reception on any one channel, it will not harm reception on others.

This article naturally does not present formulas or methods for tuning lines or trapping any interference other than the original frequency in the form of a ghost. It is understood that a ghost is recognized. If transients or other effects, due to improper alignment of the set itself, are apparent in the pictures, no amount of work on

the antenna system will ever do any good. Although, however, many *tunable* transients can be directly traced to the antenna installation. These, a tuned stub can trap out without any difficulty. In any case where there is doubt as to the origin of transients or close reflections, applying the right stub won't hurt. An open-end antenna, because of a high mismatch, more often requires this stub tuning than a folded dipole, yet the simpler antenna is favored in a reflected area, where, as has been mentioned before, the signal strength is usually high.

Ghosts show up as shadows and are even more troublesome on the proposed ultra-highs and with color transmission, so there's no sense in waiting. You've got a ghost, and if you throw away your antenna and end up with a delta match on the guyed-mast itself, it's perfectly acceptable if it kills the ghost.

—30—

OSC. TUBE REPLACEMENT IN TV TUNERS

By MATTHEW MANDL

WHEN replacing defective local oscillator tubes in television receivers the technician usually finds that the center setting of the stations has been disturbed and often the fine tuning control is no longer able to make adequate adjustment. Rather than go through the process of retuning each oscillator slug for every station the technician should try several oscillator tubes until one is found which has interelectrode characteristics close enough to the old one so that the frequency change is not too great.

The service notes for the particular set under repair should also be consulted because several manufacturers are now including a master oscillator adjustment on their tuners so that an over-all change in oscillator frequency can be compensated without the necessity for tuning the individual oscillator slugs for each station. This control is usually located on top of the tuner near the oscillator tube and a slight adjustment will bring the oscillator tuning back to its previous setting.

—30—

"Oh, my heavens! We left the television on all night!"

AFCA NEWS

ARMED FORCES COMMUNICATIONS ASSOCIATION

This Association is a patriotic non-profit organization, with chapters in most of the larger cities, dedicated to developing and maintaining efficient personnel, commissioned, enlisted, civilian, for the supply (including design and development), installation, maintenance, and operation of communications and electronic equipment for Army, Navy, and Air Force and their supporting civilian activities. It publishes a magazine "SIGNALS" at its national headquarters in Washington. Every American interested in any way in communications is eligible and invited to join. Dues are $5.00 per year. Application should be submitted to the secretary at 1624 Eye St., N. W., Washington 6, D. C., who will furnish details upon request.

AFCA CHAPTER NEWS

Augusta—Camp Gordon

The regular monthly meeting was held at the Signal Corps Demonstration Building on April 12th.

A motion was introduced and passed whereby a sum of $25.00 was made available to partially defray expenses of a member to the national convention in New York on May 12th and 13th. Delegates to the convention are: Lt. Col. Henry J. Hort, chapter president, and Hugh A. Fleming of *Southern Bell T&T Co.*, former chapter president.

Chicago

The Society of Motion Picture and Television Engineers and the Chicago Section of the IRE were hosts to the Chicago Chapter at a meeting held at the Drake Hotel, April 24th.

After a 6 p.m. dinner at the Officers Club in the Knickerbocker Hotel, chapter members adjourned to the Grand Ballroom of the Drake to hear a discussion by Frank H. McIntosh, consulting engineer from Washington, D.C., on the "Properties and Characteristics of Color TV Systems Proposed to the FCC." His talk covered the *CBS, RCA,* and *CTI* systems.

Col. John R. Howland, *Zenith Radio Corp.*, spoke on "Phonevision" and presented a film demonstrating the new television service.

Cleveland

The Cleveland Chapter's April 13th meeting took place in the auditorium of the Telephone Building and featured "Nationwide Television Networks" as the subject of the evening. In the preliminary portion, Robert Clark of the public relations staff, *Ohio Bell Telephone Company*, presented a very interesting and enlightening demonstration on the principles of radio relay and microwave transmission.

A. M. Rose, division transmission engineer of the Long Lines Department, *American Telephone and Telegraph Company*, discussed some of the problems associated with furnishing television service on network facilities. The *Bell System* film, "Stepping Along with Television," closed the discussion, and the group was then conducted through the microwave terminal facilities located on the top floor of the Telephone Building.

A third item in the inspection tour was the control room and terminal equipment associated with coaxial cables terminating in Cleveland.

Decatur

The new officers of the Decatur Chapter are: Robert C. McMurtrey, president; Earl L. Chrisman, 1st vice-president; Kenneth C. Colman, 2nd vice-president; Edward C. Whitcomb, secretary-treasurer.

At its April 27th meeting, the chapter decided to send Edward C. Whitcomb and Sherman F. Hickman as delegates to the AFCA national convention in New York.

President McMurtrey informed the group of the plans being made for a chapter meeting in July at the time the Signal Depot Commanders' Conference will be held in Decatur.

Captain Kenneth Colman then presented motion pictures of the highlights of the 1949 World Series baseball games.

European

Members of the European Chapter met in Frankfort on April 14th. Lt. Col. Steve J. Gadler, chapter president and chief of the USAFE supply control division, presided at the annual meeting which followed a dinner at the Frankfurt Casino.

Speakers for the evening were Maj. Gen. Jerry V. Matejka, chief of the EUCOM signal division, and Col. David C. G. Schlenker, USAFE director of communications.

New officers were elected as follows: President—Col. I. P. Doctor; Vice-Presidents—Col. E. B. Garland and Mr. G. A. Spear; Treasurer—H. E. Aldridge; Secretary—C. E. Laurendine.

Fort Monmouth

Col. George P. Nixon, national executive secretary of AFCA, addressed

the April 12th meeting of the Fort Monmouth Chapter and was followed by Col. W. F. Atwell's outline of the second day of the annual convention at Fort Monmouth on May 13th.

Colonel Dixon talked on the over-all membership and the need of additional group members in the association. This retired officer, who formed a chapter while stationed in Brazil and is a former president of the New York Chapter, emphasized the importance of the chapter president to an organization, as he together with the executive committee and other committee chairmen are responsible for the activities of a successful chapter. Colonel Dixon also stated that a representative of the office of the Chief Signal Officer is now touring the ROTC in the midwest and southern areas where he will speak on the AFCA at sixteen universities to the Signal Corps ROTC. It is hoped that several additional student chapters may be formed in the near future.

Colonel Atwell then briefed the group on the itinerary scheduled May 13th for the AFCA annual convention at Fort Monmouth. Included among the outstanding items on the day's program will be the 82nd Airborne Division with a radio team parachuting to earth and describing its sinking sensations; laying telephone wire under combat conditions; lunch in a Post mess hall; exhibits and a parade.

Entertainment by the Post Special Services and refreshments followed the meeting.

Boston

The newly activated Boston Chapter, AFCA, met at the Boston Naval Shipyard, Charlestown, on the evening of April 27th. Rear Admiral T. F. Halloran, USN (ret.), *General Communication Company,* who has been acting as chairman of the committee working toward the rehabilitation of the chapter, presided at the meeting. In his opening remarks he explained to the members and others who had come to the meeting because of interest in the association, what the plans were for the local chapter and why Boston should be represented in the association as one of the outstanding chapters. Admiral Halloran gave much credit to his working committee for getting the crowd out to this first meeting, and then called on Colonel George P. Dixon, AFCA national executive secretary, to tell something about the national setup of AFCA and its objectives.

The next item of business was the election of officers and the following names were submitted by Raymond B. Meader of the *New England Tel & Tel Co.,* chairman of the nominating committee, and upon motion duly made were elected: President—T. F. Halloran; Vice Presidents—Myron D. Chase, *New England Tel & Tel Co.* and Paul Hannah, *Raytheon Company;* Secretary—Major James E. Foster, Asst. PMS&T, Massachusetts Institute of Technology; Treasurer—Gardiner

BC 434 COMPASS CONTROL BOX contains 0-5 mil meter suitable for "S" meter—pots, knobs, crank, jacks, switches, five grain of wheat bulbs and numerous other parts.
Like new at only **$1.29**

Portable VHF Communication Unit

Two-way radio telephone equipment designed for operation between 152 and 162 megacycles. Adaptable for many uses, a complete unit including the rechargeable storage battery weighs but fifteen pounds, and is housed in a sturdy case 11½"x 9"x4¼", provided with shoulder straps.
This brand new set of big name manufacture comes complete with battery, battery tray, and handset but less crystal........................**$89.50**
Battery charger is extra at................**$19.95**

Mobile VHF Communication Unit

Adaptable for many mobile uses, this is a compact unit 3½"x8"x15½", operating on 152 to 162 megacycles. It is six volt powered direct from storage battery, and is complete with the tone filter and crystal; handset, control box, antenna and installation kit.
Brand new, ready to go................ **$129.50**
Extra 18" stub type antennae are available...**$2.95**
Extra handsets (cradle type)...............**$5.95**
Extra control units which house a PM speaker and provide mounting for handset............**$4.95**
A combination of both the handset and control box..................................**$9.95**

TUBES

Drastically Reduced from 10 to 50% Nationally Advertised Brands

Type	Net Price	Type	Net Price	Type	Net Price
1A4P	$0.24	6R7	$0.34	36	$0.24
1A6	.19	6SF6GT	.34	37	.24
1B5/26S	.24	6S7G	.39	38	.24
1B26	2.29	6S8GT	.69	39/44	.24
1B29	.39	6SG7	.69	49	.39
1B32-632A	2.29	6SF7	.39	60	.39
1C6	.19	6SJ7	.69	68	.24
1C7G	.19	6T7G	.39	67	.24
1D6GP	.24	6U7G	.29	76	.24
1D7G	.19	6Z7G	.39	77	.24
1F4	.24	6ZY6G	.29	211/Vt4L	.29
1F6G	.24	7C4/1203A	.24	316A	.34
1H4G	.24	7E6/1201	.39	371B	.34
1J6G	.24	10YVT26A	.19	700A	7.96
1J6GT	.24	12A6	.34	703A	1.49
1P6GT	.24	12A6GT	.34	706A	.79
1V	.24	12A7	.34	714AY	6.96
2A6	.39	12A8GT	.19	724B	4.96
2A7	.24	12F6GT	.29	801A	.39
2C26A	.19	12H6	.29	829	6.96
2V3G	.49	12J6GT	.24	832	4.96
2X2/879	.39	12J7GT	.24	837	1.49
3FP7	.98	12Q7GT	.24	841	.29
4AP10	.98	12SF6	.24	864	.29
6BP4	2.96	12SF6GT	.24	872A	.98
6CP1	2.96	12SF7	.24	964	.19
6D21	9.96	12SH7	.24	966	.34
6FP7	.96	12SR7	.24	967	.34
6J23	6.95	12SR7GT	.29	1625	.29
6T4	.49	12SN7GT	.89	1626	.24
6W4	.49	12Z3	.29	1630	.29
6Z4	.49	16R	.19	1642	.29
6AB7	.69	19	.69	2060	.89
6AJ6	.89	2J22	1.96	2061	.49
6B8	.69	28D7	.34	9002	.34
6C4	.39	30SPEC (Vt67)	.69	9003	.39
6D8G	.69	30	.24	9006	.29
6F6GT	.39	304TL	1.29	GL4A21	.29
6F6G	.69	32L7GT	.39	Amperite 10T1	.29
6H6	.29	33	.24	Jan CRP72	.98
6J7GT	.39	34	.24	REL36	.69
6K6G	.69	36/61	.24	VR106	.69
6L6G	.39				
6L7G	.39				

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HEADSETS—MIKES

HS-23 Hi Imp.Headsets................New $2.95
HS-33 Lo Imp. Headsets..............New 2.95
HS-30 Hi Imp. Headsets..............New 1.50
Used .79
T-17D Carbon Mike..................New 2.75
T-24 Hi Imp. Carbon Mike............New 1.19
T-30 Throat Mike....................New .98
T-45 (or Navy) Lip Mike.............New .98
CD-307 Extension Cord for Headsets....New .59

CONDENSERS

	Each
2 mfd. 4000 VDC. OIL FILLED	$2.95
	4 for 10.00
1 mfd. 6000 VDC. OIL FILLED	1.98
.25 mfd. 15000 VDC. OIL FILLED	4.95
.00025 mfd. 25000 VDC. OIL FILLED	2.95
.4 mfd. 1500 VDC. OIL FILLED	.29
	10 for 2.49
2 mfd. 600 VDC. OIL FILLED	.39
	3 for 1.00
1 mfd. 600 VDC. OIL FILLED	.24
	5 for 1.00
.1x.1x.1—1200 VDC. OIL FILLED	.59
	2 for 1.00
50 mmfd—5KV—5 Amp. Vacuum Cond.	1.19

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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	17.50	24.95
RA 10 DA Receiver	17.50	24.95
RT7/APN1 Transceiver	4.95	9.95
APN 1 Complete	—	24.50
BD 71 6 Pos. Switchboard	9.95	12.95
EE 8 Field Phones	7.95	—
BC 347 Interphone Amplifier	—	2.95
I-70 Tuning Meter	—	.89
AM 61 Indicator Amplifier	—	9.50
SCR 625 Mine Detector	—	39.50
BC 461 Veeder Root Counter	—	.59
BC 442 Less Condenser	1.49	1.95
APS 13 UHF Antenna, Pair	—	.98
FL 8 Filter	—	2.95
I-97 Bias Meter	$4.95	3.95
RM 29 Remote Telephone Control	7.95	9.95
BC 602 Control Box	—	.98

One Tube Interphone Amplifier—Small compact aluminum case fully enclosed. 2¼"x3¾"x5¾". Less Tube..............................79c
BC 717 Transmitter, New but less Tubes....$24.50
96Q1 Complete Autotune assembly with motor and frame as used in **ARC-1** Transmitter. New $35.00
BC 709 Battery operated lightweight interphone amplifier. Complete with tube and shock mount, but less battery..................New $3.95
SCR 183 Complete.................New $49.50
Motor—Universal Electric, 24 VDC, will also operate on 24 VAC Diameter 1⅝"; Length 2 9/16", Shaft ¼"x¾"......................New $1.49
BC 1291—Control box contains motor rheostat control rated 10 ohms at 3.88 amps. Brand new with cord and plug-in ventilated, mounted case. $1.95
MC 385A—Headset Adapter...........New 49c

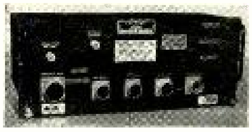
Information and Prices on Request

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

SURPRISE PACKAGE
20 lbs. Ass't radio parts A $25.00 value for only.................. **$1.95**

MONTHLY SPECIAL

RT7/APN1 TRANS-CEIVER UNIT—



used as an altimeter, it may be converted for signaling control circuits, citizens band, etc. Complete with 14 tubes and dynamotor they are in good used condition at the amazingly low price of.......................**$4.95**

LM Navy Frequency Meter. A limited supply is available less calibration book, tubes and crystal. Good condition...................**$12.95** ea.

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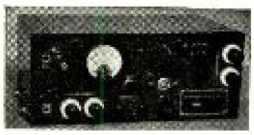
BC 188 MODULATOR without tubes but with numerous parts,



including an 0-200 MA Simpson meter making it an exceptional buy at.....**$3.95**

AS-138/ARN—10 inch streamline loop as used with direction finding receivers. Fixed position, it is ideal for planes, boats, automobiles.
New **$1.95**

SOLENOID 110V 60 cycle coil complete with trip arms that really snap into place and hold. New **49c**

COMMAND (SCR 274 N) EQUIPMENT

	Used	New
BC-453	$12.95	—
BC-454	4.95	$6.95
BC-455	7.95	9.95
BC-456	1.95	2.95
BC-457	5.95	—
BC-458	5.95	8.95
BC-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	—

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**

T39-APQ9—Less tubes.... Used **$7.95**

BC-605 Interphone Amplifier

Easily converted to an ideal intercommunication set for office—home—or factory.
Original—New...**$4.95**
Like New........ **3.95**
(With Schematic)
See April 1950 Radio News for complete conversion data.
All necessary parts and instructions to convert the above to AC operation with one remote station $8.25 additional.

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 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**

All shipments FOB warehouse. 20% Deposit required on all orders. Minimum order accepted—$6.00. Illinois residents, please add regular sales tax to your remittance.

Greene, *Workshop Associates;* National Council Member—Lt. Col. F. H. King, Signal Officer, 67th Fighter Wing, Air National Guard; Members at large for Executive Committee: Raymond B. Meader and Capt. A. R. Taylor, Supervising Inspector of Naval Material.

Following the business meeting the group adjourned to the Officers' Mess at the Naval Shipyard where an excellent dinner was served and an opportunity was afforded for everyone to become better acquainted.

A large delegation from Boston was expected to attend the national convention in New York.

Kentucky

The April meeting of the Kentucky Chapter was held on April 14th at Fort Knox. Through the generous cooperation of the staff of the Armored School, luncheon was held in the Armored School cafeteria at noon, after which there was a bus tour of Fort Knox, including the Gold Depository, the Armored School and the General Patton Museum.

The Communications Department of the Armored School exhibited the very latest communication equipment, some of which was demonstrated during the visit. This school offered a great deal of interesting equipment which has been developed since the close of World War II.

At the close of the tour, the group assembled at the Country Club for dinner and a business meeting. During the meeting a charter was presented by Kentucky Chapter President R. H. McAteer to the new Louisville-Fort Knox Sub-Chapter.

New York

At its meeting on April 19th the New York Chapter concluded arrangements for the AFCA annual convention in New York. Brig. Gen. A. W. Marriner of the *IT&T*, chairman of the convention committee, gave a full report on the preparation for the convention at the Hotel Commodore on May 12th and at Fort Monmouth on May 13th. The New York Chapter will be host at a reception and cocktail party preceding the annual banquet at the Commodore May 12th.

After dinner, Chapter President Thompson H. Mitchell, *RCA Communications,* introduced the guest speaker, Major H. L. Roberts of the Signal Corps Photographic Center. Major Roberts spoke briefly of his various experiences in making motion pictures during the past war. He then showed a new 1950 training film just released, entitled "The Ionosphere and its effect on Radio Propagations." This film consisted of animated cartoons depicting the effects of sky-wave propagations and the ionosphere on long distance radio communications.

Philadelphia

Colonel George W. Goddard, director of photography and research development at the Air Force center, Wright Field, Ohio, gave a demonstration-lecture on the Air Force's tri-dimensional photography show before a meeting of the Philadelphia Chapter at the Franklin Institute on May 2nd.

Colonel Goddard described a camera capable of taking clear pictures from a low flying airplane going 3000 miles an hour, if such a speed were attainable. The camera uses moving film, doing away with the conventional type of shutter and "makes an exceedingly sharp picture." "On a recent test," he said, "a jet plane at 500 miles an hour flew over a man holding playing cards, passing only 50 feet over his head. The picture was so sharp you could read the ace of spades."

The Air Force officer told of other products of Air Force research, including photoflash bombs for taking pictures from 40,000 feet at night that are "so good it is difficult to tell them from pictures made in daytime." Another new camera detects camouflage by using two layers of film, one an infra-red film that records only natural vegetation, and a second layer that picks up imitations.

Distortion of wide-angle shots is being overcome, he said, by photographing on the inside of a spherical glass plate instead of on flat film. With this, a picture can cover 750 square miles from an altitude of 40,000 feet.

Colonel Goddard revealed the use, in the Okinawa invasion, of a camera that gauges the heights of obstacles on a beach and the depth of water up to 30 feet.

Pittsburgh

Members of the Pittsburgh Chapter were guests at a lecture in the Mellon Institute auditorium on April 17th when Stewart L. Bailey discussed ultra-high frequencies and color television. The meeting was sponsored by the AIEE, IRE, and ESWP.

Sacramento

The Sacramento Chapter's April 13th meeting featured an organized tour of three world-wide broadcasting stations located within a few miles of each other in the open country near Dixon, Calif. The party met at The Milk Farm on Route 40 for dinner and then formed into groups for the tour.

The *AT&T* station placed on the air in 1931 is a radio-telephone broadcasting station and is in communication with Trans-Pacific points as well as ships at sea. The station is served by sixteen transmitters of varying powers and has 23 rhombic directional antennas. The method of scrambling and unscrambling messages, which insures privacy of conversation, was described.

The *NBC* station, placed in service in 1942, is the western outlet for the State Department's "Voice of America" covering South America, South Pacific, the Orient and Alaska. The rhombic antennas there are mounted on towers 190 feet in height.

The third station visited was the U. S. Naval Station which was placed in service in 1949. It is strictly a working station and serves as a back-up station for the more important Naval Center at Mare Island Navy Yard in Vallejo, Calif., in serving the Western World including naval ships at sea and Alaskan ports.

Seattle

An intensive recruiting campaign to increase the Seattle Chapter's membership was launched by Chapter President C. D. Lawrence at the organization's April 12th meeting in the Chamber of Commerce Building.

The chapter's guest of honor was Maj. Gen. Frank E. Stoner, until recently Chief of Communications, United Nations. General Stoner emphasized the importance of friendly relations between the armed forces and industry and stated that the AFCA can achieve this goal in the communications field through the members representing the communications industries.

Admiral C. E. Anderson, guest speaker, entertained the chapter with stories of his many amusing experiences during the war from the time of his first physical examination to the Sands of Iwo Jima.

Mr. Frank D. Keyser of *Pan American Radio* then gave an outline of the demonstration to be presented on radio marine equipment and introduced Maurice F. Kerr, Chief Engineer of *Pan American Radio* and former president of the Seattle Chapter. Mr. Kerr discussed the problems encountered in the cruiser, work boat, and fishing boat classes.

ANNUAL CONVENTION

At the annual convention of AFCA held in New York on May 12th, Theodore S. Gary, vice-president and director of *Associated Telephone and Telegraph Company,* was elected president of the Association, succeeding Frederick R. Lack, vice-president of *Western Electric Company.* Mr. Gary who has long been active in the work of the AFCA, was until his recent election first vice-president of the Association in charge of chapters.

Other officers elected at the annual meeting were: W. W. Watts, vice-president of *RCA Victor,* as first vice-president; Rear Admiral E. E. Stone, until recently Chief of Naval Communications, second vice-president; J. R. Cunningham, *United Air Lines,* third vice-president; C. O. Bickelhaupt, vice-president and secretary of *A. T. & T.,* fourth vice-president; and D. R. Hull, assistant vice-president of *Raytheon Manufacturing Company,* fifth vice-president. —30—

DOWN EAST HAMFEST

THE Portland Amateur Wireless Association, Inc., is holding its second annual Down East Hamfest at the Eastland Hotel in Portland, Maine, on July 29.

Tickets are $3.50 each and include everything from prizes to the ice cream at the end of the banquet. The advance sale of tickets is being handled by Manley W. Haskell, W1VV, 15 Hemlock St., Portland, Maine. —30—

Volume Expander

(*Continued from page* 51)

developed by the contact bias generated by the 6SR7.

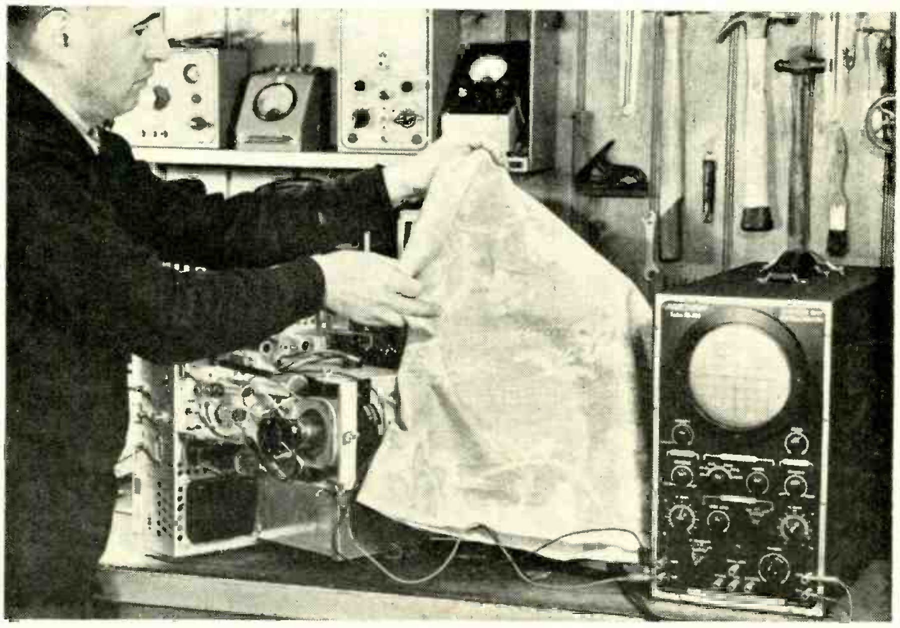
A good quality interstage transformer, such as the *Chicago Transformer* unit used by the author, is recommended for several reasons. First of these is that it provides a convenient method of changing from push-pull output to single-ended input for use with existing equipment. A second reason is that it provides a good means of mixing the asymmetrical signals from the plates of the 6SK7's and likewise prevents the passage of d.c. surges that might tend to block following stages, thus making its inclusion desirable even when a push-pull circuit is used throughout the system. No difficulty from hum pickup was noted in the expander shown, but preferably the interstage transformer should be isolated as well as possible from power and high level output transformers.

The self-contained expander requires an input of between one and two volts and will deliver a maximum output of approximately five volts at the twenty decibel expansion level. The input level required is such that the expander may be operated directly from most crystal pickups or radio tuners, while a preamplifier will be required if it is to be used with a low level magnetic cartridge. It should be noted, however, that for best results a fairly flat input should be applied to the expansion control and some bass attenuation may be required when using a crystal cartridge in order to prevent undue expansion of some low level bass passages. An optional addition to the expander circuit, that may be found useful, is an expansion indicator using a type 6E5 tube, illustrated in Fig. 3. This device provides visual indication of the amount of expansion taking place and may aid in setting the correct level for different recordings. The correct level may be readily determined after a short period of practice.

In closing, some mention should be made of various factors that must be considered by the prospective user before incorporating volume expansion in his system. Other than the listening tastes of the user, perhaps the greatest drawback to a wide dynamic range in reproduction is the noise level of the listening location. If the noise level is high, then the listener will be able to perceive only a limited dynamic range unless recourse to excessively high peak output power is taken. Indeed, under some conditions, such as using classical music for a background in a hotel or restaurant, it may be desirable to introduce volume compression into the reproduction in order to present a fairly constant sound level. Nevertheless, the critical listener with good reproducing equipment and an adequate listening location should find much to recommend the use of volume expansion, not only due to the added dynamic range which tends to give depth to poor recordings, but for the other possible benefits such as scratch reduction, use as a dynamic tone control, to achieve the effect of variable acoustics, or as a means of producing an interesting illusion of audio perspective, as described in an article on three dimensional reproduction in the June 1949 issue of RADIO & TELEVISION NEWS. Similarly, the amateur or public address operator may benefit from the use of some of the principles outlined in this article in the design and construction of high quality limiting amplifiers for communications work.

—30—

To protect picture tube and technician, when a television chassis is propped up on the service bench, simply drape the tube with a piece of old toweling, canvas, or other material. Tuck the cloth over the face of the tube and around the neck so entire glass area is covered.



COMMUNICATIONS EQUIPMENT COMPANY

★ SPECIALS ★

ELECTROLYTIC CONDENSERS

D. Y. Type Prong Mount
18c ea. 10 for $1.75

MFD.	VOLT	MFD.	VOLT
40	150	40	250
80	150	30	300
10	200	80	350
8	450	10	450
16	450	15	450
20-20	25	30-30	25
10-10	150	20-10	150
20-20	150	40-20	150
40-40	150	50-30	150
20-30	250	20.	350
3X20	150	10.	300

Write for Many Others

29c ea.
10 for $2.75

MFD.	VOLT
6	400
50	400
40	450
30-20	150
50-50	150
20-20	350/25
20-20	400/25
40-20-10	150
40-30/20	150/25
50-50/20	150/25
60-40/10	150/25
60	300
30	450
32	450
30-30	150
70-30	150
30-20	350/25
10-10	450
40-20-20	150
40-30-20	150
3X50	150
40-20 100	150/10

MANY OTHERS

AC CONDENSERS

75-84	125	1.30
20-24	110	1.00
26-30	110	1.00
31-37	110	1.00
38-42	110	1.00
43-48	110	1.00
43-65	110	1.25
50-75	110	1.25
72-87	110	1.25
86-96	110	1.45
88-106	110	1.50
107-129	110	1.75
124-138	110	1.75
130-150	110	1.75
130-180	110	1.90
161-180	110	1.75
158-191	110	2.00

Write for many others.

MINICAPS PIGTAIL

Mfd.	Volt	Price
30	450	$0.49
30	300	.45
30	350	.48
40	450	.50
40	525	.70
16	350	.35
16	525	.45
16	450	.40
16	100	.24
20	25	.20
20	80	.25
20	450	.40
24	350	.40
8	400	.30
8	150	.15
10	150	.20
10	50	.15
4	50	.15
4	150	.14

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
50	50	.35
6000	12	2.00
9000	12	4.00

DS Filter Condensers

40-20	135	19c
20	150	19c
2x20	150	29c
2x30	150	29c
40-20	150	39c
2x40	150	39c
30-50	150	39c
2x50	150	39c
3x20	150	39c
3x30	150	39c
50/2x40	25/150	39c
2x40/12	150	39c
2x40/20	150	39c
3x40	150	39c
2x50/20	150/25	39c
2x50/10	150	39c
60-30/150	150/25	39c
80-40-30/100	150/25	39c
40-30	200	39c
20-16/10	200/25	39c
2x32	250	39c
30	350	39c
2x32	350	39c
50-30	350	39c
20	450	49c
16-8	450	49c
2x16	450	55c
32-16	450	55c
2x8/25	450/75	49c
30-20/20	450/25	49c

Many Others

6V Input Dynamotor

Output 150V /75MA or 12V Input, 500V /50MA Out ..$3.49

LAMPS

#1488—14V 10/50c
#623 — 24-28V 10/50c
#1251—24-28V 10/50c
LM37 13V 10/50c
Red 10W 60V 8c ea.

1619—1619—1619

Octal Base Pentog Aversatile High Perveance Tube.. 21c
5 for Gtd. New $1.00

MICA CAPACITORS SOLAR XMB TAPPED POLES

Mfd.	Price
2500 V Test	
.00001	$0.35
.000025	.35
.00003	.35
.00005	.35
.000075	.35
.0001	.35
.00015	.35
.00025	.35
.0003	.35
.0004	.35
.0005	.40
.00075	.40
.00085	.40
.001	.50
.0015	.50
.0016	.50
.0017	.55
.002	.65
.0023	.65
.003	.75
.004	.95
.005	.95
.006	.98
.0063	.98
.0069	.98
.007	.98
.0075	.98
.0076	.98
.008	1.05
.01	1.25
.015	1.25
.02	1.30
.025	1.30
.027	1.35
.03	1.45
5000 V Test	
.0015	1.75
.002	2.00
Solar XQ Solder Lugs 2500 V Test	
.01	1.25
.015	1.30
.02	1.50
.04	1.75
.001	.60
.0015	.60
.002	.75
.0022	.75
.0023	.75
.0024	.75
.0025	.75
.0027	.80
.003	.80
.004	.85
.005	.90
.0056	.95
.006	.95
.0063	.95
.0075	1.00
.0076	1.00
.008	1.05
.0085	1.20
.0005	.60
.00085	.70
.00015	.60

Write for Many Others

Write for Catalogue of Xfrmrs, Chokes, Cond., Etc.

RF CHOKES

1MHY/125 MA.	$0.23
1.9-HMHY	.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

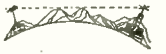
HEAD SETS AND MIKES

Dyn. Mike & Hdset-comb: Used in B19 tanks $2.75
R15 Hdset: 8000 ohm imp. rubber cushions w/8 ft. cord and PL-55. NEW ..$2.95
Head Bands: HB1, HB4. HB30. NEW. Ea. 25c
Carbon, Xmitter Elements: TS11J. TS11L, TS13E 75c

VARIABLE CERAMICONS

395-475 MMF ...20c
170-315 MMF ...20c
22-195 MMF ...20c
12-145 MMF ...20c
15-160 MMF ...20c
5-50 MMF ...20c
Set of 6 for...$1.00

ANTENNA MAST

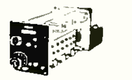


Are you in a dead spot? If you can't get a good T. V. Picture here is a sig. Corp. Ant. mast 30' high of rugged plywood construction to solve your problem. It telescopes into 3 ten ft. sect. for easy stowage. Easy to Mnt. Comp. with stakes & rods. Each..........$19.95

SCR-522 100-156 Mc. RECEIVER AND TRANSMITTER

One of the most interesting and useful pieces of surplus equipment. For plane and ground station use, unit offers remote control of any four preselected crystal controlled frequencies in the spectrum of 100-156 Mc. This spectrum covers facsimile, air navigation aids, airport control, railroad, police, urban telephone, as well as the amateur band 144-148 Mc. October 1948 Radio News gives details for converting the SCR-522 receiver section, BC-624. Transmitter section, BC-625, is voice amplitude modulated and has an output of 8-9 watts.

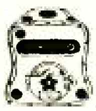
Tubes included: 2—832, 3—12A6, 1—6G6, 2—6SJ7, 1—12J5GT, 3—12SG7, 1—12C8, 1—9002, 3—9003, 1—12AH7GT $33.95



ARR2 Homing Receiver

Tunes 234-258 MC. 4—6AK5, 6—9001, 1—12A6. Ideal for 2-6-10 Mtr. Conv. w/Dyn $5.95. Less Dyn.......$3.95

GIBSON GIRL



The Emergency Radio Transmitter. Sends S O S signals automatically on 500KC. 150-mile range. No batteries required. Has hand-driven generator, tubes, wire. New. It's only.......$3.25

RECEIVER BC-733-D

Localizer receiver of the blind landing system. Companion to the glide path receiver. Also contains 90 and 150 cycle band-pass filters. 108.3 to 110.3 mc. by relay selection of crystals in the local oscillator. Wide pass-band on 6.9 mc IF's ideal for FM. Has a wonderful AVC system using rectified output of an RF oscillator as power supply for 100 volt DC bias. With relays, and 10 tubes: 3—717A, 2—12SG7, 1—12SQ7, 1—12A6, 1—12AH7, 2—12SR7. Condition: Used, excellent.

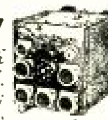
Only..........$4.95
w/DYN $6.95

SCR610 Mobile FM TRANSCEIVER—Includes 10 meter band. Excellent condition with tubes $15.95

PE-120 Power Supply— Less Vibrator Condenser and Tubes $5.50

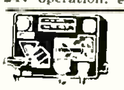
Combination BC-620 and PE-120. Both for.........$20.95

RL 9 or RL 7



Interphone Amplifier Convert to High Fidelity Phone Amp. or Spch. Amp. Compl. w/ 12A6, 12SL7, 2 Chokes, 1XFRMR, DYN for 24v operation, etc. $2.75

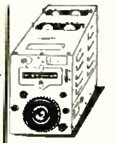
Navy ARB 4-Band Rec. 195KC to 9 M.C.



For Ships, Planes, Mobile Most Ideal of All Surplus Receivers

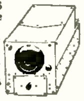
You can convert this easily to a good ham receiver. One of the hottest values in surplus receivers 28 volts DC input. Covers 4 bands, 195 kc to 9 mc. A deluxe superhet receiver, frequency coverage includes the standard broadcast band. Has 4 gang tuning condenser; can be converted to a 110 volt AC receiver. Tubes: 12SF7, 12SA7, 3—12SF7 and 12A6. Has dial built on front of chassis. Electric driven or manual band change switch. Weight 28 lbs. Size 6x7x15 inches. ARB with tubes and dynamotor. Used. Fair condition $14.95

ARC/5 Transmitters 40 Watt Output These Famous V.F.O. Drivers Available



2.1—3 MC $5.95
3—4 MC 6.95
7—9.1 MC 6.95
Used. Good cond. w/tubes & XTAL.

ARC/5 RECEIVERS



Sensitivity is 2-6 microvolt 6 tube Superhets w/12SK7 RF Amp. 12K8 Mixer 12SK7, 1st IF Amp. 12SF7, 2nd IF Amp. 12SR7 Detec. FO. 12A6 Audio Amp. Used. Good condition.

190—550KC $7.95
1.5—3MC 10.95
3—6 MC 4.95
6—9 MC 5.95
UHF Rec as is condition (Fair) 11.95
UHF Trans as is condition (Fair) 14.95

ARC/5 PARTS

80 Mtr. Xmitr. Conv. Kit	$1.50
Fuses, 10A, 3AG	.04
Condenser Kit, 4—3X-.05, 1-15 Mfd.	.75
Cond., .05-.01-.05	.19
Cond., 3X .05	.19
Mod. Xfrmr. 807 to Parlel 807	1.00
Xmttr. Rack	1.79
Shock Mts. for Rec.	.29
Control Cable	1.19
Modulator, w/Dyn. & Tubes. New	7.95
Parasitic Suppressors	.10
Dial Plates, Rec. & Trans. 190-550 Kc.	.10
Plates for Control Box. 190-550, 6-9.1	.10
Kit of 2—5 Mfd. Cond.. 1 — Choke 5634, 1 — Trans. 692327-1, 1 — Choke 5546	.98
Control Box Switch	.15
Neon Ind. Bulb	.15
15 Mmf. Trimmer	.15
Relay, 24V Dpdt.	.49
12SK7 Tube	.59
12SR7 Tube	.59
12A6 Tube	.29
12SF7 Tube	.59

PLUGS FOR ARC-5

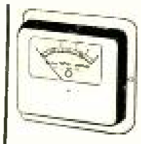
9821—8 Png, Female	.55
6418—8 Png, Male	.30
6577—8 Png, Female	.55
5577—6 Png, Male	.30
PL154A—12 Png, Female	.55
PL154—12 Png, Male	.45
W/15U—16 Png, Female	.55
PL148A—3 Png, Female.	.35
7027—18 Png, Male	.30
PL147—2 Png, Female	.50
6967—5 Png, Female	.50
Small—3 Png Chassis, Female	.10
Large—3 Png Chassis, Female	.15
Chassis—6 Png, Male	.15
7025—12 Png, Male	.30
FB103442—5 Mfd.	.19
.85 Mfd., 600V	.23
5413—3X .22 Mfd.	.49
10247—.35 Mfd.	.19
7582—3 Mfd.	.19
3X .05 Mfd.	.19
2933—4X .8 Mfd.	.29
7324—Variable Cond.	1.95
7321—Variable Cond.	1.95
5032—Variable Cond.	1.25
6558—Variable Cond.	1.95
5546—Rec. Choke Assy., RF	.49
5634—Rec. Choke Assy., AF	.49
6385—Relay Spst.	.69
MC211A—Right Angle Drive	.50

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/220 Ma. 6.4/8.7A, 6.4/.6, 5V/3A, 1.25/.3 ....$2.95

XMTR COILS AIR WOUND

80 MTR Bar Prong 100 w. 40 MTR 5 Prong 50w plug-in socket.
160 MTR 5 Prong 50w plug-in socket.
40 MTR 3 Prong Bar 100w.
#C538 2-3.5 MC 300w Fix. Link.
#C390 5-7 MC. 300w Fix. Link.
160 MTR Bar Type 100w.
Each $1.19



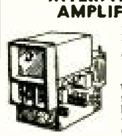
0-5MA SQ 2" Metal Case or 0-10 volt movement readrite meter 98c

Birtcher Tube Clamps

926C	926C-24
926—16	926—C15
926—B1	926—C13
926—B2	926B
926—B8	
926B—16	
926A—14	
926C—19	
926A	
926—C1	
926—A11	

11c ea.
100 for $10.50
1000 for 10c ea.

BC 605 INTERPHONE AMPLIFIER



Easily converted to an ideal intercommunications set for office—home — or factory. Complete w/conversion diagram for 110V operation. Brand New......$4.49

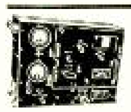
Meter Cabinet

For BC221 Freq. Meter. Brand New Wood. 14½H x 10½W x 10D. Value $20.00. Only $2.95

VFO FOR BC 221 FREQ. MTR.

Unit contains two temperature and moisture compensating coils, wafer switch, 3 variable condensers, carbon resistors, and silver mica condensers. FULLY WIRED and mounted on sturdy aluminum sub-chassis, ready for installation. Brand new — in original packing $6.95

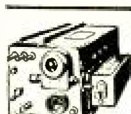
BC 223 XMITR



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 speech amplifier Price with TU 18A Tuning Unit. 3—4.5 MC or TU 25, 3.5-5.2 MC w/Tubes..$22.95

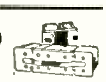
TUNING UNIT FOR BC 223

TU 18A 3-4.5 MC..$2.25
TU 25 3.5-5.2 MC. 2.25



Aircraft Rec. or Xmittr (RU/GF) for Mobile or Aircraft Covers 187 — 13,950 Kcs by interchange plug in tuning units includes one Tuning Unit. w/Tubes..$3.95 ea.

RU/GF (SCR 183) REC. TUNING UNITS



D—Range 850-1330 Kc
E—Range 1330-2040 Kc
F—Range 2.04-3 Mc
G—Range 3-4.5 Mc
H—Range 4-6 Mc
K—Range 9.05-13.5 Mc
Dual Range 400-600 Kc 6-9 Mc
$1.95 EACH
3 For $5.00

RU/GF (SCR 183) TRANS TUNING UNITS

1-1.2 Mc $1.49
1.2-1.5 Mc 1.49
3.2-4 Mc 1.49
5-6.2 Mc 1.49
3 For $4.00
4-5 Mc w/4495 Ks XTAL 2.95

BC-603 Receiver

10 tube, superhet FM receiver; Foster Seely discriminator, 10 channel; pre-tuned, push-button selector; optional manual tuning; adjustable squelch control; speaker mtd. in rec.; freq. range 20 to 27.0 mc. Small change in RF trimmers will cover 10 & 11 meter bands. POWER REQUIREMENTS—Receiver 260-280 v. at .08 amps DC, 14 v. at 3.5 amps. AC.
Price $18.95

BC-684 Transmitter

30 Watt 10 Channel Push Button Controlled 27-38 MC. Complete with Tubes Price $23.95

AUDIO XFRMRS

UTC 80707 ouncer Pl. to Mult. Gds.$1.29
5119—Ouncer Pl. to line 49
901—Pl. to V. coil. .75
6262—Pl. to Hdst or line 69
5640—Mike or Line to Grid. 1.29
T202—6V6 Pl to 811 Gds. 1.45
765—Line to Grd... .98
25—Pl. to Line.... .98
837—1:1-1:2 Ratio. .75
622—1:2.28 Ratio.. .75
9449 — PP6V6 to PP805 Class B, 10 Watt..$4.95
9446 Hi-Fi 60-15000CPS 250W. Audio 9000∼PP to 9∼ Voice Coil...$12.95
353 AB1 PP 6L6 to 250∼ Line 9 voice coils 20∼, 12∼, 1.7∼, 16∼ 25 watt $3.95
631 Mike to PP Grids.29c
959 Dyn & Carbon Mike to PP Grids........79c

Line FILTER, GE 100 Amp Filter w/2x5Mfd 50V oil cond. Operates on 110V AC DC......$1.98

ARC3 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
COMPETE KIT OF THREE $2.98

MOUNTINGS

FT 234A For 274N Trans
FT 232A For 274N Trans
FT 229A For 274N, BC442
FT 225A For 274N, BC456
MT 62 For ARC/5, ARR2
MT 78/ARC5 Control Unit
MT 85/ARC5 Junction Box
FT 141 6⅜x4⅜
MT 80/ARC5 Junction Box
MT 65/ARC5
MT 76/ARC5
MT 63/ARC5
MT 69/ARC5
MT 68/ARC5
FT 282A P/o SCR 518A
FT 308A P/o PE119A
MT 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

XFMR POWER SUPPLY KITS

Trans. 1080V/55Ma 6.3V/1.2A, 6.3/1.2 A, 2-.1 Mfd 2500V 2X2 Tube, Socket, 1-100000 ohm Resis. Price.........$6.95
Trans. 2300V/4Ma. 2.5/2A. 2-.1 Mfd 7500V Pyr. 2X2 Tube. Socket, 1-100000 ohm Resis.$8.49
Pwr. Supply contains Trans. 600VCT/.155 MA, 6.3V/5A, 5V/3A, 2—7 MFD 600V. Dual Choke. 10HY 200MA, 5T4 Tube, Socket. Price.....$6.95
Pwr. Supply contains Trans. 820VCT/200 MA. Dual 10HY 200 MA Choke, 2—7MFD 600V. 5T4 Tube. Socket. Price.....$8.95
Contains Xfmr 550-550V 250MA 6.3V/1.5A, 200 Bias. 2—10HY Chokes 2—4MFD 1000V Cond. All for $10.95

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
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	27.50
.015	16K	6.95
.25	20K	16.95
.5	25K	32.50
1	25K	75.00
4	50	.29
1	100	.15
2.5	100	.23
200VDC		
2x.1	2ST	.15
2x.1	3TT	.15
2x1	4ST	.16
2	2ST	.20
.5	2TT	.15
.5	2ST	.15
400VDC		
2x.25	3ST	.21
2x.1	3ST	.21
2x.1	2TT	.20
3x.1	3ST	.25
.1	2TT	.19
.5	1TT	.19
1	2ST	.23
2	3BT	.26
600VDC		
.1	2BT	.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

Xfrmr Specials 9V/1.6A ...$1.60

Pri 110V-80V 60cy. Sec 1250V/2Ma, 6V/4A, 650VCT/85, 2.5V/1.75, 6V/.6. $4.95

T.V. Transformer, 7" or 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

RADAR SETS

APS-2	Airborne	10 CM, Major Units
APS-4	Airborne	3 CM, Compl.
APS-15	Airborne	3 CM, Major Units
SD-4	Submarine	200 MC, Compl.
SE	Shipboard	10 CM, Compl.
SF-1	Shipboard	10 CM, Compl.
SJ-1	Submarine	10 CM, Compl.
SL-1	Shipboard	10 CM, Compl.
SN	Portable	10 CM, Compl.
SQ	Portable	10 CM, Compl.
SO-1	Shipboard	10 CM, Compl.
SO-8	Shipboard	10 CM, Major Units
Mark 4	Gunlaying	10 CM, Compl.
Mark 10	Gunlaying	10 CM, Compl.

Above—Less Rack New, Less Rack Used

CPN-3	Beacon	800 MC. Less Ant.
CPN-6	Beacon	3 CM, Compl.
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SCR-533	IFF/AIR	500 MC. Search Tracer

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V.T.V.M.

(Continued from page 45)

However, in most cases observed by the author the change in readings did not amount to more than a few hundredths of a volt on the 0-1.75-volt range. This condition may be checked by the user by simply reversing the d.c. voltage applied to jack J_1 and throwing switch S_2 to "Negative." If desired, separate calibration curves may be plotted for positive and negative input.

After the v.t. voltmeter has been adjusted for d.c. operation, the a.c.-r.f. probe may be connected and an a.c. calibration made. Turn on the instrument, as previously explained, and allow a few minutes for maximum stability to be attained. (1) Set switch S_1 to 1.75. (2) Set S_2 to "Negative." (3) Plug-in the a.c.-r.f. probe by inserting P_1 into SO_1. (4) If milliammeter is deflected from zero, adjust potentiometer R_9 in probe to bring pointer back to zero. (5) Apply carefully measured a.c. or r.f. voltage (variable from 0 to 2 volts r.m.s.) to "High" and "Low" probe input terminals. (6) Set this voltage to various steps between 0.1 volt and full-scale deflection of the meter. (7) Prepare special meter scale or calibration chart showing a.c. volts corresponding to milliammeter readings. A special a.c. scale is imperative for the lowest voltage range. This is because the diode response is not exactly linear at low voltage inputs. However, it will be noticed that the d.c. meter reading will be close to the peak value of the applied a.c. at voltages above about 10 volts r.m.s.

Operation

This v.t. voltmeter may be used for all d.c. measurements between approximately 0.05 volt and 1750 volts in high-resistance as well as low-resistance circuits, while a.c. voltage measurements may be made well into the u.h.f. region.

When placing the instrument into operation, always set switch S_3 first to position 1 and pause for a few seconds to allow the filament to heat. Then throw the switch to position 2. But when turning the instrument off, this pause will not be necessary in position 1.

After initial calibration adjustment, the setting of rheostat R_6 ordinarily need not be disturbed until the 1G4/GT-G tube is subsequently replaced.

When checking d.c., filament drain in the instrument is only 50 milliamperes. When the external a.c.-r.f. probe is connected for a.c. measurements, this drain increases to 200 milliamperes. The zero-set cell (B_4) normally supplies about 2 milliamperes, and the plate battery (B_2) approximately 2 milliamperes. The probe bucking cell (B_3) supplies approximately 1½ milliamperes. These low drain levels insure long battery life and infrequent replacements.

If the meter deflects backward when checking d.c., indicating that the negative terminal of the test voltage is connected to the high contact of jack J_1, simply throw switch S_2 to its opposite position. *CAUTION:* The instrument case (if connected to "B-minus") is "hot" if the input voltage has such polarity that S_2 must be thrown to "Negative." For this reason, it is advisable to keep the high side of jack J_1 connected to the positive terminal of any high-voltage source being tested.

Whenever completing a.c. or r.f. voltage measurements, remove the external probe from the circuit by removing P_1 from SO_1. This automatically disconnects the 1A3 filament from cell B_1, while simultaneously disconnecting cell B_3 from potentiometer R_9.

When higher voltages than about 175 r.m.s. are to be measured with the a.c.-r.f. probe, it is recommended that a capacitive-type voltage divider be employed at the input terminals of the probe. In this way, it will be possible to extend the a.c. and r.f. ranges of the instrument without exceeding the maximum allowable peak inverse voltage of the 1A3 diode.

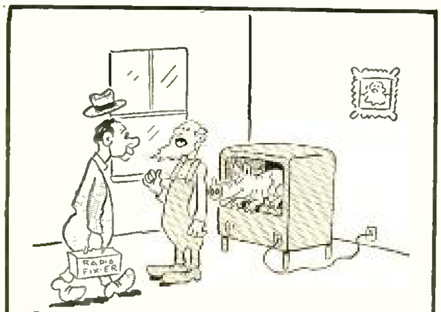
An a.c.-r.f. probe requiring no batteries at all may be made around a *Sylvania* 1N34 germanium diode, instead of a tube, and this probe may be connected by means of a phone plug directly into jack J_1. However, the maximum allowable a.c. voltage applied to this probe will be less than that permissible with the tube, because of the lower peak inverse voltage rating of the crystal diode. Several such probes have been described previously in this magazine. —30—

UNIVERSAL TEST KNOB

By NEIL A. JOHNSON, W2OLU

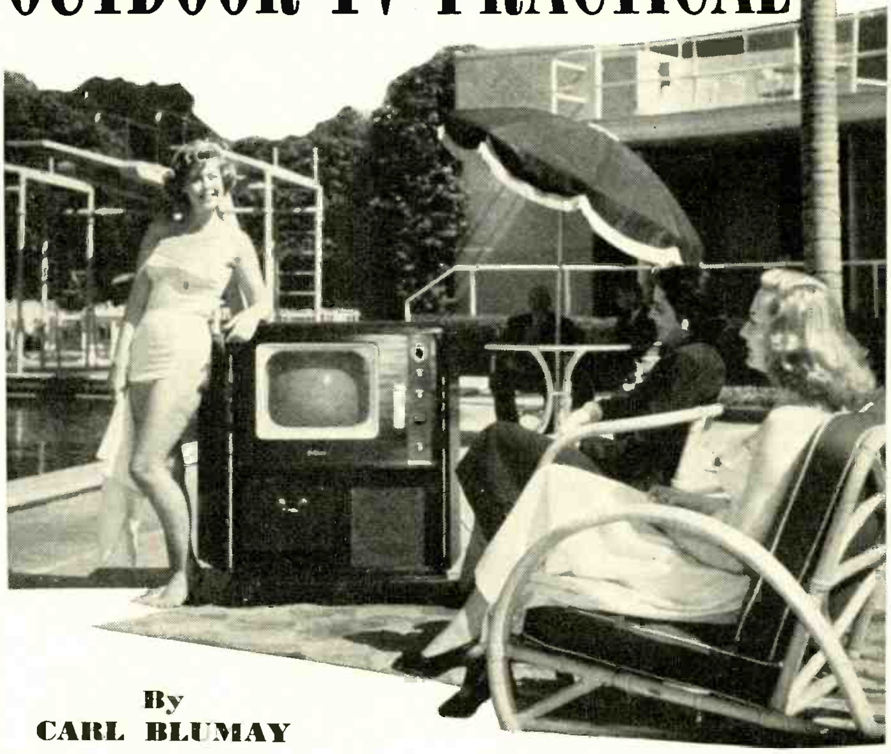
TAKE an ordinary small bar knob and remove the set screw. Next find an 8-32 screw that will fit the hole and leave about ¼ inch extending when screwed onto a ¼ inch shaft. This bolt preferably should have a flat head.

Then find a brass washer, about ½ inch in diameter. File a small flat on one edge of the washer, insert it in the slot of the screw, and sweat the two together. Now, insert the 8-32 screw into the bar knob and you will have a "universal test knob" that can be put onto any ¼ inch shaft and removed easily—in less time than it takes to describe the operation. —30—



"I've been keeping Susie in there while she's ailing, the tubes keep her stomach warm!"

NEW TECHNIQUES MAKE OUTDOOR TV PRACTICAL



By
CARL BLUMAY

Outdoor television at the Beverly-Wilshire.

Built-in antennas, black-faced tubes, and new high gain circuits make outdoor televiewing practical.

THE advent of summer has caused most people to "move outdoors"; many of them, in addition to dining and relaxing in the wide open spaces, are moving their television receivers to the porch or patio where they can continue to enjoy their favorites along with the balmy breezes and brilliant sunshine.

Until recently, outdoor televiewing would have been impossible as full enjoyment of the program on the average screen was possible only in darkness or semi-darkness. Today, with the new black-faced picture tubes and improved circuit designs, outdoor viewing has become commonplace.

Efficient built-in antenna systems, along with increased receiver sensitivity, eliminate awkward antenna lead-in wires and make it practical to move the receiver from the living room to the patio, garden, or poolside.

In addition, many sets have the safety glass assembled so that it tilts slightly downward, thus effectively eliminating undue sky reflection in outdoor applications. Some of these safety glasses are slightly tinted which permits an even greater reduction of reflections resulting in sharper and more detailed pictures.

The vogue for outdoor televiewing seemingly originated with a prominent motion picture star who was discussing the possibilities of using his set outdoors with H. L. Hoffman, president of *Hoffman Radio Corporation*, Los Angeles. Since last spring this actor has been enjoying television programs at the side of his pool. The idea soon spread, not only to other members of the Hollywood colony but to some of the swank hotels in the area.

The lush Beverly-Wilshire Hotel in the heart of Beverly Hills has installed a television set near its huge swimming pool, a feature which has gone over big with the guests.

This month's cover was photographed at The Copa Club of the B-W's pool and shows a *Hoffman* Model 947 mahogany receiver with a 16 inch angle screen and a black-faced picture tube. The scene shown has become a familiar one around many pools in sunny climates. Every warm day finds a group of swimming and sunbathing enthusiasts clustered in front of the set watching the programs or listening to the recorded programs available on this combination instrument. The most popular of the *Hoffman* sets, for poolside and outdoor use, has been the unit which combines a three-speed record player, AM and FM radio, and a 16 inch tube television set. —30—

TUBE BARGAINS

1B3/8016	$.89	715A/B	$5.95	RK25/802	$3.50
6C6	.41	715C	14.50	830B	2.90

5R4GY	$1.10	6SH7	$0.45	2D21	$1.17
5T4	.75	6SJ7	.52	2J21A	10.95
5U4G	.59	6SK7GT	.49	2K25	23.50
5V4G	.88	6SL7GT	.64	205F	4.95
5W4	.72	6SN7GT	.69	283A	10.95
5X4G	.62	6SQ7	.50	303A	4.95
5Y3GT	.42	6SS7	.55	307A	5.50
5Z3	.69	6SU7/GTY	1.25	316A	.49
6A7	.74	6V6	.94	4-65A	14.10
6AC7	.79	6V6GT	.65	4-125A	25.95
6AG5	.74	6W4	.69	GL502	1.90
6AG7	1.03	6Y6G	.69	703A	1.95
6AK5	.85	7C5	.53	707B	10.95
6AK6	.82	7F7	.64	715B	9.95
6AL5	.62	7N7	.73	715C	24.50
6AQ5	.54	7Z4	.62	723AB	11.95
6AT6	.48	12A6	.21	725A	8.95
6AU6	.62	12AT6	.49	803	4.50
6B4G	.94	12AT7	.62	804	12.95
6B6G	.84	12AU6	.60	805	5.95
6BA6	.59	12AU7	.70	807	1.75
6BE6	.57	12BA6	.59	809	2.25
6BG6G	1.49	12BE6	.53	810	8.95
6BH6	.62	12SA7	.60	811	1.95
6C4	.25	12SK7	.60	813	7.25
6C5	.49	12SQ7	.55	814	3.95
6C6	.52	25L6GT	.60	815	1.57
6C8G	.59	25Z5	.49	816	1.05
6D6	.49	35W4	.45	826	.49
6F5	.52	35Z5GT	.47	829B	7.95
6F6	.62	50B5	.58	832A	4.95
6F8G	.79	50L6GT	.58	836A	1.75
6H6	.42	80	.49	837	2.45
6J4	4.55	83	.79	845W	4.85
6J5	.49	117L7	1.29	866A	1.15
6J6	.99	OA2	1.55	872A	1.25
6J7	.72	OB2	1.76	892R	250.00
6K6GT	.49	VR75	.89	1625	.29
6K7	.53	VR90	.95	2050	1.20
6K8	.85	VR105	.89	2051	.85
6L6	1.19	VR150	.69	8025	3.60
6N7	.79	1N21	.55	9001	.39
6SA7	.50	1N23	.85	9002	.30
6SC7	.64	1N34	.80	9003	.40
6SF5	.53	1N35	2.05	9004	.29
6SG7	.64	2C40	4.95	9005	1.40

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20 HY 110 MA Sub Sig Herm Seal	3.45
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5 HY 200 MA 65 OHM Sub Sig	3.95
7 HY 200 MA 100 OHM Herm Seal	2.49
4-16 HY 200 MA 140 OHM SW CH	3.85
4 HY 125 MA 200 OHM	.90
3 HY 250 MA 15 OHM	1.65
15 HY 250 MA 60 OHM	2.95
3-14 HY 300 MA 80 OHM SW CH	5.60
8 HY 300 MA 80 OHM	5.55
8 HY 450 MA 88 OHM Herm Seal	5.95

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JBT 31-F FR. MTR	7.95

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0-5 MA GE AMP Scale	2.49
0-10 MA WH	2.49
0-20 MA SP Scale	2.49
0-25 MA SP Scale	2.49
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2 MF 600 VDC	.59	.1 MF 2000 VDC	1.79
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6 MF 600 VDC	.89	1 MF 2000 VDC	1.25
10 MF 600 VDC	.95	2 MF 2000 VDC	2.45
1 MF 1KV WAX	.29	4 MF 2000 VDC	3.95
2 MF 1000 VDC	.90	8 MF 2000 VDC	5.95
5 MF 1000 VDC	1.79	.25 MF 3000 VDC	1.45
10 MF 1KV DC	2.49	4 MF 3000 VDC	8.95
15 MF 1KV DC	2.95	3 MF 4000 VDC	4.75
.5 MF 1.5 KV DC	1.25	2 MF 5000 VDC	6.95
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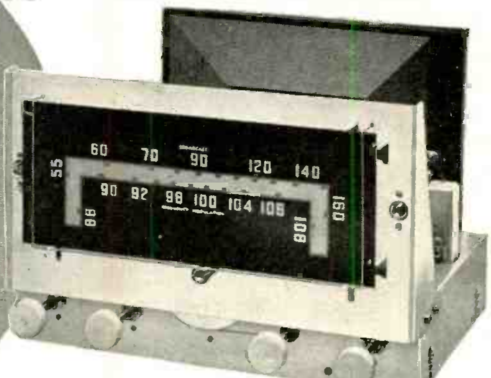

Here's the outstanding 9A — complete with tubes, power supply, built-in antenna, escutcheon, knobs, etc.

features that place the 9A in a class by itself

- High Selectivity and Sensitivity
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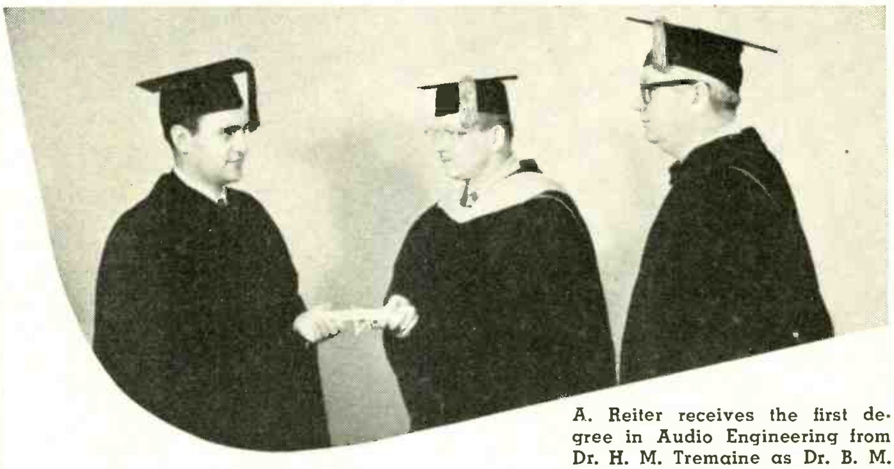


A. Reiter receives the first degree in Audio Engineering from Dr. H. M. Tremaine as Dr. B. M. Klekner, Hollywood U.'s president, witnesses the ceremony.

First Degrees Granted In Audio Engineering

ON MAY 18, 1950, the *University of Hollywood,* of Hollywood, California, conferred the first Bachelor of Science degree in Audio Engineering that has ever been granted by any university or college. The College of Audio Engineering of the University has raised the standards of Audio Engineering, placing it in a professional classification. Now Audio Engineering is recognized academically as being an engineering profession.

Dr. George K. Teffeau, Dean of the University, officiated at the first commencement exercises, conferring Bachelor of Science degrees in Audio Engineering to twenty-three graduates of the University. To Mr. Abraham Reiter goes the distinction and honor of receiving the first Bachelor of Science degree in Audio Engineering. He previously received a Bachelor's degree in Mechanical Engineering from *Cooper Union,* New York City, and was awarded a certificate for outstanding work by the student branch of the *American Society of Mechanical Engineers.*

Hilliard, Read, da Costa and Browne Honored

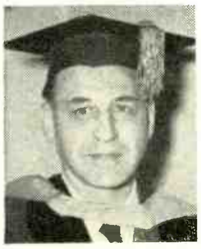
The colorful graduation ceremonies were concluded with a banquet and the presentation of honorary degrees. Mr. John K. Hilliard, Chief Engineer of *Altec Lansing Corporation* and a recognized authority in the radio, motion picture, and sound industries for many years, received the honorary degree of Doctor of Science in Audio Engineering. Mr. Hilliard was honored in recognition of the contributions he has made to the science of audio and film engineering.

Prior to his association with *Altec Lansing Corporation,* Mr. Hilliard was an engineer in the Sound Department at *Metro-Goldwyn-Mayer Studios.* He actively participates in the activities of various engineering societies such as the Institute of Radio Engineers, the Audio Engineering Society, the Society of Motion Picture and Television Engineers (Fellow), and is vice-chairman of the Z-57 Group of the American Standards Association.

An honorary degree of Doctor of Science in Audio Engineering was also conferred on Mr. Oliver Read, Editor of RADIO & TELEVISION NEWS and RADIO-ELECTRONIC ENGINEERING. This honor was given Mr. Read "because of the valuable contributions he has made to the science of audio engineering in his capacity as an editor, and furthermore, in recognition of his recent authoritative literary contribution as the author of the book entitled, "The Recording and Reproduction of Sound" and many articles on audio subjects.

An honorary degree of Doctor of

Dr. Hilliard



Dr. Read

Dr. da Costa

Dr. Browne

Literature was bestowed on The Honorable Dr. Sergio Correa da Costa, Brazilian Consul. Dr. da Costa was honored "because of the contributions he has made in cementing the cordial relationship that exists between Brazil and the United States in his capacity as Brazilian Consul at Los Angeles, and in recognition of the brilliant diplomatic services rendered as former Secretary of the Brazilian Embassy in Buenos Aires and in Washington as member of the Brazilian delegation to the various Inter-American conferences, as acting delegate to the Governing Body of the Pan-American Union, to the Inter-American Economic and Social Council and to the Central Committee of UNRRA."

An honorary degree of Doctor of Science in Business Administration was conferred on Mr. Burton Browne of Chicago, Illinois. Mr. Browne received his award in recognition of "the valuable contributions he has made in the development of commercial motion pictures, in consideration of his outstanding research work in the field of industrial radio advertising, and for compiling and publishing an all-important book entitled, 'Best National Advertising of the Year.'"

Mr. Hilliard was the guest of honor at the banquet which followed the commencement ceremonies and was the principal speaker at this event. He presented to the graduates a story involving the history of Audio Engineering and the science of communications. He particularly directed the attention of the graduates to the fact that they, being the first Audio Engineers to have ever received degrees in Audio Engineering from a university, were about to embark on a career that offers to all of them a brilliant future, and that their future potentialities and achievements will be limited only by their sincerity of purpose, personal initiative, and determination to grow with a great and rapidly expanding industry.

It was Mr. Hillard's contention that the tremendous improvements and strides made in the radio, television, and motion picture industries within the past few years are indicative of the developments to come. He was of the opinion that the surface has hardly been scratched as far as engineering research and development is concerned, and contended that within the lifetime of those present, they will see marvelous improvements and developments that will be "sensational" when compared to the facilities which are being used today—facilities which considered standard and acceptable from an engineering point of view.

Dr. Benjamin M. Klekner, President of the University, paid warm tribute to his co-founder of the University, Dr. Howard M. Tremaine. Dr. Klekner reviewed the accomplishments of Dr. Tremaine, as well as the contributions he has made personally in the development of Audio Engineering facilities.

Dr. Tremaine informed the graduates that television is going to open a new avenue of opportunity in the field of Audio Engineering, and that the need for audio engineers in the television industry is great. He also stated that if and when the Federal Communications Commission opens the ultra-high frequency channels to the video industry, literally thousands of television stations will be established throughout America and audio engineers will be needed to man the telecasts.

During the past six months the College of Audio Engineering of the University of Hollywood has mushroomed from a single building to an institution occupying five buildings. Their recording studios, audio frequency measurement laboratories, and film engineering laboratories are among the best equipped in the country. In the film engineering laboratory students are trained on *RCA* 35 mm. Standard Film Recorders, and the University boasts of the fact that it is an *RCA* Licensee. Because of this fact students are trained on the same equipment that is to be found only in the production and recording departments of the various motion picture studios.

Dr. Teffeau, Dean of the University, reported that the Board of Trustees of the University has leased four additional buildings which will be ready for occupancy September 1st, thereby enlarging the facilities for the College of Audio Engineering to nine buildings.

Other buildings which are being added to the University's facilities are designed to house one of the finest television production stages, and are to be occupied by the College of Television Technique of the University. In this proposed school students will be trained in the field of Television Engineering. The buildings are to be equipped with the latest television cameras, camera chains, booms, and consoles for mixing both video and audio.

Students Form Amateur Club

The Student Council of the University is very active and plays an important part in governing student activities. The student representatives are permitted to sit in on executive conferences with the officers and faculty of the University. Because the students are allowed to participate in the formulating of plans, practices, and procedures adopted by the University, a high degree of enthusiasm is generated. Recently, the Student Council of the University formed the University of Hollywood Amateur Radio Club, and the Federal Communications Commission granted them a license for the operation of a "ham" station. The call-letters assigned are W6IEK.

The Electronic Industry, which now includes many specialized fields, will be given even greater recognition now that Audio Engineering takes its place with Radio and Electrical Engineering as a recognized profession.

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Oscilloscope

(*Continued from page* 33)

checking in transmitters. For this application, two r.f. pickup loops will be required. Connect one loop to terminals *C* and *D* and couple it to the crystal oscillator tank. Connect the other loop to terminals *A* and *B* and couple it to the tank of the multiplier stage under check. Fig. 3 shows the patterns

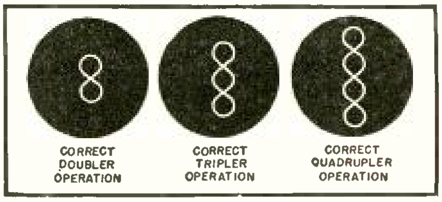


Fig. 3. Trapezoidal patterns used in checking harmonic operation of transmitters.

obtained for correct doubler, tripler, and quadrupler operation. No sync circuit is needed—the pattern remains perfectly stationary on the screen, since in the case of frequency drift each stage drifts by the same percentage and in the same direction. This method of checking harmonic operation often is more reliable than use of a wavemeter or similar device. —30—

FCC EXAMS

At a session of the Federal Communications Commission held at its offices in Washington, D.C. on May 12th, the Commission took under consideration the necessity for amending the Appendix to Part 12 of the Rules and Regulations to reflect certain changes in its list of points at which examinations for radio operator licenses may be taken.

It was ordered that effective June 3rd, the Appendix to Part 12 of the Commission's Rules and Regulations be amended as follows:

Examination Points: (a) Delete Cleveland, Ohio, from and add Mobile, Ala. to the list of points at which examinations are given by appointment. (b) Delete the list of points at which examinations are given quarterly, semi-annually, and annually, and substitute the following list.

Quarterly Points: Birmingham, Ala.; Little Rock, Ark.; Phoenix, Ariz.; Fresno, Calif.; Ft. Wayne and Indianapolis, Indiana; Davenport and Des Moines, Ia.; Grand Rapids, Mich.; Jackson, Miss.; St. Louis, Mo.; Omaha, Neb.; Schenectady and Syracuse, N. Y.; Winston Salem, N. C.; Cincinnati, Cleveland, and Columbus, Ohio; Oklahoma City and Tulsa, Okla.; Pittsburgh and Williamsport, Pa.; Sioux Falls, S. D.; Knoxville, Memphis, and Nashville, Tenn.; Corpus Christi and San Antonio, Tex.; Salt Lake City, Utah; Charleston, W. Va.; and Milwaukee, Wis.

Semi-annual Points: Tucson, Ariz.; Bakersfield, Cal.; Hartford, Conn.; Jacksonville, and Tallahassee, Fla.; Boise, Idaho; Wichita, Kan.; Louisville, Ky.; Bangor and Portland, Maine; Marquette, Mich.; Butte, Mont.; Manchester, N. H.; Albuquerque, N. Mex.; Wilmington, N. C.; Jamestown, N. D.; Hilo, Lihue, and Wailuku, Territory of Hawaii; Amarillo and El Paso, Tex.; Roanoke, Va.; and Spokane, Wash. —30—

NEW TV PRODUCTS on the Market

FRINGE AREA ANTENNA

Trio Manufacturing Company of Griggsville, Illinois, has developed a new television antenna designed especially for fringe area applications.

The new "Controlled Pattern" antenna system provides high gain in the forward direction and overcomes co-channel interference. A high voltage from two double dipole Yagis is phased by the use of the new tunable "Phasitron" to provide addition of voltages from the desired direction and cancellation of undesired voltages. The unit uses two 300-ohm feed lines of random length, two double-folded Yagis for exact impedance matching. Separate antenna systems are available for each of 12 channels, though considerable gain is achieved on adjacent channels.

HIGH-GAIN ANTENNA

Technical Appliance Corporation of Sherburne, New York has developed and is marketing a new all-channel, high-gain antenna designed to emphasize reception on Channels 11, 12, and 13.

The new *Taco* "Tri-X" is being offered for use in areas where the Lazy-X does not provide sufficient gain for the upper end of the high band. The forward angle of the antenna elements has been increased and a third antenna element added in between other antenna elements to provide the conical effect necessary for this type of antenna.

Special noise-snubbers eliminate the wind-whistle effect and a new apex design has been used to overcome the inherent weak point of X-type antennas.

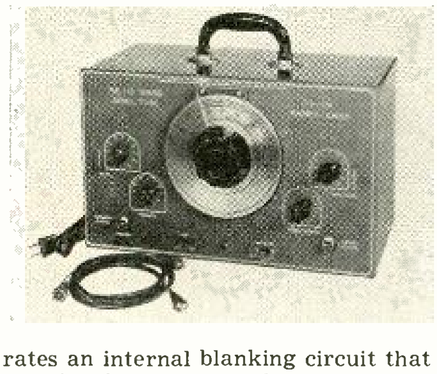
The company's "Jiffy-Rig" type of construction, used in the antenna, assures quick, easy, and permanent assembly of the array.

For full details and prices on this new antenna array, write direct to the company at the Sherburne address.

SWEEP GENERATOR

A new television-FM sweep generator and marker which is combined in a single instrument is currently being offered by *Radio City Products Co.* of 152 West 25th Street, New York 1, New York as the TV-80.

The sweep generator uses an electromagnet type of sweep and two oscillator circuits. The design incorpo-



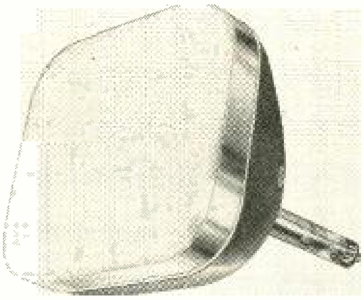
rates an internal blanking circuit that permits the retrace to be blanked out independently regardless of the type of oscilloscope used.

The unit has a range of from 5 to 240 mc., continuously variable. The sweep width is variable from 400 kc. to 10 mc. The marker range is from 17 to 48 mc. The instrument is housed in a steel cabinet finished in grey and white and measures 15 x 9 x 7 inches. It weighs 14 pounds and operates on 105-125 volt a.c. power

VIDEOTRON TUBE

National Union Radio Corporation of Orange, New Jersey has recently added two new 16" and 14" rectangular units to its line of cathode-ray tubes.

The *N.U.* 16KP4 is a 65 degree direct



view tube which provides a 10⅛" x 13½" rectangular picture having the standard 3 x 4 aspect ratio. It features a face plate having an integral neutral gray filter which increases the contrast ratio when viewing under ambient light conditions. The tube utilizes the new tilted beam type gun to obtain improved picture detail. It requires only a single field ion trap. The 16KP4 is identical to the *N.U.* 16TP4 except for an increase in neck length to 7½" which permits adaptability to a greater range of focus coil and deflection yoke designs.

The *N.U.* 14CP4 provides an 8⅝" x 11½" rectangular picture but in other respects is similar to the 16KP4.

ROOF MOUNT

Joseph R. Steele Mfg. Co. of P.O. Box 854, New Haven, Conn. is in production on a new, universal roofmount which has been designated the "OMA."

The new unit fits any sized mast from ¾" to 1¾", and can be installed on any type of roof. The unit is constructed of heavy gauge steel and is plated with a heavy zinc plating.

ELECTRICAL TAPE

Minnesota Mining and Manufacturing Co.'s "Scotch" brand No. 33 electrical tape is applicable to many television installation and maintenance operations, according to the new pocket-sized folder just released.

The tape which has 7000 volts dielectric strength, 7 mil thickness and unusual resistance to sunlight, aging, water, salt water, acids and alkalies is especially recommended for such TV applications as wrapping the antenna leads to keep moisture out and prevent snow on the picture tube, wrapping of a high voltage harness to prevent shorting, and taping the eye for a television lead.

The folder and tape samples are available from the company at 900 Fauquier Street, St. Paul 6, Minn.

TV BOOSTER

Peak tuning and close impedance match on any channel, accomplished from the cabinet exterior, is the unusual feature of the new television preamplifier SP5 recently developed by *Radio Merchandise Sales Co., Inc.* of 1165 Southern Blvd., New York 59, New York.

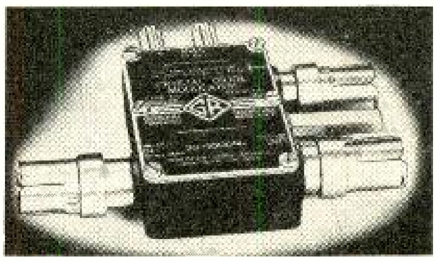
The new booster which is housed in a mahogany finished metal cabinet, provides wide bandwidth, good signal-to-noise ratio and low insertion loss. Tuning is accomplished by a single gear-driven knob.

Full details are available from the company on request.

DIODE MODULATOR

Designed for laboratory use, TV receiver production testing, and television service work, the new Type 1000-P6 crystal diode modulator has been announced by *General Radio Company* of 275 Massachusetts Avenue, Cambridge 39, Massachusetts.

The new unit converts an oscillator, standard signal generator, or other r.f. source into a test signal generator for television receiver testing. It modulates the oscillator signal after attenuation so that reaction on the oscilla-



tor frequency is negligible. Thus it produces an amplitude modulated signal with no significant incidental FM.

The range of modulating frequencies is 0 to 5 mc. and the carrier frequency range is 20 to 1000 mc., covering the proposed new u.h.f. television bands as well as the currently used frequencies.

For receiver testing, a video signal can be conveniently derived from a TV receiver tuned to a local channel. With this video signal applied to the modulator, and an oscillator tuned to the desired carrier, a TV picture can be placed on any desired channel merely by tuning the carrier oscillator.

The modulator is small, compact, and equipped with Type 874 coaxial connectors for r.f. input, output, and for modulation input. Adaptors are available for connection to other types of terminals. Impedance is 50 ohms for r.f. circuits, and coaxial 50 ohm attenuators and other accessories are available.

DU MONT COLOR TUBE

The *Allen B. Du Mont Laboratories, Inc.* of Passaic, New Jersey has announced that the U.S. Patent Office has granted Patent No. 2,508,267 covering a three-color direct-view television tube.

The tube was invented by Henry Kasperowicz of the company's laboratories and the patent was applied for October 26, 1945. In its construction, the new tube is similar in most ways to the familiar black-and-white picture tube except for a new form of fluorescent screen. The new color tube has a fluorescent screen composed of tiny fluorescent dots which give forth red, blue, and green colors respectively when struck by the electron beam. The tiny dots are arranged so that each dot of one color is adjacent to adjoining dots of another color.

The new color television tube can be used in any one of the three color systems now under consideration by the FCC, namely the field sequential, dot sequential, or line sequential.

TV SCOPE

A new high-gain, wide-band cathode-ray oscilloscope designed particularly for television circuit, laboratory, and industrial applications has been announced by the Radio Tube Division of *Sylvania Electric Products Inc.* of 1740 Broadway, New York 19, New York.

The new type 400 oscilloscope, which comes equipped with a 7-inch 7JP1 green screen cathode-ray tube, provides a vertical sensitivity of 10 milli-

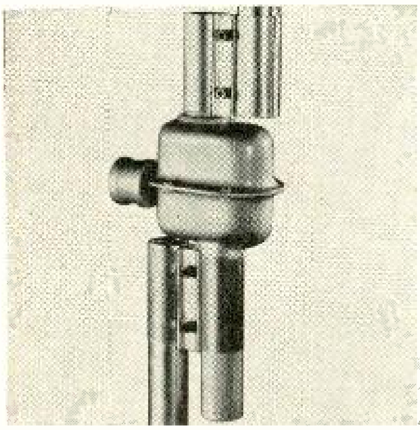
volts per inch and a vertical response which is useful up to 4 mc.

Other features include a four-position, frequency-compensated attenuator for uniform frequency response at any gain setting; vernier gain control; low internal hum level; internal 60 cycle sine wave sweep which eliminates one set of leads during TV alignment operations; wide-range phasing control; internal hard tube sweep circuit; control for synchronizing to either positive or negative signal; good vertical bounce and return characteristics; and rapid return trace.

"TELE-TURNER"

The *Joseph Shaw Company* of 6225 Benore Road, Toledo 12, Ohio is currently marketing a new, mechanically-operated, non-electric antenna rotator which sells in the moderate price class.

Known as the "Tele-Turner," the new unit is easily installed and operated. It comes complete with directional indicator, inside manual control,



and all necessary hardware. The rotator is ball-bearing equipped and locks the antenna into position easily and positively.

A data sheet covering the "Tele-Turner" is available on request.

24-INCH TUBE

General Electric Company of Syracuse, New York is currently setting up production lines to manufacture a new 24-inch direct-view picture tube slated for appearance this fall.

In addition to its large size, the tube features a dark face plate which improves contrast and detail and an aluminum backed fluorescent screen which increases the picture brightness and permits operation at lower voltages.

LOW-LOSS LEAD-IN

An ultra low-loss transmission line of open wire construction for TV receiver antenna lead-in and amateur-commercial transmitting and receiving applications, has been announced by the *Gonset Company* of Burbank, California.

Known as the *Gonset* Line, it will replace ribbon type molded lead-in to advantage particularly in fringe areas, or wherever else weak signals are encountered.

Using polystyrene spacers to minimize dielectric losses, and one inch spacing to minimize line pick-up and radiation losses, the new line exhibits only .5 db. loss per 100 feet at 200 mc. and the losses do not increase appreciably under unfavorable weather conditions or with aging.

Accessory items include standoff insulators and a broadband linear transformer for matching the line to 300 ohms for television applications. The line is available in continuous lengths up to 500 feet.

ALL-BAND ANTENNA

JFD Manufacturing Co., Inc. of 6101 Sixteenth Ave., Brooklyn 4, N. Y., is now in production on a new "Vee-Beam" all-band television antenna which has been specially engineered to deliver the highest gain and sharpest directivity possible with a minimum of noise and interference.

Employing the "end fire" principle, the new antenna delivers high gain and directivity on the upper band. In addition, the new array provides gains up to 10 db., a single-stack gain of 7 db. on uppper channels with 11 db. for double stacks. The unit is designed to match 300 ohm sets.

Complete information and literature on the new array is available on request.

RAYTHEON COMBINATION

The *Belmont Radio Corp.* Division of *Raytheon Manufacturing Co.*, 150 E. 50 Street, New York 22, has recently added "The Devonshire" to its line of "Silver Anniversary" model television receivers.

This Model RC-1405 combination unit features a 16" glareless picture

tube, an AM-FM radio, and three-speed phonograph which plays all size records. The new set also has the "Ray-Dial" tuner, Synchromatic Stabilizer, a pre-fixed focus, and a built-in "Ray-Tenna" aerial.

The set is housed in a hand-rubbed mahogany veneer cabinet of authentic period design. Provision is made in the cabinet for record storage. The radio and phonograph will play with the full-length doors either open or closed.

FARADAY SHIELD

In order to reduce TVI caused by capacitively coupled harmonic radiation, the *E. F. Johnson Company* of Waseca, Minnesota, has introduced a new Faraday Shield which has been designed to be attached directly to the link.

With this new unit there is no limitation in the use of shields with any standard *Johnson* plug-in link from 2 turns to 10 or 12 turns. Construction of the shield includes a screen of conductors plated on low-loss polystyrene sheets. The pattern of conductors is such that the shields may be trimmed slightly for adaptation to other makes of links.

With a hood over the link terminals and copper braid covering the link leads, shielding is complete. Screens are grounded to the hood by means of a contact on the link. It is not necessary to disconnect the ground lead to change plug-in links.

Four models of the Faraday Shield are available; for 150/500 watt swinging links, 1000 watt swinging links, in complete assemblies and the same values, shield only.

A complete data sheet on the new shield is available on request.

VIDEO COMBINATION

Admiral Corporation of 3800 W. Cortland Street, Chicago 47, Illinois, has announced the availability of a new TV and radio-phonograph unit which features a 16" rectangular tube.

The new set is available in two versions, the 36 R 45 and the 36 R 46, in

walnut and mahogany cabinets which are classic modern adaptations of 18th century furniture design. The cabinets allow for roomy record storage and are equipped with doors so that all of the electronic equipment is concealed when the instrument is not in use.

"MICROSTICK"

An ingenious television "ruler" which can actually measure the millionths of a second it takes for a television signal to travel across the face of a picture tube has been devised by the Tube Department of *Radio Corporation of America* as an aid to service technicians in television picture analysis.

The "Microstick" is a transparent plastic ruler which in use is held flat against the safety glass of a television receiver to check a number of factors important to reception. The ruler is scaled for use with all picture tube sizes.

The unit may be used to measure the bandwidth of a television receiver, calibrate vertical wedges in test patterns, determine the beat frequency of interference, and measure the air path distance of ghosts and other reflected signals. In addition, the ruler is useful for determining the frequency of ringing in video circuits and for measuring the duration of sync pulses, horizontal blanking, and other types of video signals.

Distribution of the "Microstick" is being handled by *RCA, RCA Victor,* and *Cunningham* Tube and Parts distributors exclusively.

FRINGE AREA ANTENNA

Brach Mfg. Corp. of Newark, New Jersey has developed a fringe area television antenna which combines a fan-type arrangement of elements for uniform high impedance and a Vee-beam alignment for a narrow high-gain lobe.

Known as the "6-Bar," the new unit eliminates the high-band drop off common to conventional conical types. The antenna comes preassembled from the factory so that with the new "Speed Rig" design installation is completed in a matter of minutes. All elements swing out into position and a few turns on easily accessible lock nuts mitre-lock them into a set position.

The low standing wave ratio of the antenna permits direct coupling to 72, 150, and 300 ohm transmission lines. The front-to-back ratio is said to be excellent under all field conditions.

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Spot Radio News

(*Continued from page* 18)

General added, color receivers would also be available in about a year, with about 200 a week being made at the beginning, and perhaps 1000 a week as '52 rolled around.

A heated exchange of questions and answers followed the conclusion of the General's testimony, with Madame Commissioner Frieda Hennock particularly active on the firing line. Perturbed about the year-long schedule outlined by *RCA's* Board Chairman, the Commissioner indicated that others had said rapid production could be affected sooner, particularly for the other color method. The General replied that earlier production promises would be impossible to keep, regardless of the system adopted. He indicated that he wished the Commisioner had a bit of plant experience, and sat in on some of the day and night production-schedule conferences, which would reveal to her why processing must take time.

Criticizing the General's interpretation of the *CBS* pictures, which he had termed "degraded," the Commissioner said that she had found the pictures "beautiful." General Sarnoff retorted that the picture was "degraded," when compared to the electronic picture.

CBS witnesses who followed the General bombarded the hearing hall with bristling copy, Dr. Peter C. Goldmark roaring away with the bulk of the blazing commentary. Sharply criticizing the *RCA* minimization of registration problems, Dr. Goldmark said that the *CBS* system was the only one that had no registration to worry about either at the camera or receiver, while with the *RCA* approach, picture resolution could be cut to 25%, if the camera tubes were off one element. He also added that the *CBS* system provided complete fidelity, which involved faithfulness at a given point in the picture, uniformity over the whole screen and stability under home conditions, three conditions which he found the *RCA* system has not met. Blasting away at the availability testimony of *RCA* the *CBS* inventor said that equipment for his method could be produced in a few months, but he had "grave doubts" if the all-electronic gear could be manufactured even within the schedule submitted.

Goldmark also reviewed his experience with an *RCA* color receiver, declaring that he had operated a model in the home of FCC General Counsel Benedict P. Cottone, and found that the color and registration were poor, and that the picture also suffered from interference. In addition, he said that the color phasing control was very critical, often difficult to adjust.

Others from *CBS* and *RCA* appeared on the witness stand and continued to bounce rounds of sharp rejoinders about the session hall which burned many an ear. As these focal hearings concluded, official reaction to the hectic testimony appeared in pertinent addresses offered during luncheons and dinners by some of the Commissioners. In one speech by the Commission's Headman, Wayne C. Coy, before the City Club of Portland, a revealing review of the color and general television allocation situation was offered.

On the subject of color, Coy said that. . . . "All three systems have shown marked improvement since their first demonstrations. . . . There is no question but what the Commission's order stating that they would entertain proposals for color television has spurred the development of these techniques by months and years."

Analyzing some of the color questions which the Commission will have to answer, Coy said that they will have to consider how important it is to have a system whose color transmission can be received in black and white on existing receivers without the expense of an adapter. They'll also have to decide whether all of the systems should be allowed to be developed further. If the latter approach is taken, then the FCC will have to determine if the freeze can be lifted, or if it will be necessary to keep the freeze on until it is practical to write engineering standards for color.

If there were to be time for further experimental and developmental work, Coy wondered about the problem of obsolescence. The Commissioner said that they must decide if . . . "there is any action which, taken now, would protect the public presently buying receivers in a manner which would reduce the obsolescence factor, in the event the Commission decision favored a color system incompatible with present black and white standards.

"Given the assumptions I have stated," Coy added, "could it be expected that the television manufacturing industry would immediately build manual or automatic adapters in all television receivers? Would the relatively small cost for such an addition to a set be worth it in terms of giving the widest possible latitude for decision after further experimentation extending perhaps a year or more? . . . Or must we write multiple standards and let the public decide in the market place which is the better system."

Continuing his appraisal of the problem, Coy said that the . . . "kind of a television system we are working on now will be well worth waiting for. It will be a better service for the public, and a more stable, attractive enterprise for the broadcaster and the manufacturer."

Commenting on the lack of video facilities in some cities, Coy stated that he sympathized . . . "with any city that did not take advantage of its opportunities to start building television stations before the freeze. There was a period of about three years after the war when any city could have applied for and constructed all the stations allocated to it under the very-high allocation table."

Describing the future of television, the Commissioner said that . . . "Our coaxial and radio relay facilities to exchange programs between cities will be more than quadrupled this year. By the end of the year more than 40 cities will be bound together. These facilities are moving steadily westward. . . . In due time you will sit in your living rooms and look in on the opening of Congress. . . . And I will be sitting in my chair and seeing via television your industrial plants, the spectacular beauties of the Columbia River Highway, the Rose Festival and the skiing contests on Mount Hood. . . . I give you my pledge that *we will lift the freeze* at the *earliest practical date,* and that in all our planning we will insure that you will share fully and freely . . . in the exciting, challenging future development of American television."

A scintillating tribute to a sparkling industry and a heartwarming survey of what sight and sound techniques can offer to the people from coast to coast, Mr. Commissioner. . . . . L.W.

Technical BOOKS

"TELEVISION COMPONENTS HANDBOOK" by A. C. Matthews. Published by *Philco Corporation*, Philadelphia. 156 pages. Price $2.50.

This handbook has been designed for the radio-television engineer, the student, and the service technician. It represents a compilation of reference data most often needed by those who work in the television field.

The book is divided into twelve chapters, an appendix, and index. The first chapter considers the general design of the various component parts and circuits used in the standard television receiver. Additional chapters deal with antenna systems and transmission lines; video, i.f. and r.f. transformers and inductors; power, audio, and deflection transformers and reactors; fixed and electrolytic capacitors; fixed and variable resistors; switches; insulating materials and components; miscellaneous television components; and vacuum tubes.

Much of the vital and frequently-used material has been tabulated for easy reference.

* * *

"OUTLINE OF RADIO, TELEVISION AND RADAR." A Symposium. Published by *Chemical Publishing Co., Inc.*, Brooklyn. 678 pages. Price $12.00.

This monumental work is a symposium prepared by eight outstanding authorities in the field of radio, television, and radar.

The book deals with the fundamental principles upon which radio, television, and radar are based, in addition to a discussion of the equipment required and the various applications of these basic principles.

Although the very size of the book might prove frightening to the tyro radioman, there is nothing awesome about the presentation of the material. The contributors have begun their discussion with the most elementary electrical theory and included brief but thorough coverage of such topics as the nature of electricity, how electrical energy is produced and used, and how electrical quantities are measured. After presenting this basic material the discussion turns to the nature of radio waves and broadcasting, consideration of such topics as resistances and potentiometers, chokes, transformers, condensers and capacity, inductance and tuning, and tubes. After a rather thorough discussion of these necessary circuit components, the various circuits themselves come in for careful scrutiny. The authors discuss r.f. amplification, the detector stage, a superheterodyne receiver, a.v.c., low frequency amplification, speakers, microphones, and pickups, power supplies for radio sets, and batteries.

The typical radio receiver circuit is explained and dissected and then short-wave and ultra-short-wave techniques are discussed. The cathode-ray tube and photoelectric cells next come in for their share of consideration. Finally the principles of television, radio direction finding, and a survey of radar are given.

* * *

"SERVICING TV RECEIVERS" by Sylvania Technical Staff. Published by the Radio Tube Division, *Sylvania Electric Products Inc.*, New York. 116 pages. Price $2.00.

This handy little spiral bound booklet contains an amazing amount of information on the servicing and maintenance of home television receivers despite the fact that it carries only 116 pages.

The material is arranged in such a manner as to be of maximum assistance to the service technician using the book. The manual is divided into various sections covering preliminary servicing measures, servicing precautions, a discussion on how television works, the test pattern, deflection circuits, antennas, the r.f. section, the video section, the sound i.f. section, low and high voltage supplies, the picture tube, set alignment, waveform notes, adjustment of the ion trap magnet and the focus coil, deflection yoke adjustment.

The book is well illustrated with actual test patterns, and oscillographs. A circuit diagram of a typical television receiver is also included. Distribution of this book is being handled exclusively by the company's authorized distributors.

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THREE-DIMENSION TV

An Industrial television system, developed by Radio Corporation of America, which can be given a third dimension was revealed recently by Dr. V. K. Zworykin in an address before the Boston Section of the Institute of Radio Engineers.

By the application of special techniques, the system's usefulness can be extended to provide this type of reception in specialized applications with only a minimum of additional equipment.

In order to produce the stereoscopic effect, two cameras would be mounted side-by-side to view the object from slightly different angles. The TV signals, corresponding to the two offset scenes, would then be transmitted to two kinescopes, either through the air or by suitable cables. The separate images would be combined and viewed through special filters to give the three-dimensional effect.

Development of the industrial television system was first disclosed by the company at the IRE Convention in New York. Described then as the smallest and simplest system ever devised for non-broadcast, industrial television operations, it was explained that the system is based on a small and sensitive pickup tube known as the Vidicon. Although less than a tenth the size of the image orthicon tube, the Vidicon is able to attain high resolution at normal lighting levels. The tube is only one inch in diameter and six inches long.

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Mac's Service Shop

(*Continued from page* 59)

"I was afraid of that attitude," Mac sighed. "That is why we are going to have us a little chat before I turn you loose on my customers. First, there is the matter of appearance. I never want you to make a house call unless you are wearing a clean shop coat, have your hair combed, and—"

"Don't worry about the appearance," Barney interrupted to reassure him. "A guy never knows when he is going to meet a slick chick on one of these service calls. Adolph Menjou will look like a tramp compared to Little Old Barney when he knocks at the door."

"Okay, but that brings up another point," Mac went on. "I want you to keep in mind that you are in the house to fix the customer's radio, not to entertain him or his good-looking daughter."

"You don't want me to be an old sour-puss, do you?"

"No, but neither do I want you to be the gabby sort that makes himself *too much* at home in the customer's house. If you really are thinking about what you are doing and doing it, there will not be much time left for idle chatter. I want you to act like a man whose time is important. Just remember how a doctor conducts himself when he calls on you. He may make a comment or so about the weather while he is taking off his coat or shaking down a thermometer; but outside of that the conversation is directly concerned with your particular complaint.

"After he has completed the examination and prescribed a treatment, he promptly puts on his coat and goes; but you do not mind his abruptness. In fact you are glad his time *is* important, for that means he has many patients, which, in turn, probably indicates he is a good doctor. The whole idea is to impress the customer with the feeling that you are not hurrying through his job at all but that your time is too valuable to be wasted in dawdling. See what I mean?"

"Yep, I get you. I'll develop a console-side manner like Young Doctor Malone."

"Manners are very important in house servicing," Mac said. "Keep in mind that the radio or TV set is probably located in the best-furnished room in the house, and see that you leave that room looking just as good as you found it. Always spread a square of clean canvas on the rug and place all of your tools on it. If the chassis must be pulled from a very dirty cabinet and you cannot help raking out some of the dirt with the chassis, request a newspaper that you can spread so as to catch the dust.

"Never leave a dirty empty cabinet when you bring the chassis and speaker to the shop, no matter how much the housewife insists she will 'take care of it.' The little hand vacuum cleaner in the truck is intended just for that job. If the housewife is watching you remove the chassis, she will probably be embarrassed and apologetic when she sees the dirt inside the radio. Always compliment her on having had the good judgment to stifle her housewifely urge to make with the dustcloth inside the set. Point out to her that such dusting could be both dangerous to her and harmful to the receiver. She will love you for this."

"Do I make house calls at any particular time of day?"

"Usually we try to catch radio complaints in the morning. The housewife is more likely to be home then. Television calls, though, are always checked in the afternoon when the test pattern from Craddock City is on. Eventually we shall probably buy some sort of cross-hatch or dot generator so that we can have a test signal on the screen whenever we want it, but the amount of television servicing in this ultra-fringe area does not warrant that yet; so we have to depend on a broadcast test pattern for trouble analysis."

"How do I decide whether to fix the set at the house or to bring it to the shop?"

"If the trouble is not something that can be located and repaired quickly, make every effort to persuade the customer to let you bring the set into the shop. Point out that we have here hundreds of dollars worth of delicate, non-portable equipment that enables us to do a really thorough job of diagnosis and adjustment quickly—which, since we are paid for our time, means doing it at lower cost. Insisting upon having the receiver repaired in the home is just like asking a surgeon to perform a major operation on the kitchen table.

"About the only troubles that are repaired in the home are such matters as bad tubes, antenna and lead-in troubles, burned-out dial lamps, etc. An amazing number of TV and a.c.-d.c. radio complaints turn out to be tube troubles. Miss Perkins always tries to get the model number of the receiver from the customer or from our files when the complaint comes in, and then you use a tube-complement book or the service manuals to make sure you have all of the types of tubes you will need on the truck before you start out."

"Do I bring the whole set, cabinet and all?"

"Only when the radio is small, the cabinet itself is in need of repair, or the built-in antenna, record-changer, or other essential part needed for a complete service job is so difficult to remove that it is easier to bring the whole works. In that event, never try to carry a set that is too large or heavy for you to manage easily. I am not concerned about your back, but trying to handle a set that is too big is a good way to damage it or mar the cabinet. Just give me a call on the 'phone, and I'll come up and help you."

"You're so thoughtful of me!" Barney murmured. "Are there any other things I should know before I start stomping on the 'Welcome' mats?"

"A lot more than I can tell you at one time, but here are a few particularly important ones: Never say anything disparaging about a customer's set, even though you know it is an electronic stinker. Keep in mind that when you criticize the set you are also insulting the owner's judgment in buying it in the first place. If he asks what you think of the set, try to find *something* about it that you can admire, even though it is nothing more than the big figures on the dial. A character like yourself who boasts that he never has any trouble with his women should have no difficulty in this white-lie department.

"Watch out for children, too. If one burns himself on a hot soldering iron or a tube you have just pulled from the set, our name is mud with the mother. If you tactfully express worry that the child may be hurt, the mother will usually see to it that he is kept out of danger—and out of your hair.

"Always insist that everyone else leaves the room before you handle a video tube, and I had better never hear of your touching one of those tubes without wearing gloves and goggles. After the tube is removed, place it at once in a cardboard carton and leave it there until you are ready to put it back in the set. Never leave an old cathode-ray tube with the customer. Bring it back to the shop inside a carton so that we can destroy it safely."

As Barney listened, he was twisting and turning in front of the small mirror fastened to the back wall of the shop while he critically examined his reflection.

"Say, Boss," he suddenly exclaimed, "I am not sure these blue shop coats will do justice to my red hair when I start calling on the public. Now if you would change to green—"

He broke off with a start as a terrific roar shook the shop. It was only a clap of thunder, but from the agonized look on his face, it could just as well have been Mac's growl of protest.

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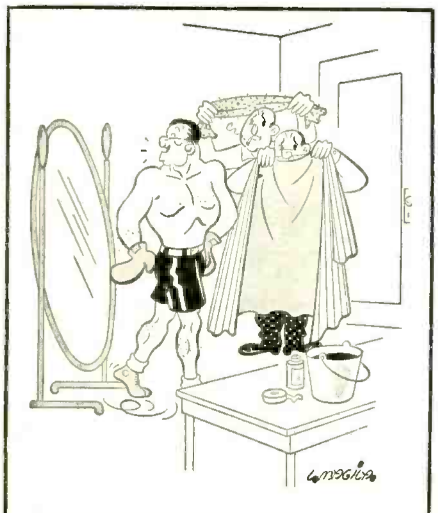

"Do yez suppose des trunks are clean enough? I'm on television tonight!"

Discount Those Bills

(*Continued from page 39*)

vert such funds to other shop expenses or for expansion. To do so places an interest burden on the shop. As a discount fund the loan carries itself and shows a net profit.

A reader may be puzzled by the fact that, apparently, suppliers can pay 18% to get the use of customers' money. He may reason that if such an interest rate is not excessive for the supplier to pay it should be no hardship for the shop owner. This misses the basic fact warranting cash discounts.

While, for all practical purposes, failure to take a discount amounts to the equivalent of an interest charge on the shop owner, it does not follow that the supplier is paying 18% (or discount) solely to get the use of the shop owner's money sooner.

The discount offered for prompt payment of bills is made possible by several circumstances. These are: (1) quicker recovery of money owed; (2) sharp reduction in credit risks and resulting credit losses; (3) elimination of collection costs, and (4) a decrease in bookkeeping and billing. These savings are simply passed on to customers in the form of a discount which rightly rewards *only* those customers who help to effect these savings for the suppliers.

Frequently, within the limits of good buying judgment, the shop owner may be able to make even larger earnings on funds by employing them for the purpose of quantity buying carrying quantity discounts. Too many shops struggle along with too small an inventory of parts, materials, and supplies in relation to their volume of business. This may be carried to the point where the shop operates inefficiently and uneconomically.

Certainly no shop, however large, can possibly carry a complete stock of every conceivable part that it may be called upon to supply for an orphan set. And this article does not so imply. Quite the contrary. But, on the other hand, there is entirely too much uneconomical hand-to-mouth buying of parts needed constantly by the shop. Lack of constantly used parts and materials results in (1) costly delays and loss of customer good will, (2) lost time of service technicians who may be idled by this, and (3) expensive re-ordering processes, as well as (4) higher unit costs of parts.

The shop owner, in essence, has only his own time and that of his employees to sell. If he spends an excessive part of that time in ordering parts on a hand-to-mouth buying basis as needed, either by letter or by phone, that is just so much productive time gone forever.

On the other hand, if he orders in quantities sufficient to carry him for a reasonable period of time, he cuts down on his unproductive time and, because a quantity is involved, earns a tidy bonus for his foresight. His attitude is one of *how much do I need to operate efficiently* instead of *how little can I get by with.*

Obviously the greater the volume of business the shop can do annually on a small *fixed average investment* in parts and materials the greater its net earnings will be on that *fixed investment.* This is the virtue of rapid turnover of inventory, provided a net profit is inherent in each turn. However, it can be carried to the point of diminishing return.

By carrying a larger inventory because of the inducement of quantity discount, a shop owner may not be able to boast of fast turnover of inventory. However, thanks to a somewhat larger investment in inventory, he may have a much more favorable net profit showing at year end.

Example: Assume a shop owner is now netting $4500 and is buying hand-to-mouth. He decides to take advantage of quantity buying discounts and, to do so, he must employ an additional $1000 in inventory. However, as a result of this, quantity discounts earn an additional $200 a year. This means his net shop earnings have jumped from $4500 to $4700 without any increase in volume. Moreover, the additional $1000 employed in the business has earned at the rate of 20% a year. That beats holding down inventory so that the shop owner can tie up $1000 in, say, a savings account paying 1½% annually.

While many shop owners are restricted in buying by limited capital, others arbitrarily hold down inventories long after they have reached a point where, with profit, they could employ funds invested outside the business. That is, having established an inventory norm tied to a lively turnover rate, they hold physical inventories at that point, even when quantity discounts offer lucrative rewards.

Accumulated shop profits are diverted to outside investments in the mistaken belief that the business has attained its maturity and can no longer profitably employ additional funds. Buying policies of the hungry days of the past dominate the owner's thinking, long after ample capital is available. At this point the shop owner has finally reached, by much personal sacrifice, the very position for which he has struggled for years. For the first time he is able to enter the market place with cash to talk terms.

Illustrating that quantity discounts

Table 2. Profit on investment on stock purchased in quantity at a quantity discount.

Stock Turns Annually	Annual Earnings on Quantity Discount Rates			
	3%	5%	7½%	10%
12	36%	60%	90 %	120%
8	24%	40%	60 %	80%
6	18%	30%	45 %	60%
4	12%	20%	30 %	40%
3	9%	15%	22½%	30%
2	6%	10%	15 %	20%
1	3%	5%	7½%	10%

are equally important with cash discounts and that quantity buying must be weighed against inventory turnover rates in wringing out a larger net profit from a shop, consider Table 2 showing the profit-on-investment in stock bought in quantity at a quantity discount.

Example: Assume a shop normally carries only a week's supply of certain items. By buying four times as much (roughly a month's supply) it can earn a quantity discount of 3% and still turn its inventory in these items 12 times a year. This means that on total money invested in inventory 36% earnings can be had on the investment. On the other hand, it would be pointless to buy a quantity of a certain part if the quantity were so large that it would take a year to work off the supply, where the discount were only 3%, as earnings would be only 3%.

Ideally, a combination of fast turnover and maximum discounts should be sought. In practice this must be a compromise between the two. A hard decision must be made between slower turnover and higher discounts, or lower discounts and faster turnover. That's where good judgment must be exercised.

By all means, the shop owner should give serious consideration to increasing inventory turnover as a means of increasing profits. He should constantly watch his stock and work off slow moving parts and materials which are tying up funds, and try to keep from getting caught with a large stock of obsolete parts for which there is a constantly decreasing demand. But, he should not attain fast turnover at the sacrifice of discounts which can materially increase over-all net shop profits.

In any event it is assumed that quantity buying will be the product of sound buying judgment with due consideration for market fluctuations. Otherwise, potential earnings inherent in quantity buying can be wiped out.

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CHANNEL SWITCH REPAIR

By DOMENIC R. RIPANI, W9JAQ

An intermittent channel switch does not necessarily mean that the switch must be replaced. Since, at best, this is one of the most difficult of all television service operations, it should be done only as a last resort.

In many cases, particularly in General Electric Models 810, 814, etc., it has been found that the wiper arms of the switch do not hit directly on the contacts, but to one side. When the switch is new and there is plenty of tension this will not show up but as the switch becomes worn, the "off-center" contact results in intermittent operation.

A simple solution is to loosen the two nuts holding the wafer assembly and turn the switch arm until the contacts again line up properly. As an added precaution it is suggested that the switch be cleaned at the same time with a contact cleaning fluid in order to remove any foreign matter in the assembly.

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Preamp

(*Continued from page 38*)

Recent standard *Columbia* records are reported to follow the NAB curve except that the low-frequency turnover is at 300 c.p.s.[3] The equalizer is illustrated in Fig. 6C; the lower turnover requires only a few changes in the NAB equalizer.

Victor 78 r.p.m. characteristic. Standard *Victor* pressings of recent date are supposed to have a low-frequency turnover of 500 c.p.s. and a treble pre-emphasis of 2.5 db. per octave beginning at 1000 c.p.s.[3] This treble characteristic is not as easy to correct as the previous ones but the equalizer of Fig. 6B does a fairly good job of it.

Decca FFRR characteristic. These English high-fidelity records have a low-frequency turnover at 400 c.p.s.; the treble pre-emphasis amounts to 3 db. per octave beginning at 3000 c.p.s.[4] The required equalizer is illustrated in Fig. 6A.

Equalizer construction. The equalizers themselves can be made very compact by utilizing half-watt resistors and the small paper condensers now being manufactured by several companies for use in miniature equipment. A number of equalizers have been constructed with 10 per-cent tolerance resistors and these condensers, and have been found in almost every case to follow the calculated curve quite closely.

To constuct the equalizers, the required condensers and resistors are assembled as illustrated in Fig. 4. The leads are soldered together and appropriately color-coded input, output, and ground wires are attached. A small glass vial, of about 8 milliliters capacity, is prepared by grinding off the bottom, resulting in a thin glass tube into one end of which a cork is fitted. This cork is pierced with a heavy needle and the equalizer ground wire is passed through it. The entire equalizer is now inserted into the prepared vial, care being taken to keep the bare leads from touching each other. The input and output leads project from the top of the tube. A label bearing the designation of the equalizer is rolled up and carefully inserted around the inside of the tube. Microcrystalline wax, preferably of the high-melting-point type (*Sunwax* 1290 yellow was found to be excellent) is heated to about 110° C. and poured into the tube; a certain amount of foaming occurs, which is caused by water vapor being driven off. The assembly is allowed to cool thoroughly, during which it may be necessary to add a little wax. The cork is carefully withdrawn from the bottom and the equalizer is removed by heating the tube and pulling the assembly out.

Made in this way, each equalizer is a neat unit resembling a standard tubular paper condenser in shape and size (Fig. 4). Shielding was unnecessary in the case of the preamplifier described, but if desired it could have been accomplished simply by enclosing the unit in braided shield attached to the ground wire. The preamplifier has adequate space behind the equalizer switch for nine of these equalizers.

Switch positions not supplied with equalizers may be grounded. This will prevent open-grid howl when an unconnected position is passed. Switching from one equalizer to another has been found to cause no excessive surges in the amplifier; the switch is of the shorting type.

Conclusions

The preamplifier and associated equalizers described have been employed in conjunction with a *Clarkstan* RV cartridge and an amplifier having a flat response (± ¾ db.) from 20 to 20,000 c.p.s. Results have been very pleasing indeed for modern pressings and generally quite excellent with older recordings. It is too much to expect any amplifying system to supply what is lacking on a record, and the real test of the unit is with modern discs. With some late *H.M.V.* records, which are reputed to include up to 20,000 c.p.s.[1] the effect is astounding. Although the pickup used has the highest voltage output of any of the higher-quality units, no evidence of distortion from overload of the preamplifier tubes has been noticed. In short, the unit has economically and simply provided reproduction of the most satisfying quality and it is recommended particularly to the lover of fine music.

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2. *Pickering, N. C. and Goodell, J. D.: "Reproduction of Microgroove Recordings."* RADIO NEWS, *October 1948, p. 40.*
3. *St. George, P. W. and Drisko, B. B.: "Versatile Phonograph Preamplifier." Audio Engineering, March 1949, p. 14.*
4. *Hallows, R.: "Transatlantic News." Radio Craft, June 1947, p. 33.*

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"Turn it off! Turn it off!"

International Short-Wave

(*Continued from page 52*)

9.919 is a harmonic of Bogota, 4.960, "Radiodifusora Nacional de Colombia"; noted around 2258 with announcement, "Radiodifusora Nacional de Colombia en Bogota"; signed off suddenly at 2303; announced as operating in the 25-, 48-, and 62-m. bands s.w. and on 1200 kc. m.w. At the time this was compiled, Stark was hearing "La Voz del Valle," Cali, on approximately 6.135 around 2200-2303 sign-off; may have vacated 4.825.

HJCF, 5.964,Bogota, heard with musical program and announcements in *both* Spanish, *English* 2030; good level in New Jersey. (Oskay)

Czechoslovakia—Prague has dropped the 49-m. channel (6.010) for the summer; now is using 11.840 at 1245-1300, and 9.550 at 1445-1500, 1645-1800. (Radio Sweden) The 9.550 outlet noted in Nova Scotia 1745. (Baines) Currently has news 1245-1300 on 11.840; 1445-1500, 1645-1700 on 9.550. (Pearce, England)

Denmark—Copenhagen, 15.165, noted 1900. (Baines, Nova Scotia)

El Salvador—YSHQ noted on 6.170 at 2230-2259 sign-off; is San Miguel. (Stark, Texas)

England—BBC's programs for the Western Hemisphere are listed—Special regional programs, to Canada, USA, Mexico, 0915-1115, 17.79, 1200-1545, 17.79, 1445-1615, 15.14; to West Indies, 0700-0730, 17.70, 0700-0730, 15.11, 1200-1230, 17.70; 1815-1845, 15.18; 1815-1845, 11.75. General Overseas Service—To West Indies, Central America, South America (North of Amazon), 0945-1015 (Saturday), 17.70; 1215-1600, 17.70; 1600-1815, 15.18; 1700-1815, 11.75; 1845-2015, 15.18; 1845-2215, 11.75; 2015-2215, 9.58. To North America (West Coast), 1700-1915, 15.14; 1915-2215, 9.51. To South America (South of Amazon), 0600-0815, 21.71; 1100-1600, 21.71; 1600-2015, 15.26; 1700-2200, 11.80; 2200-2215, 9.51. To Canada, USA, Mexico, 0600-0800, 15.26; 1615-2015, 15.14; 1700-1845, 11.70; 1900-2200, 11.75; 2015-2315, 9.825.

Fernando Po—Does anyone have any recent information on the high-powered Spanish s.w. transmitters projected for this location?

Finland—Helsinki noted signing on weekdays 0700 on 17.800, 15.190, news 0715 announced as in 31-, 19-, 16-m. bands; at 0725 announces that a transcribed variation of the news for North America is radiated 2200 on 15.190. (Pearce, England) Callarman, Oregon, confirms that Helsinki, 15.190, does have a news bulletin at 2200 for the first 10 minutes of its daily 2200-2400 transmission; announces as operating in the 31-, 25-, and 19-m. bands (probably 9.556, 11.780, 15.190?).

France—I understand that Paris dropped its *English* transmission to North America 1945-2000 due to "budgetary reasons"; may be resumed soon.

French Equatorial Africa.—Grove, Ill., has received this current data from *Radio Brazzaville:*

Uses 800 watts on 7.000, 21.000; 15.5 kw. on 6.024, 9.964, 17.840; 7 kw. on 9.440; 50 kw. on 11.970, 15.595.

Radio Brazzaville is scheduled 0000-0215—6.024 to local areas, 7.000 to local areas, 9.440 to Middle East, 9.964 to local areas, 11.970 to Europe; 0500-0720—6.024 to local areas, 9.964 to local areas, 15.595 to Middle East, 17.840 to Europe, 21.000 to Europe; 1100-1400—6.024 to local areas (opens 1210), 7.000 to local areas, 9.440 to Middle East, 9.964 to local areas, 11.970 to Far East; 1400-1600—6.024 to local areas, 7.000 to local areas, 9.440 to Middle East, 9.964 to local areas, 11.970 to Europe, 17.840 to *North America;* 1600-1800—6.024 to local areas, 7.000 to local areas, 9.440 to South America, 9.964 to local areas, 11.970 to *North America;* 1800-2030—6.024 to local areas, 7.000 to local areas, 9.440 to *North America,* 9.964 to local areas, 11.970 to South America. *English* news is scheduled daily 0015, 0515, 1100, 1315, 1550, 1745; Mailbag Program in *English* for Sunday after news bulletins at 0015, 1100, 1745; *English* talks are scheduled Tuesday, Thursday, Saturday after news bulletins at 0015, 1100, 1745. Portuguese news Mon.-Sat. 1515, Sun.-Fri. 1900; Portuguese talks Sunday 1315, Saturday 1900. Spanish news daily 2000 (in near future, probably by now); news in Danish 1500 on second and fourth Wednesday; Swedish news 1500 on third Wednesday; French at all other times, including news daily 0000, 0100, 0200, 0630, 0715, 1200, 1330, 1530, 1630, 2015.

French Morocco—Radio Maroc, Rabat, sent Cox, Dela., this schedule for its s.w. transmissions—Chain A, 6.006, 2.5 kw., 0145-0300, 0730-0930, 1515-1805; same channel, Chain B, 0300-0330, 0600-0700, 0700-0735, 1310-1515; Chain A, 7.214, 50 kw., 0800-0900 (may mean "Voice of America" relay at Tangiers takes relay from Rabat?).

French West Africa—Radio Dakar sent *new* type of QSL card for 19-m. reception; gave schedule on 11.895 as 0200-0300, 0700-0830, 1320-1800; on 15.340, 1400-1530. (Pearce, England)

Greece—Radio Athens is now radiating on 9.607 at 0000-0235, 0500-0630; on 15.345, 1015-1115, 1730-1830, and on 7.300, 1200-1335, 1400-1620, 1630-1645, says *Radio Sweden.* Another Greek station has been reported to *Radio Sweden* as heard on 7.635, 1200-1500.

Armed Forces Broadcasting Station, 6.745, Larissa, noted Thursdays with *English* 1530-1545. (Pearce, England)

Bluman, Israel, lists these schedules for Greek Regional outlets—Macedonia, 7.950, 0000-0100, 0600-0700, 1100-1530; Peloponnesos, 7.020, 0000-0100, 0600-0730, 1100-1430.

Guatemala—TGTO, 6.285, Guatemala City, noted recently 0025-0055; signs off 0115. (Callarman, Ore.)

Honduras—Balbi, Calif., has heard HROW, 6.02, *Radio Monserat,* Tegucigalpa, testing a *new Western Electric* 3 kw. transmitter 0320-0330; strong signal; gave *English* announcements often, American recordings; frequency given in Spanish at 6.020.

India—Mysore's s.w. outlet is scheduled on 6.028 at 2030-2200, 0230-0400, 0700-1130. (Sampat, India) The *English* hour from AIR at 1400-1500 now has 1400-1410 to precede musical program; noted in England on 7.240, 9.620, 11.760, 11.850. (Pearce)

Indochina — "Voice of Vietnam," 7.265, Saigon, goes past 0730; news 0615-0630. (Stark, Texas) Saigon still noted on 11.84 with news 1000 but with QRM from LRT, Argentine; however, can be copied in Melbourne. (Sanderson, Australia)

Indonesia—The 7.100 Indonesian recently had moved up to 7.105; heard mornings. (Stark, Texas)

The *English* session 1000-1100 to Asia and the West Coast USA from Djakarta is now radiated on 15.150 and 11.770; has added to announcement, "and for South Africa." YDF2, 11.785, may open as early as 1100 with Arabic instead of former 1115. (Dilg, Calif.)

Djogjkarta's YDS, 5.070, heard to after 1000; YDQ, 9.550, YDQ2, 5.030, Makassar, sign-off 1000 after playing "Now Is the Hour"; YDI, 3.980, good strength in New Zealand to 1000 sign-off. (Cushen)

QRA for *Radio Djakarta* is Gambir Selaton No. 17, Djakarta, U.S.I. (Halvorsen, Norway)

According to a letter received by Dilg, Calif., from *Radio Djakarta* officials, prewar time zones have been restored making North Sumatra GMT plus 6:30 hours; South Sumatra, GMT plus 7:00; Java and Borneo, GMT plus 7:30; Celebes, GMT plus 8:00; Moluccas, GMT plus 8:30.

Iran—*Radio Teheran* noted on approximately 9.660 with news 1500-1505 followed by dance music (titles in *English*) to 1530 when said time was 2400 and end of two-hour broadcast of news and music which is on the air daily 2200-2400 Teheran Time (1330-1530 EST); has French news 1430, recordings 1440-1500 (*English* announcements). (Pearce, England)

Israel—QRA for "Voice of Zion" is P.O. Box 754, Jerusalem, Israel; schedule is 1430-1645 (1600-1645 in *English*) on 9.000; the North American Service has been postponed until the *new* 50 kw. transmitter is ready for operation later *this* year; new QRA of Kol-Israel is Broadcasting House, Jerusalem, Israel; this one is scheduled on 6.830, Tel Aviv, and 8.170, Haifa, at 2330-0100, 0200-0715, 0800-1515 (*English* at 0600, 1415) and is relayed over 9.000 at 1100-1430. (Bluman, Israel)

Studios of the I.B.S. are located in both Tel Aviv and Jerusalem; the *Eng-*

ADDITIONAL NOTES ON SQUARE-WAVE CLIPPER

("Wide Frequency Range Square-Wave Clipper" by Louis E. Garner, March 1950 issue)

THE clipper circuit, as originally designed and built, was used as an incidental part of other experimental units. For this reason, extended experiments in other applications were not carried out. The audio signal source used was a very low impedance source. Because of this, square waves with a very flat top and sharp corners were obtained (the rise time, as is customary with clipped sine waves, is not extremely short), using the component values specified.

In the last few weeks, an opportunity has arisen to try the clipper circuit using a commercially available signal source which has a medium to high impedance output. The results were not too good; the negative-going portion of the square wave was not constant in amplitude, and the wave shape was far from being symmetrical. It has been suggested that another series clipper with reversed polarity and in parallel with the regular clipper be used. Generally, however, it is not necessary to go to this extreme as a change in the component values used suffices to correct this deficiency.

In accordance with Fig. 1, when V_1 conducts, R_2 is essentially in parallel with R_1 and the impedance presented to the signal source becomes lower. A voltage division occurs between the internal impedance of the generator, R_{gen}, and R_1 and R_2 combined, lowering the voltage applied to the clipper. On the negative half cycle, when V_1 is not conducting (signal voltage exceeds battery voltage) then an essentially higher voltage is applied to the clipper circuit. Hence the applied signal does not have equal amplitude positive and negative half cycles.

To correct this, when the clipper circuit is used with a medium or high impedance signal source, the size of R_1 should be dropped and the size of R_2 increased. When this is done, the change in impedance presented to the generator when V_1 stops conducting can be minimized, and more symmetrical square waves produced. It was found that R_1 and R_3 should be changed to about 4700 ohms and R_2 to 22,000 ohms, when the clipper is used with generators having an internal impedance of greater than 100 ohms, if best results are to be obtained.

In addition, it has been brought to the author's attention that there are some inexpensive audio signal generators available which use an electrolytic condenser to couple to the output terminal. This may cause a small d.c. voltage, in addition to the audio signal, to be available on the output terminals of the generator. If sufficient, this d.c. may interfere with the operation of the clipper. In such cases a large (from .5 to 4 μfd.) paper condenser should be connected in series with the input terminal of the clipper.

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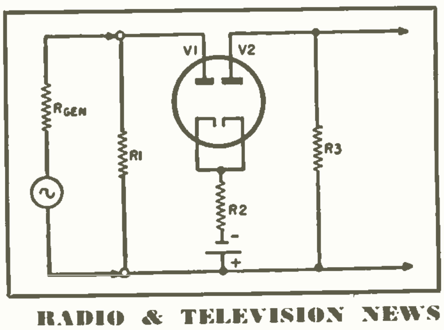
Fig. 1.



lish program 1600-1645 on 9.000 is from studios in Jerusalem; transmitter is just outside Tel Aviv; a letter from station officials states that in going up to the third floor of the Jerusalem studios you can look out of the East Window and see Mount Calvary about 400 yards away in the Arab-held section. (Fargo, Ga.)

Italy—Rome, 11.81, noted ending news 2015; announced 9.630 was in parallel and asked for reports comparing reception on the two channels. (Stark, Texas) Rome noted 1410 signing on *English* program for Europe on on 11.81, 9.63; news 1430; noted another day 1355 ending news and program for South Africa (signs this period on at 1340). (Pearce, England) Bluman, Israel, reports Rome on 11.900 and 17.820 daily 0500.

Japan—The Radio Corporation of Japan sent a special greeting card commemorating its 25th anniversary on the air; said JKM had changed from 4.930 to 4.940; also that during summer, Daylight Savings Time makes programs now *one hour earlier.* (Pearce, England)

Kashmir—"Azad Kashmir Radio" has moved from the 60-m. to the 48.8-m. band; does *not* use *English.* (Sampat, India)

Malaya—Stark, Texas, and Dilg, Calif., believe *Radio Malaya's* Blue Network, Singapore, is no longer using the 7.250 channel.

Malta—FBS, 11.895, noted from 0430; at 1015 says closing on this channel, and suggests listeners retune to 7.270; still heard afternoons (EST) on 4.965 to closedown 1700; noted 0200 on 7.270 when said was closing on that channel to reopen 0430 on 11.895, 7.270. (Pearce, England)

Bluman, Israel, lists current schedules as to Africa on 4.965 at 2300-0200, 0830-1700; 7.270 at 0430-0815 (Sunday 0230-0815); to Egypt and Cyprus over 7.270, 2300-0200 (may be replaced by 6.140 if schedule can be worked out with Sharq-el-Adna to avoid QRM with ZJM4 on 6.135), and on 11.895, 0430-1015 (Sunday 0230-1015); at 1030-1700, FBS is still testing several channels. A third transmitter beamed on East Africa, for relay by FBS, Mombasa, Kenya Colony, soon will begin tests in the 13-m. band during Malta "daylight" time and on 25-m. Malta "evenings."

Mauritius — Forest Side, approx. 15.050, noted in Indiana with BBC news 2200; also seems to take BBC relay around 2230. (Leary) Pearce, England, reports he hears this one now usually to 1230 when signs off with "God Save the King."

Mozambique—Grove, Ill., says *English* programs from Lourenco Marques are scheduled 2300-0200 Mon.-Sat. on CR7BU, 4.932, CR7BJ, 9.766, and 11.764; 0000-0200 Sun. on CR7BU, 4.932, CR7BJ, 9.766, and 11.764; 0200-0930 daily on CR7BJ, 9.766, and 11.764; 0930-1000 daily on CR7BJ, 9.766; 1000-1100 daily on CR7BU, 4.932, CR7BJ, 9.766; and 1100-1600 daily on CR7AB, 3.490, and CR7BU, 4.932.

The 3.490 and 4.932 channels noted in Australia around 1515-1530 with music. (Sanderson)

New Caledonia—Stark, Texas, believes the French-speaking station he hears on 6.037 around 0200-0552 may be *Radio Noumea* as reported from "Down Under" sources; noted leaving air 0552 announcing as "La Voix du France. . . ." QRN prevented good copying. Rosenauer, Calif., also reports this one.

Nicaragua—YNDG, Leon, still seems to be on 7.660; no tests noted on projected 5.990 channel. (Leary, Ind.)

Northern Rhodesia—Lusaka's ZQP is scheduled on 3.914 at 0900-1230; QRA is P.O. Box 209, Lusaka, Northern Rhodesia. (Radio Australia)

Norway—Oslo noted on a Sunday on 9.645 at 2100 with a 5-minute newscast, followed by talk in *English;* left air around 2115. (Cox, Dela.)

Pakistan—In its External Services, *Radio Pakistan,* Karachi, broadcasts a daily newscast at 1230 on 11.885; Western music is heard on 11.885 and 17.835 at 0300-0330 (*except* Friday), and daily on 11.885 at 1200-1230. *Radio Pakistan,* Lahore, is operating currently on 6.075; has a talk in *English* 1100 on Monday, Tuesday, Thursday, Friday, lasts 15 minutes. (Sampat, India) The 15.335 channel is good in Indiana 2100 with news. (Leary) The 9.645 outlet still has news 1015. (Rosenauer, Calif.)

The 17.83 channel noted 0210 with world and local news; 15.335 with news 2100; 11.54 with news 0700 (also on Dacca, 7.14). (Sanderson, Australia)

Philippines—DZI3, 6.110, noted 0500 with *English;* DZH3, 9.50, heard in *English* 0445; DYB2, 4.98, noted 0445 with music. (Sanderson, Australia). Davao, 3.950, is used for *educational purposes only.* DYH2, 4.980, Bacalod City, heard 0500; DYH3, 6.105, Cebu, signs off 1105, uses 250 watts; DZH3, 9.500, signs off 1105, uses 1 kw. and single-wire-fed antenna; DZH5, 9.690, 250 w., uses single-wire-fed antenna; DZI3, Republic Broadcasting Corporation, 6.110, heard from as early as 0500 to 1200 sign-off, lists power as 5 kw., relays DZBB on 580 kc. (Cushen, N.Z.)

Poland—Warsaw, 6.215, noted 1445 with news and usual interval signal, then music. (Sanderson, Australia)

Portugal — Lisbon noted back on 9.745, signing off 2032. (Leary, Ind.)

Sao Tome—The *Radio Club de Sao Tome e Principe* is reported again by *Radio Sweden* as heard with Portuguese music on 17.6775 at 0730-0800.

Saudi-Arabia—Mecca is now also heard with a "morning" period at 0030-0100; frequencies include 11.950. (Radio Sweden)

South Africa—ZRB, 9.110, Pretoria, noted signing off 0924, only fair level; Johannesburg, 9.523, noted 0955 with variety show in Afrikaans; Cape Town, noted on 9.6024 in Afrikaans on another day at 1105. (Triebel, Wash.)

Southern Rhodesia—ZEAH, 7.290, Salisbury, signs off 1500. (N.Z. DX Times)

Surinam—Paramaribo, 15.405, noted

in Calif. 1830 to 2030 sign-off. (Russell)

Syria—Damascus not heard lately near 6.910; letter-verie states has moved to 41.9 meters; however, noted close 7.13 or 7.14; schedule given Thursdays 2345-0300 (Fridays), 0400-0800, 1100-1700; other days, 2345-0100, 0600-0800, 1100-1700; *English* news 0600-0610, 1630-1640; *English* musical program 0430-0500; French 0610-0620, 1640-1650 (news); French musical program 0500-0600. (Pearce, England) Bluman, Israel, says Damascus has been testing some days on 9.550, other days on 7.145, in parallel with 6.000 and 12.000.

Tahiti—Radio Tahiti, 12.080, 6.982, Papeete, now has *English* announcements 2330-2345 and requests for details on the scenic attractions of the islands are referred to the nearest French Consul or direct to P.O. Box 478, Papeete, Tahiti. (Cushen, N. Z.)

Taiwan—BCAF, 8.99, National Chinese Air Force Station, noted 0715 with recorded program of Western music followed by news in Chinese. (Sanderson, Australia)

BED7 moved from measured 7.1515 to measured 7.1488; news heard 0615. (Oskay, N. J.) Balbi, Calif., reports BED3, 15.235, has replaced BED4, 11.725, for the 2300-0100 beam (first hour in *English*) to USA; signal is poor, QRM'd by Tokyo.

Tangier—Radio Africa, 7.090, noted in French and with music 1730-1800. (Sutton, Ohio)

Thailand—HS8PD, 6.241, Bangkok, noted 0940 with oriental music, weak signal. (Triebel, Wash., via URDXC) HSJ4, 15.91, noted 0500 with music; news at 0545. Thailand also heard some time ago on approximately 12.04, not on regular schedule, but at times had news 0545 and 0615; signal quite fair in Melbourne. (Sanderson, Australia)

USA—Summer schedules for "Voice of America" s.w. relays overseas are—6.060, Tangier-1, 1700-1730 to Europe; 6.080, Munich-3, 1045-1715 to Europe; 7.214, Tangier-1, 0800-0900 to North Africa (RDF); 7.250, Munich-4 1045-1715 to Europe; 9.530, Manila-3, 1800-2000 to East Asia; 9.540, Munich-2, 1045-1715 to Europe; 11.790, Honolulu-1, 0400-0915 to East Asia; 11.790, Tangier-2, 1500-1715 to Europe; 11.870, Munich-1, 1430-1730 to East Europe; 11.890, Manila-1, 0400-1045 to Far East, 1645-1700 to Korea, 1800-2000 to East Asia; 15.210, Tangier-1, 1215-1630 to East Europe; 15.250, Tangier-2, 1100-1500 to Europe; 15.250, Manila-2, 1645-1700, 1800-2000 to East Asia; 15.280, Munich-1, 1100-1245 to East Europe; 15.330, Manila-2, Tue.-Sat. 0215-0300 to Southeast Asia, and Manila-1, Tue.-Sat. 0300-0345 to Southeast Asia, and Manila-2, 0400-1045 to East Asia; 17.780, Manila-3, 0400-1045 to East Asia; 17.800, Honolulu-1, 0215-0345 (Tue.-Sat.), relaying United Nations to Philippines-Southeast Asia; 21.570, Manila-2, 1535-1545 to Southeast Asia.

USSR—Radio Moscow announces

The August issue of **RADIO & TELEVISION NEWS** will be on sale August 1. Be sure to reserve your copy with your Newsdealer.

summer schedule of *English* programs to North America for 1820-1930, 2000-2100, 2130-2300 on 15.23, 15.11, 11.96, 11.71, 9.69—with 15.18 and 11.82 added for the last two periods. However, Moscow is heard also on a number of other (unannounced) channels during these transmissions.

Vatican—Bluman, Israel, informs me that the *new* 100 kw. transmitter for the Vatican will *not* operate on s.w. but on m.w. 1529 kc.

HVJ noted on a Saturday on 15.12 at 0215 with program to Australia-New Zealand (news). (Sanderson, Australia)

Venezuela—YVOA, 4.830, San Cristobal, *"La Voz de Tachira,"* noted 2030 in Texas. (Stark)

* * *

Last Minute Tips

Pearce, England, airmails me that "This is Rhodesia Calling from Salisbury" is heard from around 1215 (sign-on believed 1100) on approx. 4.880 when relays "Radio Newsreel" from the BBC, London; time given as 7:15 p.m. Southern Rhodesia Time; news from BBC 1300; weather report, local news, sports, South African news to 1330; signal deteriorates after 1400 but on one occasion was heard to 1505 when signed with "God Save the King;" man and woman announcers.

Verie-letter from *Radio Douala,* French Cameroons, stated frequency is 9.150, on air daily 1430-1515, 600 watts, antenna is delta pointed NW-SE. (Oskay, N. J.)

The 15.196 transmitter of Lourenco Marques, Mozambique, is CR7BG, 10 kw. (Radio Sweden, others)

Tentative schedules for *Radio Sweden* for July 31-October 29 will be 1900-2030, 10.780, 15.155; 0015-0230, 6.065, 15.155; 0230-1015, 11.705, 15.155; 1015-1700, 6.065, 10.780; usually has breaks on weekdays 0230-0600, 0900-1015. (Skoog, Sweden)

Pearce, England, and others have noted Rome on approximately 11.890 in parallel with 11.81 and 9.63 at 1340 when carrying news for South Africa; also noted mornings (EST) in Italian in 16-m. band; these do *not* seem to be harmonics. I noted the 16-m. outlet on approximately 17.835 one day at 1340 with news.

A verie-letter from *Radio Tirana,* ZAA, Albania, gives frequency of 7.850, schedule 1230-1600; measured recently as 7.8455. (Oskay, N. J.)

Emisora Radio Menorca, Mahon, 7.550, Menorca, noted signing on 1430; is now heard to 1700 sign-off with singing of a National Marching Air. (Pearce, England)

A letter from Makassar states YDQ2, 10 kw., 9.550, is scheduled 1700-1900, 2300-0100, 0400-1000; YDQ3, 3 kw., 11.084, at 0500-1000, 1700-1800; asked for more reports to Radio Republik Indonesia Serikat, Studio Makassar, Stanweg Zuid 2, Makassar, U.S.I. (Oskay, N. J.)

Radio Tahiti, Papeete, has informed Rosenauer, Calif., that work is under way on a powerful station which may be in operation *later this year* for longer and more frequent transmissions on various wavelengths. The installation also will be used for radiotelephonic communications from Papeete to France, USA, New Zealand, Australia. Said rhombic aerial for 12.080, 600 watts, is directed on San Francisco and Paris; gave no data on the 6.982 outlet.

* * *

Press Time Flashes

Laubscher, South Africa, flashes that "Springbok Radio" is now on the air with "C" (commercial) programs at 2345-0145, 3.356; 0145-1000, 7.295 (Sunday from 0100); 1000-1600, 3.356 (Saturday to 1700); power is 5 kw.; programs are all sponsored, mostly in *English* although about 1½ hour daily is in Afrikaans; regular SABC schedules are still unaffected, but as soon as new high-quality land lines—now under construction—are completed to connect Johannesburg, Cape Town, and Durban for better service, the "morning" and "afternoon" breaks will be filled from these centers. With the opening of "Springbok Radio," SABC began to issue a program magazine called *"Radio."* ZRB, 9.110, Pretoria, is now relaying "Springbok Radio" but programs are still interrupted for weather and other reports of use to flyers.

Kemna, Mo., reports *Radio Nigeria* heard on 9.60 at 0115-0200, excellent, in clear, relaying BBC's General Overseas Service.

Singapore's Blue Network on 7.250 is again audible in Calif. and still parallels the approx, 7.200 outlet. Communist-Chinese noted on approx. 6.650 around 0730, may be Hankow (?); another one noted on approx. 8.005 around 0830. (Dilg, Calif.)

Prague has inaugurated a new schedule to North America; noted and widely reported on 11.840 and 15.230 at 2100-2200 and (repeat) 2230-2330; announced a *new* transmitter is in use, presumably on 11.840 which is a "powerhouse" signal in East late evenings (EST); news 2100, 2230.

ZL4, 15.28, Wellington, N.Z., noted in N.C. 2200. (Ferguson) ZL3, 11.78, good in Calif. 2400. (Winch)

BED3, 15.235, Teipeh, Taiwan, noted 2300-0100 (first hour *English*); very poor signal. (Balbi)

TIPG, 9.618, San Jose, Costa Rica, noted weekdays with *English* program 1930. (Mulvey, Conn.)

Radio Continente, Caracas, Venezuela, notified Lane, South Dakota, that it recently moved from 5.030 to 5.040 at request of FCC. Said most reports are from Sweden, England, Australia, New Zealand; is beamed east-west to cover interior of Venezuela. Does *not* have printed QSL cards but sent nice letter, confirming reception of YVKM, 5.030; also listed YV5RY, 3.380; QRA given as Radio Continente, Bolsa A Padre Sierra 22 (Altos), Apartado No. 866, Caracas, Venezuela.

Nairobi, 4.851, Kenya, has been putting in a good signal in England around 1245; at 1300 announces "This is Nairobi," and then relays BBC news from London. *Radio Clube de Cabo Verde*, Cape Verde Islands, will shortly increase power from 300 watts to 1 kw. HVJ, Vatican, has new studios under construction for its Overseas Services. Now that Moscow has changed to summer schedules and is no longer using 6.090, *Radio Luxembourg* is heard well on this channel in all parts of Europe; *English* is Sundays 1530-1800, weekdays 1700-1800; all reports on *English* periods should be sent to Radio Luxembourg, 36 Davies St., London, W.1, England. (Patrick, England)

I have just learned from "Down Under" that *Radio Australia* is now being operated by the Australian Broadcasting Commission; by this time *new* schedules will have been effected; it is likely that the 1643-1815 beam to Eastern North America over VLA6, 15.220, will have been discontinued by now, and that "morning" programs to North America will be over the 100 kw. transmitter, VLB, on 9.540 at 0700-0900 to East Coast; 0900-1000 to Central and Mountain Zones, and 1000-1115 to West Coast.

The Far East Broadcasting Company, Manila, currently operates DZAF, 680 kc., DZH6, 6.030, and DZH7, 9.730, in parallel; DZH6 heard in Calif. 0730-0900 sign-off, fair signal: DZH7 completely covered by QRM. (Rosenauer)

Radio Teheran, 15.100, noted with news daily 1500; excellent signal. (Bellington, N. Y., Fargo, Ga.)

Helsinki, 15.19, noted with news daily 2200, 0715. (Bellington, N. Y.)

Kol-Israel heard on 9.000, 8.17, 6.83, all weak, opening 2245. (Bellington, N. Y.)

Programs from Saudi-Arabia are broadcast only from Djedda at present but soon the main portion will originate in Mecca; operates on 3.960, 5.985, 9.645, 11.760, 11.950 and a m.w. channel; output is 3 kw.; scheduled 0030-0100, 1200-1330. (Radio Sweden)

Summer schedules of Djakarta, received direct from the station, are—0600-0700 *English*, YDC, 15.15, to Australia, New Zealand, and YDB2, 4.91, to Malaya; 0700-0800 Chinese, YDC, 15.15, to China, YDB2, 4.91, regional; 0800-0900 *English*, YDC, 15.15, to China; 0900-1000 Hindu-Urdu, YDC, 15.15, to India and Pakistan, and YDB2, 4.91, regional; 1000-1100 *English*, YDC, 15.15, to India, Pakistan, Burma, and YDE, 11.77, to West Coast USA and South Africa; 0930-1030 Indonesian, YDF, 6.045, to Southeast Asia; 1100-1200 Arabic, YDF2, 11.785, to Middle East, and YDC, 15.15, to Near East; 1200-1300 French, YDF2, 11.785, to Near and Middle East, and YDC, 15.15, to Europe; 1300-1400 Dutch, YDF2, 11.785, to Europe and New Zealand; 1400-1500 *English*, YDF2, 11.785, to Europe and New Zealand; 0800-0900 Arabic, YDB2, 4.910, to Indonesia and Malaya; 1030-1130 French, YDB2, 7.270, to Indochina, and YDB2, 4.910, regional. QRA given as Gambir Selatan No. 17, Djakarta, U.S.I. (Dilg, Calif.)

The *Newark News Radio Club* has

just chosen Irving R. Potts again as president for the coming year; others named include Albert Sauerbirer, executive secretary; Benjamin Feinstein, assistant executive secretary; Walter L. Townley, treasurer; G. Dudley Clarke, Canadian vice-president; and Peter J. McKenna, Louis Hahn, Harold Robinson, Lester W. Kraemer, Henry T. Tyndall, Lloyd J. French, Charles S. Sutton, John W. Reichert, Earl R. Roberts, LeRoy Waite, Charles U. Atherton, and Jack D. Rhea, vice-presidents.

CR7BV, 4.932, Lourenco Marques, Mozambique, heard in Newfoundland 2300-0000 in parallel with CR7BE, 9.755, CR7BH, 11.764. (Peddle)

Radio Pakistan, 15.335, does *not* give location at newscast 2100 but says "simultaneously operating from Karachi, Lahore, and Dacca." (Cox, Dela.)

YNEQ, 6.963, Nicaragua, noted 2230-2300, good quality. (Saylor, Virginia)

Radio Trinidad, 9.625, sent schedule of 0500-1300, 1600-2200. (Baines, Nova Scotia)

Finally, here are tips received airmail from Serrano, Brazil—from listening, complete schedules for SRI programs from Buenos Aires are LRY, 9.455, 1545-1645 (except Sun.) Spanish, 1710-1750 Italian, 2115-0100 *English;* LRS, 11.88, 0900-1200 Portuguese, 1200-1300 German, 1300-1400 Swedish, 1400-1600 *English,* 1600-1800 French, 1800-2200 Portuguese; LRU, 15.29, 1215-1330 *English,* 1330-1445 (except Sun.) Spanish, 1445-1545 Italian, 2100-0100 (Sat. 2200-0100) Spanish. *Radio Ministerio da Educacao e Saude,* Rio de Janeiro, has returned to PRL4, 9.77, 1 kw.; scheduled 0330-1200, 1500-2130; verifies all reports, may be sent in Portuguese, *English,* French, or Spanish, and an IRC is appreciated; *new* s.w. transmitters are under construction for this station, more details expected soon. A license to operate on s.w. has been issued to *"Emissora Continental"* at Niteroi, capital of the State of Rio de Janeiro; no further details yet available.

* * *

Acknowledgement

Thanks for the FB cooperation. Keep it up, please!............KRB.

"This commercial won't do at all. It's too sensible!"

FOREIGN SET OWNERSHIP

FROM the Department of Commerce comes further data on set production in various foreign countries, as reported by U. S. Embassies, Consulates and Legations.

Because of the licensing restrictions in effect in Brazil imports of assembled radios was substantially reduced during 1949. Almost all of the major foreign radio manufacturers previously supplying the market were assembling receivers in Brazil at the end of the year. The number of sets assembled in 1949 totaled 150,000 units, compared with 70,000 in 1948 and 55,000 in 1947. Insufficient stocks of some imported components prevented a larger volume of production in 1949. The United States continued to be the principal source of supply for components. However, the devaluation of the pound Sterling in September stimulated interest in components of European manufacture.

Retail sales of radio receivers continued at a high level throughout the year. Demand was confined principally to quality sets. Prices remained firm, with some of the higher priced sets selling at a premium because of their limited availability.

The purchase of two television transmitters of U. S. manufacture aroused considerable interest in the radio trade. However, no information is available on the Central Bank's policy for the importation of television receivers.

An estimated 42,000 radio receivers were in use in Iceland in March, 1950 of which 40,000 were licensed. An estimated 3.4 persons listened to each set.

Assembly of radio receivers in Mexico during 1949 totaled 116,000 sets, compared with 71,500 in 1948. Ten firms were assembling radios at the end of the year.

Imports of radio receivers totaled 7404 sets in 1949, compared with 6087 in 1948 and 185,225 in 1947. Imports of radio receiving tubes and components aggregated 25,883,454 pesos in 1949, representing an increase of 51 per-cent over 1948 imports.

The devaluation of the peso in relation to the dollar resulted in an increase in the cost of tubes and components imported from the United States. Retail prices of receivers were raised approximately 40 per-cent which resulted in a substantial decrease in sales. In order to stimulate demand some assemblers reduced discounts at the wholesale and retail levels.

An estimated 1,221,360 sets were in use as of February 1, 1950, compared with 1,113,534 on the corresponding date in 1949. About 87 per-cent of the sets in Mexico operate on a.c. power lines. An estimated 55 per-cent of the sets are designed to receive medium- and short-wave broadcasts, and 37 percent to receive medium-wave broadcasts only. Interest in short-wave reception has declined. Table model radios are preferred.

A television transmitter is being installed in the Mexico City area. One radio station in Mexico City is being converted for television transmission. It is expected that this station will be in operation by the end of the year. Television standards adopted in Mexico are similar to those in the United States.

Radio apparatus is produced in Norway by 27 firms, of which 20 make home type radio receivers, 2 produce commercial radio equipment as well as home type sets, and 5 manufacture only commercial equipment. About 1000 persons are employed in the industry. The average weekly wage is approximately 100 kroner (a kroner equals approximately 14 cents U. S.).

Imports of radio receivers totaled 2012 units during the period from January through November, 1949. Of this number 1218 were from the Netherlands. Only 48 sets were imported from the United States.

Imports of receiving tubes totaled 1,005,811 units during the first 11 months of 1949 of which 653,190 were from the Netherlands and 254,235 from the United Kingdom. Imports for the year 1948 amounted to 1,245,103 tubes, of which 693,017 were from the Netherlands; 311,122 from the United Kingdom, and 225,929 from the United States.

Radio receivers and tubes are not produced in the Philippine Republic. However, it is reported that one U. S. firm is contemplating the assembly of radios.

Approximately 95 per-cent of all sets imported are of U. S. manufacture. Philips (Dutch) is the principal European brand imported. Table model radios in plastic cabinets are preferred. Approximately 90 per-cent of the radios in use are designed to receive short-wave broadcasts. Since electric power is available only in the larger cities and environs, battery-operated sets are popular and account for 40 per-cent of the sets in use.

Effective December 1, 1949, annual imports of home-type radio receivers valued over $50 (port of entry value) and radio-phonograph combinations valued over $150 were limited to 80 percent of the quantity imported in 1948. Imports of home-type radios valued under $50 and radio-phonograph combinations valued under $150 were limited to 50 per-cent of the quantity imported in 1948. There are no restrictions on the importation of radio receiving tubes in the Philippine Republic.

An estimated 390,000 radio receivers are in use in Portugal. About 87 percent of the sets are designed to receive short-wave broadcasts. The number of listeners per set is estimated at 2.5 persons.

Approximately 1,200,000 radio receivers were in operation in Spain in November, 1949, of which 555,000 were licensed. About 90 per-cent of the sets in use were designed to receive short-wave broadcasts.

—30—

Manufacturers' Literature

Readers are asked to write directly to the manufacturer for the literature. By mentioning RADIO & TELEVISION NEWS, the issue and page, and enclosing the proper amount, when indicated, delay will be prevented.

GRAY "TELOP"

Gray Research and Development Company, Inc. of 16 Arbor Street, Hartford 1, Conn., has released a four-page data sheet covering its "Telop" unit for the projection of newsphotos, comics, announcements, and commercials in television studios.

There is a brief description of the operation of the unit, including data on the functioning of the various parts of the instrument. This television optical projector has been designed for use with various TV film cameras. Several of the possible applications of this unit are illustrated and described in the booklet.

Requests for additional details and copies of this data sheet should be made on the letterhead of the television station with which the writer is associated.

TV SUPPRESSION DATA

To answer the radio amateur's demand for knowledge in curing television interference, *Barker & Williamson, Inc.* has just published a 20 page booklet which contains a wealth of valuable data on the subject.

Entitled "Filter-Facts," this booklet clearly explains the causes of TVI and the procedures necessary to eliminate it, including discussions on shielding, filtering, and bypassing. Fourteen easy-to-follow wiring diagrams illustrate the right and wrong ways of making circuit connections to reduce TVI.

Copies of "Filter-Facts" may be obtained by sending 15 cents in coin to the company at 237 Fairfield Avenue, Upper Darby, Pa.

NEW W-J CATALOGUE

Walker-Jimieson, Inc. of 311 S. Western Ave., Chicago 12, Illinois, has just released its new 1950 television, radio, and electronics parts catalogue.

Specially designed for quick and easy use by the service technician, the new catalogue lists thousands of items including television equipment, radio parts, major tube lines, test equipment, tools, accessories, and other electronic supplies.

In writing for copies of this publication, please specify Catalogue No. 169.

HI-FI CATALOGUE

Of interest to the audio enthusiast is the new six-page illustrated catalogue just released by *University Loudspeakers, Inc.* of 80 South Kensico Avenue, White Plains, New York.

Devoted in its entirety to the company's complete line of high fidelity equipment, the new catalogue lists cone speakers, tweeters, tweeter adapters, crossover networks, and coaxial speaker systems.

The new catalogue is unique in that complete installation instructions are given for each model, enabling the prospective purchaser to determine beforehand what work or preparation is required.

Among the new items included in the catalogue is the company's 12 inch, 30 watt wide-range cone speaker. Complete details are given on this unit and other items in the line.

EMC CATALOGUE

The 1950 edition of *Electronic Measurement Corporation's* catalogue of electrical testing equipment is currently available from the company at 423 Broome Street, New York 13, New York.

Included in the multi-colored catalogue are listings on the company's complete line of products, photographs and specifications on all types of equipment, from the company's economy line of pocket voltmeters through the standard line of test meters to accessories such as TV antenna orienters and extension cords.

Copies of the catalogue are free on request.

SOUND GLOSSARY

A glossary of terms used by tape recording technicians and customers is currently being offered by *Minnesota Mining and Manufacturing Company* of 900 Fauquier Street, St. Paul 6, Minnesota, makers of "Scotch" sound recording tape.

The new publication, entitled "Time for Sound Talk," has been designed for use by retailers and their sales personnel in "talking the language" of tape recording customers.

Included in the booklet are four pages of technical terms and definitions, plus details on various sizes and types of sound recording tape, dual and single track recording, and different tape recording speeds.

TV ACCESSORIES

Of interest to television technicians is the new 28-page catalogue just issued by *Interstate Supply Co.* of 10th and Walnut, St. Louis 2, Mo.

This comprehensive publication lists hundreds of items needed for TV installation and servicing. Included are all types of well-known antennas, masts, and antenna kits; trailer units for transporting bulky masts and antennas; antenna rotators, and mounting hardware; test equipment of all types; servicing tools; condensers, resistors, and controls; amplifier strips; and cathode-ray tubes.

Copies of this accessory catalogue are available without charge. Address your requests direct to the company.

TIMING DEVICES

An 8-page catalogue covering electrical timing devices is currently available from the *Haydon Manufacturing Company, Inc.* of Torrington, Conn.

The listing includes units for time delay, interval, repeat cycle, and elapsed time functions. The two-color catalogue is illustrated with photographs, dimensional drawings, and diagrams. A brief discussion of each type of unit gives important features, specifications and ratings, along with ordering aids.

Copies of the catalogue may be secured by addressing requests to E. B. Hamlin, Advertising Manager, at the company. Ask for catalogue No. 323.

PERMOFLUX CATALOGUE

Permoflux Corporation of 4900 West Grand Avenue, Chicago 39, Illinois has just issued a four-page catalogue that describes the company's new "Royal Eight" Model 8T-8-1 speaker in some detail.

The catalogue, No. J201, carries a response curve on the new speaker and full details on the constructional features that give this unit the same performance as comparable 12" speakers, according to the company.

A particularly valuable section of the folder is data on the proper baffling of the speaker or speakers. All dimensions are given for the baffle cabinet in addition to details on the materials to be used both for the outside and as lining. —30—

MEXICAN TV

MEXICO'S first television station, equipped with a 5 kw. transmitter and associated studio and mobile pickup units supplied by RCA, is scheduled to go on the air in Mexico City this summer.

The station, owned and operated by Television de Mexico, S.A., will operate on Channel 4 and will be located in the 20-story National Lottery Building in the center of the Mexican capital. In addition to studios, rehearsal halls, scenery storage space, and offices on the upper floors, provision has been made on the ground floor for a large auditorium which will be used for televising concerts and stage plays.

In preparation for the opening, Romulo O'Farrill, Sr., publisher of the newspaper "Novedades" and owner of Television de Mexico, arranged for members of the station staff to visit the RCA Victor plant in Camden, New Jersey for a study of manufacturing operations and to observe program production methods at NBC's studios in New York.

RCA Victor Mexicana, S.A., RCA's associated company in Mexico, is installing the equipment. —30—

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PANELS for electronic, nucleonic construction projects. Complete service for designers, custom builders. Circular upon request. Gilpin Instrument Works, P. O. Box No. 8. Mt. Clemens. Mich.

RADIO Engineering Broadcasting, Aviation and Police Radio, Servicing, Marine Operating and Electronics taught thoroughly. Expenses low. Write for catalog. Valparaiso Technical Institute. Dept. N, Valparaiso, Ind.

SALE

RCA Wire Recorders. Famous model MI-12875. Brand new, complete with microphone and cartridge. Original cost, $195.00. Our price, $75.00. Electronic, 1310 S. Staples, Corpus Christi, Texas.

WILCOX CW-3 receivers complete with tubes and coils. These receivers new at only $50.00 each F.O.B. First come, first served. James P. Bridges, 1350 Meander St., Abilene, Texas.

FIVE Element TV Yagi Beams. High Band, $6.75; Low Band, $8.50. Aluminum Tubing, etc. Willard Radcliff, Fostoria, Ohio.

TEST Equipment bargain. RCA WR-59A TV Sweep Generator, WR-39A TV Calibrator, DuMont 208B Oscilloscope, Weston 798 Tube Tester, Simpson 260 Volt Ohmmeter. All new condition. Half price. A. W. Randall, 4923 Central, Indianapolis, Ind.

WEBSTER 79 wire recording mechanism, $30.00. Phillip Lazzio, Lake Geneva, Wis.

SELL: Rack mounting HRO-7 in three-foot cabinet. Perfect condition. Your price. P. O. Box 430, Eau Claire, Wis.

RECEIVER BC-639. Tunable 100 to 156 mc. New. With 110 volt AC power supply. Price, $150.00. Warren J. Madigan, 2936 Lutaway Dr., Toledo 14, Ohio.

NC-TV7M National Television Receiver with Enlarger. Make offer. Douglas Brotherton, Park Rapids, Minn.

RECORD Changer Parts for leading makes. We ship everywhere. Friend's Wholesale Distributors, 106 N. 6th St., Philadelphia 6, Pa.

BARGAINS. New and reconditioned Hallicrafters. National. Collins, Hammarlund, RME, Meissner. other receivers, tuners, television receivers. transmitters, amplifiers, speakers, etc. Lowest wholesale prices. Terms. Shipped on trial. Liberal trade-in allowances. Write Henry Radio, Butler. Mo., and 11240 W. Olympic, Los Angeles. Calif.

HOTTEST surplus list in the country. Electronics-Hydraulics, Aircraft-Gadgets. Dick Rose. Everett, Wash.

RADIO Diagrams 50c; Record Changers, Recorders 60c; Television Diagrams with service data $1.00 up. State Manufacturer and model number. Kramer's Radio Service, Dept. RX, 36 Columbus Ave., New York 23, N. Y.

NEW low voltage Geiger Counter $35.00 complete. No C.O.D. Joseph O'Connor, 2304 S. Ogden St., Denver, Colo.

SELL: TCS-12, new, $295.00; RA-34 Rectifier. $85.00; 522 Equipment, new, $49.00; BC-654 Equipment, new, $69.00; TBY Manuals, $1.00. T. Howard, 46 Mt. Vernon St., Boston 8, Mass.

COAXIAL cable, 53 ohm, 100 ft., $3.00; Sample, 10c; 300 ohm twin lead, 500 feet, $5.00. Harry H. Van Dick, Box 236, Little Falls, N. J.

WEBSTER Chicago record changer and wire recorder replacement parts. We ship everywhere! Friend's Wholesale Distributors, 106 N. 6th St., Philadelphia 6, Pa.

ALL Steel T.V. Towers which can be erected to 70' or more. Built to climb. Shipped direct from the factory at $8.50 F.O.B. per 10' section. Weight 20 pounds per section. Write for more details. The Youngstown Steel Towers, 1316 Wilson Avenue. Youngstown 8, Ohio.

COLOSSAL bargain in radio parts, over 150 assorted radio parts including resistors, condensers, controls, coils, etc. All new, $75.00 value, guaranteed satisfaction or money refunded, postpaid in U. S. A., $2.50. Write for catalog. Buyers Syndicate, 30 N. Taylor St., Springfield 3, Mass.

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GOVERNMENT Surplus. Gunnery Training Tables, new, $100.00. Acme Outlet, 3904 Prospect, Kansas City, Mo.

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WANTED—New GN-45 or GN-58 Hand Generators. Quote quantity price. Box 506, % Radio & Television News, 185 N. Wabash Ave., Chicago 1, Ill.

HELP WANTED

INSTRUCTORS in Electronics and Radio. Prefer former Navy Radio Technician instructors willing to locate in the Detroit, Mich., area. Write to Box 452, c/o Radio & Television News, 185 N Wabash Ave., Chicago, Ill.

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YOUNG man 24, with first class phone license, wants employment in Broadcast or Television Station in California, New York, or Chicago; Ex Navy Man. Irving Stein, 43 Morrell St., Brooklyn 6, New York.

HIGH class technicians. Graduates of first class radio-television course. Broadly trained for all phases of industry. Call, wire, or write Rush Barnes, Electronic Radio Television Institute, Omaha, Nebr.

FIRST class 'phone licensee, three years college, teaching and laboratory experience, desires position anywhere. Harry Macomber, Box 256, Clinton, Ark.

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USED Correspondence Courses and Books sold and rented. Money back guarantee. Catalog free. (Courses bought.) Lee Mountain, Pisgah, Ala.

PATENT ATTORNEYS

HERMAN Lewis Gordon, Registered Patent Attorney. Patent Investigations and Opinions. Warner Building, Washington, D. C.

LANCASTER, Allwine & Rommel. Registered Patent Attorneys. Patent practice before U S. Patent office. Validity and Infringement investigations and opinions. Booklet and form "Evidence of Conception" forwarded upon request. Suite 414, 815 15th St., N.W. Washington 5, D C

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RADIOMEN, Servicemen, Beginners. Make more money, easily, quickly, $250 weekly possible. We show you how. Information free. Merit Products, 216-32R 132 Ave., Springfield Gardens 13, N. Y.

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100	John Shul

ERRATA

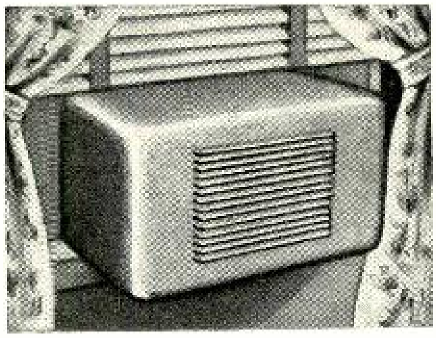
In the schematic diagram appearing on page 56 of the May issue ("A High Efficiency Triode Amplifier"), the lead from the lower end of CH_2 to ground should be removed.

* * *

In the article "Transmitter Keying and Biasing Problems," appearing in the April issue, the value of R_4 in Fig. 4 (page 66) should be 500 ohms, 10 watts.

BANISH FOREVER HOT *DAYS! NIGHTS!*

FIRST TIME ANYWHERE AT THIS LOW PRICE!



- ***USES NO WATER***
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NO WIRING OR ALTERATIONS

PLUGS IN LIKE A RADIO—NO INSTALLATION REQUIRED

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PERFECT VENTILATION. Air filtration is assured by use of **PATENTED FILTER** for ELIMINATING DUST, DIRT and POLLEN from outdoors.

Ventilates your room with CLEAN, COOL, FILTERED AIR . . . SUMMER or WINTER. Enables you to SUBDUE outside NOISES by keeping windows closed and to get the amount of air you want, whether calm or stormy.

Easily ADAPTED TO ANY WINDOW without cutting or marring; mounted flush with inside of window for pleasing appearance.

Cabinet is made of HEAVY STEEL with "BAKED ON" BRONZE HAMMERTONE FINISH. Will blend with all home, office, or showroom surroundings.

References: Marine Midland Trust Co. of N. Y., 143 Liberty St., New York, N. Y.

Regular Price **$85.00**

YOUR COST $44.95*

110 V. 60 Cycle AC.

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110 V. D.C.	$59.95*
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TERMS: 20% Deposit
Balance C.O.D., F.O.B., N.Y.C.
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The new Price Tenna-Trailer will put you way out front of your competition. It enables you to quickly raise a 51 foot mast. One man can set the versatile unit in position, crank up telescoping mast, rotate for best signal — all in a matter of minutes. You'll be thrilled with its ingenious, sturdy construction!

MAST AVAILABLE SEPARATELY

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Trailer is ruggedly constructed of steel, furnished complete with tires and standard trailer coupler with ball. Unit trails easily, stands rigid in high winds, yet is the lowest price portable mast in the field.

Write for illustrated folder for full details. Don't delay! You, too, can get the jump on your competition with the Price Tenna-Trailer!

Complete, Trailer with Mast, Net....$225.00
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INDEX OF *Advertisers*

JULY 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.]

Geiger Counters

(*Continued from page* 35)

stant and it is then applied to the nine hundred volt Geiger tube. The advantage of this circuit is that the current drain is very small which makes possible a long battery life. It is also lightweight and small in size.

The Model 106 has earphones, a neon flasher, and a three range meter as indicating means. It weighs about three and one half pounds. It detects both betas and gammas.

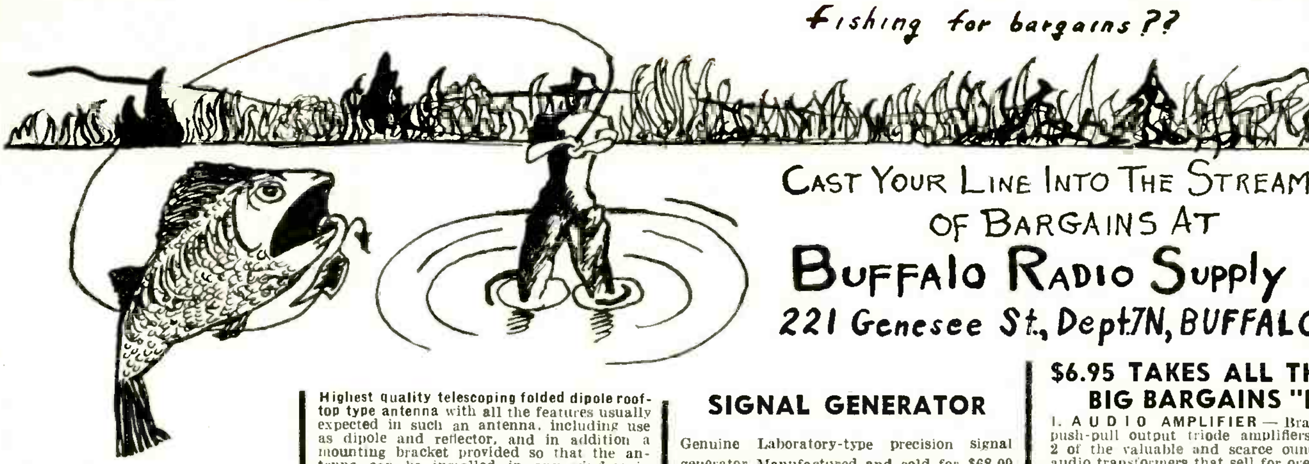
The manufacturers of Geiger counters have brought the price of their product down to well within the reach of the public. Not long ago any kind of a counter sold for several hundred dollars. All but one of the instruments described here sell for less than one hundred dollars.

Great progress has also been made in size and weight. In the past, Geiger counters weighed anywhere up to a hundred pounds or more and were very cumbersome. Now the more modern instruments weigh only a few pounds and most are small enough to fit in the palm of a hand.

The use of the Geiger counter is very simple and requires no experience. When surveying a location the prospector takes the count of the number of clicks per minute heard in the earphone. This count is a measure of the strength of the radioactivity present at the location. In doing this it is important to know that a small number of pulses exist even when no uranium is near. These pulses are caused mainly by cosmic rays and are known as the "background count." The background count must be deducted to obtain the correct reading. Generally speaking when the number of clicks are double or triple the average background count of the area, uranium may be present. When the instrument includes a neon flasher the neon lamp will flash with each pulse which makes it possible to use the instrument without wearing earphones. In order to better evaluate results an instrument with a meter should be used. The intensity can then be read directly on the meter and no count need be taken. Since the intensity varies over wide ranges a three range meter is the most practical. With an instrument of this type the quality and quantity of ore may be estimated in the field.

Uranium occurrences in the United States are by no means rare. The large carnotite deposits of Utah and Colorado have been mined for some time. Rich strikes have been reported in California, Nevada, Arizona, and other states. In over half of the forty-eight states, as well as Alaska, uranium occurrences have been found. In most cases the amounts have been insignificant in view of the insatiable demand. The government is, therefore, doing everything in its power to spur the search. The era of Geiger counters is indeed here.

—30—



CAST YOUR LINE INTO THE STREAM OF BARGAINS AT

BUFFALO RADIO SUPPLY

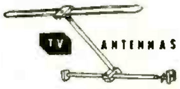
221 Genesee St., Dept.7N, BUFFALO N.Y.

!!SPECIAL ANNOUNCEMENT!! FCC AUTHORIZES RADIO FOR PRIVATE SERVICE!!!!

(The FCC announced that effective June 1, any American over 18 years of age may be eligible for a 5 year station permit. In the "Citizens" band, no code test or technical knowledge are necessary for transmission.)

GENERAL ELECTRIC 15 TUBE TRANSMITTER-RECEIVER SET. This brand new 15 tube transmitter-receiver was designed for mobile storage battery powered service. Properly modified, it will operate on voice in the Citizens Band. It's a cinch for the experimenter to connect this unit for 110-volt a.c. operation by following the instructions and diagrams supplied, which cover numerous applications, including FM and amateur television transmission and reception. For those intending to use on car or boat, a new dynamotor, exactly as originally supplied, costs only $15.00. Don't fail to write for FREE descriptive bulletin. Order our RT-1248 for only **$29.95**, or two for **$53.90**.

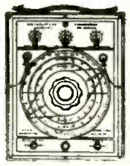
Highest quality telescoping folded dipole rooftop type antenna with all the features usually expected in such an antenna, including use as dipole and reflector, and in addition a mounting bracket provided so that the antenna can be installed in any window in two minutes or less. Any slight loss in gain because of the reduction from rooftop height is more than compensated by the ability to orient the antenna instantly by opening the window and adjusting for maximum signal strength. Mounting bar can be installed horizontally or vertically in window frame or even between attic rafters, whichever is most convenient. Your cost **$7.00**. With high frequency attachment for channels 7 to 13 **$9.00**. Either type 10% less in dozen lots.



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**.

SIGNAL GENERATOR

Genuine Laboratory-type precision signal generator Manufactured and sold for $68.00 each in large quantities during the war by Northeastern Engineering Corp., one of the top manufacturers of electronic equipment for the U.S. Govt. Five fundamental bands starting at 150 KC. Strong harmonics up to 120 MC. Five step ladder type attenuator as well as potentiometer output control. Regular 1000 cycle audio oscillator using vacuum tube, not a cheap neon sawtooth audio oscillator. Audio output separately available externally. Weight without packing material 16 lbs. which should show what a world of difference exists between this signal generator and the ordinary cheap oscillator used by the average serviceman. Complete with fused plug and coaxial output lead. Super Special **$38.75**.



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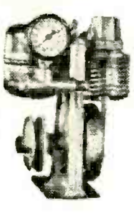
2. **BANDSWITCHING TUNING TURRET** made by Western Electric. Covers 4 bands above 100 MC. All coils wound with #14 silver-plated wire. Complete with tuning condensers and powerful electric driving motor. **ONE OF OUR MOST TERRIFIC VALUES—ONLY** **$2.95**
3. **CARBON MIKE** with Push-To-Talk Switch and Gold Plated Carbon Lapel Mike. Combination offer on both mikes **$1.75**

DELUXE SUPERHET A.C.-D.C. RADIO KIT

Extra high quality 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. 12AT6, 12BA6, 12BE6, 50B5 & 35W4 tubes supplied. 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**

COMPRESSED AIR

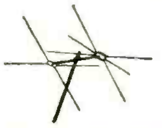
Instantly Anywhere



Portable Air Compressor and Storage tank. Ruggedly built. Best Materials. Lifetime lubricated ball-bearing on connecting rod and oil-impregnated main bearing on shaft. Unusual design forever eliminates valve trouble, the most common fault in air compressors. **PATENTED** unique air intake system increases efficiency tremendously so that air output is much greater than that from larger compressors powered by heavier motors. Delivers approximately 3500 cu. inches of air per minute at maintained pressure of 30 lbs., or will inflate a 90 lb. truck tire in less than one minute. Complete with 100 lb. gauge. Finger-tip adjustment allows setting of output pressure at any value, which will automatically be maintained. Works from any ¼ H.P. motor. Useful for spraying paint, lacquer, disinfectant, insecticide, annealing or brazing with natural gas, inflating tires, etc. Price **$14.50** postage prepaid anywhere in the U. S. Efficient, completely adjustable syphon type spray gun complete with 12 ft. of 100 lb. tested hose only **$7.75** with pint container, also prepaid.

FOLDED DIPOLE WITH REFLECTOR

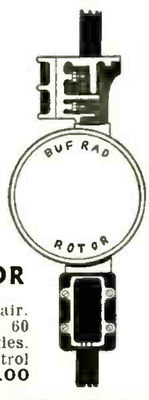
Full size folded dipole with reflector and mast. Stand-off insulators included. $4.75 complete. $40.00 per dozen. Order No. 6430.



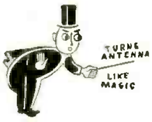
Latest model fan type conical with reflectors. Better on all channels, but superiority is most terrific on higher channels. A year ago we advertised an antenna that sold for over $100.00. This antenna is hotter. $4.75 each. In lots of 10—$40.00. Order No. 6491.

Connector bars for double stacking either antenna. FREE with orders for 2 or more.

LAPEL MIKES—(Specify whether carbon or magnetic) 93c



BUFRAD ANTENNA ROTATOR



TV Antenna adjusts from your easy chair. Complete 360° turn. Plugs in any 110 V, 60 cycle outlet. Not subject to electrical codes. Absolutely complete with pushbutton control and 50' weatherproof lead...........**$20.00**

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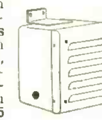

Latest type PM Speaker in a fully-enclosed crackle finished metal cabinet. This speaker and case match communication receivers, and in addition make perfect intercom remote stations. Our price $4.50. With output transformer....$4.95

SPEAKERS—These PM speakers are the finest that are available. All have heavy oversize Alnico V magnets.

3½"	$1.15	6 for $6.60
4"	$1.15	6 for $6.60
5"	$1.10	10 for $9.50
6"	$1.50	6 for $8.70
6"x4" Oval	$2.10	6 for $10.80
7" (Car Radio Size)	$4.50	6 for $21.50
8" ....10 oz.	$3.95	6 for $20.50
8" ....21 oz.	$4.95	6 for $26.50
10" ....21 oz.	$5.50	6 for $30.00
12" ....21 oz.	$7.95	6 for $42.00

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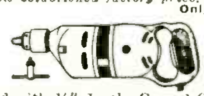
This analyzer, featuring a sensitive repulsion type meter housed in a bakelite case, represents the culmination of 15 years achievement in the instrument field by a large company specializing in electronic test equipment.

Specifications of the AC-DC Model Volt-Ohm-Milliammeter:
AC Volts—0.25, 50, 125, 250
DC Volts—0.25, 50, 125, 250
Milliampers 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 anywhere in the USA—**$7.00**. Similar DC Meter, lacking the AC operated ranges of above, **$5.50** prepaid.

½" ELECTRIC DRILL

Cannot mention brand name as we are selling way below established factory price.
Only $29.95.



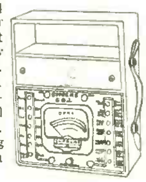
Equipped with ½" Jacobs Geared Chuck and Key. Not an intermittent duty drill, but a full sized rugged tool. Most convenient type switch, pistol grip handle. Precision-cut gears—turbine type cooling blower — extra long brushes. No stalling under heaviest pressure because of powerful 110V AC or DC motor and multiple ball thrust bearing. Other bearings lifetime lubricated. Amazing lifetime factory guarantee.

Supreme Instrument Corp. Model 592 SPEEDTESTER. Not just 20,000 ohms per volt, but

25,000 ohms per volt

The world's most sensitive voltohmeter

The finest multimeter money can buy. "Tops" in quality, accuracy, complete coverage, and speed of operation. 44 ranges at your fingertips. 1 Microampere to 14 amperes. Either 100 ohms per volt or 25,000 ohms per volt meter sensitivity, instantly available. 0.1 to 1400 D.C. Volts. ¼ ohm to 50 megohms. No removal of test prods necessary—1 pair pin jacks for all ranges. In beautiful oak case. Regularly $58.95, we are offering these brand new testers for a limited time only **$48.95**.



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and other surplus. Large or small quantities. Send your list for our bid.

We especially want BC654 and SCR284 components

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You get long and trouble-free service from Mallory Vibrators because of a three-way combination that can't be beat. The patented tuned mechanism assures slow contact impact, for minimum wear—high contact pressure, for low resistance—fast contact break, for reduced arcing and pitting. That's a Mallory exclusive!

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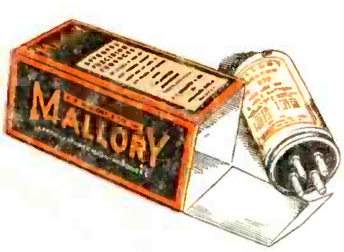
When you use Mallory Vibrators for replacement, you are sure of long life, dependable starting and high output efficiency. See your Mallory distributor now!

More Mallory Vibrators Are Used In Original Equipment Than All Other Makes Combined.



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