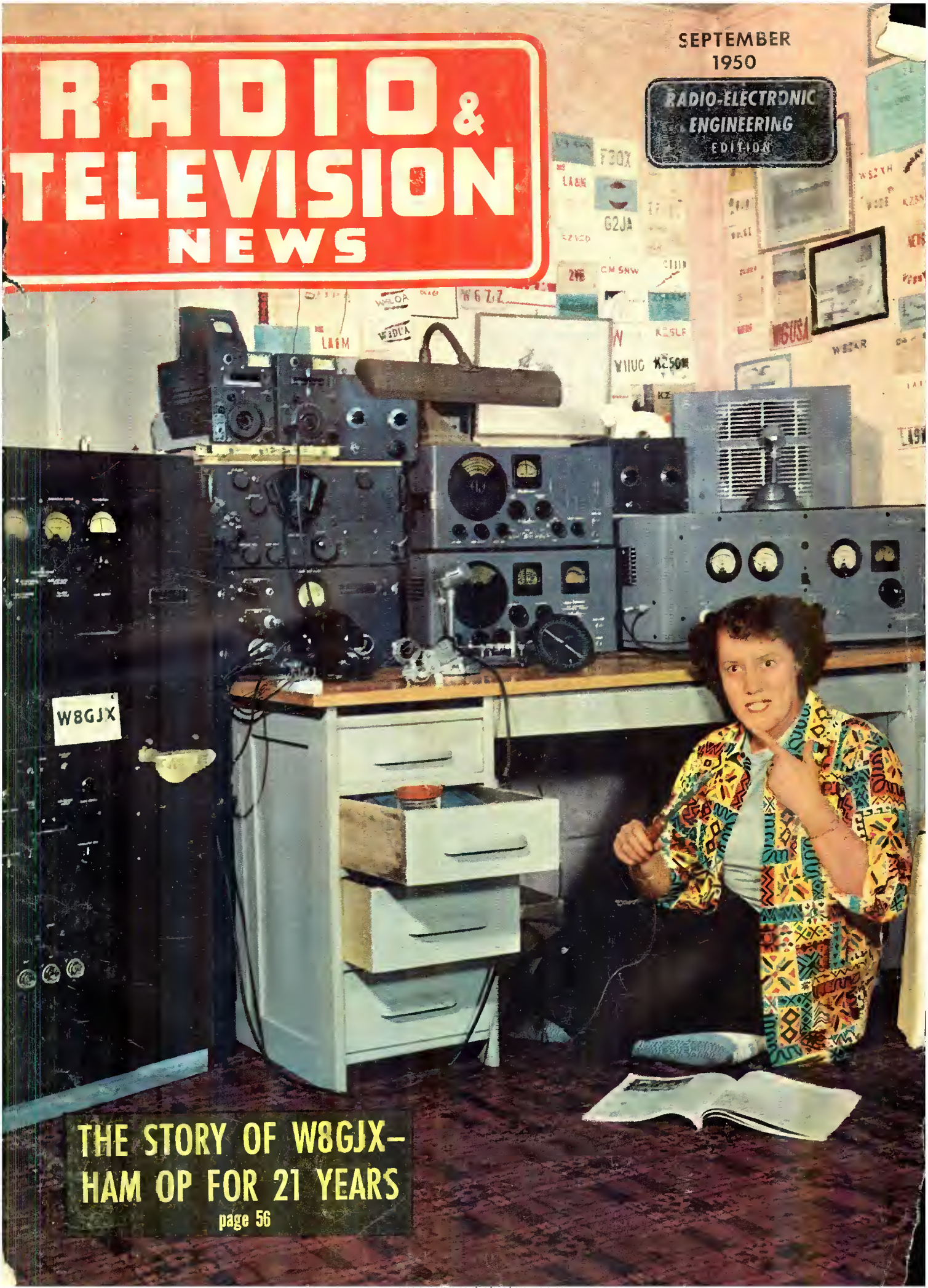
RADIO & TELEVISION NEWS

SEPTEMBER
1950

RADIO-ELECTRONIC ENGINEERING EDITION



THE STORY OF W8GJX—
HAM OP FOR 21 YEARS

page 56

THE QUALITY OF **RCA** TUBES IS UNQUESTIONED

RCA for *Deflection Tubes*

. . . with dependability

Each standard by which you judge a tube in service is considered in establishing the design requirements of RCA tubes. Dependable performance of deflection circuits starts with *dependable* tubes. For example.

RCA-designed driver tubes, such as the 6SN7-GT and 12AU7—as well as the RCA-6K6-GT and RCA-6AQ5 vertical-deflection tubes—are exceptionally low in microphonics. They are built for *dependable* performance.

RCA-designed horizontal deflection tubes, such as the 6BG6-G, easily withstand peak plate voltages of 5000 volts, and as readily meet peak emission demands on the cathode. They, too, are built for *dependable* performance.

For these reasons, RCA tubes offer *dependability* beyond the average. With fewer service failures and fewer costly call-backs, there is, then, an additional hidden profit in every RCA tube and kinescope you sell.

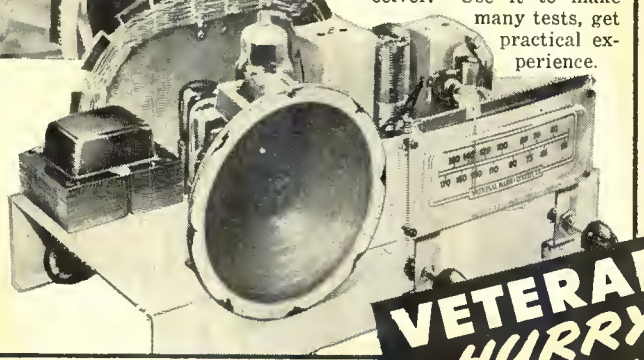
Always keep in touch with your RCA Tube Distributor

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

I Will Show You How to LEARN RADIO-TELEVISION SERVICING OR COMMUNICATIONS by Practicing in Spare Time

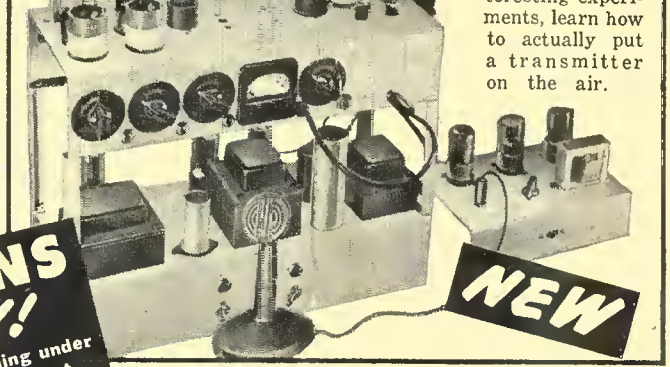
YOU PRACTICE RADIO SERVICING

You build the modern Radio shown below as part of my Servicing Course. I send you speaker, tubes, chassis, transformer, loop antenna, everything you see pictured and EVERYTHING you need to build this modern Radio Receiver. Use it to make many tests, get practical experience.



YOU PRACTICE RADIO COMMUNICATIONS

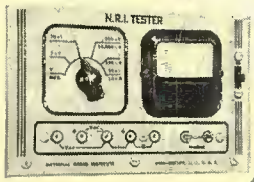
I send you all the parts to build Transmitter shown below as part of my new Communications Course. Conduct actual procedure of Broadcast Operators, practice interesting experiments, learn how to actually put a transmitter on the air.



NEW

VETERANS HURRY! To get this valuable training under G. I. Bill. Time is running out.

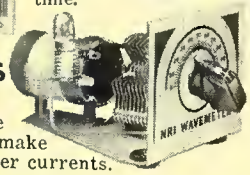
YOU BUILD THIS TESTER



with parts N.R.I. sends early in course. Soon helps you fix neighbors' Radios and EARN EXTRA MONEY in your spare time.

YOU BUILD THIS WAVEMETER

and use it to determine frequency of operation, make other tests on transmitter currents.



YOU BUILD THIS SIGNAL GENERATOR

for more valuable experience. It provides amplitude – modulated signals for many tests and experiments.

I TRAINED THESE MEN AT HOME

"While learning, made $5 to $10 a week in spare time. Now have a profitable spare time shop." —L. ARNOLD, Pontiac, Michigan.

"4 years ago, a bookkeeper on a hand-to-mouth salary, am now a Radio Engineer ABC network." —N. H. WARD, Ridgefield Park, N. J.

"Have my own shop. Am authorized serviceman for 5 manufacturers and do servicing for 7 dealers." —P. MILLER, Maumee, Ohio.

"After graduating, worked for servicing shop. Now Chief Engineer of three Police Radio Stations." —S. W. DINWIDDIE, Jacksonville, Ill.

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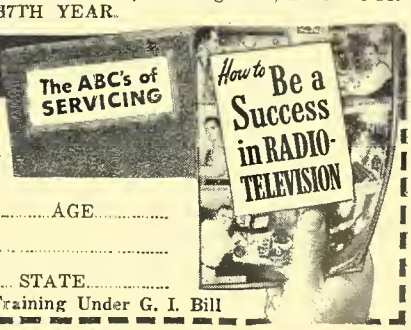
Good for Both—FREE



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National Radio Institute, Washington 9, D. C.

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☐ Check if Veteran Approved for Training Under G. I. Bill

COVER PHOTO: W8GJX in her ham shack. After 21 years of hamming Helen Cloutier still finds it a stimulating and interesting hobby.

(Kodachrome by B. F. Schultz)

First in
radio-television-electronics

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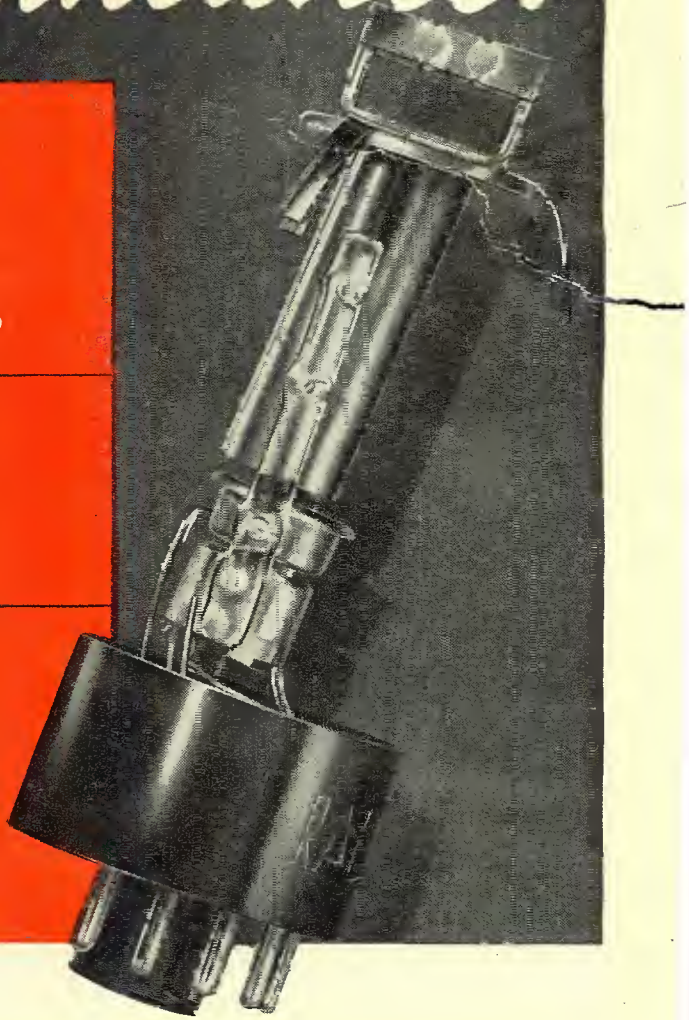
Rauland Announces

NEW "Tilted Offset" Gun



Rauland is happy to announce its newest advancement in Electron Gun design—the fifth Rauland development in a year to benefit both set makers and service men. Effective at once, Rauland is incorporating in all its picture tubes a new "Tilted Offset" Electron Gun which requires only a single ion trap magnet (although a double magnet can be used)—and bends the electron beam only once—and gives the sharpest possible beam focus.

At the same time, Rauland is incorporating in all electron guns the Indicator Ion Trap feature which has proved so popular since its introduction in the Rauland 12LP4A. This Indicator Ion Trap eliminates mirrors and guesswork—provides a positive means for correct ion trap magnet adjustment.

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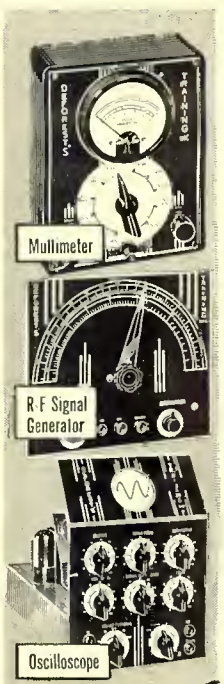

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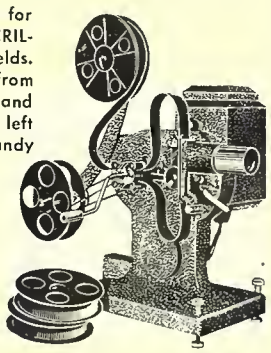

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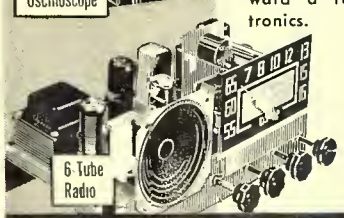

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For the RECORD

BY THE EDITOR

INSTRUCTION BOOKS AND THE ENGINEER

WE HAVE been noticing a sorry lack of adequate instruction data which accompanies quality merchandise in the radio, television, and electronic fields. Our own experience includes items designed for application in audio, amateur radio, television, and allied fields.

Our first example is an expensive high quality audio amplifier, possessing features of advanced design and capable of superb performance, even for FM broadcast use. In fact, the amplifier in question is far superior to most units in any price class. This unit retails in excess of $200.00 and is quality merchandise throughout. Many innovations in design are apparent to the audio man versed in circuitry.

The instruction book enclosed with the amplifier devotes many paragraphs pointing to the design features, the achievement of high efficiency coupling, the wide frequency response, and how the chassis is constructed for speedy servicing.

But—and this applies to many manufactured items—there aren't any specific instructions which will permit the purchaser to install and maintain the equipment intelligently. Most needed data is not included. In fact there is no plate current data, voltage analyses, or other necessary information for routine testing, and yet this amplifier is a "Cadillac" in its field.

Our second example is a 10 and 20 meter, 3-element beam for amateur communications, complete with heavy duty rotator and remote position indicator. It sells complete for approximately $300.00. The instructions for assembling the elements comprise a faded mimeographed sheet. In fact, it is almost impossible to follow the very brief data. Comprising nearly a gross of bolts, nuts, brackets and washers, it becomes a tedious process to try and assemble the elements with bolts of proper length and proper sequence. If adequate instructions (not a faded mimeographed sheet) had been printed, the time for assembly could be reduced by at least 50%.

The single page sheet with the rotator was crumpled like a dried out spit ball and was really a classic. One paragraph stated, "a 5-wire cable connects the antenna rotator to the indicator. It should be rubber covered." Now isn't that just peachy! There is a multiple terminal strip within the rotator housing with no identification or diagram whatsoever. There are 5 terminals all right, but that's all.

At the remote indicator is another set of terminals. The terminals are not identified or marked and are apparently connected without any particular sequence of wiring. After much transposition, it was discovered that the two terminal strips, one at the rotator, the other at the indicator, were reversed. Another headache and another hour wasted.

Our final example is an instruction folder furnished by a leading transformer manufacturer. It apparently is intended to serve as a guide for connecting various impedances to numbered terminals on the base of the transformer. Here an attempt has been made to consolidate the entire transformer line of the manufacturer in a condensed and inadequate tabulation.

Many of the transformers shown and designed for a specific application could be used for other purposes, providing the instructions stated whether or not the current (d.c.) could flow in the windings. In audio in particular, there are several "bridging transformers" that could be used as "plate-to-line" if shunt feed were used by the technician to keep the d.c. out of the primary.

The point of our discussion is to call the attention of the manufacturer to the necessity for having his instruction data carefully checked by at least two persons who are not too familiar with his product or its application. It is a real mistake for the design engineer to be charged with the responsibility of doing a complete instruction sheet.

It is axiomatic that he will skip over important data, simply because he is *too* well informed on the product and assumes that the purchaser will also know exactly how to use the equipment or components properly.

Much can be done to win the confidence of the purchaser if the manufacturer will insist that someone, not too well versed in the original design, actually check and use the product exactly as he is told in the instruction book and to note and ask questions. By employing "guinea pigs" many overlooked points will be clarified and corrected before such instructions are approved and printed for inclusion with the manufacturer's products.

A few hours' attention to the "end user" can surely help in making better relations between the manufacturer and the customer. The added cost to the manufacturer is peanuts compared with the loss of confidence and the resulting loss of sales on the part of the confused and disgruntled purchaser. . . . . O.R.

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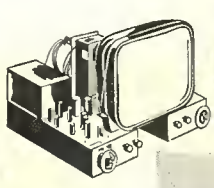

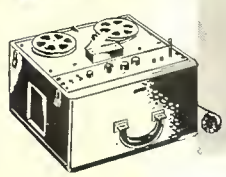

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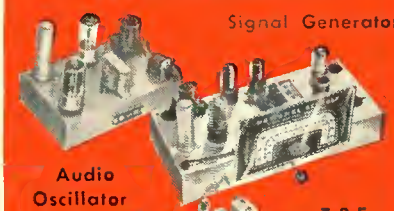
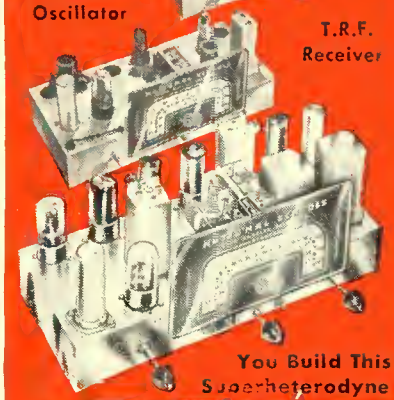


Signal Generator

Audio Oscillator

T.R.F. Receiver



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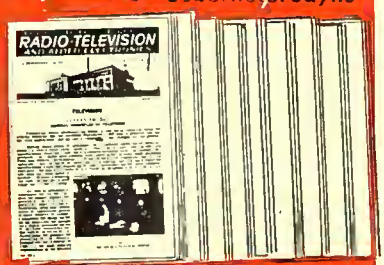

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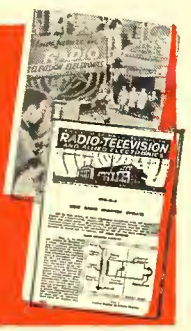

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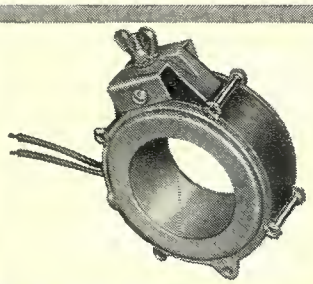

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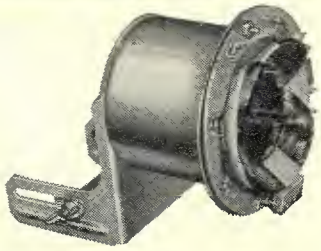

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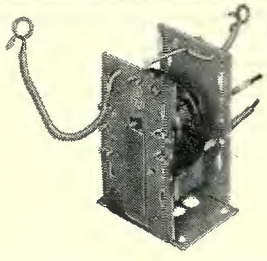

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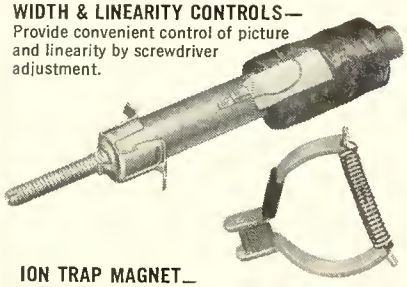

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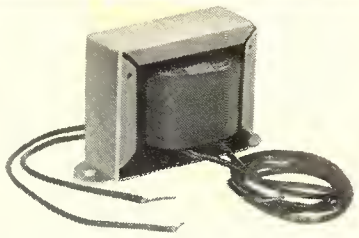

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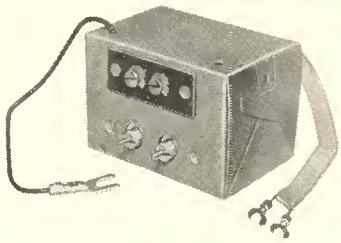

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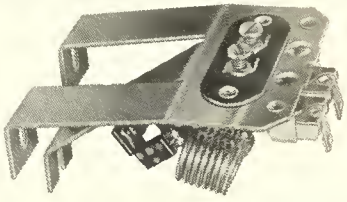

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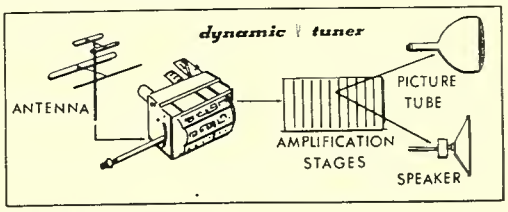

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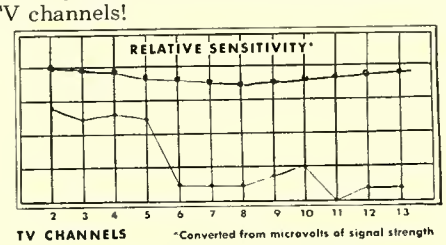

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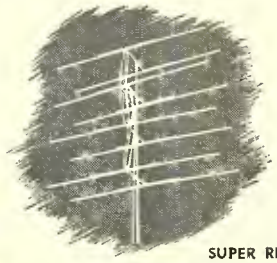

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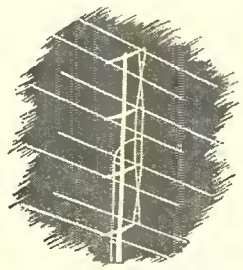

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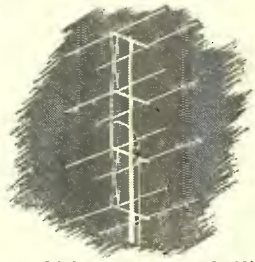

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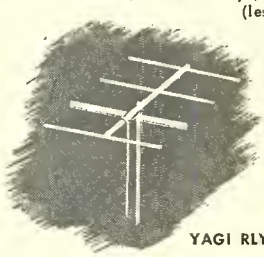

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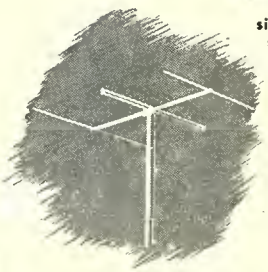

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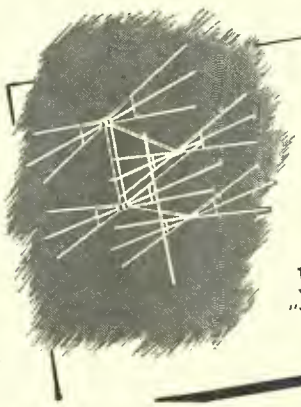

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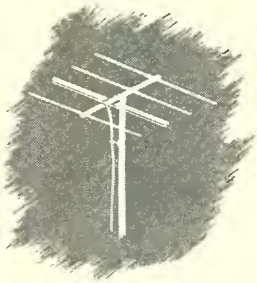

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Spot Radio News

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

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

COLOR TV, a year ago in quite a hopeless state, sharply criticized by most as an impossible medium for the present and perhaps for many years, now appears to have emerged from that completely dismal condition and become tinged with a few rays of hope. The fringe glow began to hover about the horizon as those breathlessly-awaited reports of industry were filed with the Commission. For the first time, there was one optimistic note in all the briefs, and that concerned the *dating.* All three proponents—*RCA, CBS,* and *CTI*—agreed that color TV should be commercialized immediately. But, and here is where the rosiness of the glow began to show signs of paling, the briefs disclosed that each system developer insisted that his method was a superior one and should be adopted, an argument that most felt would eventually stymie decision rendering for more months than anticipated. While everyone expected that staunch support for each of the proposed ways and means for solving the color war would prevail, there was a general feeling that some compromises might be effected to avoid any further hectic debate and consequent delay in a final edict.

Each of the three aspirants for the red, green, and blue prize submitted husky volumes in defense of his ideals. The *RCA* story appeared in what will probably become an historic technical document, a 200-page book, covering practically every aspect of the situation to date.

Presenting the case for the dot-interlace system, the Commission was told that . . . "Standards based on the *RCA* system may be adopted which will give the greatest potential for the speedy development of a commercial color service now and for future improvement without disruption of present or future black and white service, and without future disruption of the color service. . . . The record establishes that the *RCA* system is free from color breakup, fringing, and flicker. Neither dot structure nor small area flicker or crawl is perceptible at a viewing distance where the line structure of an ordinary black and white picture is not resolved."

In rows of pages devoted to a critical commentary of other systems, particularly the one proposed by *CBS,* the report covered every characteristic of method operation. Detailing the problem of compatibility, *RCA* declared that: "The *CBS* statement . . . that the problem of compatibility is 'merely transitional' cannot serve to obscure the real significance of compatibility. *CBS* seeks to minimize the importance of continuing black and white reception to present owners of receiving sets by calling the problem 'transitional.' *CBS* has, however, no suggestion which would enable the Commission to keep faith with the more than six million owners of black and white receivers, other than the unjustifiable expense of unsatisfactory adapters and an 'obsolescence' which is wholly without support."

Continuing in its tirade, the brief said that . . . "*CBS* claims that 'within a few years' the problem of incompatibility will disappear. This statement underscores in a dramatic way the real importance of compatibility. That is, to make it economically possible for all broadcasters to give the public color now; not 'within a few years.' "

Recalling the early days of TV, when many criticized the adoption of the present black and white electronic method, *RCA* pointed out that there were those who claimed . . . "it was impossible to attain the goal of 6,660,000 picture elements per second on a practical basis. . . . However the fact is that the 6,660,000 picture elements per second . . . has been attained . . . on a practical basis. . . . So, too, the nearly 867 hours of color broadcasting time on *RCA* color standards . . . over WNBW and . . . KG2XCL bear witness to the fact that the *RCA* color system is practical for day-to-day broadcasting operations."

In a review of the possibilities of the three-gun, tri-color tube, as used in the *RCA* setup, employing circuitry which bypasses the mixed highs and eliminates the dot component after sampling in the picture signals, the report declared that . . . "each of the three electron beams is available 100% of the time for each color, whereas when this tube is used in the *CBS* system, each electron is available only 33% of the time. . . . Accordingly the available light from the

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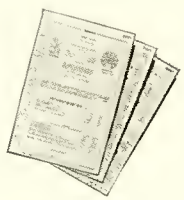

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tri-color tube can be up to three times greater for the *RCA* system than for the *CBS* system."

Reviewing the problems of resolution, the report said . . . "At a viewing distance of eight times the picture height, a viewer . . . can enjoy more vertical and horizontal resolution (430-line vertical and 340-line horizontal) with the *RCA* system . . . than is provided by the *CBS* color system at any viewing distance."

Disc-type receivers were subjected to quite a sequence of scathing comments in the FCC brief, which declared in part . . . "Another defect of these disc receivers is reflected in the *CBS* operating manual. . . . In the manual it is stated . . . 'Caution . . . do not move receiver while it is in operation.' . . . On cross-examination of Dr. Goldmark, it was brought out that this warning was made because Dr. Goldmark feared that if the receiver was moved suddenly, the whirling disc would scrape the inside of the housing and be scratched. . . ."

During the hearings, the subject of adapters was quite a topic, with scores of witnesses appearing to testify as to costs, date of delivery, and their general usefulness. *CBS* had contended that external adapters would be a simple item, while *RCA* implied that the application was replete with difficulties, economical and technical. Elaborating on this point in their present report, *RCA* said: "In the light of the complexity and the cost to the public of adapting existing receivers to receive *CBS* color in black and white, and if only on this basis alone, the Commission should reject the proposed *CBS* system. Because of the complexity and cost of adaptation, many present owners of television receivers probably would not adapt their receivers and would thus be deprived of service which is now available to them. For *CBS* to urge that color service is, from this point of view, an addition to the black and white service now offered on presently authorized channels, would be either to attempt to mislead the Commission or to reveal a lack of faith in their own proposals. If incompatible color is merely to supplement black and white programming on present channels and is to be confined to off-hour broadcasting indefinitely, then the Commission should not authorize the service. . . . If, on the other hand, incompatible color can fairly be expected to grow and eventually replace black and white programs during desirable broadcasting hours, owners of existing receivers will be deprived of service unless they adapt those receivers. . . . On the basis of *CBS* figures (estimates for external adapters ranging from $32 to $50) the cost of adapting the more than six-million receivers now in the hands of the public would be on the order of $192,000,000 to $300,000,000."

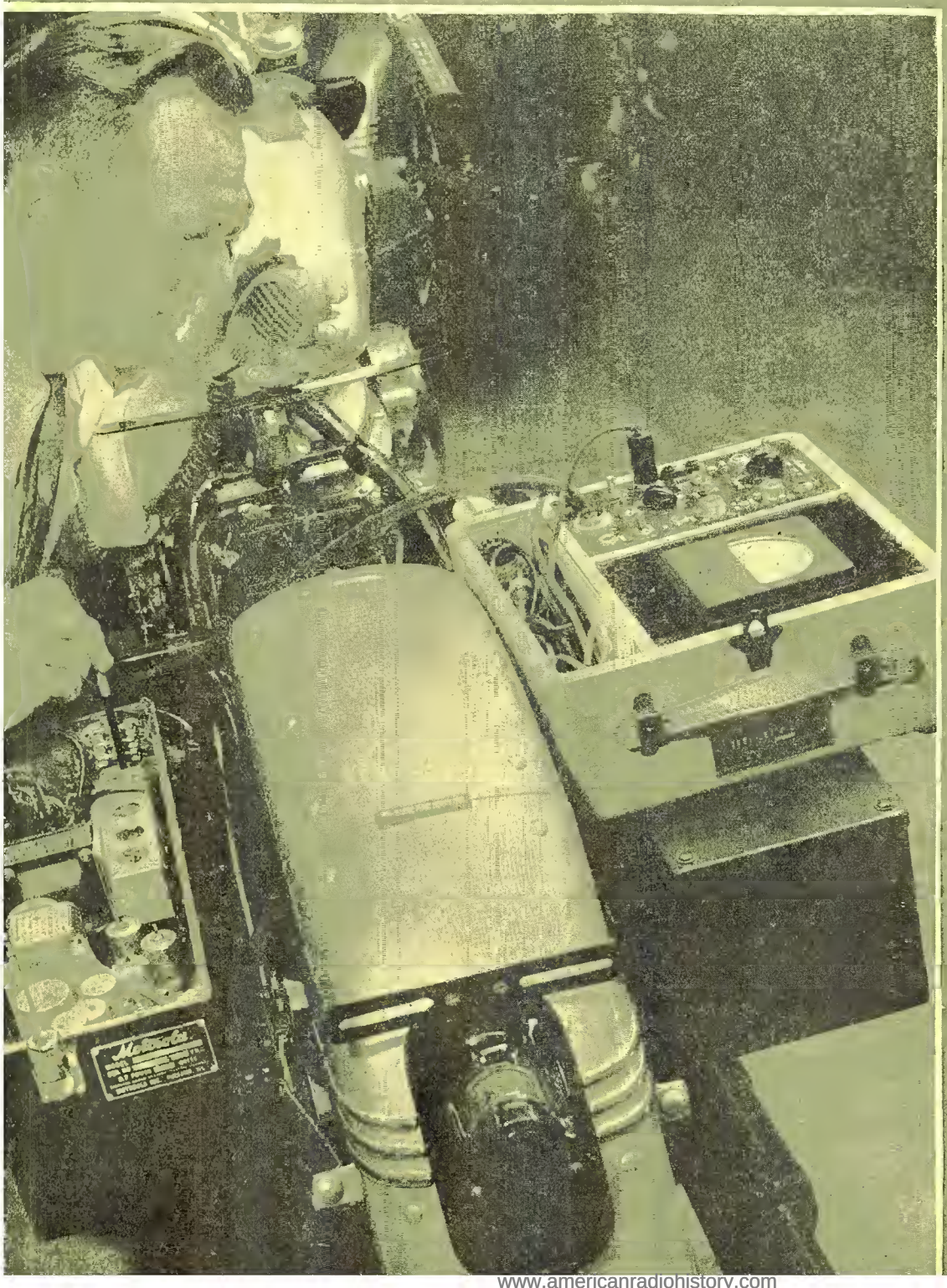
CBS was far from docile in its re-

(*Continued on page* 106)

SEPTEMBER, 1950

RADIO & TELEVISION NEWS

RADIO-ELECTRONIC *Engineering*



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VARIABLE PULSE WIDTH VOLTAGE CALIBRATOR.....Ralph H. Baer 8A

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VOLUME 15, NUMBER 3,

COVER PHOTO—Courtesy of Harley-Davidson Motor Co.

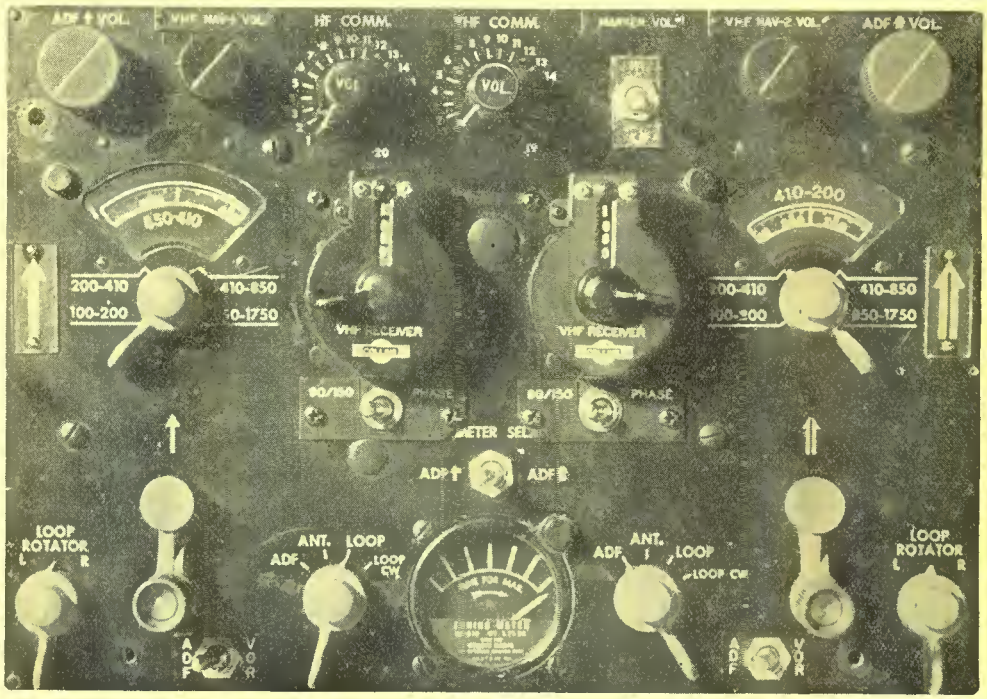
Victor Sierpinski, radio engineer at the Harley-Davidson Motor Co., Milwaukee, Wis. aligns the antenna circuit on the transmitter portion of the 2-way FM Motorola radiotelephone mounted on a police motorcycle. Over 500 police departments are using 2-way FM radiotelephone on motorcycles.

RADIO NAVIGATION EQUIPMENT

By

JOHN P. GRIFFIN

Northwest Airlines, Inc.



Radio control panel with the VOR selectors in the center.

Part 1 of a 2-part article discussing various electronic equipment used in air navigation.

ONE of the most interesting of air navigation techniques is that employed in the use of VOR (Visual Omni-Directional Range) equipment. A pilot has merely to fly so that a meter needle, known as a Deviation Indicator, remains centered and he will head directly toward the station he is receiving or he will be flying away from the station on a radial he has chosen.

If his ship is equipped with an electronic autopilot he has only to flip a switch and enjoy automatic flight over any airway where VOR ground stations are installed. Upon approaching his destination, tuning the VOR receiver to the local ILS (Instrument Landing System) station will supply signals to the autopilot which will bring the ship down through the heaviest overcast, in line with the runway and at the correct glide angle for a perfect landing.

Visual Omni Range stations are rapidly being commissioned and eventually will replace the four course high frequency range now in general use throughout this country.

For the sake of a foundation upon which to build a discussion of VOR, let us review the principles involved in the presently used h.f. range system.

The radiation pattern transmitted by an h.f. range station consists of four quadrants, each identified by continual transmission of either the letter *A* or *N* in code. As shown in the sketch in Fig. 2A, adjacent quadrants are identified by different letters. Down the center line of the overlap zone the dash-dot of the *N* blends with the dot-dash of the *A* to form a continuous tone and thus establish a course. These courses or legs, as they are more familiarly known, can be set at any convenient angular relationship to each other at the ground transmitter.

Inherent in this type of range are many disadvantages, prominent among which are the vagaries peculiar to low frequencies; atmospherics, night effect, bent beams, multiple courses, etc. Another and probably the most serious disadvantage is the time consuming and complicated procedure necessary for a lost pilot to orient himself. For example, a pilot receiving an *N* signal would have no way of immediately determining which of the *N* quadrants he is flying in.

A pilot in an airplane equipped with ADF (Automatic Direction Finding) would find his bearing indicator needle pointing toward the station and he could fly toward the station merely by following the needle (homing). His track over the ground, however, would be influenced by cross wind and would not necessarily be a straight line. He could fly a more direct route to the station by rotating the compass card on his ADF indicator, noting his bearing to the station as indicated by the ADF needle, and using that bearing to fly toward the station. If he chooses, the pilot can head his airplane toward the nearest leg and fly that leg to the station.

In order to overcome these difficulties a new type of range was developed which utilized v.h.f. and which gave the pilot an immediate and unmistakable indication of his quadrant. It is known as VAR (Visual-Aural Range) and is so named because the signal from two of its courses is made to operate an indicator while the signal from the other two is aural.

Overlapping of two patterns establishes the visual courses. The patterns are frequently described as essentially cardioid shaped but as is apparent from Fig. 2B, more closely resemble a pair of kidneys. One sector is designated blue, the other yellow and each has a characteristic modulation: blue—90 cycles, yellow—150 cycles. This relationship is maintained in all cases including ILS which is the same type of signal. In fact the same indicating instrument is used for both.

Fig. 2C shows that since no two quadrants give the same combination of signals, instant identification is possible.

At the time this was written only 70 visual-aural ranges were being operated by the CAA. The program was halted when it became apparent that the new type facility, VOR, had reached the practical stage of development.

Instead of just four range legs, the VOR station transmits a theoretically infinite number of radials, any one of which the pilot can choose to home on without the necessity of making bearing calculations. Moreover, he can maintain his heading with greater accuracy since the information can be presented

VOR installation in NWA aircraft showing ADF receivers on lower shelf.

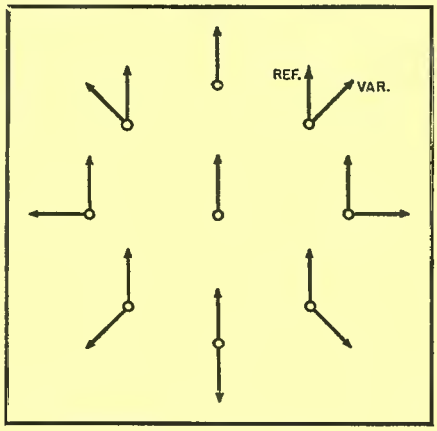


Fig. 1. Vectors of the reference and variable signals.

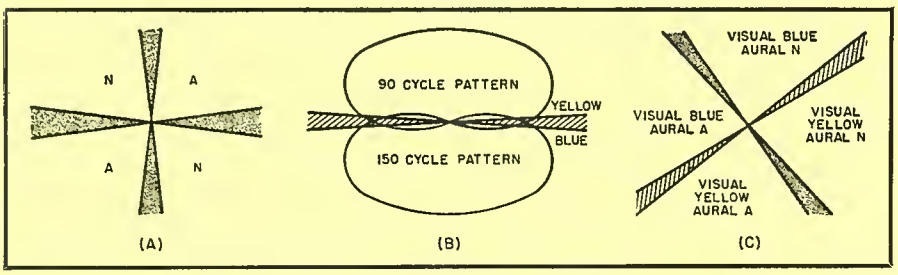
on the ILS deviation indicator whose needle movement is large for small changes in aircraft position.

In addition to the ILS deviation (cross pointer) indicator, the modern airplane is equipped with a Master Direction Indicator (MDI), a flux gate or valve for sensing the airplane's position relative to the earth's magnetic field, and a dual ADF system.

As is evident from Fig. 7 the RMI (Radio Magnetic Indicator) has two needles and a rotatable compass card. During the interim period between nation-wide installation of VOR stations and the decommissioning of h.f. ranges, the RMI needles in most installations are switchable from VOR to ADF. The RMI card is driven by amplified signals from the flux valve and therefore presents information about the airplane's heading relative to magnetic north. Presentation of VOR information on the ILS deviation indicator is accomplished by other switching arrangements.

The VOR ground station in effect transmits an infinite number of radials, any one of which can be selected by the pilot and flown by means of the vertical pointer on the ILS deviation indicator. Although the present four course range can be flown in a similar manner by homing on the ADF needle, the deviation indicator presents a more accurate indication of deviation and can be used as a vernier supplementing the ADF type of information.

Fig. 2. (A) Four course high frequency range. (B) Radiation pattern for visual courses. (C) VAR range showing quadrant identification.



Transmitted Signal

A pair of antennas—whose radiation pattern when energized in phase opposition simultaneously is a figure eight—is fed by a transmitter through a goniometer (1800 r.p.m. motor-driven capacitor).

As a result of the constant change of capacity, a pattern builds up and decays 30 times per second. Another pair of antennas situated at right angles to the first pair sets up a similar pulsating pattern but with a 90 degree phase difference. The revolving capacitors are driven by the same shaft and are fixed 90 degrees apart circularly.

Rotation of the goniometer has the following effect: When the field due to one pair of antennas is maximum, the field from the other is minimum. When one field begins to decay, the other begins to build up. The fields are additive and will always produce a resultant field whose position will be dependent upon the relative magnitude of its components.

At the position where one field begins to decay and the other begins to build up, Fig. 5C, the slightly less than maximum number one field adds to the slightly more than minimum number 2 field and the resultant is a maximum field a few degrees displaced from the starting point, Fig. 5D.

For each decrease in one and increase in the other there occurs a proportional rotation of the resultant figure eight field. The over-all result is a single figure eight field rotating at 30 c.p.s. (1800 r.p.m.).

A fifth antenna is placed equidistant from the other four and is made to radiate a non-directional pattern. Since the two lobes of the figure eight pattern are opposite in phase, one of them will be in phase with the non-directional pattern and additive, the other will be out of phase and subtractive, Fig. 5E. One lobe will thereby be enlarged and the other reduced. The resultant pattern will approximate a revolving cardioid, Fig. 5F.

Transmission Principles

A receiving antenna at any point within the range of the transmitter would be energized with a 30 c.p.s. voltage varying sinusoidally from zero

to maximum to zero with each sweep of the revolving field. Assume there is a 30 c.p.s. oscillator at the receiver and in phase with the receiver antenna voltage. The frequency of the oscillator remains fixed and if the receiver is moved in any direction other than to or from the transmitter, there will occur a shift in phase between the oscillator frequency and the frequency of the receiver antenna voltage. This is so because the receiver and its antenna have moved to a point where the revolving pattern encounters the antenna and starts a cycle either sooner or later, depending on which direction the receiver and its antenna were moved. The phase of the 10 kc. carrier does not vary with azimuth. If this phase difference were made to operate a zero center deviation indicator, then movement on any path other than toward or away from the transmitter would result in a needle deflection either to the right or to the left of zero. As long as the indicator needle reads zero the path is either to or from the transmitter.

Instead of a fixed oscillator at the receiver, the non-directional center antenna transmits a fixed 30 c.p.s. voltage, called Reference Voltage, which is used for comparison with the induced antenna voltage, called Variable Voltage, Fig. 1.

In order to accomplish separation of the two signals at the receiver, the 10 kc. signal (actually 9960 cycles) which the center antenna radiates, is frequency modulated with the 30 cycle reference voltage. When the rotating pattern reaches north, the 10 kc. signal starts a new cycle. Thus the relation —the phase separation—between the two signals at any one point around the transmitter remains fixed. The receiver has then only to separate a frequency modulated signal from an amplitude modulated signal. In order to retain the advantages of v.h.f. and avoid the necessity of having two r.f. sections in the receiver, the 10 kc. signal is not a carrier in itself but modulates the amplitude of a v.h.f. carrier 30 per-cent. The v.h.f. carrier can also be modulated 30 per-cent by voice.

Fig. 3 shows the Omni-Bearing Selector. The figures in the window of the Selector are set up by the knob on the right. These figures indicate the selected track—the ship's bearing from the station. If the figures in the window read zero and the ship is on radial 315 there will be a phase difference between the reference and variable signals of 315 degrees. By turning the knob, the phase shift can be reduced to zero and the figures in the window will then indicate through what angle the variable phase had to be shifted in order to reduce the difference to zero. If the deviation indicator is connected to the receiver output it will now be centered and will remain so as long as the selected radial is flown. Any needle position to the left of zero indicates that the airplane has to be flown to the left to return to its course.

During the time of flight to the station, the TO-FROM indicator on the Omni-Bearing Selector remains in the TO position. Upon passing over the station it changes to FROM thereby acting as a marker. If now the airplane is turned and headed back to the station on the same radial, the heading will become the reciprocal of 315. By turning the knob on the left of the Omni-Bearing Selector, the window openings will change and 135, the reciprocal, will appear. The action of changing the window also reverses the connections to the TO-FROM indicator which will then read TO. Connections to the deviation indicator are also reversed and sensing remains normal.

Fig. 7 illustrates the Radio Magnetic Indicator. This instrument operates in a manner identical to the ADF indicator except that the magnetic scale card instead of being adjusted by hand is automatically and continuously adjusted by means of amplified signals from the flux gate. Thus magnetic bearing is continuously available. By utilizing a switch on the radio control panel, either the single or double pointer needles can be connected to either VOR or ADF. The illustration depicts a condition in which the double pointer needle is being actuated by the signal from a station whose magnetic bearing from the aircraft is 206 degrees. The bearing of the aircraft from the station is the reciprocal, 26 degrees. In other words, the aircraft is north-northeast of the station. The heading of the aircraft as read at the top of the dial is 256 degrees.

Fig. 3. Omni-Bearing Selector.

With the equipment described, it would only be possible to obtain a fix by triangulation and then only if two or more stations could be received. Distance Measuring Equipment (DME), now in the process of development, will present to the pilot a simple meter indication of his distance from a selected ground station with an ac-

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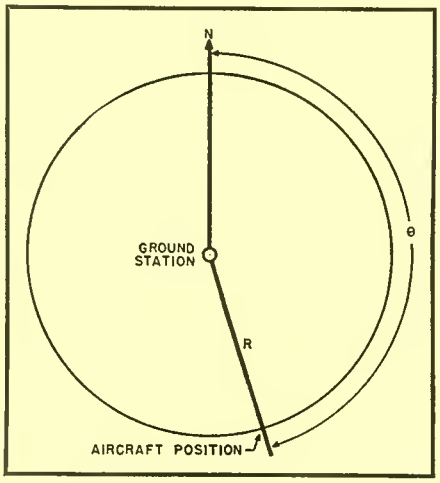
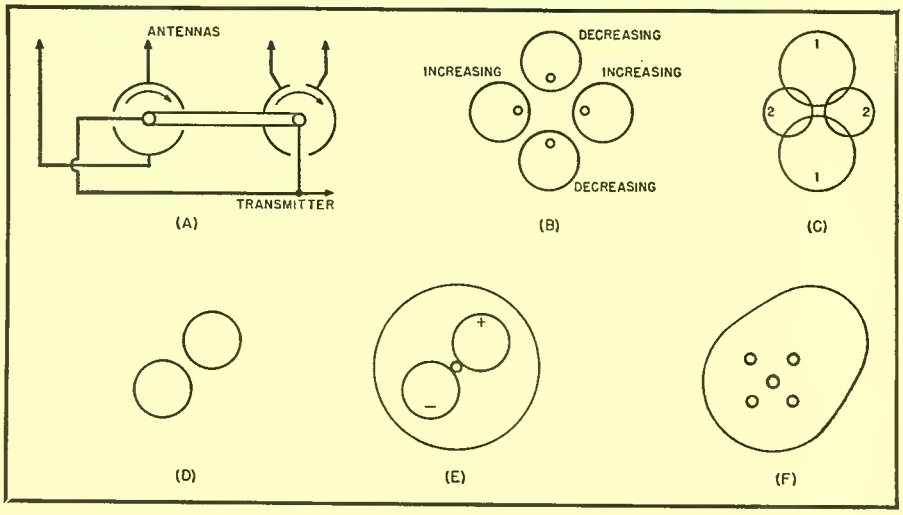


Fig. 4. R-Theta information.

Fig. 5. (A) and (B) Goniometer and its effect on radiation pattern. (C) No. 1 field decreasing, No. 2 increasing. (D) Resultant field, displaced. (E) Another field added by center antenna. (F) Resultant field.



TV Impulse Interference Generator

By JOHN D. FOGARTY

Senior Engineer, Research Div., Philco Corp.

A device for generating controllable impulse noise for simulating action of ignition noise on TV sets.

THE purpose of the equipment described in this paper is to generate controllable impulse noise which will simulate the action of ignition and other such impulse noise on television sets. Its use enables comparative tests to be made of the effects of varying amounts of noise on different types of synchronizing circuits.

Introduction

Using the Television Impulse Interference Generator, an impulse can be placed anywhere in the television picture and in the synchronizing regions. Pulses are made in a vertical group of variable length, one pulse per line recurring on each successive line for the duration of the group. The pulses occur one below the other; that is, the horizontal positioning of each pulse is the same on every line. The group length can be varied from 1 to 150 pulses. The pulse groups recur once every frame; that is, on alternate fields.

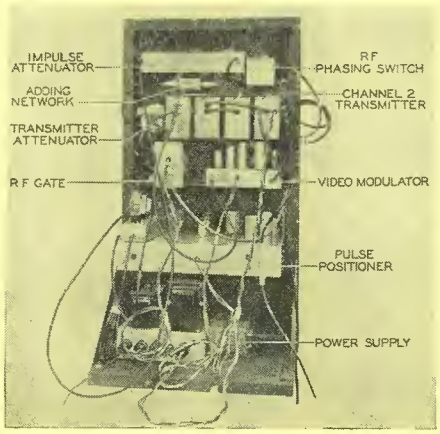
The amplitude of the transmitted signal and the noise impulses can be controlled independently. The phase of the r.f. carrier of the impulse envelope with respect to the transmitter carrier can be adjusted so that the impulses add or subtract from the signal, thereby creating black or white noise.

It is known that the frequency spectrum of man-made impulse noise is continuous up to at least 600 megacycles. Since a television receiver has a bandpass of about six megacycles, it is only necessary for the impulse noise to have frequency components within its passband. In this generator, the noise impulse consists of a burst of r.f. carrier 0.1 microsecond in duration. A pulse of this width is beyond the resolving power of the receiver, and so produces an action similar to that of a noise spike.

In this device, the noise impulse is generated by putting part of the video carrier through a gated amplifier and then feeding it into the receiver input through an attenuator and a phasing control. The transmitter is fixed-tuned to Channel 2 only, because the receiver's action on one channel is indicative of its response to noise on the other channels.

Since only Channel 2 carrier is used for the impulse noise, the r.f. phase of the carrier burst with respect to the transmitter carrier is controlled by inserting different lengths of delay line between the gated amplifier and the mixing box.

Fig. 1. Rear view of the TV impulse interference generator.



Description of Units

Rear and front views of the interference generator are shown in Figs. 1 and 6; Figs. 2 and 3 show simplified block diagrams of the equipment.

a. Television Transmitter

The television transmitter used in this equipment was originally a crystal controlled r.f. section built for Channel 1, but was modified as a self-controlled unit tuned to Channel 2. It contains a self-controlled oscillator feeding a buffer amplifier. Part of the output of the buffer amplifier is fed to the final video stage and part of it goes to the gated amplifier which generates the impulse bursts. After the final video amplifier there is a step attenuator for varying the output of the transmitter.

The transmitter contains a final audio amplifier to generate a sound carrier. The use of the sound carrier in this equipment is simply to aid in tuning the receiver being tested or to hold the automatic frequency control if the receiver has one.

b. The Modulator

The equipment contains a video modulator for use with the television transmitter. This modulator unit contains video amplifiers, and the percentage-modulation and black level controls. The modulator is fed with a composite video signal of one volt peak-to-peak with the sync down. This signal can be obtained from the laboratory line or from the output of another receiver operating on an air signal.

c. R.F. Gate

The r.f. gate provides the pulse and is a grounded-grid amplifier with the grid biased below cut-off. The carrier r.f. from the transmitter is fed into the cathode of the gated amplifier which is biased much beyond tube cut-off, and the 0.1 microsecond trigger pulse is applied to the grid to raise the tube to conduction. The output circuit of the gated amplifier is a heavily-damped tuned circuit whose bandpass is about 15 megacycles between half-power points. The gate output is a 70-ohm coaxial line. The output line which goes to the impulse attenuator is a long coaxial line cut so that the r.f. phase comes out properly.

d. Impulse Attenuator

This attenuator is built of resistive T-sections which can be switched in and out by means of toggle switches. A total of 80 db. of attenuation is available in one db. steps.

e. R.F. Phasing Switch

This is a three-position switch and in the zero-degree position the circuit is straight through the switch. Carrier

bursts from the r.f. gate go through the length of line into the attenuator, and are impressed on the carrier of the transmitter. By turning this switch, a quarter- or half-wave length of coaxial line may be connected into the gate output. This enables one to vary the r.f. phase relationship between the carrier bursts and the transmitter carrier from zero degrees to 90 degrees and to 180 degrees. Hence, in-phase and out-of-phase impulses can be generated, giving black or white impulse noise, depending also on the amplitude of the impulse with relation to the transmitted signal. The transmitter picture signal and the burst of impulse noise are added together in a resistive adding network which provides a 70-ohm coaxial output to the receiver on test.

f. Pulse Positioner

The composite video signal used with this apparatus is also fed into the pulse positioner. Here it passes through several video amplifier stages into a sync separator stage of the same type that is used on conventional receivers. See the block diagram in Fig. 5 and the waveforms shown in Fig. 4. The horizontal synchronizing pulses from the sync separator go through a horizontal blocking oscillator. The vertical sync pulses from the sync separator go through a relaxation oscillator, which is here called the vertical pulse alternator, because it only fires on every other one of the vertical pulses. This vertical alternation enables the impulse group to be put on every frame, that is, on alternate fields. The vertical timing pulses from the vertical alternator go into a cathode-coupled multivibrator which is used for the vertical positioning of the group. These timing pulses trigger the cathode-coupled multivibrator, which in turn produces an output pulse a variable length of time afterwards. This timing pulse next goes into the group-length multivibrator, another cathode-coupled multivibrator whose output is in the form of a pedestal with a variable length, starting when the output of the vertical positioning multivibrator hits the next stage.

Let us now consider the horizontal sync pulses. After coming through the blocking oscillator, the output pulses next go into another cathode-coupled multivibrator which provides a continuously variable delay from about 10 to 15 microseconds up to 40 microseconds so that they can cover about half the picture width. There is also available another fixed multivibrator which provides about half a line of delay. By use of these two delaying multivibrators, the pulse group can be positioned anywhere horizontally on the picture and through the horizontal sync

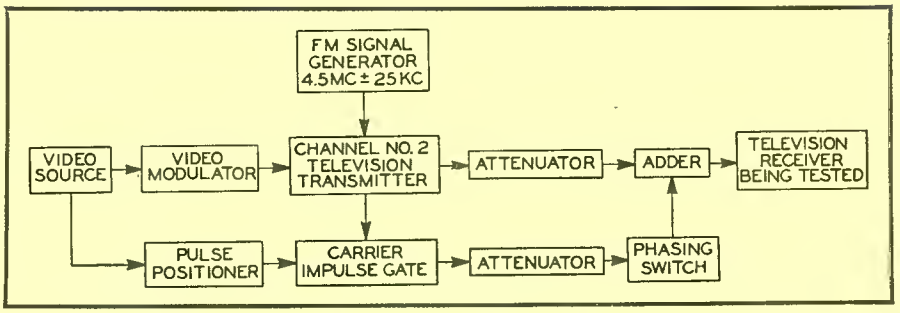


Fig. 2. Block diagram of the television impulse interference generator.

region of the transmitted signal. These delayed horizontal pulses and the vertical group-length pedestal are both fed into the group-length gate tube whose output consists of the horizontal timing pulses, a group of pulses coming out whenever the group-length pedestal is applied to the gate. This group of timing pulses is then amplified through a trigger amplifier and is applied to the pulser stage. This is simply a thyratron line-driven pulser which provides the 0.1 microsecond triggering pulse for use by the r.f. gate. Thus, the pulse positioner unit provides the 0.1 microsecond triggering pulses to the carrier burst gate in such a way that the impulses can be positioned on the picture of the television set being tested.

g. Power Supply

A standard laboratory power supply is used that provides 250 volts of B+ voltage which is regulated and —30 volts of bias voltage which is not regulated. The plate current drawn by the entire interference generator is about 175 milliamperes.

Operation

A composite video signal is required to run the transmitter modulator and to provide timing pulses for the pulse positioner operation. This video signal should be one volt peak-to-peak with the sync down. This can be obtained from the laboratory line or from the output of another television receiver which is picking up a signal off the air.

A *Boonton* FM signal generator was employed to provide sound carrier for the transmitter, because 0.7 volt output at 4.5 megacycles (± 25 kc.) could be obtained with 400 cycle modulation.

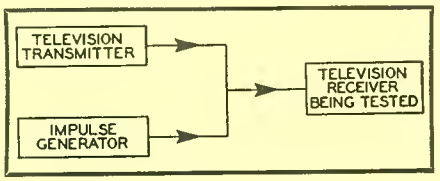


Fig. 3. Simplified diagram of operation.

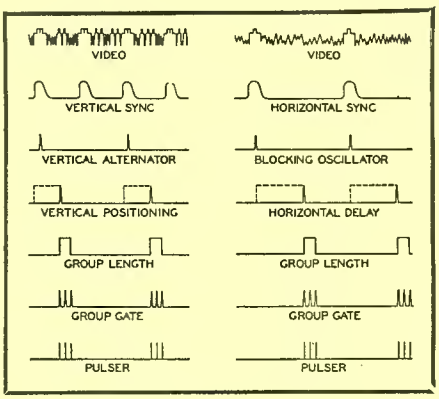


Fig. 4. Pulse Positioner waveforms.

The impulse interference generator is connected to the receiver on test by a 70-ohm coaxial line. For receivers having a 300-ohm balanced line input, a half-wave coaxial matching transformer may be used.

After power supply adjustments have been made, the next step is the adjustment of the transmitter and modulator. The transmitter output depends on the setting of the ladder attenuator on the front of the transmitter panel and upon the adjustment of the black level voltage to the modulator. The peak amplitude of the sync pulses is held constant in the transmitted signal. A percentage

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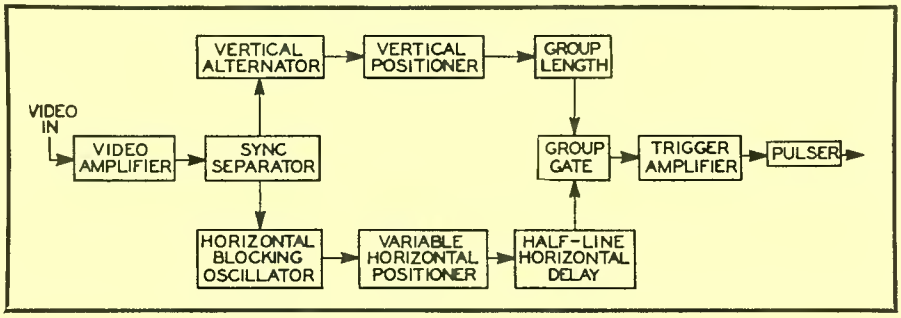
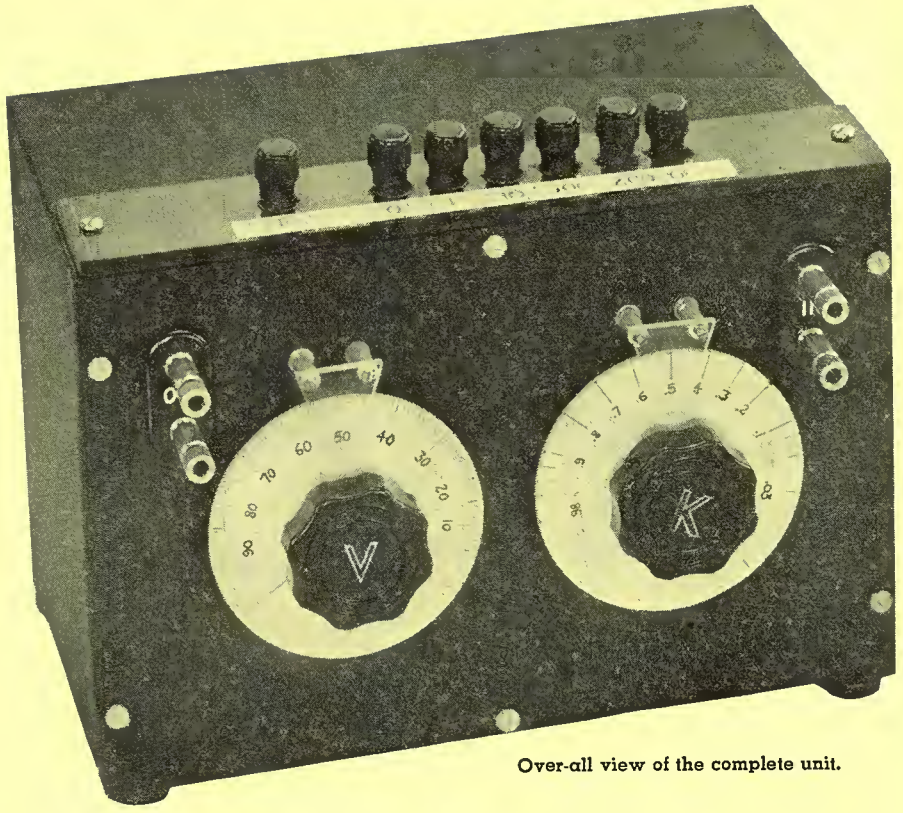
Fig. 5. Block diagram showing components of the pulse positioner.



VARIABLE PULSE WIDTH VOLTAGE CALIBRATOR



Over-all view of the complete unit.

By **RALPH H. BAER,** Chief Engineer
Wappler, Inc., New York

This unit provides an output of variable amplitude and adjustable zero reference line for calibrating oscilloscopes.

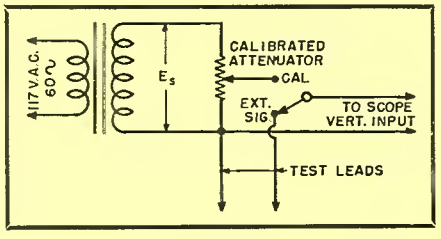
EFFECTIVE laboratory and production use of cathode-ray oscilloscopes generally calls for the employment of accessory devices in considerable numbers. Low-capacity probes, time marker generators for x-and z-axis calibration, peak limiters and voltage calibrators are familiar examples of such instruments. Of these the voltage calibrator is the most indispensable aid in the development and production testing of electronic equipment. The calibrator effectively converts the oscilloscope into a high-impedance voltmeter capable of accurate quantitative measurements over wide amplitude ranges and irrespective of waveform.

Basically, voltage calibrators provide a signal of variable amplitude which may be substituted for the signal under investigation and adjusted for identical peak-to-peak deflection on the CRT screen. Calibrated attenuators or meters then provide a direct indication of the signal amplitude. An elementary type of voltage calibrator may take the form of Fig. 1. Power line frequency sine wave signals and a potentiometer calibrated in fractions of E_s are substituted for the waveform under observation. A practical version of this circuit is shown in Fig. 3. Calibrations will hold for any oscilloscope with an input impedance exceeding one megohm. The instrument is initially calibrated by varying R_1 and R_2 with switch S_1 in the 500 v. and 1 v. positions respectively.

Simple calibration instruments of the type described above suffer from two practical disadvantages: lack of accuracy due to line voltage variations and alignment ambiguity. Due to the low rate of amplitude change of a sine wave near its maximum excursions it is difficult to line up the calibrating signal peaks with the desired horizontal lines on the transparent coordinate grid customarily attached to the CRT screen. For this reason commercial calibrators deliver square waves or flat-topped, clipped sine waves. In addition, some stable voltage reference such as a gaseous VR tube is used to maintain the initial calibration independent of line-voltage changes. A circuit of this type is shown in Fig. 4. In this arrangement the sinusoidal signal applied to the attenuator is limited on both peaks to a value equal to one-half the VR operating voltage. R_4 is selected to give some convenient peak-to-peak voltage value for the maximum range which lends itself to simple decimal reduction by means of the attenuator switch S_1.

A convenient procedure for rapid measurements with calibrators of the symmetrical square wave type is the preadjustment of the oscilloscope gain controls to yield a suitable unit deflection per scale division. For example,

Fig. 1. Basic voltage calibrator circuit.



if it is expected that signals of less than 100 volts peak-to-peak amplitude will be encountered, the voltage calibrator would be set to the 100-volt range and the oscilloscope trace adjusted until its maximum excursions coincided with two horizontal reference lines on the coordinate scale. After this the gain controls are left in place and signal amplitude determined from the number of grid subdivisions between peaks. This method works out very well whenever the effects of minor adjustments on the scope waveform are studied or when signals of the same order of magnitude are involved. Measurements are then reduced to an adjustment of the vertical centering control to position the trace with respect to the grid so as to permit quick interpolation.

For many oscilloscope applications this procedure is inadequate; on one hand widely varying signal levels are usually encountered as different portions of the equipment or individual circuit are approached; on the other hand, visual interpolation between grid lines does not particularly lend itself to accuracy. Furthermore, any vertical nonlinearity of the oscilloscope introduces an additional error into the measurement. A direct comparison method will lead to greater precision. Switching from the signal being scoped to the voltage calibrator and adjusting the latter for identical peak-to-peak amplitude makes it possible to read the signal level directly from the calibrated attenuator without possibility of error. In pulse circuit development this direct comparison method is frequently found most convenient as the test probe is moved from point to point in a physical circuit layout. Even when variations in waveshape or level at the same point are being studied where these changes are of a minor order of amplitude, the necessity for maintaining large screen deflection to obtain readable patterns of small detail means continuous readjustment of the vertical gain control. The use of the precalibration method is, therefore, automatically precluded. A new difficulty now arises. Dissimilarity of signal and calibrator waveforms necessitates the adjustment of the vertical centering control each time the calibrator is switched to the oscilloscope input, and once more when the latter is switched back to the signal under test. This condition results from the axial dissymmetry of most pulse waveforms, resulting in the familiar baseline shift common to all oscilloscopes using resistance-capacitance coupling in the vertical amplifier. It will be remembered that this effect is due to the fundamental requirement that the current into a coupling condenser such as that shown in Fig. 2A must equal

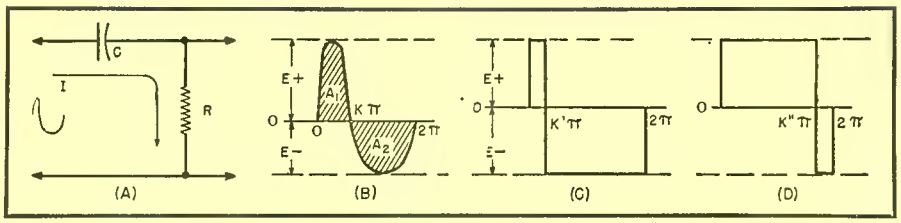


Fig. 2. Baseline shift of assymetrical waveform (B) after passing through R-C network (A). Waveforms in (C) and (D) will produce opposite baseline shifts which are proportional to K.

the current out of the condenser, averaged over each complete cycle. Hence the quantity of charge and discharge Q must also be zero. But:

$$Q = \frac{1}{C}\int I dt \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Since the integration indicates area under the curve it follows that areas A_1 and A_2 must be equal in order to prevent a residual charge on C at the termination of a cycle. Hence, from Fig. 2B:

$$\frac{1}{C}\int_0^{K\pi} I dt = \frac{1}{C}\int_{K\pi}^{2\pi} I\,dt \quad . \quad . \quad (2)$$

For nonsinusoidal signals Eqt. (2) can be true only if the current under the integral signs are different functions of time. Furthermore, if they are not symmetrical, their peak amplitudes $E+$ and $E-$ must be different and, in general, periods $0 - K\pi$ and $K\pi - 2\pi$ will not be equal. This suggests the use of a pulse waveform for voltage calibrators in which the sum of the positive and negative excusions $E+$ and $E-$ is constant but K is continuously variable as in Fig. 2C and D; to provide a high degree of practical utility it should be possible to vary K over wide limits. If the pulses have steep sides and flat tops it can be shown that the baseline shift is directly proportional to K. Hence, in order to produce upward or downward shifts of 90% of the peak-to-peak value (to compensate, for example, for the pattern displacement by a waveform consisting of a narrow exponential pulse), K must be capable of a 45:1 variation, both positively and negatively. With a voltage calibrator generating a pulse of this waveform, the calibrator output is adjusted for proper amplitude and shifted vertically by varying K, without necessitating the continuous readjustment of the oscilloscope centering control. In addition, calibrating the variable element producing the baseline shift directly in terms of K enables one to determine at a glance the relative amplitude of positive and negative excursions of any signal. This makes it immediately possible to determine the actual amplitude of either the positive or negative pulse with respect to zero reference

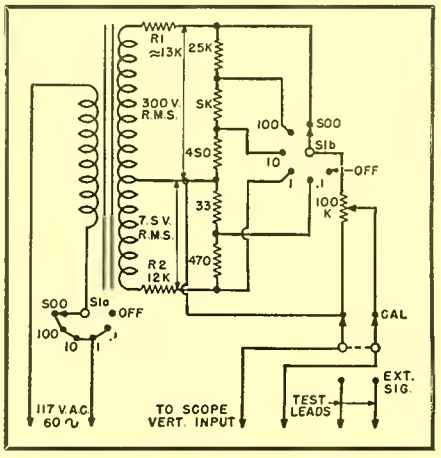


Fig. 3. Practical form of powerline frequency sine wave voltage calibrator with 500 v. max. peak-to-peak range.

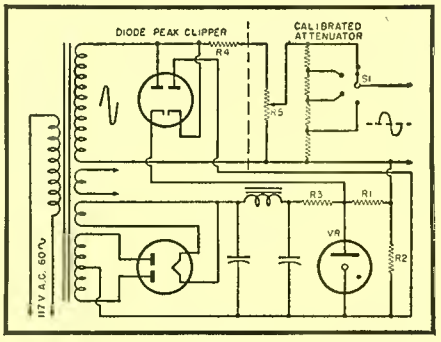
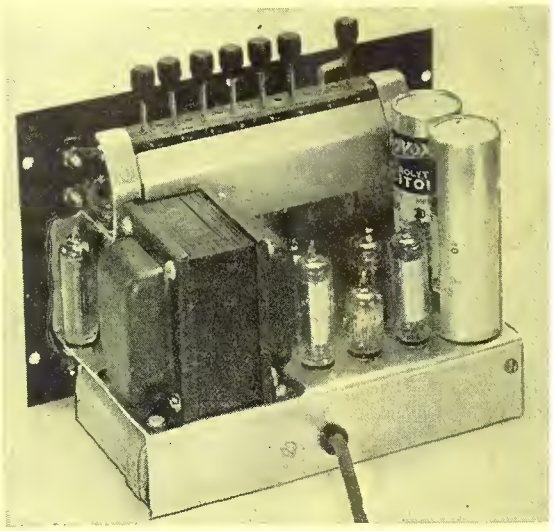


Fig. 4. Voltage-stabilized calibrator circuit for generating clipped sine waves.

Top rear view of calibrator.



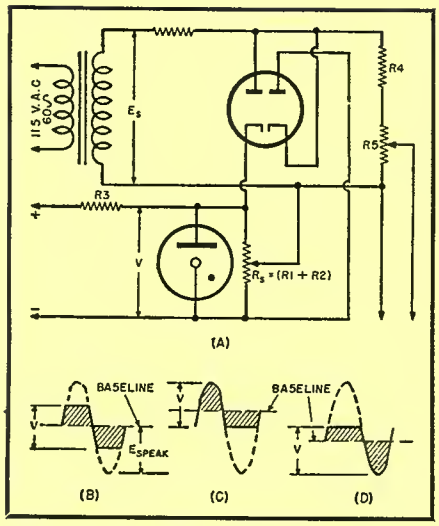


Fig. 5. Clipped sine wave generator (A) and output waveforms for (B) central setting of R_s and (C and D) for extreme settings of R_s.

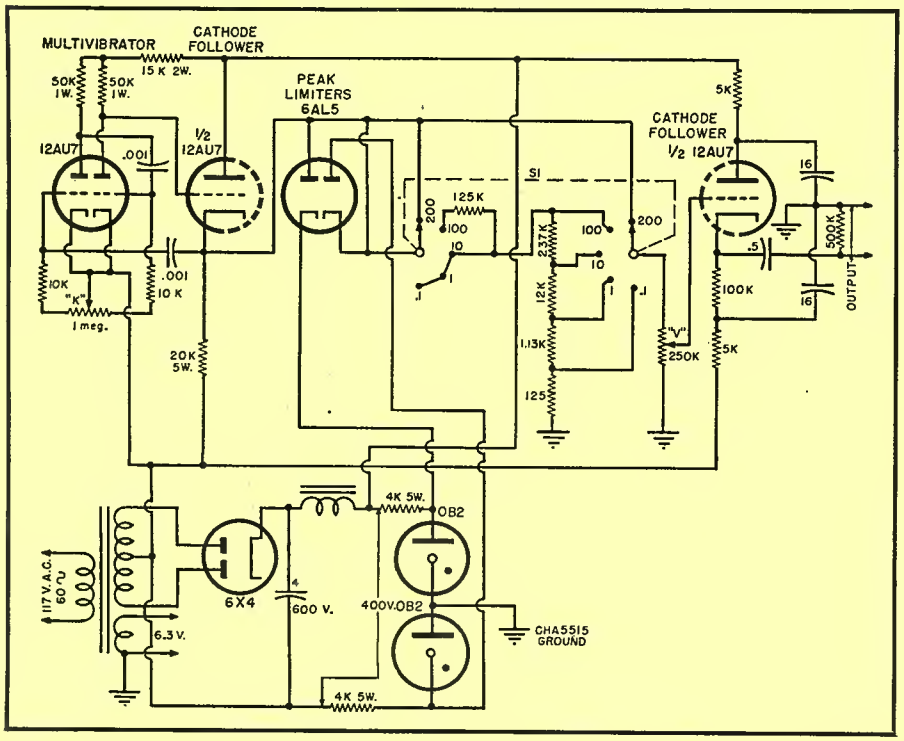
level, whichever may be of interest in the particular circuit application. For example, if a steep-sided pulse is to be positively peak-limited, used to synchronize a multivibrator, differentiated to produce a positive trigger, etc., the maximum positive amplitude is of more interest than the peak-to-peak value. The shift-control calibration eliminates the guess-work and the inaccuracy entailed in a visual estimate of an imaginary baseline which divides the waveform into equal areas and thus establishes the ratio of + to − peaks.

The design of a voltage calibrator operating along these lines may be approached in several ways. A simple variant of Fig. 4 will provide a limited range of baseline shift. The circuit is redrawn in Fig. 5 in which R_1 and R_2 have been replaced by potentiometer R_s capable of varying both clipping levels simultaneously with respect to the reference voltage V. If V is made equal to the peak value of E_s, the output at extreme settings of R_s will consist of half-wave rectified sine waves as indicated in Fig. 5. The maximum baseline shift obtainable when $V=E_s$=peak is 14% of the peak-to-peak excurison or a total of 28% as compared with a desirable maximum of 100%. Greater shifts are possible with extensions of this circuit, none of which have sufficient range or acceptable waveforms. The ideal waveshape of Fig. 2 (C and D) can best be approximated by an assymmetrical multivibrator. When the output pulse is taken from one of the plate loads of the multivibrator and the grid-to-cathode resistors are simultaneously varied in an opposite sense, pulse width changes over a range exceeding 95:1 can readily be obtained. However, while the positive leading edges are of acceptable steepness, the charging current of the coupling condenser through the plate load from which the output is taken gives the trailing edge of the negative pulse an exponential slope for low values of grid resistance. A low plate load will minimize this condition but a point is soon reached where oscillations cease or the output voltage falls below the required level. Inserting a direct-coupled cathode follower between the plate load and the condenser provides a low-impedance path for the condenser charging currents and improves the shape of the negative-going pulse considerably. The cathode follower is also a suitable driver for a pair of diode peak limiters of the type shown in Fig. 4 and Fig. 5. They will simultaneously square off the pulse tops and hold their maximum values to the limits determined by the bias.

A variable pulse width calibrator of this type is illustrated in Fig. 6. Use of a second cathode follower between the attenuator and the output of the calibrator permits high-impedance elements in the attenuator. Thus loading of the diodes becomes negligible and the wave tops are clipped perfectly. The low input capacity of the final cathode follower prevents degradation of the waveform at various attenuator settings. A pulse repetition rate of a few hundred cycles is satisfactory and aids in maintaining steep edges. Too low a frequency may result in flat top tilting due to falling off of the low-frequency response of the oscilloscope and thus sets the lower limit near one hundred cycles. The highly degenerative character of the final cathode follower maintains accuracy over wide ranges of load impedance and power line variations, the stage gain remaining fixed at 0.92. Use of two OB2 voltage regulator tubes limits the peak-to-peak amplitude at the output of the clipper to 206 volts, which is conveniently reduced to 200 volts by the cathode follower.

Baseline shift problems of a different nature are encountered with ordinary voltage calibrators when a direct-coupled oscilloscope is employed. Providing the calibrator output is axially symmetrical, the attenuator may be adjusted until the positive and negative peaks of the signal and calibrator coincide, depending on the polarity of the signal to be measured. Its peak-to-peak value is then one-half that indicated by the attenuator. This reduces the highest output range by the same ratio and limits the usefulness of the calibrator for the direct comparison method. The variable pulse width calibrator of Fig. 6 eliminates this difficulty by virtue of the coupling condenser at the output of the second cathode follower. At extreme settings of the baseline shift control, the a.c. axis of the pulse waveform approaches the zero d.c. level to within 2 per-cent of the peak-to-peak amplitude. Hence the output is practically unipolar and may, therefore, be directly compared with any d.c. signal having a peak amplitude of less than 200 volts. A central, horizontal grid line on the CRT screen extends the range to 400 volts without forfeiting the convenience and accuracy of the direct comparison method.

Fig. 6. Circuit of the calibrator. Attenuator range-switch S_1 is part of the push-button selector whose remaining functions have been omitted for simplicity.



The Auto-Sembly Technique

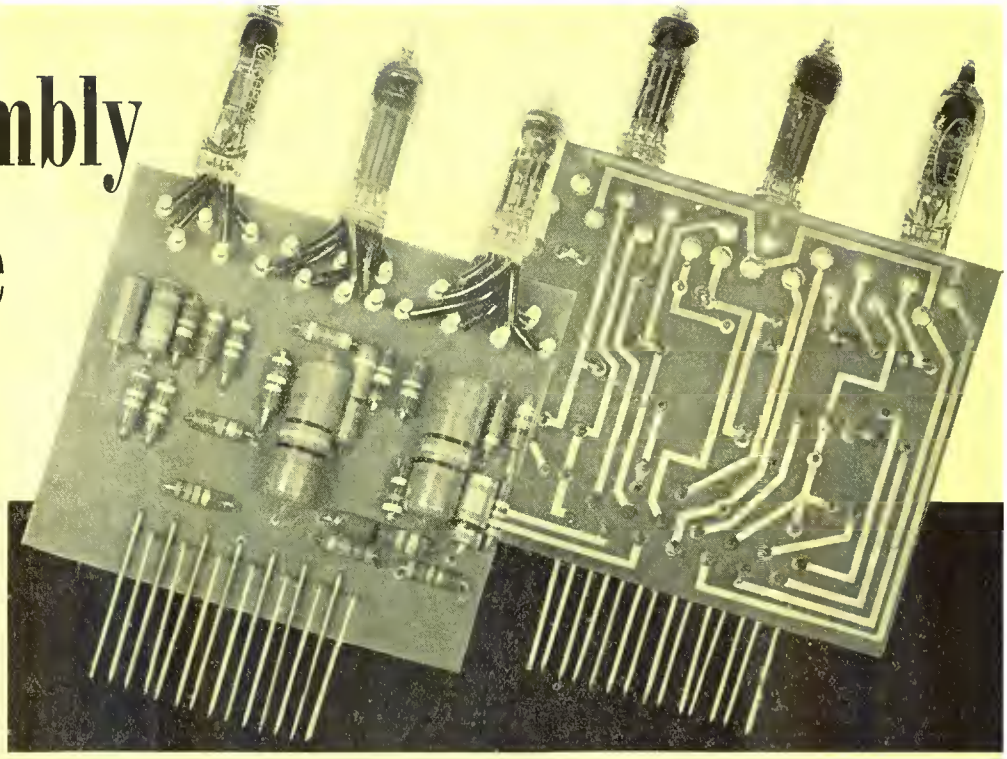


Fig. 1. Front (left) and back (right) views of typical electronic circuit built by Auto-Sembly techniques. The unit shown is an experimental model of a phase shift oscillator, amplitude limiter, and wave shaper.

An interesting, flexible, and realistic adaptation of printed circuitry to electronic circuit assembly.

THE Signal Corps Engineering Laboratories at Fort Monmouth, N. J., has developed a technique of miniature circuit fabrication called the Auto-Sembly process which promises to provide reductions in equipment size, mechanization of production to increase output and reduce error, and general manufacturing simplification in the construction of electronic products. The technique was described in a paper prepared by M. Abramson and S. Danko and presented by Mr. Abramson at the Radio Engineers Convention in New York on March 9, 1950.

The basic circuit of the device being built is first printed on a sheet of plastic, with holes at each point where a component termination is to be made. The components, which must have extended terminations, are then dropped in place with the leads passing through the appropriate holes. The plate is then dipped in solder, thus soldering the components to the printed circuit wiring. Excess lead lengths are snipped off and the unit is ready for processing.

Several techniques have been developed for fabrication of the conductive pattern. One method which appears to be meeting with considerable success consists of bonding a thin copper sheet to the plastic base by means of a suitable adhesive, then etching away the undesired portions in an acid bath. The pattern of the conductors is placed on the copper sheet before etching by a photographic process. The holes in the basic printed circuit can be easily formed by mass punching operations.

Components for mounting on this printed circuit base must have extended terminations such as lugs, wires, studs, etc. which will pass readily through the holes. Separately fabricated groups of components can also be adapted.

Loading these components onto the base may present some problems. At present, it appears that hand-loading is most suitable, but machines could certainly be built to make this loading operation completely automatic, if the quantity of finished units required were large enough to warrant the expense.

Several rapid soldering methods are adaptable. One technique consists of dipping the patterned surface in a flux and then momentarily in a molten solder bath, thus sweating the components to the pattern in one operation. This process does not have any adverse effect on the pattern or the surface of the plastic base.

The term "packaging" is used to indicate the preparation of a ruggedized and protected sub-assembly. Techniques of casting in thermosetting resins are well advanced, and offer an excellent approach to ruggedization.

Several features of the Auto-Sembly process appear to offer advantages in the mass production of electronic components, whether for military or civilian use. The costly process of hand-wiring and soldering, with the attendant possibility of errors, is eliminated. Accuracy and complete uniformity are assured, and rejects, other than those due to faulty components, practically eliminated.

The photographs show several units that have been laboratory fabricated by Signal Corps engineers to illustrate the versatility of the system.

Fig. 2. Solder dipped pattern showing how the component terminations are solder joined to the pattern.

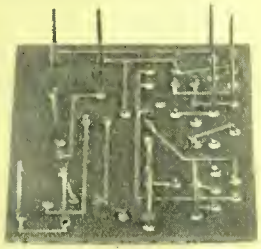
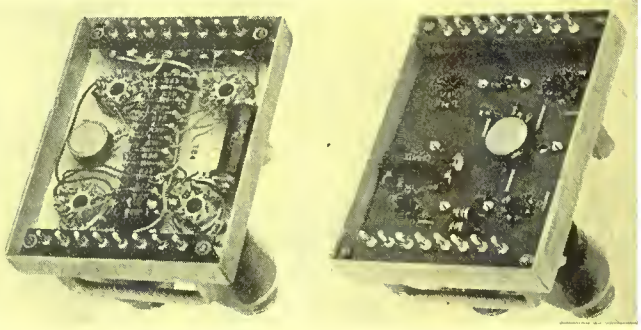


Fig. 3. A 50 megacycle radio-frequency amplifier and mixer that has been constructed using the Auto-Sembly process.

Fig. 4. (left) Underside of a conventionally built 20 watt d.c. amplifier compared to its exact Auto-Sembled counterpart (right). All wiring is on top-side of Auto-Sembled chassis.



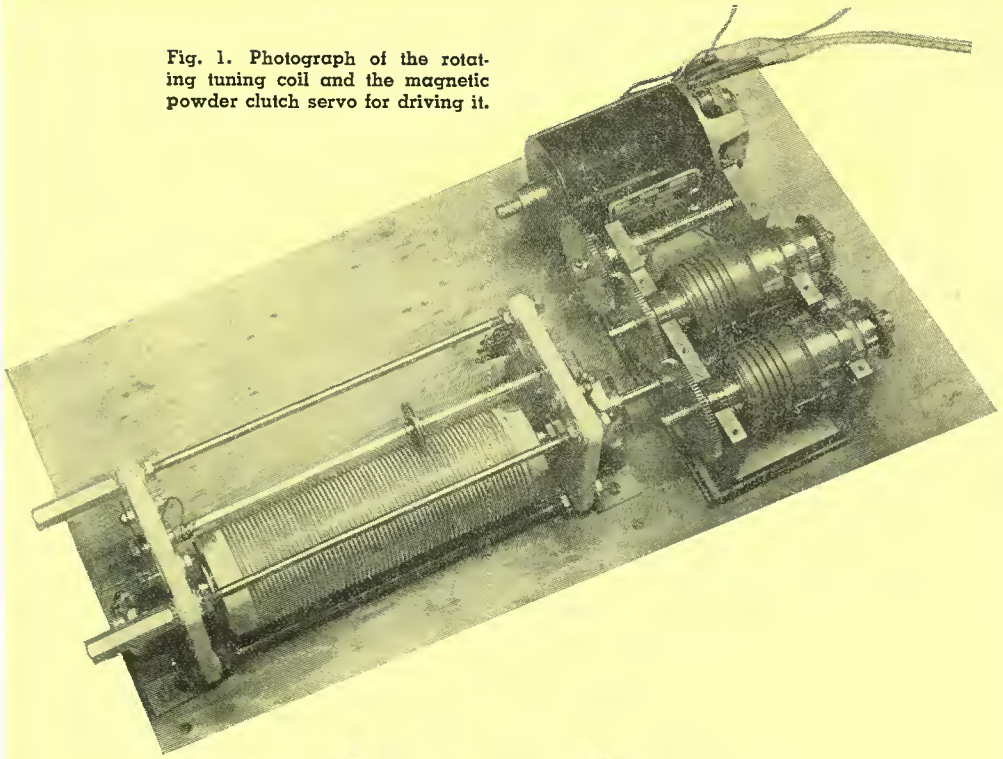


Fig. 1. Photograph of the rotating tuning coil and the magnetic powder clutch servo for driving it.

MAGNETIC POWDER CLUTCH SERVO

By S. WALD, Principal Engineer
Bendix Radio Div., Bendix Aviation Corp.

Dry magnetic powder has some advantages over the so-called "magnetic fluid" in certain applications.

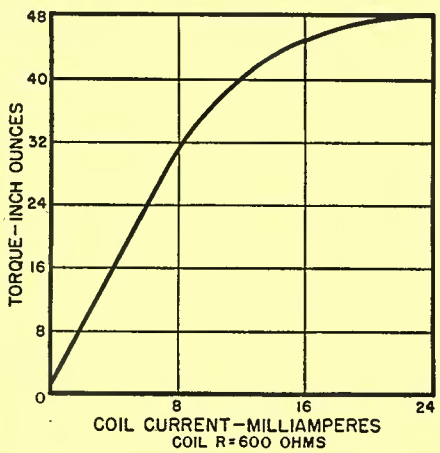
SINCE the announcement in April 1948 by the National Bureau of Standards that a mixture of powdered iron and oil could be used as a controllable friction medium in a clutch, there has been a justifiable widespread interest in both the phenomenon and its possible applications.

It was obvious that if some of the problems encountered in the use of the new "magnetic fluid" could be successfully overcome, a new and useful mechanism could be added to the repertoire of the electromechanical designer. There has always been the need for a clutch, which by means of a small control current, could interrupt or transmit large amounts of mechanical shaft power.

The fluid clutch promised to do this with an exceptionally smooth transition between these two extremes.

One important application for the clutch suggested itself almost immediately to the author, who was at the time of the disclosure of the principle engaged in the design of a high speed automatic tuning assembly for a military aircraft communications radio equipment.

Fig. 2. Torque-current characteristics of a single dry powder clutch.



The problem was to devise an electronically operated servo which could operate from a d.c. source (28 volts) and could accurately and rapidly position a multiturn inductance coil. Fig. 1 shows a picture of the rotating coil which has a diameter of two inches and is wound with about 60 turns of No. 16 bare silver wire. In order to accomplish the tuning in the allotted time a coil speed of 1200 r.p.m. would be necessary. Referring again to Fig. 1, the mechanical drive finally evolved consisted of two magnetically controlled clutches continuously driven in opposite directions by a d.c. motor. The driven element in each clutch is geared to a common output shaft. Thus, if clutch number one is energized, the coil will be driven in one direction. If number two is energized, the coil is driven in the opposite direction. The two clutches are not energized simultaneously. The purpose of this article is to discuss some of the shortcomings of the magnetic fluid filled clutch and how the development of a dry powder unit resulted in a successful design for this application. Fnally, the circuit of the drive system will be covered briefly.

As an initial step in the development, a magnetic fluid clutch was designed around the following requirements:

1. Clutch speed—1000 to 2000 r.p.m.
2. Torque—48 inch ounces
3. Ambient temperature range —55°C. to +85°C.
4. Size and weight to be a minimum

The first design was a failure from the standpoint of a practical device but was valuable in pointing out the difficulties that had to be surmounted in subsequent designs. In the first place the viscous drag of the magnetic fluid with zero excitation was about 16 inch ounces at 1200 r.p.m., while the maximum torque which could be transmitted without slippage was about 40 inch ounces. The magnetic fluid was a nine to one mixture by weight of Carbonyl "E" powdered iron and *Dow-Corning* DC-200, 10 c.s.k. viscosity silicone.

Besides having high viscous drag, the iron powder in the mixture settled out and increased the drag still further. In order to forestall settling out of the powder, a wetting agent was added to the mixture very early in the development. A number of different additives, such as Butyl oleate and Antarox B-100, were suggested by both the Bureau of Standards and *General Aniline and Film Company*, Antara Division. However, the extreme heating caused by viscous drag resulted in breakdown of the additive and again the powder in the mixture would cake and settle out.

After many unsuccessful attempts to operate a magnetic fluid clutch at high rotational speeds, it was decided to attempt a somewhat unorthodox approach to the problem, that is, elimination of the fluid medium and to use only the powdered iron. The author was aware that although the liquid in the mixture imparted many desirable characteristics to the operation of the clutch, such as smooth engagement, good heat transfer and protected the iron powder from rapid oxidation, most of the difficulties at high speeds were attributable directly to it. Accordingly, it was decided to design a clutch to use Carbonyl "E" iron powder in the dry state. Fig. 5 shows the main sub-assemblies and an assembled dry powder magnetic clutch which performed successfully at speeds up to 5000 r.p.m.

The exciting coil and housing rotate as a unit and cause a radial magnetic flux in the air gap of the hat-shaped sub-assembly shown in the lower center of Fig. 5. The portion shown at the extreme right comprises a cup-shaped rotor with a number of axial slots, a double bearing and a simple shaft seal. The complete clutch assembly appears in the upper portion of Fig. 5. Here the housing, which is one clutch member, is rigidly attached to the large gear at the right and supported by a large diameter ball bearing at the left and the small bearing at the right. The second clutch member terminates in the smaller spur gear at the left end. About two grams of Carbonyl "E" are placed in the air gap sub-assembly prior to joining the two main portions of the device by means of the coupling nut. Fig. 3 shows a cross section of an improved version of the clutch shown in Fig. 5.

It can be seen that the air-gap sub-assembly in Fig. 3 is no longer hat-shaped but flush on both sides to give better mechanical alignment and to reduce the magnetic reluctance. The coil has 3700 turns of No. 38 Formex wire and a resistance of 600 ohms. Depth of the cup-shaped rotor element is approximately ¼ inch, while the radial gap is .012 inch. The diameter of the cup is 1 inch and about 5 grams of Carbonyl "E" powder is required for proper operation. The quantity of powder is not critical provided an excess is avoided.

Tests of the clutch model shown in Fig. 5 showed the design to be quite practical. At 2000 r.p.m. there was negligible drag due to the iron powder. Fig. 2 shows the torque vs. current characteristic. Frictional drag including seal was constant at about 2-3 inch ounces, independent of speed. All low temperature limitations are removed,

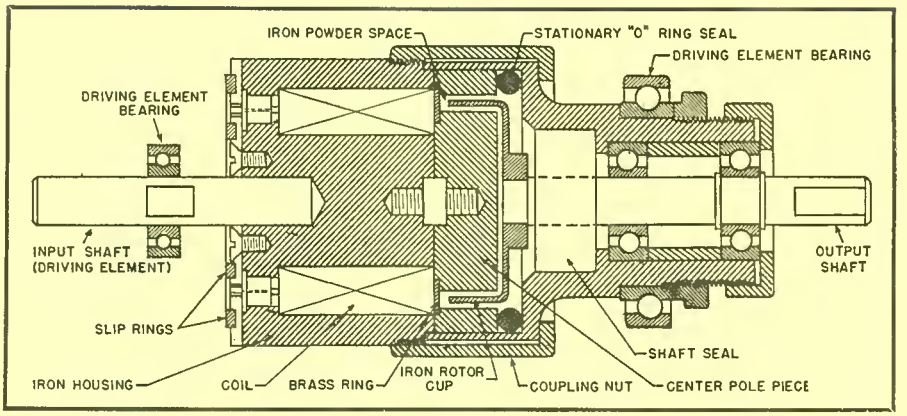


Fig. 3. Sketch showing the final design of the magnetic powder clutch unit.

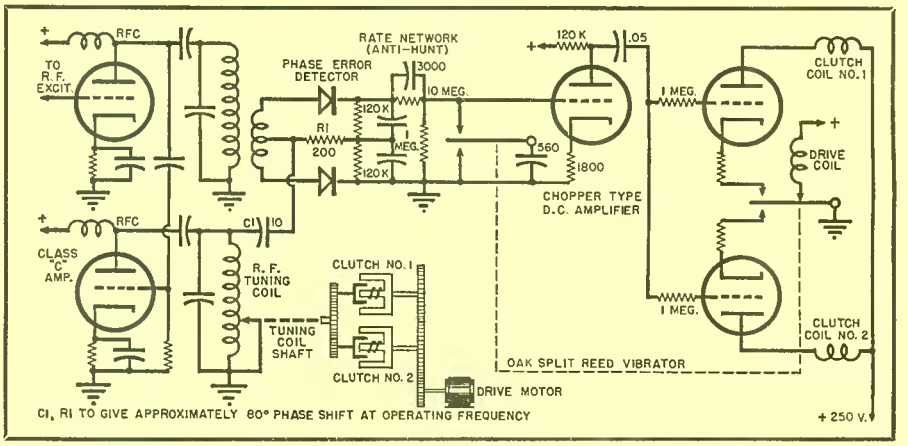


Fig. 4. Magnetic powder clutch servo drive as applied to transmitter automatic tuning.

the clutch being operative down to the lowest temperature tried—that of "dry" ice. There is no loss of torque if the maximum iron powder temperature is restricted to about 150°C.

Since there is no mixture, there are no separation problems associated with centrifuging. Shaft seals become a minor problem because of the absence of the fluid and simple devices such as the National or Perfect oil seal or Chicago Rawhide "sirvene" seal have a life depending only on shaft hardness, runout, and finish. Problems of expansion, internal pressure, and loss of

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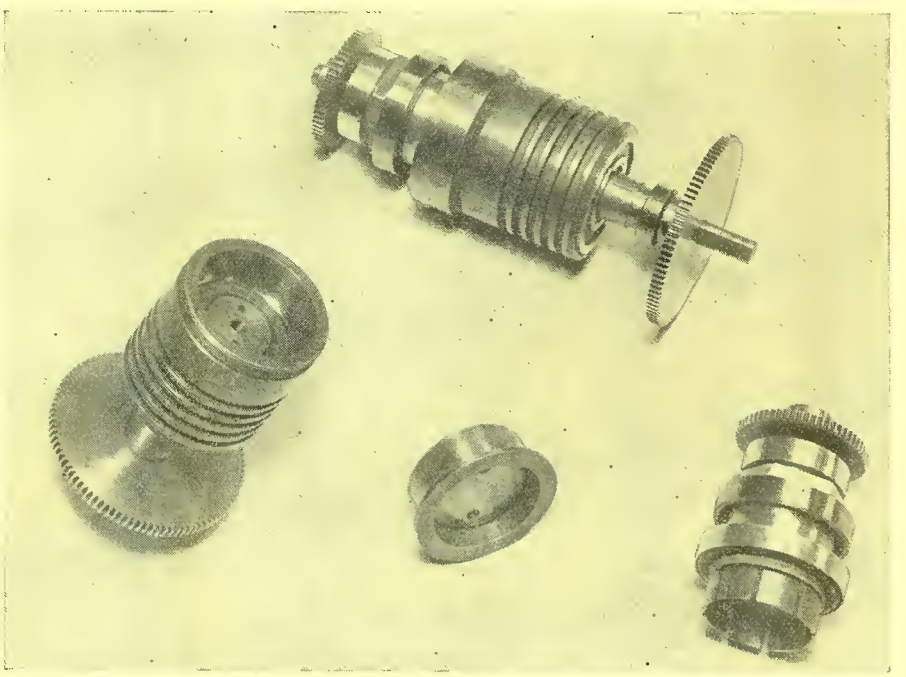
Fig. 5. Complete clutch assembly (top), with component parts shown below.



U.H.F. TV for AREAS NOT SERVED by V.H.F. TV

By J. R. POPKIN-CLURMAN
Hazeltine Electronics Corp.

Modulating a u.h.f. transmitter with v.h.f. TV channels will permit the use of conventional v.h.f. TV receivers.

ONE of the knotty problems presently facing the television industry and the Federal Communications Commission is that of u.h.f. television. The public is also concerned because a u.h.f. television receiver is necessarily more expensive than a conventional TV set, as it must accommodate the standard channels and have additional circuitry for the u.h.f. channels. Further, the u.h.f. television receiver is more costly to produce than a straight v.h.f. set due to the difficulties of adjustment, alignment and holding within production tolerances. Also the small volume of u.h.f. sets that would initially be manufactured will result in an increase in the unit cost.

These added costs of u.h.f. receivers will minimize their use in areas now served by v.h.f. television stations, and a new u.h.f. broadcaster in these sections would have a hard time establishing profitable operations in the face of the existing audiences for v.h.f. For this reason, u.h.f. television is likely to be confined largely to those areas not now served by v.h.f. stations.

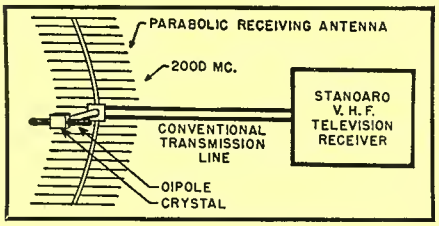


Fig. 1. The u.h.f. signal is detected at the antenna and conventional v.h.f. signals pass to the receiver.

Recent surveys indicate that few of the major marketing areas still remain to be developed for television broadcasting. For these areas not yet having TV service the potential television audience is limited and does not economically justify more than one or two u.h.f. stations, unless some new economical way could be found to provide multi-program service. For the many medium-sized cities in this class there is a definite need for some practical means of providing a real choice of TV programs, such as a selection of four to seven different available transmissions.

With the above considerations in mind the system described in this article is proposed. It is a method affording economical u.h.f. television. The system envisages each viewer using an ordinary v.h.f. television receiver with absolutely no alterations, the only new feature being an inexpensive special antenna embodying a crystal detector. The television signals would be received at 700, 2000, or 3000 mc., or any other suitable point in the u.h.f. band. The key to the success of the proposed system lies in the crystal mixer-detector, which is part of a small high-gain receiving antenna. Because of the use of v.h.f. amplitude modulation for the transmission of the u.h.f. television signals, the crystal at the antenna detects this modulation on the u.h.f. carrier and thus delivers complete TV signals for the usual v.h.f. television channels, such as Channel 2, 3, 4, etc. See Fig. 1. These channels are radiated as modulation sidebands separated from the u.h.f. carrier by the amount of the sound and picture carriers and associated frequencies, such as 54 to 60 mc. for Channel 2. The receiving antenna has connected to it a conventional 300-ohm transmission line or other v.h.f. connecting cable, down which the demodulated v.h.f. signals pass from the crystal detector to the conventional television receiver. The losses in the transmission line are only those existing for the normal v.h.f. region of the spectrum. As far as the public is concerned, they tune the television receiver exactly the same way as for standard television broadcasts, and the viewer may not know that special frequencies and additional modulation are being utilized to deliver programs to him.

Fig. 2 shows how this type of signal is produced at the transmitter. Signals are first generated at v.h.f. channel frequencies and are complete with sync, blanking, video, and sound. These are obtainable in a number of ways. For example, signals picked up from v.h.f. stations outside of the normal area to be covered by the u.h.f. transmitter may be directly received by a well located antenna and low-noise receiver and reamplified, all at v.h.f. Or such signals from v.h.f. stations at fair distances may be brought in over a special TV relay system of one or two radio repeaters. As an alternative, the video may be derived locally from camera chains, etc., or be tapped off coaxial cable or obtained from existing microwave television relay systems.

An important feature is that in case there is some interference with an existing v.h.f. signal in a u.h.f. area, the v.h.f program may be remodulated before being fed into the u.h.f. transmitter so as to occupy an unused v.h.f. channel.

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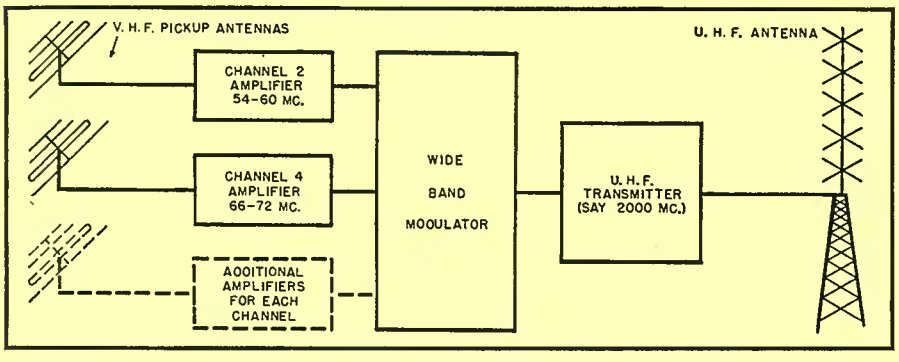
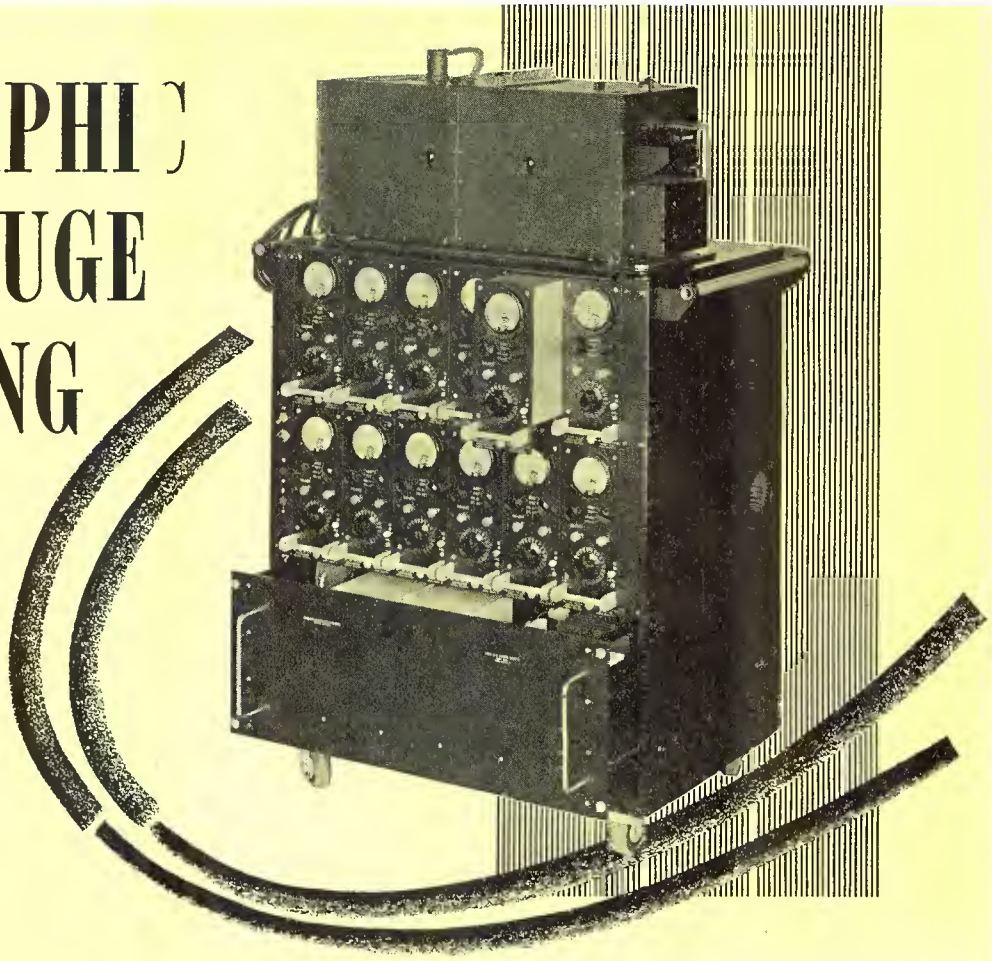
Fig. 2. Block diagram showing how signal is produced at transmitter.



OSCILLOGRAPHIC STRAIN GAUGE RECORDING

By ALVIN B. KAUFMAN



Model H recording oscillograph arranged for use with amplifier.

Factors such as galvanometer damping and resonant frequency must be considered.

THE recording of stress or strain, as indicated by strain gauge output voltage, may be done with a simple *L & N* potentiometer, galvanometer, or complex automatic potentiometer where static or quasi-static testing is performed. However, where several or more strains are to be recorded along with other associated phenomena, or where *dynamic* data is to be recorded, it is no longer possible to coordinate meter readings or to read high meter fluctuations visually, even were the meters to respond.

Oscillographs to record dynamic and multi-channel information are therefore used commonly in the recording of strain gauge data. These oscillographs may be grouped roughly into three types, only one of which is used to a large extent. The recording medium: film, photosensitive paper, or paper (plain, wax, or heat resistive) determines the group type of oscillograph and indirectly its usability for dynamic recording.

Film recorders are normally used for very high speed transient phenomena and employ cathode ray tubes for the "writing" mechanism. They are very good, but limited in use, generally being both bulky and heavy and having not over one to six recording channels. The recording frequency response is almost unlimited.

Paper recorders consist almost always of a D'Arsonval meter movement of one type or another operating a pointer carrying either an inking mechanism (*Esterline-Angus*), a scratching or marking device (*Brush*), or a hot element (*Sanborn*). This class of recorder is suitable only for very low dynamic frequencies and suffers generally for lack of recording channels, excessive weight, and a sensitiveness to vibration. They can be very excellent for the recording of static and very low frequency dynamic information, any test recording being instantly available for examination without development time.

The photosensitive paper recorder is by far the most popular oscillograph with electrical engineers, due to its light weight, many recording channels (6 to 48), high frequency response, and easily changed galvanometers. The galvanometers are of the moving coil type (Fig. 3) in which a folded wire lies in a magnetic field. A small mirror is cemented to the wires and as the wires turn in the field (with application of current) the mirror reflects a spot of light on a moving roll of photosensitive paper (or film). After any records are run, a magazine containing the exposed paper is removed from the oscillograph and developed in a dark room with the usual photographic techniques. As this phase of oscillographic recording is covered adequately by the manufacturers of the recording papers, there is no need for this article to elaborate and only the electronic phase of oscillograph recording will be discussed.

The recording of oscillograph records is basically simple in theory but complex in practice where accurate records are desired. That there is considerable variation in recording systems may be suggested by a breakdown of the components used. These components are the strain gauge bridge circuit, amplification system (if any), and the type and characteristics of the recording galvanometer. Each of these items is much more complex than is at first apparent.

The recording galvanometers used in modern oscillographs are almost always of the moving coil design suspended in silicone or other damping oils. Crystal and other forms of recording heads have been made but they are not commonly in commercial use today. The action of the moving coil galvanometer is essentially that of a simple direct current motor, except the field is a permanent magnet and the armature consists of the reflecting mirror across which the two or more armature wires are cemented. Here any similarity ceases and problems of critical damping, natural resonant frequency, etc., must be resolved to make the galvanometer useful.

A galvanometer's natural frequency and its damping determine its utility. This natural frequency (or resonance) should be two or more times higher than the fundamental frequency to be recorded. When it is desirable to record the normal harmonics of the fundamental without excessive distortion, then the galvanometer natural frequency should be five times or higher than the fundamental. In practice, this strict a requirement is not necessary unless the harmonic content is sufficiently high

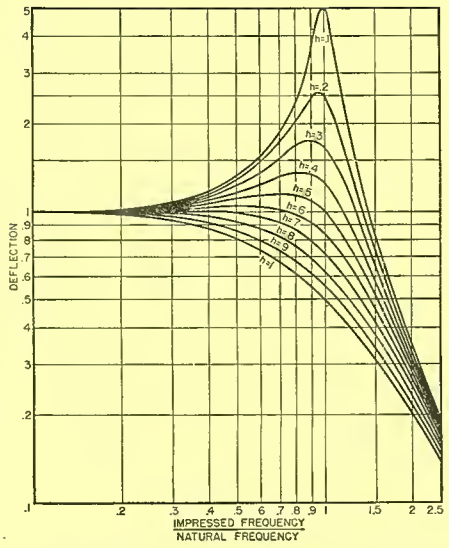


Fig. 1. Galvanometer response for various degrees of damping.

to warrant investigation. The frequency at which this type of galvanometer is resonant depends to some extent upon the mass of the moving elements and the tightness to which the wire armature is stretched. This tightness and the extent of the galvanometer integral damping is regulated by the galvanometer manufacturer. The galvanometer damping depends to a great extent upon the fluid encompassing the moving element and the external shunting resistance of the bridge or circuit. Therefore, matching impedances for maximum sensitivity may not result in the best value of damping. Too high or too low will reduce the constant frequency response to less than 50% of its natural frequency, which is generally considered attainable with critical damping of the order of .6 to .7. The effect of various degrees of damping is shown clearly by the curves in Fig. 1. The degree of damping will also vary with temperature, where liquid damping is used, unless silicone or other oil of constant viscosity is employed as the damping medium.

For aircraft testing a range of recording frequencies from 0 to 30 c.p.s is quite satisfactory for general aerodynamic information. With engine speeds of 1800 r.p.m., fundamental vibration frequencies of 30 c.p.s. may be generated mechanically, whereas flutter frequencies are generally much lower. As damping may vary, a galvanometer of 75 cycle (or higher) resonance would be the best choice for general aircraft flight test use. As the sensitivity or deflection of a galvanometer is inversely proportional to the square of its natural frequency it is unadvisable to use a galvanometer whose natural resonant frequency is any higher than absolutely required. As an example, a *Wm. Miller Corporation* galvanometer with a natural frequency range of 30 c.p.s. has a sensitivity of *five microamperes* per inch deflection at the record (or paper), a similar 3500 c.p.s. galvanometer in the same oscillograph requires *65 milliamperes* for the same deflection.

Regardless of how the galvanometer is matched to the bridge or output of the amplifier, a definite relationship should be maintained between the galvanometer resistance and the generator impedance if optimum sensitivity is to be achieved. As indicated previously, this condition may lead to a loss of constant frequency response, as the galvanometer damping varies from critical. If this change of damping does not pull the galvanometer constant response below the region of the frequencies to be recorded then the optimum configuration exists. Otherwise it would be necessary to deliberately mismatch the galvanometer or change to another one with a higher natural frequency to obtain the required recording frequency range. It is then necessary to estimate or calculate which method of securing the desired frequency range would cause the least loss in sensitivity. If amplification is employed, the output impedance can be adjusted to the value for optimum damping and the amplifier gain increased to handle the loss due to mismatch. Where the galvanometer is to be operated directly from a strain gauge bridge, maximum sensitivity may be required to secure a satisfactory record and this problem is more acute. The mathematical formulas for optimum matching will be discussed later.

As the damping of a given galvanometer may vary due to internal factors or external impedance matching, it is important to determine the constant frequency range of the galvanometer with the operating configuration used at recording time. The degree of damping may be determined roughly by the "decay" method, but possibly more practically by a constant signal level calibration. Fig. 2 shows a typical set of decay curves of a galvanometer which has been deflected to a uniform amount and then allowed to seek its natural repose. The degree of usable constant frequency response may be determined by supplying the galvanometer with a steady voltage of variable frequency and then plotting the deflection amplitude against frequency. It will also be possible to determine the galvanometer's natural frequency (unshunted) by increasing the frequency of the supply and determining what frequency causes maximum amplitude. Knowing the natural frequency, the external shunting (or output impedance) for critical damping may be determined by adjusting the impedance until the galvanometer response is flat to 50% of the natural frequency.

The galvanometer may be operated by other equipment than strain gauges. A typical use is shown in the photograph of a recording made on an electrical spot welding machine. Here a strain gauge recording of electrode pressures is accompanied by voltage, current, and operation of associated relays as indicated. As this record had no timing traces across the paper, the 60 cycle sine wave at one side of the record was recorded to be used for time measurement.

The combination of these factors on one record allowed the sequences of operation to be noted, an invaluable use in many industrial processes. In aircraft, position, pressures, loads, and other phenomena are commonly recorded together to give an over-all picture of flight conditions. There may be a combination of photographic and oscillographic recording, as the occasion demands. With the aid of a transducer any phenomenon may be recorded.

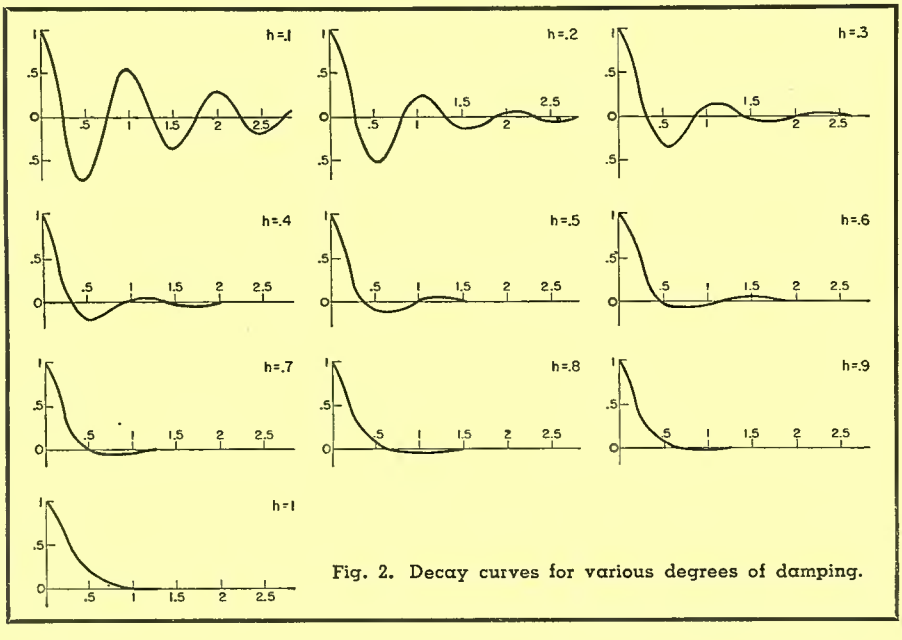


Fig. 2. Decay curves for various degrees of damping.

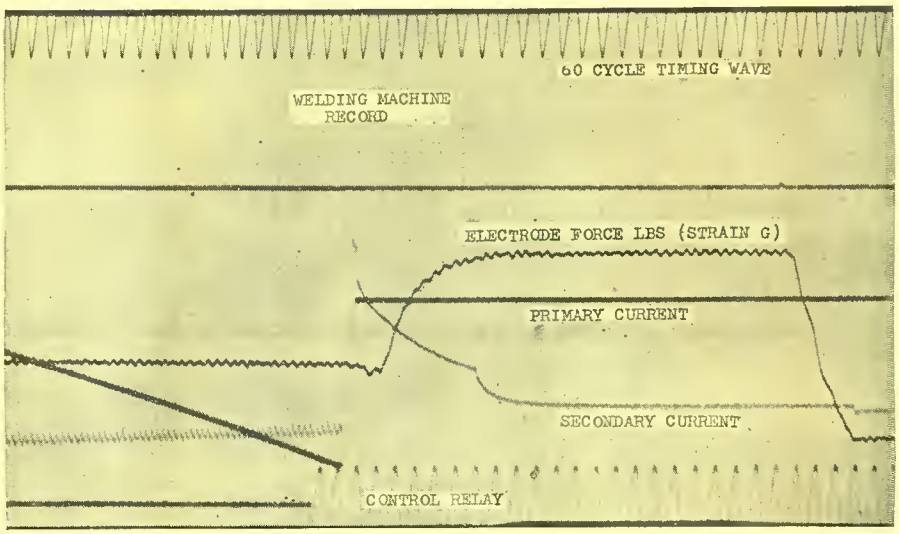
Typical recording oscillograph used in the aircraft field is the *Wm. Miller Corporation*, Model H unit. It records on a six inch wide record strip, 200 feet long, and is usually constructed with twelve galvanometer channels having isolated return circuits. As many as seventeen channels can be built into this model instrument. Provision is made for visual scanning of the galvanometer traces simultaneously with or without recording, and for cutting and perforating the individual records. A record number is automatically photographed on each record. The timing system is tuning fork controlled and photographs timing lines across the record each .01 second. The oscillograph can be constructed with record speeds from a fraction of an inch per second to more than 48" per second. The commonest speed ranges supplied are either 4" to 24" per second, or 8" to 48" per second, each with two intermediate speeds. The *Hathaway Instrument Company* manufactures an oscillograph with a regular gear box allowing a much wider range of recording speed, but at the sacrifice of weight. There are many companies manufacturing oscillographs, of many types. This article will not attempt to describe them, but will endeavor to indicate recording systems and circuits.

A large number of methods have been used to apply the strain gauge signal to the recording galvanometer. The galvanometer has been connected directly into a variety of d.c. bridge circuits, or into the output of an amplifier system.

Strain gauge amplifier systems, in general use, are of three types. These are the d.c. amplifier or the a.c. bridge carrier systems employing either amplitude or phase sensitive detection. The direct-coupled amplifier is used with direct voltage on the bridge. The amplifier must necessarily be a direct-coupled or d.c. amplifier if steady components of the strain are to be recorded. This type of amplifier is subject to drift (i.e., change in output indication with no change in input signal) and usually is not stable unless unduly complicated. This error can be minimized if the "zero" is frequently checked manually or automatically by special circuit design. As indicated, where long term stability is required this amplification system is unsatisfactory.

With a.c. power supplied to the strain gauge bridge, any unbalance bridge voltage may be amplified and detected back into d.c. variations. The name "carrier system" comes from the analogy to the amplitude modulated carrier in ordinary radio broadcasting. The frequency of the output voltage, called the carrier frequency, is the same as the frequency of the bridge supply voltage. The carrier frequency, as with broadcasting, must be 10 to 15 times higher in frequency than the intelligence it is to carry. The higher the carrier frequency the easier it is to filter out the hash components of the carrier from the d.c. output signal. The polarity of the rectified signal will not change regardless of which way the bridge is unbalanced from null. For this reason the bridge is generally balanced off of the null position so that any resulting change in strain upward or downward can be indicated. An ambiguity is sometimes produced when the strain causes a down scale deflection *through* the null point.

A bridge may be perfectly balanced for direct current but show a considerable output when a 1000 cycle signal is used for the bridge energizing source. This is duc to unbalanced capacitances from stray wire, etc., that exist across the arms of the bridge. An a.c. bridge must be balanced capacitively as well as resistively. The difficulty is overcome by including a reactance control in the balancing system, consisting of adjustable shunt capacities. In practice then, the bridge is brought to balance (or null) for zero load by means of both



Recording made on an electrical spot welding machine.

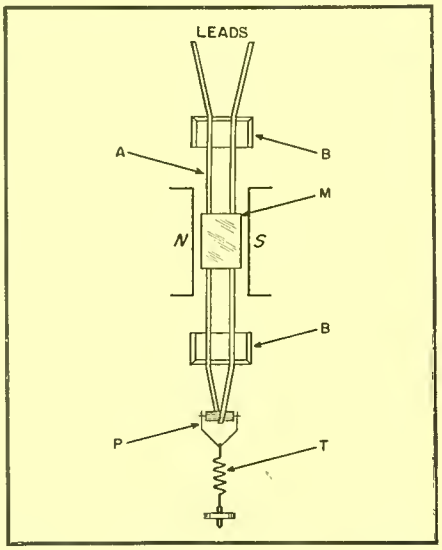
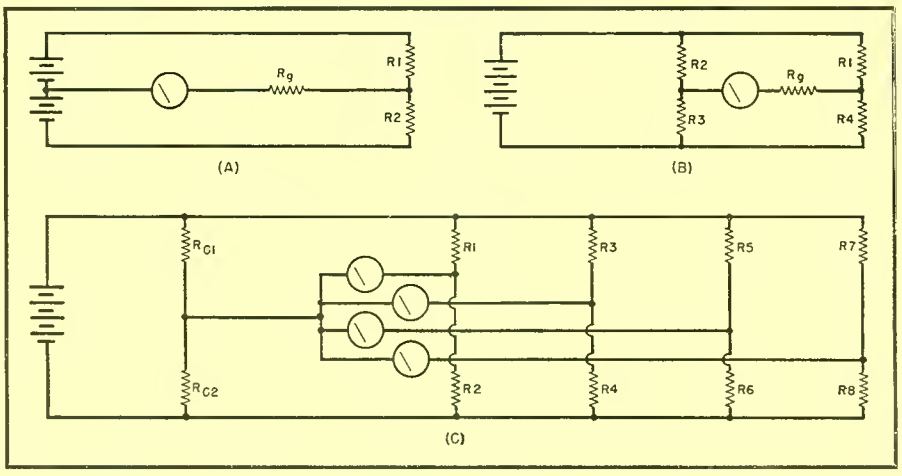
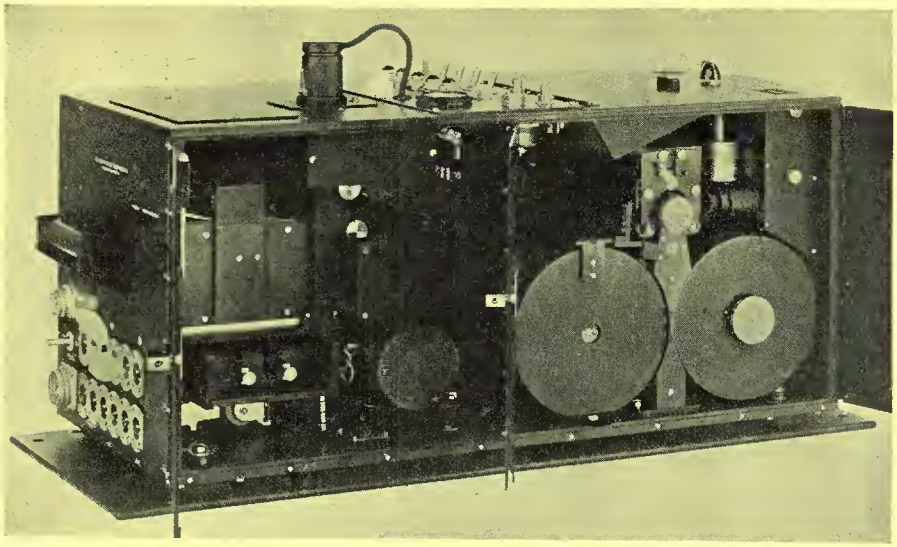


Fig. 3. Typical basic galvanometer unit. A—armature wire; B—ivory bridges; P—pulley; T—tension spring; M—mirror.

Fig. 4. Simplified bridge circuits. (A) Battery bridge. (B) Wheatstone bridge. (C) Wheatstone bridge incorporating low value fixed resistance as two bridge arms, simulating carrier type of configuration.





Model H Miller oscillograph, 12 to 17 channels, 6 inch wide record.

balance controls. The sense of the change in strain is then obtained by adjusting the zero load balance point to half scale deflection of the galvanometer (which then may be repositioned mechanically to any point) by changing the resistance balance control. A tension strain would then cause a deflection opposite to a compression strain.

The inconvenience of the dual balancing system can largely be eliminated if a phase sensitive detector system is used. The unbalance voltage produced by a capacity unbalance is about 90° or 270° out of phase with the bridge supply voltage and will produce no steady output with this circuit. The unbalance voltage produced by the strain gauge is in phase or 180° out of phase with the supply voltage, depending on the sign of the strain. The direction of the current output of a phase sensitive detector changes as the reversal of phase of the bridge output voltage. The amplitude of the output current is directly proportional to the resistive unbalance. Electronically the phase sensitive unit consists of a conventional a.c. amplifier feeding into a ring demodulator. The ring demodulator is also excited by the bridge supply. In practice, unlimited capacitive unbalance is not practical; the out-of-phase signal is excessive, causing erratic phenomena or blocking of the amplifier.

An amplifier system to operate the galvanometers makes the oscillograph very versatile and is particularly useful where widely different sensitivities are necessary, or where the required sensitivity is not calculable. The amplifiers are adjusted to give the desired deflection on the record. A fictitious strain may be simulated by placing a resistor of known value across one leg of the bridge momentarily so as to produce a calibration of the amplifier and system on the oscillograph record.

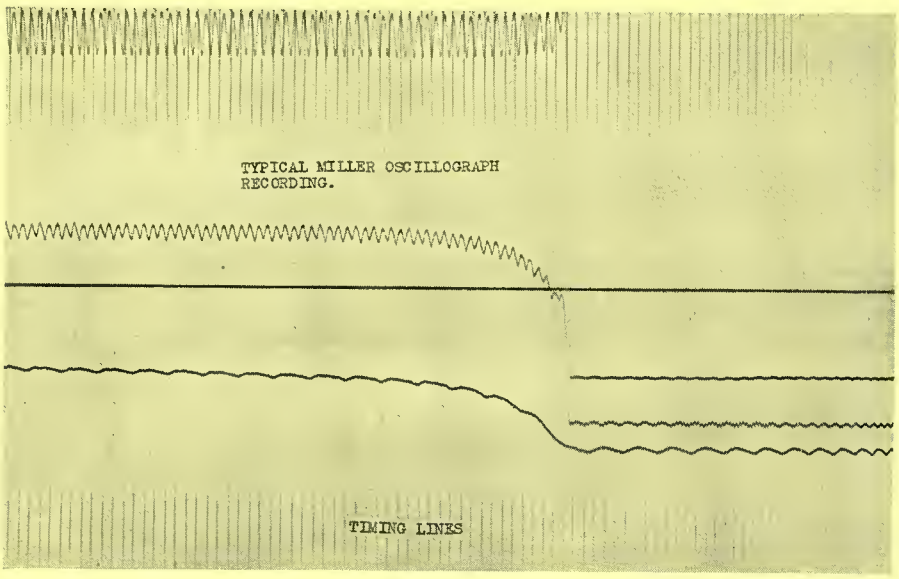
There are limitations on the carrier system of amplification. The upper limit range of useful carrier frequency is about 3000 cycles, since higher frequencies are excessively attenuated by the necessary shielding; also problems of intermodulation are more serious. Thus this system is limited to an upper frequency response of about 500 cycles. In transient studies the amplifier requirements are much more severe than that required for sinusoidal amplification. Theoretically a transient will be distorted if the amplifier does not pass an infinite band of frequencies. In practice the distortion can usually be limited so that results of engineering accuracy are obtainable with reasonably simple amplifier design. The low frequency limit of the amplifier depends upon the intelligence that is to be recorded. For static to quasi-static strains the amplifier (with detector) frequency response must be to zero cycles. The low frequency cut-off of amplifiers not having this range of coverage must not be too high or too rapid or confusing results may be observed due to "backlash." The upper frequency limit required of the amplifier is roughly that the rise time of the wave front to be recorded *must be greater* than one-half the upper frequency limit of the amplifier. This may be stated mathematically: Rise Time (sec) $> = \frac{1}{2}$ Upper Freq. Limit (c.p.s.).

The operation of galvanometers directly from a strain gauge bridge has numerous good and bad features depending upon the installation. It is desirable generally to use amplification, as no special problems exist as to gauge installations and the bridge output voltages are not critical, practically any installation allowing satisfactory recording of strain. However, where space and weight (or economic) factors dictate otherwise, it is possible in many cases to dispense with amplification.

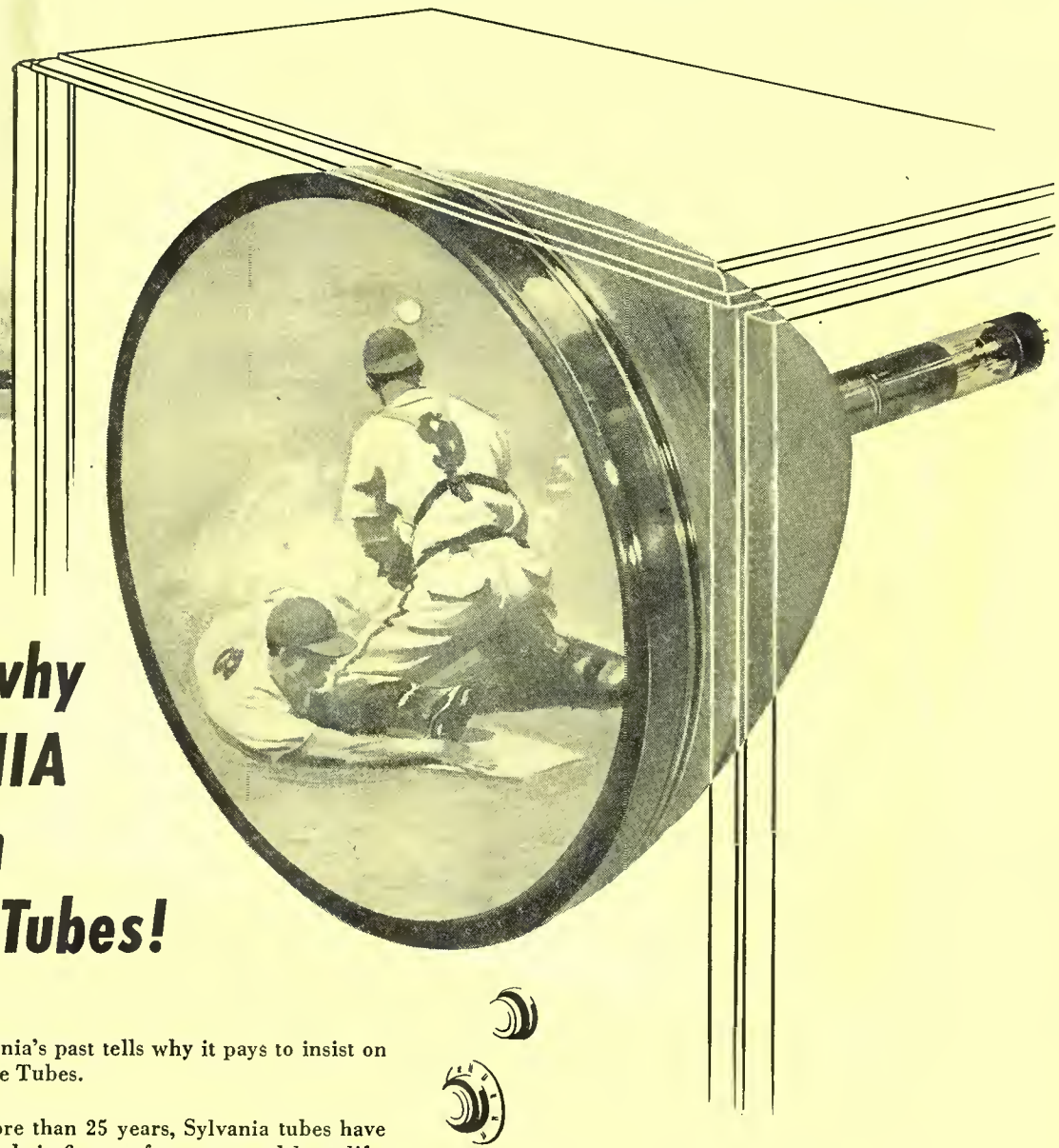
For many installations it is impossible to have more than one or two active legs in the bridge circuit; in all cases, the more active legs that can be employed, the better. Any given installation may also have more than one gauge in each arm. In such cases all gauges are made of equal resistance, connected in series or parallel. The effective unit change of resistance in that arm is then the average of that of all the gauges comprising the arm. The series connection would be simply the same as increasing the resistance value of a gauge, so that total series resistance in the arm would be used in any formula, the K remaining constant. The parallel connection is similar, but the parallel resistance value would be used with the formulas. This type of installation is of limited value, allowing in some cases closer imped-

(*Continued on page* 27A)

Typical strain gauge recording made with Miller oscillograph.



It takes Experience to make a Leader



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Radio. For more than 25 years, Sylvania tubes have been noted for their fine performance and long life. Out of this experience has come a knowledge of electron behavior . . . clearer picture reception and Sylvania's famous ion trap now licensed to other leading picture tube makers.

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For illustrated catalog giving ratings and engineering data concerning all Sylvania TV Picture Tubes, address: Sylvania Electric Products Inc., Dept. R-2309, Emporium, Pa.

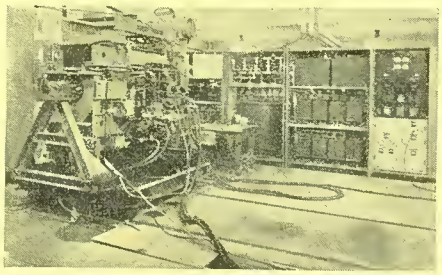
SYLVANIA ELECTRIC

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

NEWS BRIEFS

BETATRON INSTALLED AT NBS

A 50-million volt betatron, designed and constructed by *General Electric*,



has been installed in the National Bureau of Standards' new betatron laboratory. This installation extends the Bureau's high-energy research into the region from 2 to 50 million electron volts, and for work at even higher energies, a 180-million-volt synchroton now being completed by *GE* will be installed at the Bureau next year.

The NBS research program with these machines has four main aspects: the investigation of shielding and protection against high-energy radiations, the medical applications of these radiations, their industrial applications, and their basic physical properties.

The new betatron laboratory, housing the 50-million volt betatron and adequate for the coming 180-million volt synchrotron, is made of reinforced concrete with walls varying in thickness between 2 and 8 feet. For studies of protective shielding, beams can be passed into a special radiation room through barriers up to 10 feet in thickness. The beam can also be taken out of doors for a distance of about 500 yards.

PACIFIC ELECTRONIC EXHIBIT

The 6th Annual Pacific Electronic Exhibit, to be held in the Municipal Auditorium, Long Beach, California, September 13-15, is expected to be the largest and most diversified display of electronic materials and equipment ever shown in the West at one time.

A recent survey among 2200 industrial concerns, all classed in trade fields other than radio, electronic or electrical, disclosed the ever-increasing general interest to all industry. The relative value of operating supplies now purchased annually by industrial concerns is: 53% Mill Supplies; 30% Electrical Supplies; and 17% Electronic Supplies.

The Annual West Coast Convention of the Institute of Radio Engineers will be held at the same time and same place.

MARINE RADAR

The Marine Exchange lookout station at the end of Meigg's Wharf in San Francisco is now equipped with a new *Westinghouse* type MU-1 marine radar set for harbor surveillance work.

The long glass, used since 1901 to spot and identify ships entering and leaving San Francisco Bay, was adequate when the weather was good, but the radar will provide an accurate and

reliable determination of the position of any object within range regardless of fog, rain, or darkness.

With its antenna located in a weatherproof radome on top of the lookout station, the radar equipment can "see" vessels outside the Golden Gate as well as in the harbor north of the Bay Bridge. Although this installation of radar is intended only for observation of harbor traffic, it is possible to utilize the information provided by the radar set for purposes of harbor control, as is now being done in a few other harbors.

ELECTRONIC NAVIGATION SYSTEMS

New types of electronic systems which have the ability to store and recognize information in a manner similar to that of the human mind were revealed by Nathan Marchand and M. Leifer of the Physics Laboratories of *Sylvania Electric Products Inc.*, at the meeting of the International Radio Scientific Union recently.

According to the *Sylvania* scientists, the rapid response of the electronic mechanism makes it particularly useful where rapid calculations are needed as in radar, sonar, and aircraft navigation. The electronic apparatus, which they described, operates through the use of a particular periodic signal which may be distinguished from all other signals by its characteristics. These distinctive characteristics include distribution of amplitudes, frequencies and phase of the modulation sidebands. Recognition of a particular signal with a high degree of certainty can be accomplished by correlating the received signal characteristic with that of a stored signal in the receiver.

NAS TO MEET

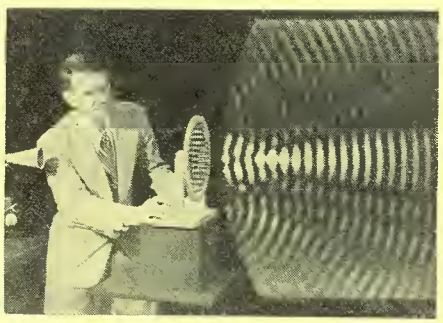
Dr. A. N. Richards, President of The National Academy of Sciences, has announced that its autumn meeting will be held at the new quarters of the *General Electric Research Laboratory* near Schenectady, N. Y. beginning Monday afternoon, October 9th.

Scientific papers will be presented on Tuesday, October 10th, and Wednesday afternoon, October 11, will be devoted to inspection trips through the various laboratory buildings, as well as the new *GE* turbine building at the Schenectady Works. A public lecture in Memorial Chapel, Union College, will be given by Dr. Cornelius P. Rhoads, director of the Memorial Hospital Center for Cancer and Allied Disease in New York, and there will be a reception at the Hotel Van Curler on Wednesday evening. Sir Lawrence Bragg, director of the Cavendish Laboratory at Cambridge University, will be the principal speaker at the dinner which follows.

General Electric scientists who are members of the National Academy of Sciences are: Dr. Willis R. Whitney, Dr. William D. Coolidge, Dr. C. G. Suits, Dr. Irving Langmuir, Dr. Albert W. Hull, and Dr. Zay Jeffries.

PHOTOGRAPH SOUND WAVE PATTERN

Scientists at the *Bell Telephone Laboratories* have developed a new technique



whereby actual photographs of the pattern of sound waves can be obtained. Equipment used in the work consists of a tiny microphone and a neon lamp,

mounted on a swinging beam which scans the wave field. As the beam moves through the field, a clear picture of the sound radiation is built up by scanning, similar to the way television images are formed.

F. K. Harvey, who with W. E. Kock developed the new technique, demonstrates the focusing effect of an acoustic lens on sound waves emitted from the horn at left.

This method will be used for studying the sound waves from telephone receivers and similar communications equipment, and for observing microwave radio wave patterns.

MICROWAVE EQUIPMENT ON POWER LINE

The satisfactory use of microwave and multiplex equipment for communication between a Pennsylvania generating station and system operating headquarters was reported at the recent Summer and Pacific General Meeting of the AIEE in Pasadena, California.

In a technical paper, four engineers described the communications method on the *Pennsylvania Electric Company* power lines from the Seward generating plant to the system operator at Johnstown, Pa., 12 miles away. As a result of the successful year's test, plans are being made to permanently control the entire Seward station switchyard from the load dispatcher's office at Johnstown using the microwave channel.

The microwave channel was described as a beamed high-frequency radio communication medium, which can be used to transmit from point-to-point, the intelligence required in the normal operation of a power system. The Pennsylvania experiment involved use of three two-way voice channels, two different types of protective relaying, two telemetered quantities and supervisory control of eight points.

Authors of the paper were D. R. Pattison of the *Pennsylvania Electric Co.*; M. E. Regan, S. C. Leyland, and F. B. Gunter, all of *Westinghouse*.

NEW LITERATURE

Aeronautical Letter Symbols

The American Standards Association has announced a new American Standard Letter Symbols for Aeronautical Sciences. It recommends standard letter symbols for 400 primary and secondary concepts, many of which are in agreement with American Standards for other phases of science and engineering.

The new document consists of two main tables: the first alphabetical by symbols and the second alphabetical by concepts. Also included in the first table for convenience in using the standard are (1) the dimensional characteristics of the various concepts in terms of mass, length, time and temperature, (2) indications of agreement with other current American Standards, and (3) helpful remarks and definitions.

Copies of American Standard Letter Symbols for Aeronautical Sciences, Z10.7-1950, may be obtained from the American Standards Association, 70 East 45th St., New York 17, N. Y. at $1.25 per copy.

Study of Research Personnel

The American Institute for Research under the sponsorship of the Scientific Personnel Advisory Committee of the American Council on Education has published a study on "Critical Requirements for Research Personnel" as an aid in the selection, training, and evaluation of research workers.

The data collected consists primarily of objective reports of the activities of research workers on the job. A large and representative sample of about 500 research workers supplied more than 2500 such critical incidents. Separate appendices have been prepared for this report which contain illustrations and detailed discussion of procedures, as well as more complete data primarily of technical interest.

Both the report and the appendices may be obtained from the American Institute for Research, 413 Morewood Ave., Pittsburgh 13, Pa., free of charge.

Survey of Power Sources

A comprehensive survey of power sources contained in a three-volume study covering both electrical and non-electrical devices, prepared by the Armour Research Foundation for the Signal Corps, is now available.

The study is concerned with methods of generating electric power, including various prime movers suitable for this purpose. Volume I deals with the predominant use of electromagnetic generators for power production. Volume II covers electrostatic generators, and the third volume covers prime movers.

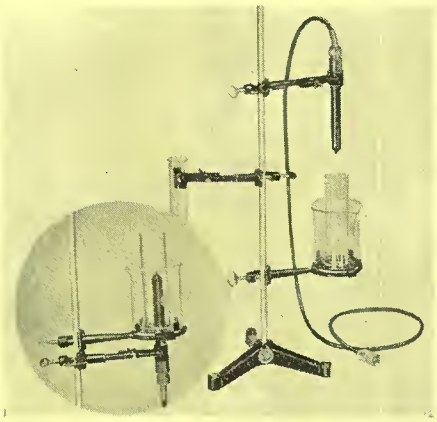
The three volumes, under the title of "Survey of Power Sources," are available separately as follows: Volume I, $15.85; Volume II, $11.30; and Volume III, $12.50, all in ozalid form. Orders should be addressed to the Armour Research Foundation, Technology Center, Chicago 16, Illinois.

The Library of Congress, Photoduplication Service, Publication Board Project, Washington 25, D. C., can supply microfilms of the three volumes (listed in order) as follows: PB 98588, $9; PB 98589, $7; PB 98590, $8.

NEW PRODUCTS

LIQUID COUNTER

A special set of equipment to speed up counting work and simplify laboratory work with solutions containing ra-



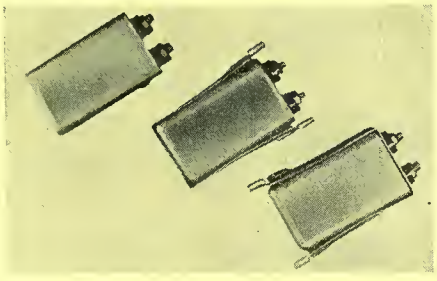
dioactive materials is now available from *Nuclear Instrument and Chemical Corporation*, 229 West Erie St., Chicago 10, Illinois.

In addition to standard laboratory pieces, such as ring stand and necessary clamps, the set also includes a special Marinelli type beaker and a support on which the beaker can be mounted. A plug-in type counter is provided with the set over which the Marinelli beaker can be placed.

As part of this set, a test tube of correct size is also provided so that the Geiger tube may be used as a dip counter. For beta counting the test tube is filled with 20 cc. of the active liquid which then covers the sensitive area of the counter. This counter is all glass and is easily decontaminated.

ZERO TEMP. COEFFICIENT CAPACITORS

Condenser Products Company, 1375 North Branch St., Chicago 22, Illinois,



is now manufacturing zero temperature coefficient capacitors.

Plasticon AS Capacitors have a positive temperature coefficient of 1000 parts per million per degree Centigrade. Plasticon LS Capacitors are negative 1000 ppm/°C. By combining matched capacitor elements of each type in a single container, temperature coefficients from plus 1000 ppm/°C to minus 1000 ppm/°C can be supplied.

Readers having engineering problems, or in need of further information, may write *Condenser Products Company* direct.

ELECTRONIC FILTER

Spencer-Kennedy Laboratories, Inc., 186 Massachusetts Ave., Cambridge 39, Mass., now has available Model 300 Variable Electronic Filter which has a continuously variable cut-off within the frequency range of 20 cycles per second to 200 kc. With an attenuation rate of

18 db. per octave it is analogous in performance characteristics to the Constant-K inductance-capacitance filter.

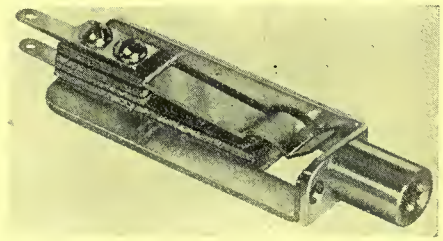
A range switch selects the type of section desired, high-pass or low-pass, as well as four decade frequency ranges. Several filters can be cascaded so that attenuation rates of 36, 54, etc. db. per octave can be realized. Sections can be combined to make a variable band-pass filter.

Further information may be obtained by addressing inquiry to Dept. RT.

TELEPHONE-TYPE JACK

Cinema Engineering Co., 1510 W. Verdugo Ave., Burbank, California, has announced a tooled telephone-type jack for patch panels incorporating the use of nickel-silver contact springs, pure silver contact, and 1/16th inch frame.

Catalog number of this jack is 1399-B. It can be used in standard *Western*



Electric and Cinema-type jack mounting strips. Distribution of this new jack will be through factory representatives, distributors, and also direct from the Burbank factory.

DELAY LINES

Shallcross Manufacturing Company, Collingdale, Pa., is now offering lumped delay lines tailored to specific applications.

A typical unit consists of eight pie-section low-loss filters having a rise time of 0.04 microseconds and a total delay of 0.3 microseconds. Maximum pulse voltage is ± 100 volts and impedance is 500 ohms. The cut-off frequency is 8.5 megacycles and the maximum operating frequency is approximately 2 megacycles based on a pulse delay error of not more than 2%. The unit consists of eight universally-wound coils of 3-strand #41 Litz wire and nine low temperature coefficient silver mica capacitors.

Many other types of delay lines can be supplied to order.

RADIATION MONITOR

The Kelley-Koett Mfg. Co., 159 E. Sixth St., Covington, Kentucky, has announced a new a.c. operated radiation monitor for use in isotope laboratories to determine simply and quickly the

contamination of laboratory accessories, benches, and hands.

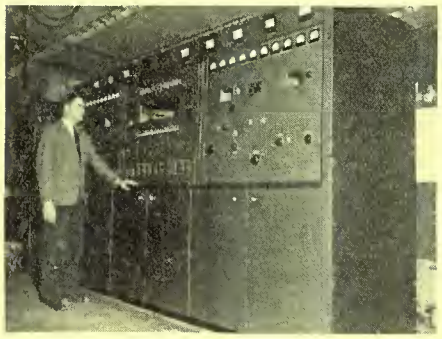
The K-900 Radiation Monitor comes equipped with the Keleket Model K-23.

aluminum thin-wall Geiger tube, sensitive to both beta and gamma radiation, and mounted in a probe connected to the main cabinet by a self-retracting cord for laboratory convenience. An easy-to-read meter indicates either radiation rates or high voltage applied to the Geiger tube. A range and H. V. switch on front panel selects either one of two ranges: 10,000 (x10) or 1000 (x1) counts per minute, full scale. The Geiger tube voltage is adjustable from 500 to 1000 volts.

Further details on this unit may be obtained upon request to The Instrument Division.

TELEVISION TRANSMITTER

General Electric Co., Syracuse, N. Y., has announced a self-contained, air-cooled television transmitter, type TT-10-A, designed to provide low installa-



tion, operating and maintenance costs. The new 5 kw. unit has a 5 kw. visual transmitter and a 2.5 kw. aural transmitter in three cubicles and is for operation on TV channels 2 through 6.

Features of the new unit are outstanding video and r.f. circuits in addition to the latest in control circuit design. No external transformers or cooling equipment are required. A simplified visual modulator incorporates features such as back porch type clamp d.c. insertion, controllable sync stretching, picture face control, adjustable white clipper, and smaller size.

Further information on this transmitter may be obtained from the *GE* Commercial Equipment Division at Electronics Park, Syracuse, N. Y.

MU-BETA EFFECT CALCULATOR

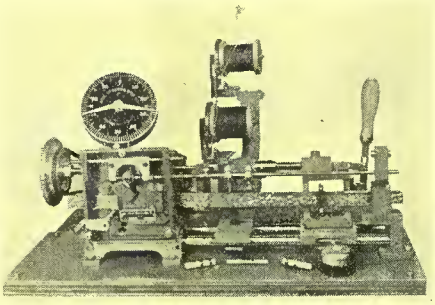
Graphimatics, 201 North Taylor, Kirkwood 22, Missouri, has announced its Mu-Beta Effect Calculator for reading complicated feedback functions with about the same ease that a simple product is read from a conventional slide rule.

The 10-inch calculator is cut from a solid disk of vinylite, protected by a chemically deposited transparent surface. Complete instructions and five examples of the use of the calculator are printed on the reverse side.

Literature describing the calculator is available upon request.

COIL WINDING MACHINE

A coil winding machine that winds coils and selenoids up to 8" in length



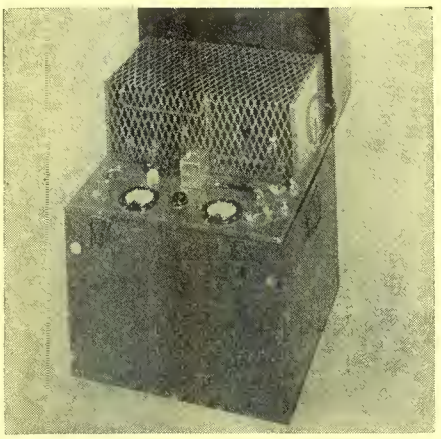
instead of 6" is announced by *Geo. Stevens Mfg. Co., Inc.*, 6022 No. Rogers, Chicago 30, Illinois. Model 125 is mounted on rods instead of a cast iron base, and the tension bracket may now be moved to any position to suit the winding arbor.

This model also winds progressive universal coils up to 4" in length and 3" in diameter, universal coils up to ¾" in width, and L.F. coils; winds wire from 20 to 44 gauge. Standard equipment includes: ¼ h.p. universal motor, foot operated speed controller, V belt drive, and double spool carrier with two adjustable oilite bearings to control wire during winding.

A dial counter (Model 50 or 51) with 6" full vision clock dial which accurately registers all turns is also available.

REGULATED POWER SUPPLY

A compact, portable, closely regulated power supply for use in testing laboratories, on production lines, for



testing radio communication and electrical equipment in airplanes, etc., has been developed by *The Richardson-Allen Corporation*, 15 West 20th St., New York, N. Y.

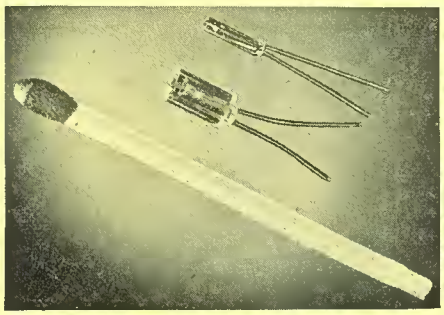
This unit has a selenium rectifier, full

(*Continued on page* 31A)

NEW TUBES

SUBMINIATURE PHOTOCELL

Sylvania Electric Products, Inc., Bayside, N. Y., has developed a tiny, inexpensive photocell which utilizes the



photosensitivity of germanium. This new photoelectric device is described as being essentially a germanium diode especially designed to permit use of the photoelectric properties of germanium and similar semiconductors. The average sensitivity of the unit in the point-contact region is reported to be about a tenth of a milliampere change in current per lumen for light in the near infrared region.

It is expected that these subminiature photoelectric devices will find wide use in such applications as decoding punched tape, electronic computing and sorting, and in the direct operation of relays such as for opening and closing doors.

At the present time these devices are still in the laboratory stage and plans have not been completed for quantity production.

RECTANGULAR TV TUBE

The Tube Division of *Allen B. Du Mont Laboratories, Inc.*, 750 Bloomfield Ave., Clifton, N. J., is announcing a new rectangular cathode-ray television

picture tube, featuring the exclusive *Du Mont* bent-gun design which assures a sharper spot focus and at the same time provides protection from ion spot blemishes. A gray filter face-plate is used for improvement of contrast in the presence of ambient light.

Designed as initial equipment, or as a conversion tube, the Type 16TP4 makes possible a picture 14⅞" wide including all the scanning area of the transmitted signal. As a conversion tube, the Type 16TP4 can provide a larger, rectangular picture in existing cabinets than original round tube equipment.

GE TUBES

Miniature Receiving Tubes

General Electric Company, Schenectady, N. Y., has announced two new miniature tubes designed primarily for television and radio receivers.

The 6S4 is a high perveance medium-mu triode for use as a vertical-deflection amplifier in television receivers which employ picture tubes having a deflection angle up to 70 degrees and operating at anode voltages up to 14,000 volts.

Ratings include a d.c. plate voltage of 500 volts; a peak positive surge plate voltage of 2000 volts; and a plate dissipation of 7.5 watts.

The 6AH6 is a sharp cut-off amplifier pentode. Its high transconductance and low input and output capacitances adapt it to use as a wide-band amplifier and as a reactance tube for television and radio receivers. Under typical operating conditions it has a transconductance of 9000 micromhos and plate current of 10 milliamperes.

Twin Triode

A twin triode, for use as a combined vertical oscillator and vertical-deflection amplifier in television receivers, has also been added to *General Electric's* tube production lines. The new tube, the 6SN7-GTA, is electrically and mechanically interchangeable with its prototype, the 6SN7-GT.

The plate dissipation rating has been increased to 7.5 watts for both plates in the 6SN7-GTA. The plate voltage rating has been increased from 300 to 500 volts, and the heater-cathode rating has been increased from 90 to 200 volts. This tube carries a peak positive-pulse plate voltage rating of 1250 volts and a peak negative-pulse grid voltage rating of 200 volts for television applications.

MINIATURE RECTIFIER

Hytron Radio & Electronics Corp., Salem, Mass., has designed a miniature filamentary-type rectifier for use in television sets as a high-voltage rectifier supplying power to the anode of the cathode-ray tube.

The 1X2A, having higher ratings than the 1X2, is designed and rated primarily for use in fly-back type of power supplies. In new equipment applications the 1X2A, when used within its maximum ratings, is a replacement for type 1B3GT/8016 at d.c. output potentials as high as 14 to 15 kilovolts.

16" TV PICTURE TUBE

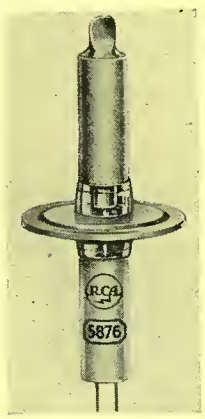
Also announced by *Sylvania* is a sixteen-inch metal television viewing tube which is five inches shorter than the 16AP4. The tube, type 16GP4, is also ¼" shorter than the standard 10" types.

Deflection angle is 70 degrees, or approximately 15 degrees greater than prior types of the same screen diameter. The tube is supplied with a neutral gray face plate to improve picture contrast, particularly in the presence of high ambient light levels.

RCA TUBES

U.H.F. Triode

One of the many tubes announced by the Tube Department of *RCA*, Harrison, N. J., is the 5876 high-mu, "pencil type" triode designed for use in grounded-grid circuits. It is particularly useful as an r.f. amplifier, i.f. amplifier, or mixer tube in receivers operating at frequencies up to about 1000 mc., as a frequency multiplier up to about 1500 mc., and as an oscillator up to 1700 mc.



As an unmodulated class C r.f. amplifier, the 5876 is capable of giving a useful output of 5 watts at 500 mc. As an unmodulated class C oscillator, the 5876 can deliver a useful power output of 3 watts at 500 mc. and 750 milliwatts at 1700 mc.

This design employs a coaxial-electrode structure of the double-ended type.

7" Oscillograph Tube

Among the other new tubes announced by the Tube Department of *Radio Corporation of America*, Harrison, N. J.,

is the 7MP7, a 7" cathode-ray tube of the magnetic-deflection and magnetic-focus type having a long-persistence, cascade (two-layer) screen. It is intended primarily for pulse-modulated applications, such as radar indicator service, and replaces the 7BP7-A in new equipment design.

Features of the 7MP7 include a limiting aperture at the end of the electron gun to provide greater effective resolution, a face plate of television quality, a neck diameter of 1 1/16", and a small-shell duodecal 5-pin base.

Miniatures for Computer Service

RCA has just made available to industrial equipment designers three new miniature tubes for use in "on-off" control applications, such as electronic computers involving long periods of operation under cut-off conditions.

The 5915 is a pentagrid amplifier of the 7-pin miniature type designed espe-

cially for gated-amplifier service. Grids No. 1 and No. 3 can each be used as independent control electrodes.

The 5963 is a medium-mu twin triode of the 9-pin miniature type intended particularly for frequency-divider circuits. It has a mid-tapped heater to permit operation from either a 6.3 volt or 12.6 volt supply, and separate terminals for each cathode to provide flexibility of circuit arrangement. It has a maximum plate dissipation of 2.5 watts.

The 5964 is a medium-mu twin triode of the 7-pin miniature type for use in frequency-divider circuits. Its cathode is common to the two triode units. The maximum plate dissipation is 1.5 watts.

Sharp cut-off Pentode

The new *RCA*-5879 announced is a sharp cut-off pentode of the 9-pin miniature type intended for use as an audio

amplifier in applications requiring reduced audio noise.

This tube utilizes a single-ended structure which is relatively short and rigidly mounted to minimize microphonics, a controlled getter deposit to minimize internal leakage, and a double-helical-coil heater to minimize hum. The 5879 is especially recommended for service in the input stages of medium-gain public-address systems, home sound recorders, and general-purpose audio amplifiers.

FIVE MINIATURE TUBES

General Electric has added five new types of miniature tubes to its product lines.

The 5749, a miniature remote cut-off pentode, is used as a radio-frequency and intermediate-frequency amplifier. The 5750, a miniature pentagrid converter, is used as a combined oscillator and mixer in superheterodyne receivers.

The 5725 is a miniature semi-remote cut-off pentode for use in gated ampli-

(*Continued on page* 26A)

Personals

HARRY ESTERSOHN, associate of the *M. J. Shapp Company,* will represent *Meissner Manufacturing* Div. of *Maguire Industries, Racon Electric Co., Dalco Manufacturing Co., Herman Hosmer Scott,* and *Switchcraft, Inc.* A graduate of the Miami University, Mr. Estersohn has been in the radio business for over ten years and for several years was associated with New York Jobbers specializing in Sales Engineering and Advertising.

JOHN A. GREEN, formerly Head of *Collins Radio Company's* broadcast engineering department, has established the *John A. Green Company,* manufacturers' representatives, and the *Equipment & Service Company,* consulting engineers and electrical manufacturers, at 6815 Oriole Drive, Dallas, Texas. Mr. Green is a Senior Member of the IRE, a member of the AIEE, and the American Petroleum Institute, and a licensed Professional Engineer in Oklahoma.

RICHARD G. LEITNER, who for the past four years has been chief engineer of the *Lear, Inc.,* California division, has resigned to take a similar post with the *U. S. Electronics Corporation,* Los Angeles, California. Mr. Leitner is a founder member of the Electronic Club of Los Angeles; a director of WCEMA and is also a member of the WCEMA executive show committee to arrange the 6th Annual Pacific Electronic Exhibit.

WILLIAM H. MILTON, JR., has resigned as *General Electric* commercial vice president to become general manager of the Knolls Atomic Power Laboratory, operated by *GE* near Schenectady for the Atomic Energy Commission. Mr. Milton will be in charge of the over-all organization, operation, and program of the laboratory. He is a graduate of the Virginia Military Institute with a B.S. degree in electrical engineering and joined *GE* in 1920.

FRANCIS X. RETTENMEYER, has joined *Philco Corporation* as executive engineer to assist in the engineering administration of the company's Government and industrial electronics program. Mr. Rettenmeyer was associated with the *Bell Telephone Laboratories* for ten years, was with *RCA* as chief receiver engineer in the home instrument division, and for the past five years has been chief engineer for *Federal Radio and Telegraph Company.*

DR. ERIC WALKER has become Executive Secretary of the Research and Development Board, Department of Defense, Washington, D. C. Dr. Walker, who has succeeded Dr. Robert F. Rinehart, is on leave from Pennsylvania State College where he is director of the Ordnance Research Laboratory and the head of the Electrical Engineering Department. During the war, Dr. Walker was assistant director of the Underwater Sound Laboratory at Harvard.

New Tubes

(*Continued from page* 25A)

fiers, gain-controlled amplifiers, delay circuits, and mixer circuits. The 5726, a miniature twin diode, may be used as an AM-FM detector, automatic-volume-control rectifier, and low-current power rectifier. The 5686, a miniature pentode power amplifier, is used as a Class A audio power amplifier or Class C radio-frequency power amplifier up to 160 megacycles.

Further information on these tubes may be obtained from the Tube Divisions, *General Electric Company,* Schenectady, N. Y.

Magnetic Clutch

(*Continued from page* 13A)

torque on heating all disappear.

The ultimate temperature limit then becomes the Curie point of the iron powder (over 500°C.). The disadvantages associated with the use of dry powder are as follows:

1. The transition from static to kinetic friction is not quite as smooth as that obtained with magnetic fluid.

2. Depending on the rotor design, the use of the iron-oil mixture may result in 10 to 15% higher output torque for a given coil current. Subsequent experiments have shown that with a rotor designed expressly for powder, there is no difference in output torque between fluid and dry powder.

3. Heat transfer from powder to metal portions of clutch is not as good as that obtained with a fluid, due to the lack of continuous intimate contact between particles and fluid.

4. The use of rotor slots decreases the available rotor area for a given over-all dimension. Since the rotor contributes only a small percentage of the over-all size of the clutch this is not considered significant.

5. Oxidation of the powder due to high temperatures. Since the permeability of carbonyl powder is greater than that of the iron oxides, continued oxidation results in a reduction of output torque.

The circuit which utilizes the two clutch drives for automatic tuning is shown in Fig. 4. With the exception of the chopper type amplifier and the new clutch drive, the radio frequency circuitry is similar to that previously published.[1,2]

Credit is due Mr. L. H. Davis and Mr. G. H. Webber of the *RCA-Victor Division,* Camden, N. J. for their valuable assistance in the successful completion of this development.

REFERENCES

1. *Wald, S., "Automatic Tuning,"* Radio-Electronic Engineering, *May* 1949.
2. *Wald, S., "D.C. Operated Servo-Amplifier,"* Radio-Electronic Engineering, *August,* 1948.

Oscillographic

(*Continued from page* 18A)

ance matching of the bridge to the galvanometer. The number of gauges per arm is limited by consideration of the strain gradient over the area required for installation of the gauges. Transverse, bending, and shear type installations allow four active bridge arms. In these installations it is a question whether to use two active legs (where space is insufficient for four) with several gauges in each of these arms or install a full active bridge. The first method would possibly allow closer impedance matching, while giving one-half the voltage output available from the full bridge. In any case, it is generally best to mismatch the bridge leg resistance higher than the galvanometer resistance in order to secure a closer match to the proper shunting resistance for critical damping. All methods should be calculated and the most suitable used. The effective shunting impedance of a standard Wheatstone bridge to its galvanometer is the resistance value of one of the four legs or arms.

Three types of bridges may be used in this application, a battery bridge, or two versions of the Wheatstone bridge. The battery bridge gets its name from the circuit configuration. The battery is tapped off at the center of its cells to give an equipotential point for the galvanometer connection, as shown in Fig. 4A. This system is not satisfactory unless zero strain calibration points may be checked frequently, because unequal drifts of cell potentials on either side of the center tap will cause indication of a strain signal when one is not present. The best galvanometer impedance match for this circuit is when the galvanometer resistance is twice the resistance of either leg of the bridge or $2\ R_g = R_1$ (or R_2). The Wheatstone bridge in both versions has four resistive arms, one wired to the standard configuration. The other version attempts to simulate a carrier operated system wherein all the gauges are fed with a center-tapped transformer. Here the center-tapped transformer is replaced with a center-tapped resistor, of low value, and it is a common return for all the half-bridge gauges as indicated in Fig. 4C. The common half-bridge connection gives rise to serious cross-talk problems in the same ratio of any one channel's output current to the total bridge current in the low resistance leg. A certain amount of cancellation cross-talk will occur in a multi-channel installation.

The full Wheatstone bridge may consist of any number of active gauges, with from one to three dummy gauges per channel, where all four gauges are not active. The calculations for this type of installation are comparatively simple. The relationship of galvanometer resistance to bridge arm resistance for maximum sensitivity for this type of bridge is unity. The galvanometer deflection values are stated by the oscillograph manufacturer, for a given instrument, in terms of "amperes per inch" deflection on the record. The galvanometer current for a given strain may be found by the formula:

$$I_{gal} = dE_o / Z_o$$

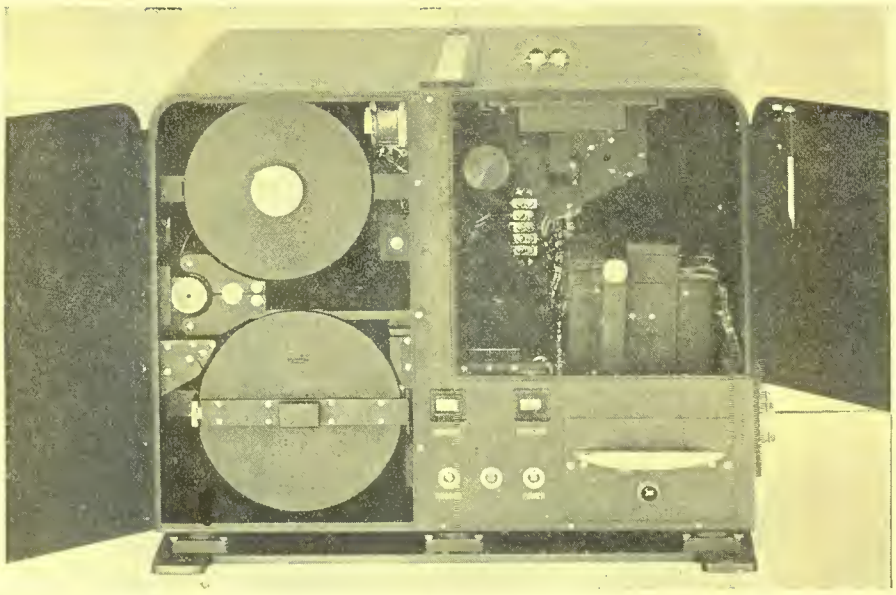
where $dE_o = (N_a/2)\ R_g\ I_g\ Kds$, and where R_g and I_g are respectively the gauge resistance (or effective value with more than one gauge) and the current (in amperes) flowing through it. K is the gauge factor, dS is the strain in inches/inch, and N_a the number of active gauges. Z_o is the resistance of the galvanometer plus the resistance of one leg of the bridge. The resistance of the galvanometer leads must be added to the galvanometer resistance if the lead resistance amounts to any appreciable percentage of Z_o. Where the expected (or actual) strain will cause insufficient deflection even with optimum impedance matching, then the bridge voltage may be set to the highest value allowable, but not to exceed one-half watt dissipation per gauge. Excessive deflection may be remedied by lowering the bridge supply voltage (and gauge current) or by purposely mismatching the bridge galvanometer.

The deflection may be interpreted directly into terms of strain where calibration has been made with a resistance placed across one arm of the bridge momentarily to simulate a resistance change with strain. Here the deflection for the simulated strain would be substituted in the following formula to give actual strain as shown by the oscillograph record:

$$dS = \frac{\text{Deflect.} \times dS_s}{\text{Deflect.}_s}$$

where the subscript s means simulated.

The bridge should be wired with a balancing control, and preferrably a calibration circuit, as outlined in previous articles.



Light weight multi-channel oscillograph especially suited for aircraft use.

TV Impulse

(*Continued from page 7A*)

modulation control is adjusted for a reasonable picture output.

The next adjustment to be considered is that of the pulse output height. This is controlled by means of the toggle switch attenuator on the top panel of the apparatus. By means of a calibration chart, the attenuator may be set for an impulse of any desired height.

The impulse phasing switch may be adjusted to obtain either white or black impulse noise. (See Fig. 7.) The effect of the impulse on the receiver also depends on the level of the impulse noise relative to the transmitted signal.

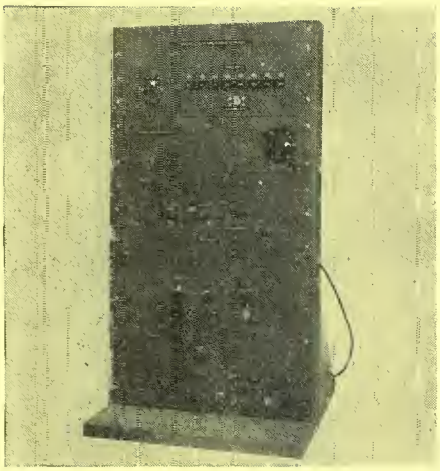


Fig. 6. Front view of generator.

The adjustment of the pulse positioner is mostly visual. As the test pattern is observed on the picture tube of the receiver under test, the step controls and the fine adjustment knobs on the vertical positioner, horizontal positioner, and group-length control on the front of the pulse positioner may be set to place the impulse noise effects where desired.

The Impulse Interference Generator has been used to test television receivers using the blocking oscillator type of sync circuits and also the automatic frequency control type. The device allows one to observe exactly how the synchronizing circuits are affected by noise impulses. (See Fig. 8.) With the blocking oscillator type of sync circuits, only the lines which are pulsed are disturbed. With the automatic frequency control type, one can watch the action of the phase detector and the sync bias, and see how the sync is pulled out and also determine the recovery time necessary for stable operation. If the amplitude and phase of the transmitted signal and the noise impulse are independently controlled, a number of different operating conditions can be simulated. The equipment promises to be a useful research tool for studying impulse-noise effects, particularly under conditions of low signal strength.

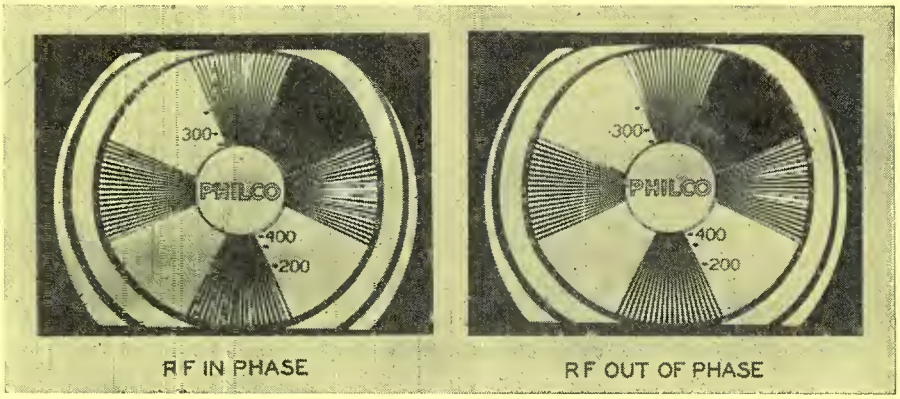
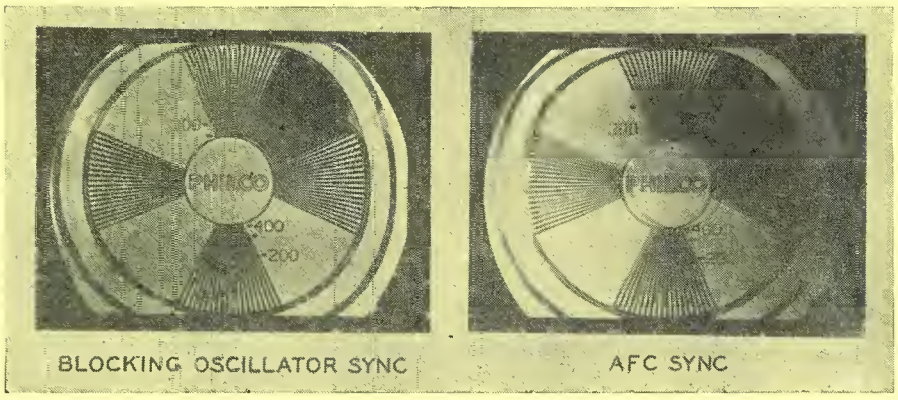


Fig. 7. Impulse group in picture with a 0.1 microsecond pulse width.

Fig. 8. Two different types of impulse interference effects.



TECHNICAL BOOKS

"THE ELECTRONIC ENGINEERING MASTER INDEX" 1947-1948. Published by *Electronics Research Publishing Co., Inc.*, 480 Canal St. New York 13, N. Y. 339 pages. $19.50.

This subject index for the years 1947-1948 is the third volume in the series covering electronic and allied engineering literature published throughout the world since 1925. It contains more than 18,000 new entries, and indexes almost three times the number of publications listed in previous volumes.

Two entirely new sources for reference have been included in this volume: the 5500 electronic and allied patents issued by the U. S. Patent Office during 1947-1948, and the declassified documents published by the U.S., British, and Canadian governments. This listing makes available much of the important war and postwar research in electronics, atomic physics, and allied fields. Included is the important work done at the M.I.T. Radiation Laboratory, Naval Research Laboratories, and universities and colleges throughout the country.

Patents are listed, in numerical sequence, under subject headings and patent references have been included with the bibliographical listings to correlate the described and patent phases of the art.

The cumulative cross index of subjects at the end of the book has been greatly expanded and serves as a guide to the present compilation, the 1924-45 edition, and the 1946 edition.

"OCEAN ELECTRONIC NAVIGATIONAL AIDS" Revised Edition, United States Coast Guard, Published by the U. S. Government Printing Office, Washington, D. C. 73 pages. 50¢.

This booklet contains information on Loran, radiobeacons, microwave beacons, Radar reflectors, and Radar, and was prepared to answer the many inquiries received by the United States Coast Guard on these subjects.

Included in the pamphlet are advisory minimum specifications for marine Radar, Loran receiving equipment, and direction-finder equipment. These advisory specifications are promulgated for the use of those interested in electronic navigational aid equipment, and are intended only as a guide for voluntary use.

The United States maritime industry, commercial airlines, and others interested in the application of electronic navigational aids will find this material beneficial in improving the safety, economy, and efficiency of transportation over the areas of the world.

U.H.F. TV

(*Continued from page* 14A)

It is not necessary to have a separate u.h.f. carrier frequency for each program channel since the one u.h.f. carrier and its various modulation sidebands, all from one transmitter, provide adequate input for the crystal detector to give appropriate demodulation products which are regular v.h.f. signals for the standard TV receiver. It thus becomes possible for one transmitter to provide at least seven channels of television service to its locality. The reason for seven channels is that this corresponds to the plan of allocation now used by the FCC for v.h.f. allocations. An alternate way of generating the u.h.f. signals, with simpler modulation methods, would be to use a single strong carrier in the u.h.f. region with additional u.h.f. transmitters to furnish the sidebands. The strong carrier is used to beat against these transmitters to produce the proper signal in the television receiver. These sideband transmitters are spaced in the spectrum such that the frequency differences between the strong carrier and each of the sidebands correspond to the frequencies of channels 2, 3, 4, etc.

Since several programs are thus carried on one transmitter, the costs for station power, maintenance, etc., can be shared, so that the cost of maintaining such a multi-program television station is reduced to only slightly more than for a conventional single-program station. There is also an equipment economy; for example, it is obvious that only one generator for making the standard RMA waveform would be required for all local programs.

The single transmitter location greatly reduces the problems associated with the highly directive receiving antennas, since orienting the antenna for one channel gives all channels. This does not prevent the radiation from the one transmitter being directed especially to those areas that it is desired to serve best. For example, a town lying along a valley would have a transmitting antenna radiating its energy in one or two beams along the valley so as to serve the greatest number of people with a strong signal.

While this system involves the use of a relatively insensitive crystal detector mounted at the antenna, the sensitivity problem is not acute, since the intention is to supply short-range distances for which the received energy would be strong enough to give good detector efficiency. If the transmitted carrier is made a number of times stronger than the sidebands, quasi-superheterodyne operation in the crystal takes place with the "local oscillator" being supplied by the u.h.f. carrier from the transmitter; then increased receiving sensitivity can be obtained. While the present powers used on the u.h.f. television frequencies are low, it would seem that following the past history of such developments, radiated powers of from 50 to 100 kw. are not too far away, making this system effective up to 15 or 20 miles. The system does not preclude the use of u.h.f. superheterodyne converters for receiving at greater distances. In this case it is only necessary to avoid using a first i.f. corresponding to any of the u.h.f. channels being received.

Since this system does not change the type of television receiver bought by the public, it could be rapidly introduced to provide television service for those areas which normally would have to wait a long time for conventional u.h.f. development. Also the economics of this system provide broadcasters the incentive to make television immediately available in those areas not presently covered.

Radio Navigation

(*Continued from page* 5A)

curacy of plus or minus two-tenths of a mile or 1%, whichever is greater.

Navigation by the *R*-Theta system, as it is called, involves the automatic solution of a geometrical problem in which *R* is the radius of a circle around a ground station transmitter, and theta is the angle a given radial makes with the north-south line, Fig. 4. The position of the receiver is thus fixed. DME information says the airplane is somewhere on the circumference and VOR information determines the angle.

These two pieces of information obviously constitute a fix but if the projected course does not pass over the station, navigating by this method becomes cumbersome.

R-Theta information is fed to the Course Line Computer which automatically solves the problem, giving the position of the aircraft in terms of lateral direction from the proposed track, and along-track distance to the destination.

Lateral deviation information is presented on the localizer needle of the ILS indicator. Distance information requires a special indicator.

Fig. 6 shows the basic problem involved. Several types of equipment are being developed.

Challenger-responder principle is used. Pulsed transmitter-receiver units will be carried in each airplane. When the airborne transmitter emits a pulse it is received by the ground station and caused to trigger the ground transmitter. On arrival of the pulse from the ground station at the airplane, special circuits measure the time lapse

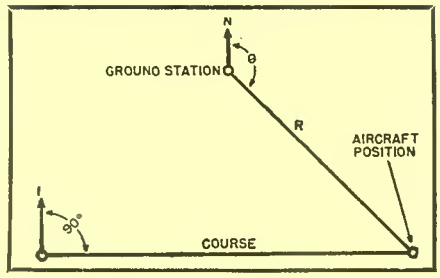


Fig. 6. The problem involved.

between the transmission of a pulse and the reception of the answer. Other circuits then translate this measurement into mechanical indication of the distance between airplane and ground station.

Since there may be more than one airplane in the vicinity of a ground station, it becomes necessary for the ground station to receive and respond to more than one signal. The resultant transmission will be a conglomeration of signals and it then becomes the responsibility of the airborne equipment to separate those signals which are responses to its transmission. The received conglomerate signal is examined stroboscopically and when a pulse is located which has a repetition rate identical to the pulses transmitted by the airplane they lock in.

There is now in the process of development for use with DME and Omni equipment, an off-schedule distance computer, which, even in its present embryonic stage can maintain a schedule over a hundred mile course with a time accuracy of plus or minus one minute. With ticket sales depending so largely on schedule maintenance, the airlines should welcome such a development with open arms.

(*To be continued*)

Fig. 7. Radio Magnetic Indicator.

1950 NATIONAL ELECTRONICS CONFERENCE

Advance program for the 1950 N.E.C. to be held Sept. 25, 26, and 27 at the Edgewater Beach Hotel, Chicago.

MONDAY, SEPTEMBER 25

1. MICROWAVES AND ANTENNAS
   (a) "Corrugated End-Fire Antennas" by Donald K. Reynolds and Winston S. Lucke, Stanford Research Institute
   (b) "New Techniques in Microwave Spectroscopy" by William E. Good, *Westinghouse Research Labs.*
   (c) "Properties of Longitudinal Slots in Circular Waveguides" by G. E. Feiker and S. C. Clark, Jr., *General Electric Co.*
2. MAGNETIC AMPLIFIERS
   (a) "Magnetic Amplifier Voltage Regulator" by John L. Wolff, *Westinghouse Electric Corporation*
   (b) "Noise Figure of the Magnetic Amplifier" by N. R. Castellini, Signal Corps Engineering Laboratories
   (c) "Magnetic Amplifiers with Orthonol Tape Cores" by W. A. Geyger, Naval Ordnance Laboratory
3. DIELECTRIC HEATING
   (a) "Dielectric Load Tuning in RF Heating" by R. H. Hagopian, *Westinghouse Electric Corporation*
   (b) "Measuring Dielectric Properties During HF Heating" by Eugene Mittelmann, Consulting Engineer
4. TIME-POSITION MEASUREMENT
   (a) "The Electronic Umpire" by Richard F. Shea, *General Electric Company*
   (b) "Thyratons as Close-Differential Relays" by Jordan J. Baruch, Massachusetts Institute of Technology
   (c) "Electromechanical Pulse Delay Unit" by James F. Gordon, *Bendix Radio Company*
5. CIRCUITS
   (a) "Miniaturizing Pentode Amplifiers by Positive Feedback" by W. B. Anspacher, Naval Ord. Lab.
   (b) "Using Conductance Curves in Electronic Circuit Design" by Keats A. Pullen, Aberdeen Pr. Gnd.
   (c) "Analysis of Twin-T Filters" by Louis G. Gitzendanner, *General Electric Corporation*
   (d) "Cascading Cathode-Followers to Provide High Impedance Transformation Ratios" by Sidney E. Smith and William J. Kessler, U. of Florida
6. TUBE TECHNOLOGY
   (a) "Electrolytic Tank Studies in Designing High Vacuum Tubes" by John E. Jacobs, Engineering Laboratory, *General Electric X-Ray Corporation*
   (b) "A Beam-Type That Multiplies" by Alexander Somerville, Northwestern University
   (c) "Low-Noise Miniature Pentode for Audio Amplifier Service" by R. A. Wissolick and D. P. Heacock, *RCA Victor Division*
   (d) "Glass Selection and Production Techniques for X-Ray and Other Tubes" by J. B. Gosling, *G. E. Co.*, and M. J. Zunick, *G. E. X-Ray Corp.*

TUESDAY, SEPTEMBER 26

7. TELEVISION
   (a) "Television in Industrial Applications" by J. A. Good, *Diamond Power Specialty Corporation*
   (b) "Stereo Television in Remote Control" by H. R. Johnson, C. A. Hermanson, and H. L. Hull, Argonne Nat. Lab.
   (c) "The Genlock—A New Tool for Better Programming in TV" by John H. Roe, *RCA Victor Division*
8. INSPECTION AND CONTROL
   (a) "Reliable Electronic Equipment—A Progress Report" by G. B. Devey, Office of Naval Research
   (b) "Detection of Tramp Metal" by C. W. Clapp, *General Electric Company*
   (c) "Production Testing Techniques for Metallized Paper Condensers in a Telephone Network" by A. L. Bennett, *Western Electric Co.* and G.M.L. Sommerman, Northwestern U.
   (d) "Selecting Critical Components for Matched Channel Radio Receiving Systems" by Harold D. Webb, U. of Ill.
9. EXPLORATION AND NAVIGATION
   (a) "Recent Lorac Developments" by J. E. Hawkins, *Seismograph Service Corporation*
   (b) "Flight Path Control" by David L. Markusen, *Minneapolis Honeywell Regulator Company*
   (c) "Radio Interference Blanking Ahead of Receivers" by M. M. Newman, J. R. Stahmann, and Edward Svendson, Lightning and Transients Res. Inst.
10. RESEARCH INSTRUMENTATION
   (a) "The Electron Optical System of a Permanent Magnet Electron Microscope" by John H. Reisner, *RCA Victor Div.*
   (b) "Electronic Scanning Techniques for Low Level Circuits" by B. R. Shepard, *General Electric Co.*
   (c) "The Point-Contact Photoconductance Cell" by George D. O'Neill, *Sylvania Electric Products Inc.*
   (d) "A Multipurpose D-C Amplifier with Reduced Zero Offset" by Will McAdam, R. E. Tarpley, and A. J. Williams, Jr., *Leeds and Northrup*
11. COMPUTERS
   (a) "The Study of Oscillator Circuits by Analog Computer Methods" by Han Chang, R. C. Lathrop and V. C. Rideout, University of Wisconsin
   (b) "Rosette Principal Strain Computer" by C. M. Hathaway and R. C. Eddy, *Hathaway Inst. Co.*
   (c) "A Versatile Small Scale Analog Computer" by James T. Carleton, *Westinghouse Electric Corp.*
   (d) "An Electrical Analog for Indeterminant Mechanical Structures" by J. P. Corbett and J. F. Calvert, Northwestern U.
12. ELECTROACOUSTICS
   (a) "Function of A-C Bias in Magnetic Recording" by R. E. Zenner, Armour Research Foundation
   (b) "Recent Design Developments on Electronic Organ Tone Generators" by S. L. Krauss and C. Tennes, *C. G. Conn, Ltd.*
   (c) "Design of Loudspeaker Enclosures" by Leo L. Beranek, Massachusetts Institute of Technology

WEDNESDAY, SEPTEMBER 27

13. OSCILLOGRAPHY
   (a) "Progress Report on Millimicrosecond Oscillography" by Y. P. Yu, H. E. Kallman, and P. S. Christaldi, *Allen B. Du Mont Labs., Inc.*
   (b) "A Six Channel Cathode Ray Recording Oscillograph" by Warren D. Tilton, Jr., *Hathaway Instrument Co.*
   (c) "A Portable Projection Oscilloscope" by Victor Wouk, *Beta Electric Corporation*
   (d) "A Cathode-Ray Oscillograph for Impulse Testing" by W. G. Fockler, *Allen B. Du Mont Labs., Inc.*
14. CONTROL INSTRUMENTATION
   (a) "Non-linear Techniques for Improving Servo Performance" by Donald McDonald, Cook Res. Lab.
   (b) "Electronic Control for Heating Systems" by J. M. Wilson, *Minneapolis-Honeywell Regulator Company*

(c) "Automatic Control of Inaccessible Terminal Voltages" by R. I. Cosgriff, and E. H. Gamble, *Curtiss Wright Corp.*

15. NUCLEONICS
   (a) "Electronic Aspects of Radiation Instruments" by E. E. Goodale and R. M. Lichtenstein, *G. E. Co.*
   (b) "Corona Voltage Regulator Tubes for Nucleonics" by D. L. Collins, *Victoreen Instrument Co.*
   (c) "Electronics in Particle Accelerators" by T. M. Dickinson and T. W. Dietze, *G. E. Co.*

16. INDUSTRIAL CONTROL
   (a) "Industrial Electronic Control Design Practices" by E. H. Vedder, *Westinghouse Electric Corp.*
   (b) "Electronics in Electric Power Central Stations" by A. J. Ward, *Sargent and Lundy*
   (c) "An Indirect Method of Process Control" by R. G. Durnal, *Westinghouse Electric Corporation*

17. SIGNAL GENERATORS AND ANALYZERS
   (a) "A 20 Mc. to 1,000 Mc. Sweep Oscillator" by John E. Ebert and Herbert A. Finke, Polytechnic Research and Development Co.
   (b) "A Miniature Crystal Controlled S-Band Signal Generator" by W. F. Marshall, *Bendix Radio*
   (c) "A High Resolution Spectrum Analyzer" by Theodore Miller and David S. Sims, *Westinghouse Research Labs.*

18. NUCLEONICS
   (a) "Radioactive Snow Gage with Telemetering Systems" by J. A. Doremus, *Motorola, Inc.*
   (b) "Design Characteristics of Air Proportional Counters" by A. C. Scheckler, *General Electric Company*
   (c) "An Investigation of a Scintillation Counter Using Anthracene Crystals" by Bernd Ross, *Radiation Counter Labs., Inc.*
   (d) "Hermetically Sealed High Pressure Ion Chambers" by J. G. Haines, *General Electric Company*

Luncheon speaker on Sept. 25 will be the honorable Wayne Coy, chairman of the FCC. At the Sept. 26 luncheon, E. A. McFaul of Northwestern U. will speak on "Is the Engineer Slipping?" The Sept. 27 luncheon speaker will be John V. L. Hogan, President of Interstate Broadcasting Co. and Radio Inventions, Inc. His subject is "What's Behind I.R.E.?"

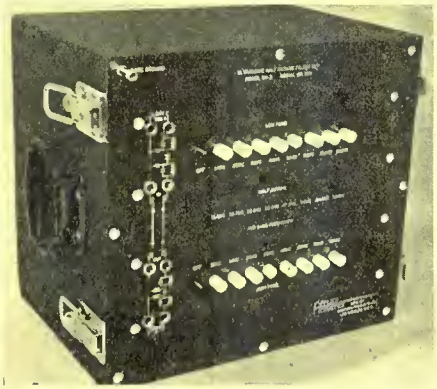
New Products

(*Continued from page* 23A)

wave, six phase. A.c. input is 220 volts, three phase, 60 cycles; delivers d.c. 24 to 32 volts, 30 amperes. The supply is continuously variable from 24 to 32 volts by rheostat control saturable reactor. Regulation is plus or minus 4% from 0 to full load and d.c. ripple, 1.5%. Ambient temperature: operates at 40°C. Convection cooled—speed of response, 0.4 seconds.

ULTRASONIC FILTER

Gertsch Products, Inc., 11846 Mississippi Ave., Los Angeles 25, California,



is now in production on its new SA-3 ultrasonic one half octave filter.

The SA-3 has a range of 10 to 160 kc. in half octave steps, and the attenuation rate is 80 db. per half octave. The minimum rejection outside the pass band is 40 db. It utilizes a passive network, without vacuum tubes and is not subject to overload. There are no beats between normal modes, and the intermodulation products are extremely low.

Loose leaf catalog sheets giving full information are available on request.

THERMOSETTING PLASTIC

Houghton Laboratories, Inc., Olean, N. Y., has available a new thermosetting plastic material for use in handling corrosive chemicals and for electrical insulation. It is reported to be inert to the corrosive action of practically all chemicals, including concentrated hydrochloric acid at room temperature, and has an exceptionally high dielectric strength with an unusually high arc resistance.

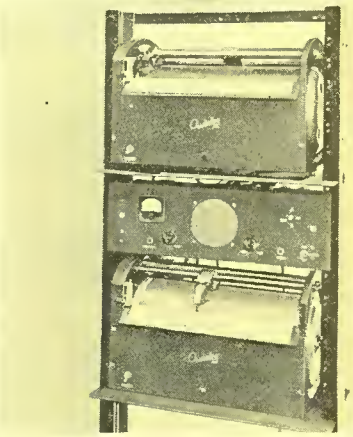
Designated Hysol 6000, this material is available in rod, tube and sheet form in a variety of sizes and may be punched or machined to close tolerances by conventional metal working machinery. It also may be cast into special shapes and components, offering unusual adhesion to metals, glass, ceramics and other materials.

Bulletin 601, which gives specifications on its chemical resistance and electrical properties, suggestions on its use, and details on its machining characteristics, may be obtained by writing the company direct.

COMMUNICATIONS RECORDER

A recording unit especially designed for logging and monitoring radio and phone communications has been announced by *Audiolog Corporation*, 440 Peralta Avenue, San Leandro, Calif.

Known as the Audiolog, this unit features the use of a thin, flexible, reusable sleeve or tube of magnetic material upon which an entire hour of speech or code communications can be recorded.



The flexible sleeves can be "telescoped" so that a 24-hour log can be filled as a compact unit. The re-usable sleeves do not deteriorate with repeated playbacks, and tests indicate they will retain the recording indefinitely.

Audiolog recorders are available in either portable or rack-mounted stationary units in single or dual type. The dual-recorder unit has automatic changeover. A small portable Audiolog using 30 minute recording sleeves is also available.

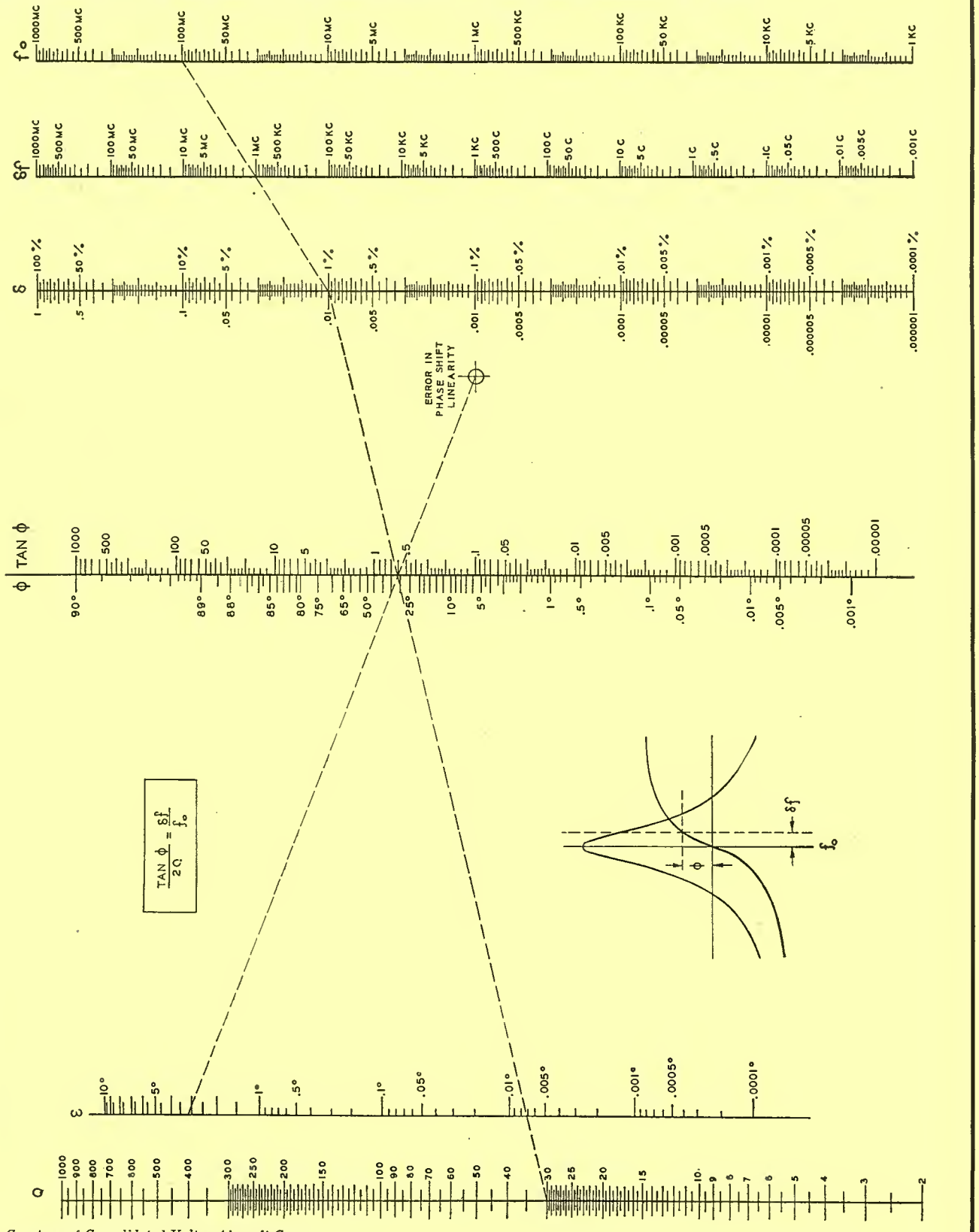
PHOTO CREDITS

Pages
3A, 4A....Northwest Airlines, Inc.
6A, 28A.....Philco Corp.
11A .....Signal Corps
12A, 13A.....Bendix Radio Div.
15A, 18A, 27A.William Miller Corp.

OFF-RESONANCE PHASE SHIFT

By CHESTER W. YOUNG, Senior Electronic Engineer, Consolidated Vultee Aircraft Corp.

This chart enables one to determine the phase shift and the deviation from an assumed linear phase shift near the resonant frequency of a tuned circuit. The resonant frequency f_o and deviation δf are aligned to give fractional detuning δ. This point is aligned with circuit Q to give phase shift ϕ. This phase shift, aligned with the "Error in Phase Shift Linearity" point, gives error from linear phase shift on ε scale.



Courtesy of Consolidated Vultee Aircraft Corp.

New LABORATORY INSTRUMENT KITS

HUNDREDS OF LABORATORIES USE

Heathkit IMPEDANCE BRIDGE as Standard

Features

● Measures inductance 10 microhenries to 100 henries ● Measures resistance .01 ohms to 10 megohms ● Measures capacitance .00001 MFD to 100 MFD ● Measures "Q" and power factor.

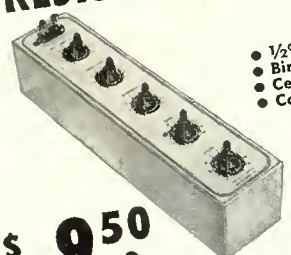
Measures inductance from 10 microhenries to 100 henries, capacitance from .00001 MFD to 100 MFD. Resistance from .01 ohms to 10 megohms. Dissipation factor from .001 to 1. "Q" from 1 to 1,000. Ideal for schools, laboratories, service shops, serious experimenters. An impedance bridge for everyone — the most useful instrument of all, which heretofore has been out of the price range of serious experimenters and service shops. Now at the lowest price possible. All highest quality parts. General Radio main calibrated control. General Radio 1,000 cycle hummer. Mallory ceramic switches with 60 degree indexing — 200 microamp type binding posts with standard ¾" centers. Beautiful birch cabinet. Directly calibrated "Q" and dissipation factor scales. Ready calibrated capacity and inductance standards of Silver Mica, accurate to ½ of 1% and with dissipation factors of less than 30 parts in one million. Provisions on panel for external generator and detector. Measure all your unknowns the way laboratories do — with a bridge for accuracy and speed.

$69.50

Internal 6 Volt battery for resistance and hummer operations. Circuit utilizes Wheatstone, Hay and Maxwell circuits for different measurements. Supplied complete with every quality part — all calibrations completed and instruction manual for assembly and use. Deliveries are limited. Model IB-1. Shipping Wt., 15 lbs.

NEW Heathkit LABORATORY RESISTANCE DECADE KIT

Features



- ½% Accuracy
- Birch Cabinet
- Ceramic Switches
- Covers 1 ohm to 99,999 ohms

$9.50

The new Heathkit Resistance Decade is a handy tool for laboratory, school and service shop. Ideal for test setups, calibrating instruments, bridge measurements, selecting multipliers, etc.

Uses the finest Centralab ceramic switches, ½% ceramic decade resistors and heavy birch cabinet matching other laboratory equipment. The range is 1 ohm to 99,999 ohms in one ohm steps.

Finest quality throughout to withstand school usage — heavy aluminum panel — laboratory type binding posts — the fine decades are extremely simple to assemble — complete kit. Model RD-1. Shipping Wt., 4 lbs.

NEW Heathkit LABORATORY POWER SUPPLY KIT

Features

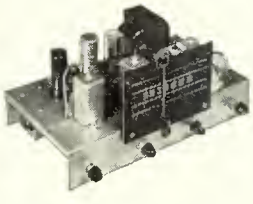
- Supplies 6.3 V. AC at 4.5 Amps.
- Heavy duty construction.
- Handy for schools, labs., and service shops.
- Supplies variable DC 50-300 Volts.
- Shows voltage or current on 3½" meter.

This new Heathkit Variable Power Supply Kit fills hundreds of needs — use it for experimental circuits — no need to build a separate power supply — use it for a test voltage to determine proper coefficients in unknown circuits — calibrate instruments with its variable voltage, etc. This new Heathkit supplies 50 to 300 Volts continuously variable DC together with an AC filament voltage of 6.3 Volts at 4.5 Amperes. A built-in 1 MA 3½" meter has proper shunts to read 0-500 Volts and 0-200 Milliamperes. The circuit uses a 5Y3 rectifier, two 1619 tubes as electronic control tubes to vary the output voltage with a single potentiometer. Case measures 7⅛" x 13" x 7⅛". Has instruction manual for assembly and use. Model PS-1. Shipping Wt., 18 lbs.

$29.50

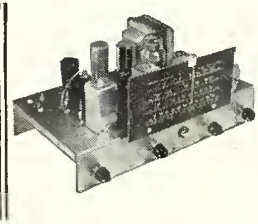
Heathkit RECEIVER & TUNER KITS for AM and FM

TWO HIGH QUALITY Heathkit SUPERHETERODYNE RECEIVER KITS



Model BR-1 Broadcast Model Kit covers 550 to 1600 Kc. Shipping Wt., 10 pounds.

$19.50



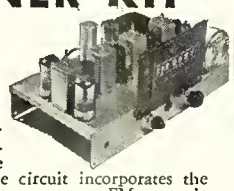
Model AR-1 3 Band Receiver Kit covers 550 Kc. to over 20 Mc. continuous. Extremely high sensitivity. Shipping Wt., 10 lbs.

$23.50

Two new Heathkits. Ideal for schools, replacement of worn out receivers, amateurs and custom installations.

Both are transformer operated quality units. The best of materials are used throughout — six inch calibrated slide rule dial — quality power and output transformers — dual iron core shielded I.F. coils — metal filter condensers and all other parts. The chassis has phono input jack — 110 Volt outlet for phono motor and there is a phono-radio switch on panel. A large metal panel simplifying installation in used console cabinets is included. Comes complete with tubes and instruction manual incorporating pictorials and step-by-step instructions (less speaker and cabinet). The three band model has simple coil turret which is assembled separately for ease of construction.

TRUE FM FROM Heathkit FM TUNER KIT



$22.50

The Heathkit FM Tuner Model FM-2 was designed for best possible tonal reproduction. The circuit incorporates the most desirable FM features — true FM — ready wound and adjusted coils — 3 stages of 10.7 Mc. I.F. (including limiter).

Tube lineup: 7E5 oscillator, 6SH7 mixer, two 6SH7 I.F. stages, 6SH7 limiter, two 7C4 diodes as discriminator, 6X5 rectifier.

The instrument is transformer operated making it safe for connection to any type receiver or amplifier. The R.F. coils are ready wound — mounted on the tuning condenser and the condenser is adjusted — no R.F. coils to wind or adjust.

A calibrated six inch slide rule dial has vernier drive for easy tuning. The finest parts are provided with all tubes, punched and formed chassis, transformers, condensers and complete instruction manual. Model FM-2. Shipping Wt., 10 lbs.

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The HEATH COMPANY

. . . BENTON HARBOR 15, MICHIGAN

NEW 1951 Heathkit SIGNAL GENERATOR KIT

Features

- Sine wave audio modulation.
- Extended range 160 Kc. to 50 megacycles fundamentals.
- New step attenuator output.
- New miniature HF tubes.
- Transformer operated for safety.
- Colibroted harmonics to 150 megacycles.
- New externol modulotion switch.
- 5 to 1 vernier tuning for accurate settings.

A completely new Heathkit Signal Generator Kit. Dozens of improvements. The range on fundamentals has been extended to over 50 megacycles; makes this Heathkit ideal as a marker oscillator for T.V. New step attenuator gives controlled outputs from very low values to high output. A continuously variable control is used with each step. New miniature HF tubes are required for the high frequencies covered.

Uses 6C4 master oscillator and 6C4 sine wave audio oscillator. The set is transformer operated and a husky selenium rectifier is used in the power supply. The coils are precision wound and checked for calibration making only one adjustment necessary for all bands.

New sine wave audio oscillator provides internal modulation and is also available for external audio testing. Switch provided allows the oscillator to be modulated by an external audio oscillator for fidelity testing of receivers.

A best buy — think of all the features for less than $20.00. The entire coil and tuning assembly are assembled on a separate turret for quick assembly — comes complete — all tubes — cabinet — test leads — every part. The instruction manual has step-by-step instructions and pictorials. It's easy and fun to build a Heathkit Model SG-6 Signal Generator. Shipping Wt., 7 lbs.

$19.50

Heathkit SINE AND SQUARE WAVE AUDIO GENERATOR KIT

- Either sine or squore wove.
- Stoble RC bridge circuit.
- Covers 20 to 20,000 cycles.
- Less thon 1% distortion.

Hundreds of Heathkit Audio Generators are used by speaker manufacturers—definite proof of their quality and dependability. The added feature of square wave opens up an entirely new field of amplifier testing. Uses the best of parts, 4 gang condenser, 1% calibrating resistors, metal cased filter condensers, 5 tubes, completely calibrated panel and detailed instruction manual. One of our best and most useful kits. Model G-2. Shipping Wt., 12 lbs.

$34.50

THE NEW Heathkit HANDITESTER KIT

- Beautiful streamline bakelite case.
- AC and DC ranges to 5,000 Volts.
- 1% Precision ceramic resistors.
- Convenient thumb type adjust control.
- 400 Microampere meter movement.
- Quality Bradley AC rectifier.
- Multiplying type ohms ranges.
- All the convenient ranges 10-30-300-1,000-5,000 Volts.
- Large quality 3" built-in meter.

A precision portable volt-ohm-milliammeter. An ideal instrument for students, radio service, experimenters, hobbyists, electricians, mechanics, etc. Rugged 400 ua meter movement. Twelve complete ranges, precision dividers for accuracy. Easily assembled from complete instructions and pictorial diagrams. An hour of assembly saves one-half the cost. Order today. Model M-1. Shipping Wt., 2 lbs.

$13.50

NEW Heathkit BATTERY ELIMINATOR KIT

Features

- Provides voriable DC voltage for all checks.
- Locotes sticky vibrators-intermittents.
- Voltmeter for accurate check.
- Hos 4000 MFD Mollory filter for ripple-free voltage.

Even the smallest shop can afford the Heathkit Battery Eliminator Kit. A few auto radio repair jobs will pay for it. It's fast for service, the voltage can be lowered to find sticky vibrators or raised to ferret out intermittents. Provides variable DC voltage 5 to 7½ Volts at 10 Amperes continuous or 15 Amperes intermittent. Also serves as storage battery charger. Ideal for all auto radio testing and demonstrating.

$22.50

A well filtered rugged power supply uses heavy duty selenium rectifier, choke input filter with 4,000 MFD of electrolytic filter for clean DC. 0-15 V. voltmeter indicates output which is variable in eight steps. Easily constructed in a few hours from our instructions and diagrams — better be equipped for all types of service — it means more income. Model BE-2. Shipping Wt., 19 lbs.

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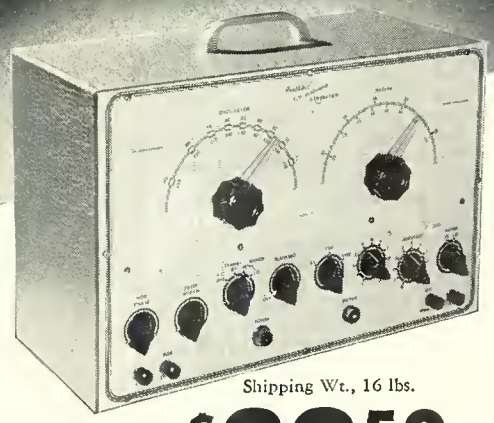
The HEATH COMPANY
. . . BENTON HARBOR 15, MICHIGAN

NEW Heathkit T. V. ALIGNMENT GENERATOR KIT



Shipping Wt., 16 lbs.

$39.50

- New 2 band marker 19 to 75 megacycles.
- New simplified circuit for easy calibratian and assembly.
- New simplified calibratian and assembly.
- Blanking circuit gives reference base line to trace.
- New 2 band built-in marker cavers 19 ta 75 Mc.
- New dual spider sweep motor far long life.
- New blanking circuit gives base line for better alignment.
- New variable oscillator gives high output fundamentals on high TV band.
- New variable oscillator gives high output an high band.
- New standby switch keeps instrument ready for instant use.
- New 6 to 1 slaw speed drive an bath master ascillator and marker tuners.

The new Heathkit TV Alignment Generator incorporates the new developments required for modern TV servicing. An absorption marker circuit covering all possible IF bands and even several of the RF bands. The new blanking circuit provides a base reference line which is invaluable in establishing proper traces. The new sweep motor incorporates dual spiders in the speaker frame assuring better alignment and long life. The mounting of the speaker sweep motor has been simplified for easy alignment.

The variable master oscillator covers 140 to 230 Mc. thus giving high output fundamentals where they are most needed. Low band coverage 2 Mc. to 90 Mc.

A new step attenuator provides excellent control of output.

Planetary 6 to 1 drives on both oscillator and marker provides smooth easy control settings.

A standby position is provided making the instrument always instantly available.

Horizontal sweep voltage with phasing control is provided. No other sweep generator under $100.00 provides all these features — comes complete with instruction manual. Model TS-2.

Heathkit CONDENSER CHECKER KIT

Only **$19.50**

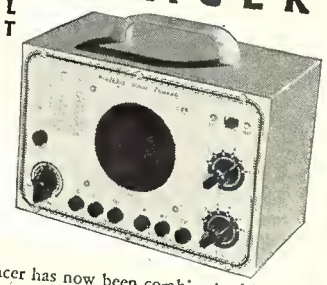
Features

- Power factor scale.
- Measures resistance.
- Measures leakage.
- Checks paper-mica-electrolytics.
- Bridge type circuit.
- Magic eye indicatar.
- 110 V. transformer operated.
- All scales an panel.

Checks all types of condensers over a range of .00001 MFD to 1,000 MFD. All on readable scales that are read direct from the panel. NO CHARTS OR MULTIPLIERS NECESSARY. A condenser checker anyone can read. A leakage test and polarizing voltage for 20 to 500 Volts provided. Measures power factor of electrolytics between 0% and 50%. 110 V. 60 cycle transformer operated complete with rectifier and magic eye tube, cabinet, calibrated panel, test leads and all other parts. Clear detailed instructions for assembly and use. Model C-2. Shipping Wt., 7 lbs.

NEW Heathkit SIGNAL TRACER AND UNIVERSAL TEST SPEAKER KIT

$19.50

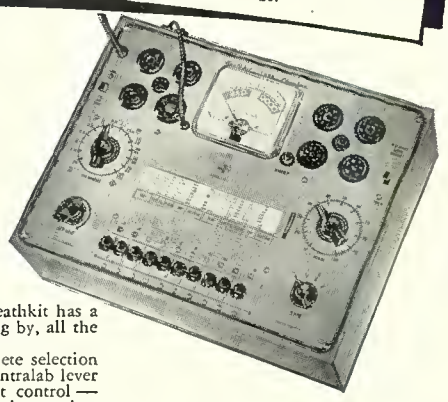


Features

- High sensitivity
- Complete set af speaker impedances
- Tests microphones and PA systems
- Tests bath single and push-pull speaker circuits

The popular Heathkit Signal Tracer has now been combined with a universal test speaker at no increase in price. The same high quality tracer follows signal from antenna to speaker — locates intermittents — defective parts quicker — saves valuable service time — gives greater income per service hour. Works equally well on broadcast — FM or TV receivers. The test speaker has assortment of switching ranges to match push-pull or single output impedance. Also test microphones, pickups, PA systems — comes complete — cabinet, 110 V. 60 cycle power transformer — tubes, test probe, all parts and detailed instructions for assembly and use. Model T-2. Shipping Wt., 8 lbs.

Heathkit TUBE CHECKER KIT



Features

- Sockets for every modern tube — blank for new types.
- Fastest methad af testing tubes — saves time — makes mare prafit.
- Rugged caunter type birch cabinet.
- Gear driven raller chart gives instant setup far all types.
- Tests each element separately for apen ar short and quality.
- Beautiful 3 calar meter — reads goad-bad and line set point.

Test your tubes the modern way — dynamically — the simplest, yet fastest and surest method — your Heathkit has a switch for each tube element and measures that element — no chance for open or shorted elements slipping by, all the advantages of the mutual conductance type without the slow cumbersome time consuming setups.

Your Heathkit Tube Checker has all the features — beautiful 3 color BAD-GOOD meter — complete selection of voltages — roller chart listing hundreds of tubes including the new 9 pin miniatures — finest quality Centralab lever switches for each element — high grade birch counter type cabinet — continuously variable line adjust control — every feature you need to sell tubes properly. The most modern type tube checker with complete protection against obsolescence. The best of parts — rugged oversize 110 V. 60 cycle power transformer — finest of Mallory and Centralab switches and controls, complete set of sockets for all type tubes with blank spare for future types. Fast action brass gear driven roller chart quickly locates the settings for any type tube. Simplified switching cuts necessary testing time to minimum and saves valuable service time. Short and open element check. Simple method allows instant setup of new tube types without waiting for factory data. No matter what the arrangements of tube elements, the Heathkit flexible switching arrangement easily handles it. Order your Heathkit Tube Checker Kit today. See for yourself that Heath again saves you two-thirds and yet retains all the quality — this tube checker will pay for itself in a few weeks — better assemble it now. Complete with instructions — pictorial diagrams — all parts — cabinet — ready to wire up and operate. Model TC-1 Shipping Wt., 12 lbs.

$29.50

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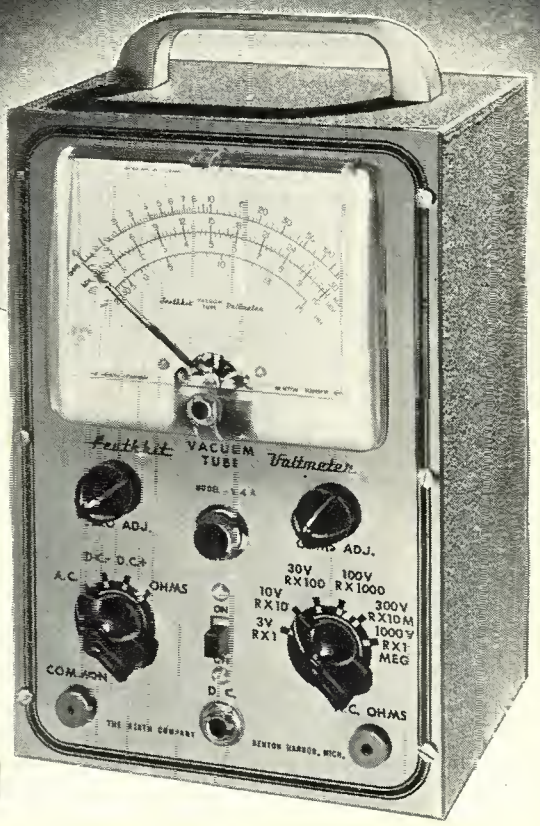
The HEATH COMPANY
. . . BENTON HARBOR 15, MICHIGAN

New 1951 • • MODEL V-4A

Heathkit VTVM KIT

HAS EVERY EXPENSIVE *Feature*



- ★ Higher AC input impedance, (greater than 1 megohm at 1000 cycles).
- ★ New AC voltmeter flat within 1 db 20 cycles to 2 megacycles (600 ohm source).
- ★ New accessory probe (extra) extends DC range to 30,000 Volts.
- ★ New high quality Simpson 200 microampere meter.
- ★ New ½% voltage divider resistors (finest available).
- ★ 24 Complete ranges.
- ★ Low voltage range 3 Volts full scale (⅓ of scale per volt).
- ★ Crystal probe (extra) extends RF range to 250 megacycles.
- ★ Modern push-pull electronic voltmeter on both AC and DC.
- ★ Completely transformer operated isolated from line for safety.
- ★ Largest scale available on streamline 4½ inch meter.
- ★ Burn-out proof meter circuit.
- ★ Isolated probe for dynamic testing no circuit loading.
- ★ New simplified switches for easy assembly.

New LOW PRICE $23.50

The new Heathkit Model V-4A VTVM Kit measures to 30,000 Volts DC and 250 megacycles with accessory probes — think of it, all in one electronic instrument more useful than ever before. The AC voltmeter is so flat and extended in its response it eliminates the need for separate expensive AC VTVM's. + or − db from 20 cycles to 2 megacycles. Meter has decibel ranges for direct reading. New zero center on meter scale for quick FM alignment.

There are six complete ranges for each function. Four functions give total of 24 ranges. The 3 Volt range allows 33⅓% of the scale for reading one volt as against only 20% of the scale on 5 Volt types.

The ranges decade for quick reading.

New ½% ceramic precision are the most accurate commercial resistors available — you find the same make and quality in the finest laboratory equipment selling for thousands of dollars. The entire voltage divider decade uses these ½% resistors.

New 200 microampere 4½" streamline meter with Simpson quality movement. Five times as sensitive as commonly used 1 MA meters.

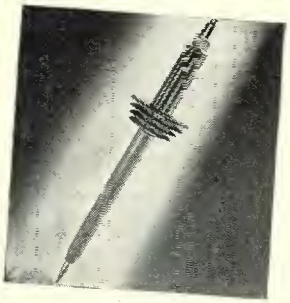
Shatterproof plastic meter face for maximum protection.

Both AC and DC voltmeter use push-pull electronic voltmeter circuit with *burn-out* proof meter circuit.

Electronic ohmmeter circuit measures resistance over the amazing range of 1/10 ohm to one billion ohms all with internal 3 Volt battery. Ohmmeter batteries mount on the chassis in snap-in mounting for easy replacement.

Voltage ranges are full scale 3 Volts, 10 Volts, 30 Volts, 100 Volts, 300 Volts, 1000 Volts. Complete decading coverage without gaps.

The DC probe is isolated for dynamic measurements. Negligible circuit loading. Gets the accurate reading without disturbing the operation of the instrument under test. Kit comes complete, cabinet, transformer, Simpson meter, test leads, complete assembly and instruction manual. Compare it with all others and you will buy a Heathkit. Model V-4A. Shipping Wt., 8 lbs. Note new low price, $23.50



New 30,000 VOLT DC PROBE KIT

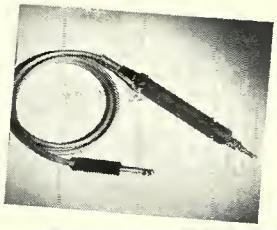
Beautiful new red and black plastic high voltage probe. Increases input resistance to 1100 megohms, reads 30,000 Volts on 300 Volt range. High input impedance for minimum loading of weak television voltages. Has large plastic insulator rings between handle and point for maximum safety. Comes complete with PL55 type plug.

No. 3366 High Voltage Probe Kit. Shipping Wt., 2 pounds. **$5.50**

Heathkit RF PROBE KIT

Crystal diode probe kit extends range to 250 megacycles ± 10% comes complete with all parts, crystal, cable and PL55 type plug.

No. 309 RF Probe Kit. Shipping Wt., 1 lb. **$5.50**



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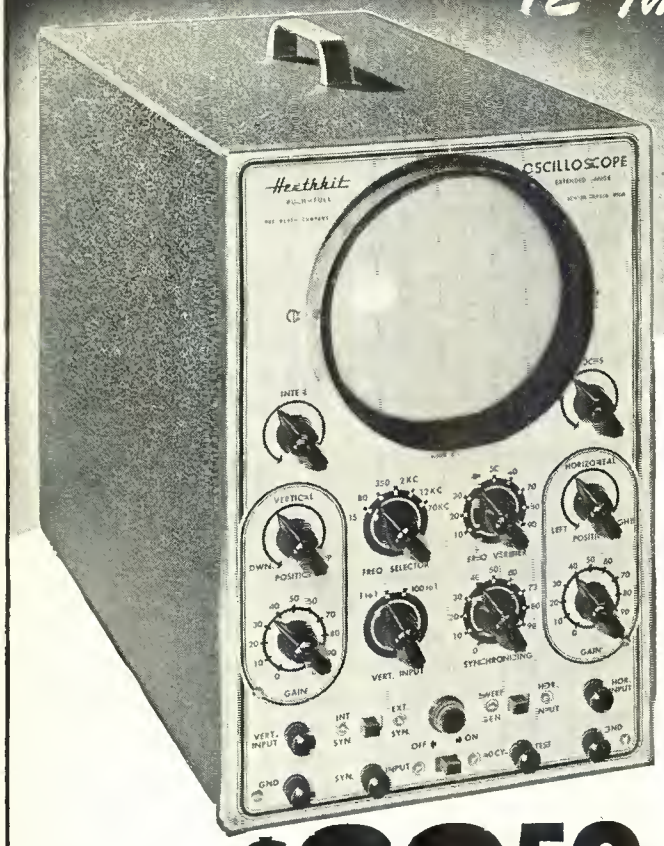
The HEATH COMPANY

. . . BENTON HARBOR 15, MICHIGAN

12 Improvements IN NEW 1951

MODEL O-6 PUSH-PULL

Heathkit OSCILLOSCOPE KIT



- ★ New AC and DC push-pull amplifier.
- ★ New step attenuator frequency compensated input.
- ★ New non frequency discriminating input control.
- ★ New heavy duty power transformer has 68% less magnetic field.
- ★ New filter condenser has separate vertical and horizontal sections.
- ★ New intensity circuit gives greater brilliance.
- ★ Improved amplifiers for better response useful to 2 megacycles.
- ★ High gain amplifiers .04 Volts RMS per inch deflection.
- ★ Improved Allegheny Ludlum magnetic metal CR tube shield.
- ★ New synchronization circuit works with either positive or negative peaks of signal.
- ★ New extended range sweep circuit 15 cycles to over 100,000 cycles.
- ★ Both vertical and horizontal amplifier use push-pull pentodes for maximum gain.

Only $39.50

The new 1951 Heathkit Push-Pull Oscilloscope Kit is again the best buy No other kit offers half the features — check them.

Measure either AC or DC on this new scope — the first oscilloscope under $100.00 with a DC amplifier

The vertical amplifier has frequency compensated step attenuator input into a cathode follower stage The gain control is of the non frequency discriminating type — accurate response at any setting. A push-pull pentode stage feeds the C.R. tube. New type positioning control has wide range for observing any portion of the trace.

The horizontal amplifiers are direct coupled to the C.R. tube and may be used as either AC or DC amplifiers Separate binding posts are provided for AC or DC.

The multivibrator type sweep generator has new frequency compensation for the high range it covers; 15 cycles to cover 100,000 cycles

The new model 0-6 Scope uses 10 tubes in all — several more than any other Only Heathkit Scopes have all the features.

New husky heavy duty power transformer has 50% more laminations It runs cool and has the lowest possible magnetic field. A complete electrostatic shield covers primary and other necessary windings and has lead brought out for proper grounding.

The new filter condenser has separate filters for the vertical and horizontal screen grids and prevents interaction between them.

An improved intensity circuit provides almost double previous brilliance and better intensity modulation.

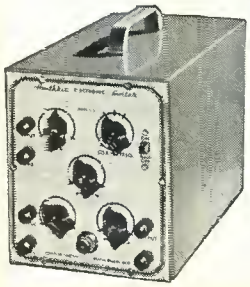
A new synchronization circuit allows the trace to be synchronized with either the positive or negative pulse, an important feature in observing the complex pulses encountered in television servicing.

The magnetic alloy shield supplied for the C.R. tube is of new design and uses a special metal developed by Allegheny Ludlum for such applications.

The Heathkit scope cabinet is of aluminum alloy for lightness of portability.

The kit is complete, all tubes, cabinet, transformer, controls, grid screen, tube shield, etc. The instruction manual has complete step-by-step assembly and pictorials of every section. Compare it with all others and you will buy a Heathkit. Model 0-6 Shipping Wt., 30 lbs.

New INEXPENSIVE MODEL S-2 ELECTRONIC SWITCH KIT



Twice as much fun with your oscilloscope — observe two traces at once — see both the input and output traces of an amplifier, and amazingly you can control the size and position of each trace separately — superimpose them for comparison or separate for observation — no connections inside scope. All operation electronic, nothing mechanical — ideal for classroom demonstrations — checking for intermittents, etc. Distortion, phase shift and other defects show up instantly. Can be used with any type or make of oscilloscope. So inexpensive you can't afford to be without one.

Has individual gain controls, positioning control and coarse and fine switching rate controls — can also be used as square wave generator over limited range. 110 Volt transformer operated comes complete with tubes, cabinet and all parts. Occupies very little space beside the scope. Better get one. You'll enjoy it immensely. Model S-2. Shipping Wt., 11 lbs.

Only $19.50

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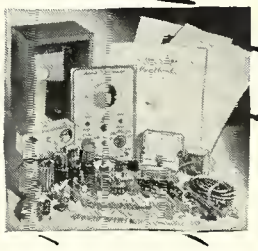
- MALLORY FILTER CONDENSERS
- WILKOR PRECISION RESISTORS
- GRIGSBY ALLISON SWITCHES
- ALLEN-BRADLEY RESISTORS
- GENERAL ELECTRIC TUBES
- CHICAGO TRANSFORMER
- CENTRALAB CONTROLS
- SIMPSON METERS
- CINCH SOCKETS



Complete KITS WITH PARTS THAT FIT...

When you receive your Heathkit, you are assured of every necessary part for the proper operation of the instrument.

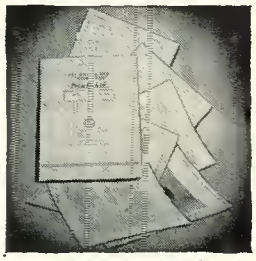
Beautiful cabinets, handles, two-color panels, all tubes, test leads where they are a necessary part of the instrument, quality rubber line cords and plugs, rubber feet for each instrument, all scales and dials ready printed and calibrated. Every Heathkit is 110 V 60 Cy. power tranformer operated by a husky transformer especially designed for the job. Heathkit chassis are precision punched for ease of assembly. Special engineering for simplicity of assembly is carefully considered.

Accuracy ASSURED BY PRECISION PARTS

Wherever required, the finest quality 1% ceramic resistors are supplied. These require no aging and do not shift. No matching of common resistors is required. You find in Heathkit the same quality voltage divider resistors as in the most expensive equipment.

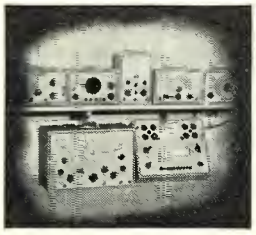
The transformers are designed especially for the Heathkit unit. The scope transformer has two electrostatic shields to prevent interaction of AC fields.

These transformers are built by several of the finest transformer companies in the United States.



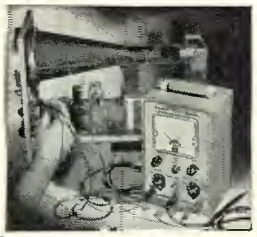
Complete INSTRUCTION MANUALS

Heathkit instruction manuals contain complete assembly data arranged in a step-by-step manner. There are pictorials of each phase of the assembly drawn by competent artists with detail allowing the actual identification of parts. Where necessary, a separate section is devoted to the use of the instrument. Actual photos are included to aid in the proper location of wiring.



Used BY LEADING MANUFACTURERS

Leading TV and radio manufacturers use hundreds of Heathkits on the assembly lines. Heathkit scopes are used in the alignment of TV tuners. Impedance bridges are serving every day in the manufacture of transformers. Heathkit VTVM's are built into the production lines and test benches. Many manufacturers assemble Heathkits in quantity for their own use thus keeping purchase cost down.



Used BY LEADING UNIVERSITIES

Heathkits are found in every leading university from Massachusetts to California. Students learn much more when they actually assemble the instrument they use. Technical schools often include Heathkits in their course and these become the property of the students. High schools, too, find that the purchase of inexpensive Heathkits allows their budget to go much further and provides much more complete laboratories.

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Sensitive Bridge-Type Photoelectric Circuit

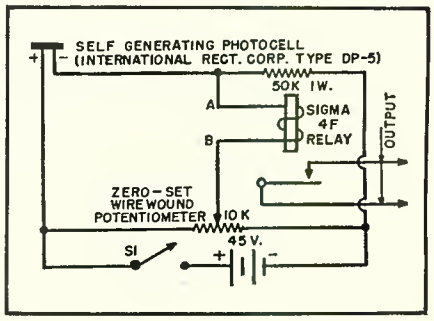
By substituting a meter for the relay you can have a sensitive photographic exposure meter.

By
JAMES KAUKE

SIZE, simplicity, and compactness often are important factors in the design of a photoelectric relay. When tubes can be eliminated, greatest simplicity is obtained. The self-generating type of photocell can be used to operate a d.c. relay directly without amplifier or power supply, but the relay must operate on a few microamperes and is both expensive and delicate.

The accompanying circuit, which has been tested thoroughly, shows how increased output, sufficient to close a 2-milliampere d.c. relay, such as the *Sigma* Type 4F, may be obtained with a self-generating photocell and 45-volt d.c. source. Better operation is afforded than is possible with the older selenium cell circuit in which the cell, relay, and battery are connected in series. In this circuit, no initial current flows through the relay coil.

The circuit is a conventional four-arm resistance bridge. The photocell is one arm of this bridge. A 50,000 ohm resistor is another arm. The remaining two arms are supplied by the 10,000 ohm wirewound potentiometer. If the relay is to operate from the application of light, the cell first is darkened and the bridge balanced by setting the potentiometer to "null out" any initial current flowing in the relay coil. (The relay contacts will open sharply to indicate this null setting.) When the cell subsequently is illuminated, the bridge unbalances because the cell resistance changes under action of the light rays, unbalance current flows through the coil, and the relay is picked up. If the relay is to operate from interruption of a light beam, the bridge must be balanced first with the cell fully illuminated.



Photoelectric bridge circuit.

While battery power supply is shown here for simplicity and portability, the circuit also has been tested with good results with a simple half-wave selenium rectifier operated from the a.c. power line.

When the bridge is unbalanced, 10 volts d.c. appear at bridge output terminals *A* and *B* under no-load conditions. If a d.c. microammeter is substituted for the relay coil, a light meter of extremely high sensitivity is obtained. With the cell darkened, the meter is set to zero by means of the potentiometer. A *Simpson* Model 260 multimeter, set to its 100 microampere range, was connected to terminals *A* and *B*, and a sizable deflection was obtained with low light values which would give no reading at all with a standard photographic exposure meter.

—30—

G.E. UNVEILS NEW COLOR TV SYSTEM

A NEW system of color television which is said to possess important technical and economic advantages over the systems previously proposed, has been announced by Dr. W. R. G. Baker, of the Electronics Department of the General Electric Company, Syracuse.

The new color system, as revealed by the company, provides a method of transmitting color picture information within a frequency band no wider than that used in the present-day black and white transmission. In addition, according to G.E. spokesmen, the new system can be used with either the three-tube or the single picture tube systems now currently under consideration by the FCC.

The new system was evolved by Robert B. Dome, a consultant in the company's Receiver Division. Known as the "frequency interlace" system, the new type of transmission would permit the use of relatively low-cost television receivers. The system is said to be inherently compatible with present black and white standards and would permit color broadcasts to be received in black and white on present-day receivers or allow the reception of black and white telecasts on color receivers incorporating this new system.

—30—

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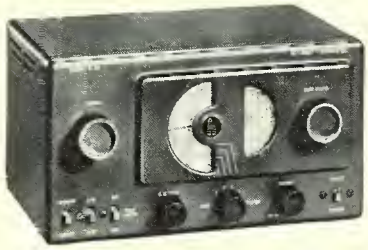

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Buy it at a substantial saving with a Walter Ashe "Surprise" Trade-In deal. What do you have to trade?

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Shpg. wt. 19 lbs. Price **Only** **$69.95**

Slash the above price by trading in your used test or communication equipment.

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Shpg. wt. 16 lbs. Price **Only**

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For amazing savings apply our "Surprise" Trade-In Allowance against this price.

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Aye, laddie, there's savings aplenty for the bargain-wise ham who gets a Walter Ashe "Surprise" Trade-In Allowance on used (factory-built) test or communication equipment toward the purchase of a brand new Hallicrafters Receiver. So pick the instrument you want. Tell us what you have to trade. We'll come right back with our money-saving offer. Wire, write, phone or use the handy coupon.

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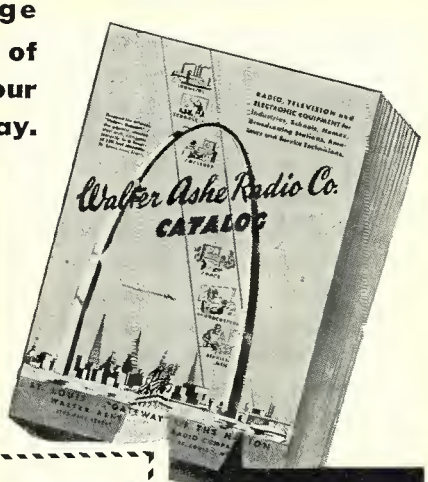
FREE! New 164-Page Catalog. The treasure chest of values! Send for your copy today.



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The latest Hallicrafters catalog, available at Walter Ashe, features current models from which you can choose the instrument that best meets your requirements. There's no better way to get started in amateur radio than with a Hallicrafters and there's no better place to buy it than at Walter Ashe. Just remember . . . *your dollars buy more at the Walter Ashe store!*

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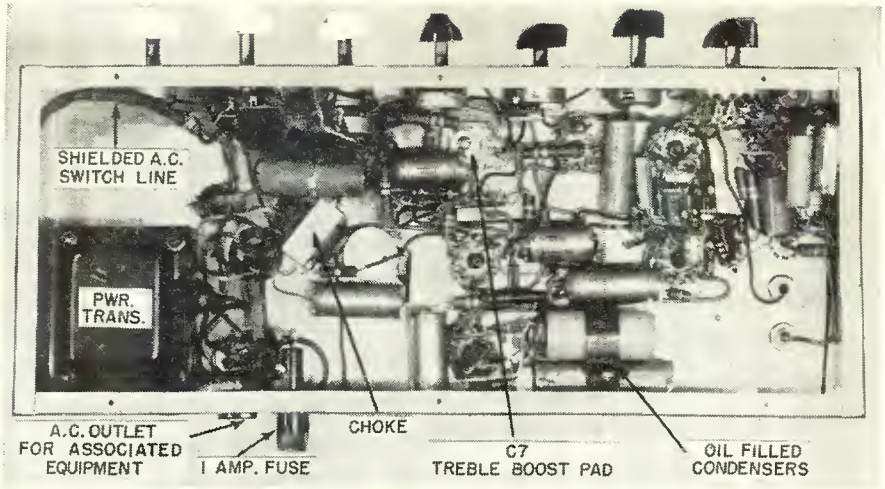


Fig. 4. Under-chassis view of author's suppressor showing location of various components.

1⅜" from the right edge of the chassis. The front row centers 1⅝" from the front edge, the middle row centers 3¾" from the front edge and the back row of tubes centers 5¾" from the same edge. With these figures as an accurate guide to location the other parts may be readily positioned. An a.c. receptacle on the rear apron is wired through the power switch and permits preamp, power amplifier, and tuner to be turned on or off together.

The wiring is straightforward; filament wiring is twisted and runs from socket to socket. One leg of the filament wiring is grounded. The ground side of the filament string is directly wired from tube to tube. Using the chassis as a conductor for part of the filament circuit is a dangerous procedure in any audio work. The connection between all wiring grounds and chassis is accomplished at only one point, the phono input connector. All other wiring ground points are grouped by stages and electrically isolated from the chassis. The electrolytic condenser is mounted on a bakelite mounting plate in a manner which insulates its can from the chassis. To the uninitiated this may seem like a lot of trouble to keep two parts, which are schematically tied together, from connecting. The reader may be assured that employment of this technique goes further towards eliminating hum and oscillations than anything else he might do in the actual construction of an audio component. Remember schematics are only a guide, they can never show the whole picture. Ground loops are almost always the real cause of trouble usually attributed to the use of a.c. heater supplies. The author has never had to resort to d.c. on high gain heater circuits to eliminate hum. Ground loops also cause those "unexplainable" squeals many p.a. men have encountered in complex installations.

Shielded wire has not been used in the construction of this unit, except in the a.c. switch leads. The only point with enough gain ahead of it to cause trouble is the input lead from the mike jack. Running this lead along the corner of the chassis will keep it away from other components and out of trouble. By not using shielded wire in any audio circuits, the high frequency response is kept flat far beyond the twenty thousand c.p.s. goal. It is a simpler task to keep the input wiring of the early stages away from filament circuits than to use shielded wire. Since the power supply is located at the far end of the chassis away from low level circuits it cannot cause trouble.

Construction of either of the models of noise suppressors discussed here is a simple matter. The use of one of these suppressors to remove high frequency noise from any signal source, including the hiss sometimes encountered in FM reception of weak stations, will bring gratifying results. The manner in which these units behave, without detracting from program quality in any way, is astounding. Certainly it must be heard to be appreciated.

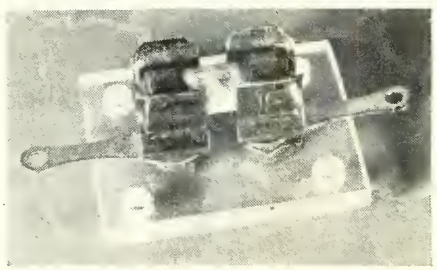
—30—

CRYSTAL MOUNT

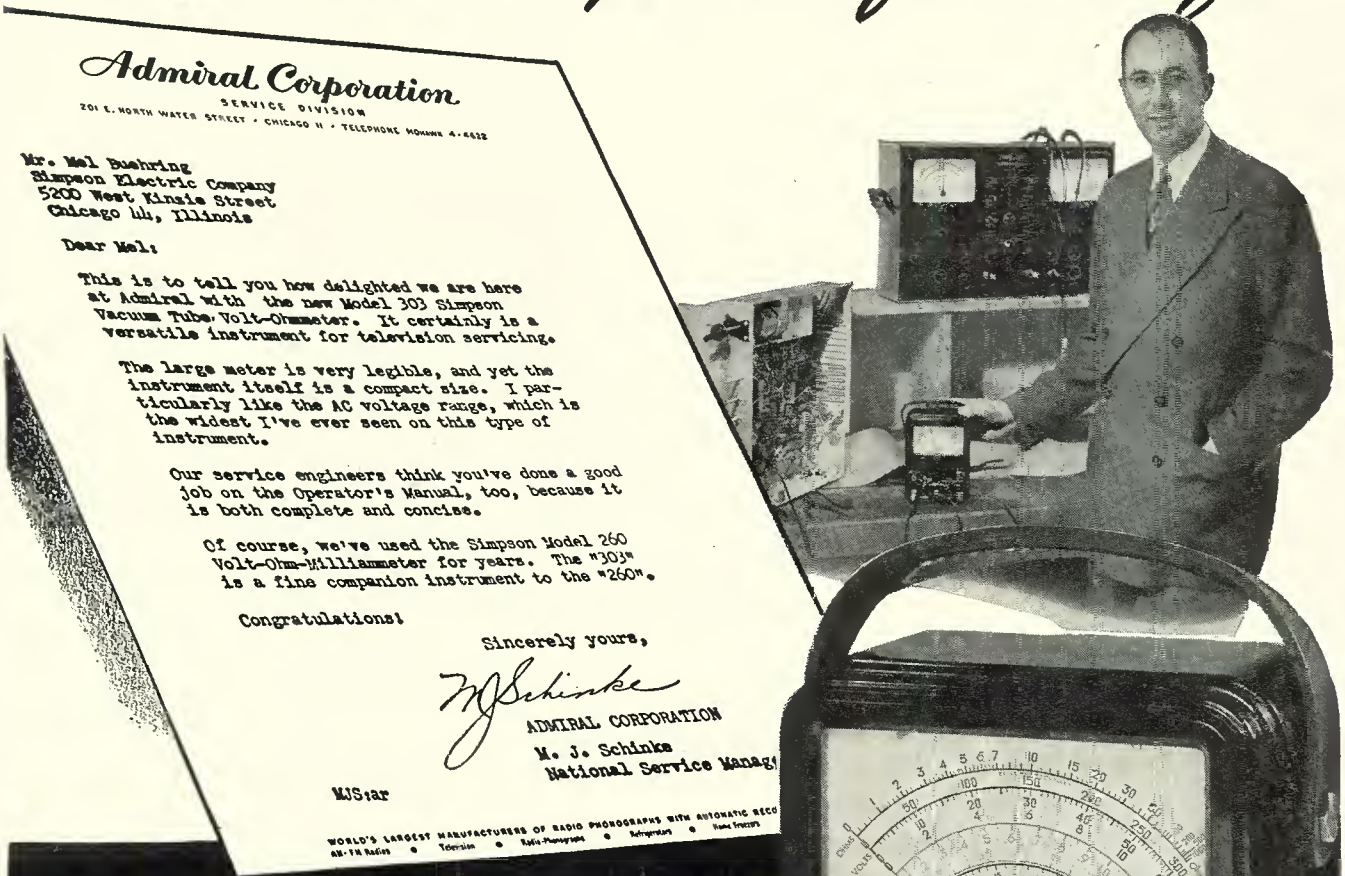
By RUFUS P. TURNER, K6AI

WHEN crystal diodes of the ceramic-cartridge type must be arranged for quick replacement in devices such as electronic counters, conventional pigtail soldering is not desirable. A handy holder for such installations is shown in the accompanying photograph. The pigtails are clipped from the crystal, and the latter is held by two Littelfuse-type fuse clips on a small polystyrene base. The measured capacitance of this holder is 0.9 microfarad at 1 mc. —30—

Handy holder for mounting crystal diodes.



..this letter speaks for itself!



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Mr. Mel Buehring
Simpson Electric Company
5200 West Kinzie Street
Chicago 44, Illinois

Dear Mel:

This is to tell you how delighted we are here at Admiral with the new Model 303 Simpson Vacuum Tube Volt-Ohmmeter. It certainly is a versatile instrument for television servicing.

The large meter is very legible, and yet the instrument itself is a compact size. I particularly like the AC voltage range, which is the widest I've ever seen on this type of instrument.

Our service engineers think you've done a good job on the Operator's Manual, too, because it is both complete and concise.

Of course, we've used the Simpson Model 260 Volt-Ohm-Milliammeter for years. The "303" is a fine companion instrument to the "260".

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Model 303
VACUUM TUBE VOLT-OHMMETER

SPECIFICATIONS

DC Voltage
Ranges 1.2, 12, 60, 300, 1200 (30,000 with Accessory High Voltage Probe)
Input Resistance 10 megohms for all ranges
DC Probe with one megohm isolating resistor Polarity reversing switch

Ohms *Ranges 1000 (10 ohms center)*
100,000 (1000 ohms center)
1 megohm (10,000 ohms center)
10 megohms (100,000 ohms center)
1000 megohms (10 megohms center)

AC Voltage
Ranges 1.2, 12, 60, 300, 1200
Impedance (with cable) approx. 200 mmf shunted by 275,000 ohms

AF Voltage
Ranges 1.2, 12, 60
Frequency Response Flat to 100,000 cycles

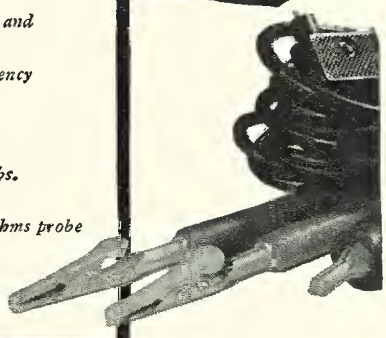
Decibels
Ranges −20 to +3, −10 to +23, +4 to +37, +18 to +51, +30 to +63
Zero Power Level 1 M. W., 600 ohms

Galvanometer
Zero center for FM discriminator alignment and other galvanometer applications

R. F. Voltage
(Signal tracing with Accessory High Frequency Crystal Probe)
Range 20 volts maximum
Frequency Flat 20 KC to 100 M.C.
105-125 V. 60 cycles

Size
5¼"x7"x3⅛" (bakelite case). Weight: 4 lbs. Shipping Wt.: 6½ lbs.

Dealer's Net Price
Model 303, including DCV Probe, ACV—Ohms probe and Ground Lead—$58.75;
Accessory High Frequency Probe, $7.50;
Accessory High Voltage Probe, $14.85
Also available with roll top case, Model 303RT—$64.75



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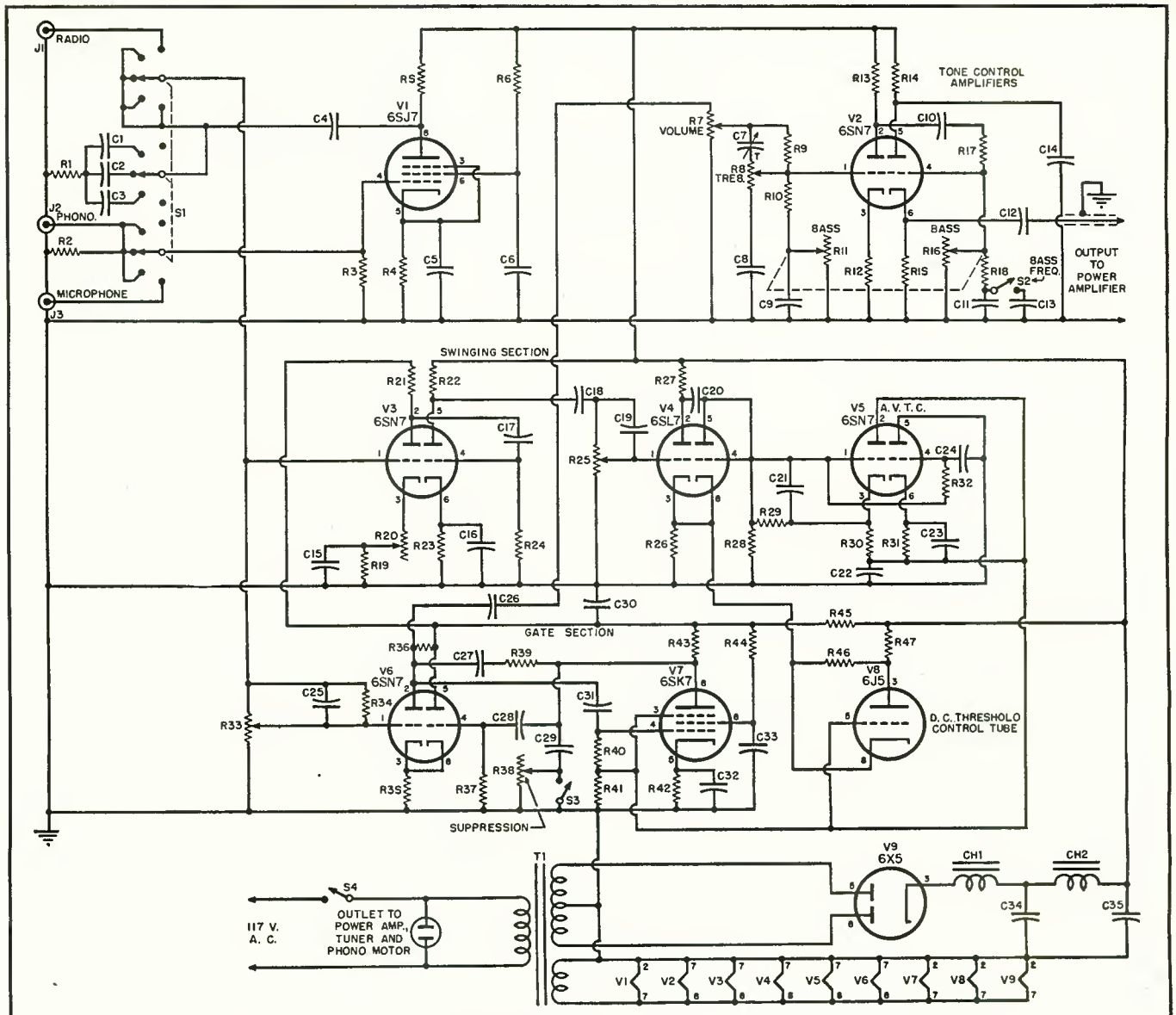
5200 WEST KINZIE STREET, CHICAGO 44, ILLINOIS • IN CANADA: BACH-SIMPSON, LTD., LONDON, ONTARIO
Phone: COlumbus 1-1221



R_1, R_{26}—5000 ohm, 1 w. res.
R_2—5 to 40,000 ohm, 1 w. res. (exact value depends on pickup cartridge used)
R_3, R_{24}, R_{28}, R_{40}—470,000 ohm, 1 w. res.
R_4—1200 ohm, 1 w. res.
R_5, R_9, R_{17}, R_{44}—220,000 ohm, 1 w. res.
R_6—1.2 megohm, 1 w. res.
R_7—250,000 ohm audio taper pot
R_8—500,000 ohm linear taper pot
R_{10}, R_{14}, R_{18}, R_{43}—51,000 ohm, 1 w. res.
R_{11}, R_{16}—1 megohm audio taper dual pot
R_{12}—6800 ohm, 1 w. res.
R_{13}, R_{29}, R_{31}, R_{39}—100,000 ohm, 1 w. res.
R_{15}—3300 ohm, 1 w. res.
R_{19}—1500 ohm, 1 w. res.
R_{20}, R_{33}—500,000 ohm audio taper pot (screwdriver adj.)
R_{21}, R_{22}, R_{34}—47,000 ohm, 1 w. res.
R_{23}—2400 ohm, 1 w. res.
R_{25}—1 megohm linear taper pot
R_{30}—1000 ohm, 1 w. res. ± 5%
R_{27}—270,000 ohm, 1 w. res.
R_{36}—2.2 megohm, 1 w. res.
R_{32}—1 megohm, 1 w. res.
R_{35}—620 ohm, 1 w. res.
R_{37}—10,000 ohm, 1 w. res.
R_{38}—100,000 ohm linear taper pot.
R_{41}—10 megohm, 1 w. res.
R_{42}—1000 ohm, 1 w. res.
R_{45}—13,500 ohm, 4 w. res. (a 22,000 and a 33,000 ohm, 2 w. res. in parallel)
R_{46}—150,000 ohm, 2 w. res.
R_{47}—27,000 ohm, 2 w. res. ± 5%
C_1—.03 μfd., 400 v. cond.
C_2, C_4, C_{10}—.05 μfd., 400 v. cond.
C_3, C_6, C_{20}, C_{33}—.1 μfd., 400 v. cond.
C_5—25 μfd., 25 v. elec. cond.
C_7—750 μμfd. (max.) padding cond.
C_8—.004 μfd., 400 v. cond.
C_9, C_{27}—.01 μfd., 400 v. cond.
C_{11}—.002 μfd., 200 v. cond.
C_{12}—.02 μfd., 200 v. cond.
C_{18}—.01 μfd., 200 v. cond.
C_{14}, C_{30}—20 μfd., 450 v. elec. cond.
C_{15}, C_{22}—.1 μfd., 200 v. cond.
C_{16}—.05 μfd., 200 v. cond.
C_{17}, C_{20}—.001 μfd., 400 v. cond.
C_{18}, C_{19}—250 μμfd. mica cond.
C_{21}—2 μfd., 400 v. oil-filled cond.
C_{23}—1 μfd., 200 v. oil-filled cond.
C_{24}—.0025 μfd., 200 v. cond.
C_{25}, C_{31}—100 μμfd. mica cond.
C_{26}—.02 μfd., 400 v. cond.
C_{28}—500 μμfd. mica cond.
C_{32}—10 μfd., 25 v. elec. cond.
C_{34}, C_{35}—40 μfd., 450 v. elec. cond.
J_1, J_2, J_3—Open circuit jack
S_1—3-pole, 5-pos. rotary sw.
S_2, S_4—Each s.p.s.t. sw. (ganged, with S_4 on first, then S_2)
S_3—S.p.s.t. sw. (suppression "on-off" sw. May be omitted if not desired)
T_1—Power trans. 315-0-315 @ 35 ma.; 6.3 v. @ 4.5 amps
CH_1, CH_2—Filter choke, 8 hy. @ 35 ma.

Fig. 3. Diagram of suppressor shown in photographs. This unit also incorporates a power supply, preamp, and a tone control.

very little stray coupling capacity is required to cause interaction between it and the gate section. A layout similar to that shown in the photographs is easy to follow and applies equally to both models shown schematically. The simpler model merely requires less chassis space. If desired, the unit built by the author may be duplicated exactly, or the phono-preamp and tone control stage may be left out if not required. The author's unit is built on a 7x17x3 inch aluminum chassis which was brushed with a rotating wire brush to give it a velvet grained appearance. The controls are located on two-inch centers on a straight line running through the center of the front apron. From left to right they are volume, on-off and bass frequency, bass (amplitude), treble, swinging control, gate control, and radio-phono-microphone selector. There are three phono positions on this second switch providing low frequency turnover points of 300, 500, and 800 c.p.s. so that recordings of the various companies may be properly equalized. The constants of the treble control afford proper high frequency equalization to accommodate any pre-emphasis recorded on the discs.

Location of other parts may be seen in the photographs. The tube sockets are centered 2⅛" from each other in the longest direction. The 6SJ7 is

pletely inactive state. The sensitivity of the swinging section rises very rapidly at the masking threshold. For most program material the gate will be either entirely open or entirely closed at any given instant. This is due not only to the sharply rising sensitivity of the swinging section, but also to the action of the "Automatically Variable Time Constant" incorporated in its circuit.

In the gate section two tubes are employed, a 6SN7 twin triode and a 6SK7 remote cut-off pentode. The potentiometer network at the grid of the input 6SN7 (R_{33}, C_{25}, R_{34}) is for limiting the input to this tube to prevent overload. Where signal sources of less than 1 volt output are to be used, it may be replaced by a single fixed resistor. The output of the voltage amplifying half of the 6SN7 is fed through a very small coupling condenser, which acts as a high pass filter, to the grid of the 6SK7. The audio output of the 6SK7 is fed back through another filter network, which has been deliberately made variable as to frequency and amplitude, to the other section of the 6SN7, which is a cathode coupling element. The combined effect of the two high pass filters, cancelling high frequencies by selective inverse feedback, results in a maximum possible roll-off approaching 12 db. per octave, or expressing it another way, the response is over 20 db. down at 10,000 c.p.s. This is more roll-off than is desirable; however, because the degree of roll-off is completely variable, there is no harm in having this maximum reserve available. When the gate filter, set at maximum, is used as a fixed filter (swinging section "off") the tonal quality of reproduced music is so muddy as to be unpleasant. Here it is the action of the swinging section which restores the full musical brilliance without allowing noise to intrude.

This swinging section is the novel part of this unit. It features an "Automatically Variable Time Constant" (a.v.t.c.) which facilitates the rapid swinging of the gate.

The same audio signal which feeds the voltage amplifier also enters a separate amplifier in the swinging section where it is amplified, coupled through a high pass filter system which has also been made deliberately variable as to frequency and amplitude, again amplified, and finally rectified and filtered. The result is a d.c. voltage which is proportional to the high frequency content of the record. This voltage could be made to bias the gate tube without any further modification. However, it has proven desirable to incorporate the additional three triode stages which make up the a.v.t.c. and d.c. threshold control portion of the swinging section. The complex behavior of this part of the circuit is required to make the action of the gate so rapid as to be unobtrusive. This may readily be demonstrated by removing the a.v.t.c. tube from its socket, particularly at a time when it is operating on such percussive modulation as piano or violin music or hot jazz.

The function of the a.v.t.c. circuit is to convert the conventional fixed time constant filter circuit that follows the rectifier into a circuit which has a time constant automatically varied over a range which is nearly instantaneous at one extreme and .1 second at the other. This permits a much shorter effective time constant than that afforded by a conventional RC time constant. The usual RC circuit, with a time constant short enough to act without inertia, would introduce serious transient distortion.

The first half of the a.v.t.c. tube acts as a shunt resistor across R_{29}. The time required to charge C_{21} under rising signal conditions is controlled by the dynamically varied plate resistance of this tube. Conversely, the time required to discharge C_{21} is dynamically controlled in accordance with the decaying signal conditions and their relation to the average signal level. The a.v.t.c. action is further modified by condensers C_{22}, C_{23}, C_{24}, and resistor R_{31}. The precise manner in which the build up and decay is shaped can only be illustrated graphically and by lengthy description.

The threshold control circuit is designed to keep the gate from opening or closing on noise signals in the absence of a desired control signal, or when noise greatly overrides low level signals. Under no-signal condition the cathode resistor develops about 4.6 volts bias across the 6SL7 cathodes. The 6SL7 normally requires about 1 volt bias; with 4.6 volts this stage operates nearly, but not quite, at cut-off. It is effectively paralyzed at low signal levels. A signal just over the level of the noise will reduce this cut-off bias so that a positive feedback of d.c. voltage will restore normal 6SL7 bias very shortly after the threshold level of noise is exceeded. It can be seen that because of this self-resensitizing action of the swinging section amplifier stage, a very sharply defined threshold point will result due to the action of this d.c. threshold control circuit. It should be further pointed out that due to Miller Effects in the various stages of this circuit it is insensitive to extreme high frequencies and will not respond to most noise.

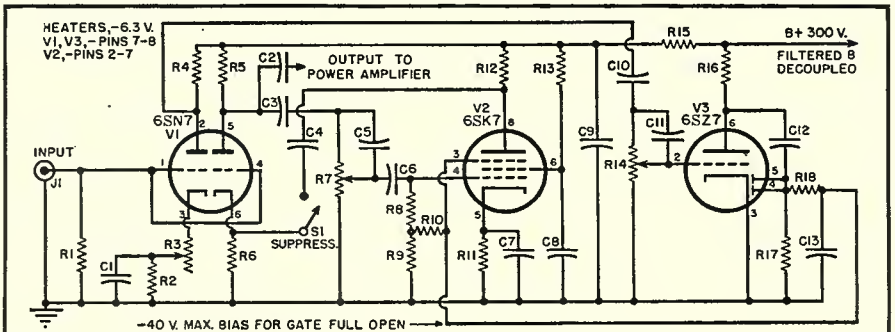
The diagrams of Figs. 2 and 3 illustrate two versions of the suppressor.

Fig. 2 is actually patterned after an early development model which did not employ a.v.t.c. or the cathode coupled type of feedback circuit. It will not permit quite as much noise suppression as the more elaborate versions; the gate action is perceptible, but not to such an objectionable degree as to be without merit.

Fig. 3 illustrates the model shown in the photographs. It was built by the author and incorporates, in addition to the latest elaborate version of the basic suppressor, a power supply and preamplifier for a magnetic pickup as well as a complete tone control preamplifier based on design data presented in the article "Design Considerations for High-Quality Reproducing Systems" (April and May, 1950, issues of RADIO & TELEVISION NEWS). A cathode follower in the output of this unit permits connection through a long shielded cable to a fixed gain power amplifier. It provides straight line frequency response over the entire range of 20-20,000 c.p.s. as measured from the input of the suppressor to the speaker voice coil.

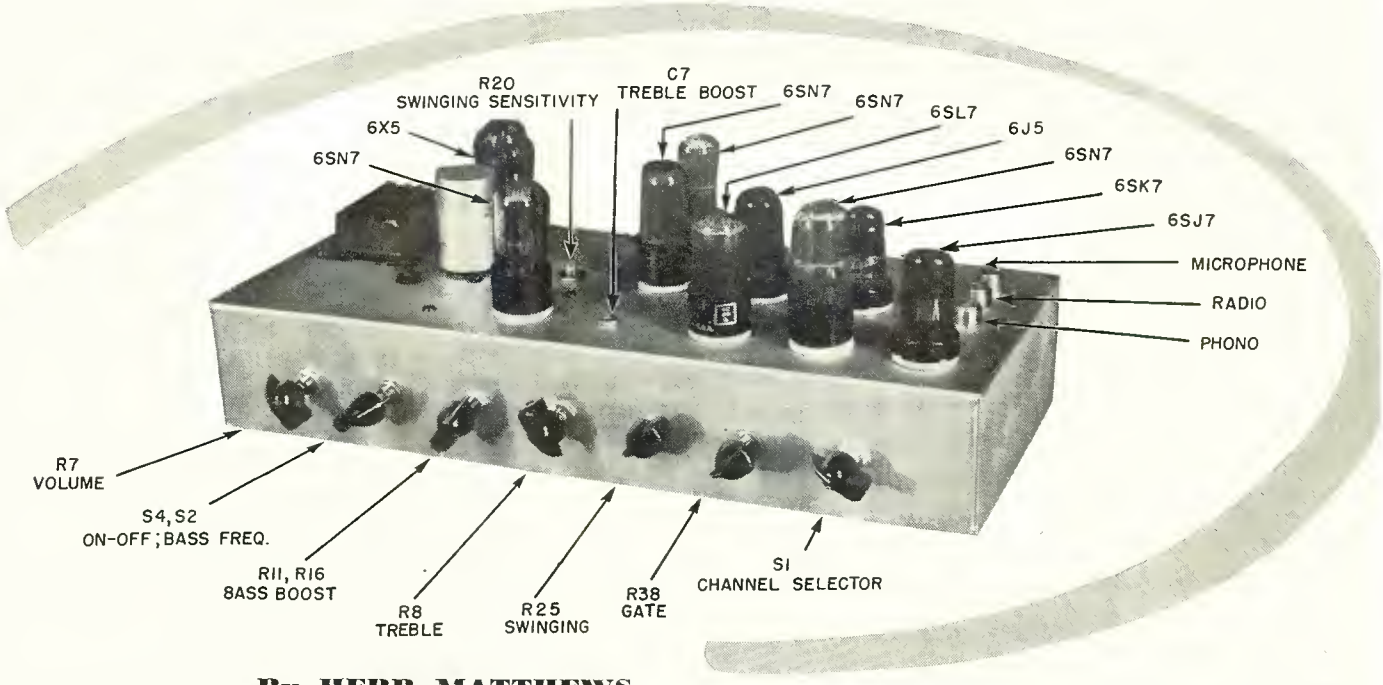
Nevertheless, actual construction of either basic suppressor is not critical. The audio signal itself is channelled through only two tubes and if normal care is exercised in keeping leads reasonably short and the components are not crowded to the point where they interact, no difficulty need be expected. The swinging section is even less critical. Remember only that it has fairly high gain at the high frequencies and

Fig. 2. Early-model suppressor which did not employ a.v.t.c. or special feedback circuit.



R_1, R_8—500,000 ohm, 1 w. res.
R_2—1500 ohm, 1 w. res.
R_3—500,000 ohm audio taper pot (screwdriver adj.)
R_4, R_5—47,000 ohm, 1 w. res.
R_6—3900 ohm, 1 w.res.
R_7—500,000 ohm pot
R_9—10 megohm, 1 w. res.
R_{10}—4 megohm, 1 w. res.
R_{11}—620 ohm, 1 w. res.
R_{12}—51,000 ohm, 1 w. res.
R_{13}—220,000 ohm, 1 w. res.
R_{14}—1 megohm linear taper pot
R_{15}—33,000 ohm, 1 w. res.
R_{16}—100,000 ohm, 1 w. res.
R_{17}—1 megohm, 1 w. res.
R_{18}—2.2 megohm, 1 w. res.
C_1, C_2, C_8, C_{13}—.1 μfd., 400 v. cond.
C_3—100 μμfd. mica cond.
C_4—500 μμfd. mica cond.
C_5—.004 μfd., 400 v. cond.
C_6—.01 μfd., 400 v. cond.
C_7—10 μfd., 25 v. elec. cond.
C_9—20 μfd., 450 v. elec. cond.
C_{10}, C_{11}—250 μμfd. mica cond.
C_{12}—.001 μfd., 400 v. cond.
S_1—S.p.s.t. sw. (optional suppression "on-off")
J_1—Input jack
1—6SN7 tube
1—6SK7 tube
1—6SZ7 tube

Noise Reduction for High Quality Reproducing Systems



By HERB MATTHEWS

Fig. 1. Over-all view of the suppressor built by the author from standard parts.

Details on the new Bielek dynamic noise suppressor. Both gate and swinging sections are panel controlled.

THE fundamental conception of a dynamically operated filter, one - - which would hold down the higher frequencies of both the noise and the music when there were no highs in the music and pass all the highs when the high frequency content of the signal was strong enough to mask out the noise, was a real contribution to the audio art. However, the technology for achieving this fundamental goal and the determination of the precise electrical characteristic which would do the most good with the least harm turned out to be an extremely difficult design problem.

The noise suppressor about to be described fully for the first time in any publication is the result of several years of research and development by Alfred D. Bielek of 359 High St., Nutley, N. J. All commercial rights for this invention are protected by patents pending. None of the retarding features of prior units are to be found in this suppressor, which is simple to construct and so smooth in operation that it has been used on live FM program material without detracting in the least from the over-all quality. The most elaborate model of the *Bielek* suppressor may be built from new parts for less than fifty dollars.

The operation of the suppressor is truly dynamic. The actual suppressor is divided up into two sections; a gate section which filters out all highs when the gate is closed and passes them when the gate is open, and a "swinging" section which actually swings the gate open or closed depending on the nature of the signal passing through the suppressor at a given instant.

Regulation of the filter action of the gate is accomplished by a panel control which varies its characteristic from one with a very gradual roll-off, starting its drop at several thousand c.p.s., to a very steep roll-off, starting at about one thousand c.p.s. The static characteristic of this filter is, therefore, both horizontal and vertical. The dynamic characteristic, as the gate swings, is primarily vertical as contrasted with the strictly horizontal action of most previous suppressors. Indeed, the difference between horizontal and vertical suppression can only be fully appreciated by a listening, or A-B, test; making a direct comparison between the two types of filter. This comparison is one of the most striking examples of the necessity for listening to audio equipment. The result is opposite to the one expected from a study of the performance curves.

Similarly the frequency-amplitude characteristic of the swinging section is adjusted by a panel control, R_{25} (Fig. 3), which regulates the "masking threshold" of the suppressor both horizontally and vertically in a carefully designed manner to provide correct behavior with various record surfaces. The screwdriver adjusted control R_{20} limits the gain sensitivity of the swinging section so that the frequency-amplitude characteristic of R_{25} operates over the desired range. Quiet records will have objectionable noise at higher frequencies than those with gritty surfaces. This is why both the filter and the swinging sensitivity characteristics must vary with frequency as they take bigger bites out of the noise.

Actual operation of this suppressor is extremely simple. The gate control is first advanced until all record noise is satisfactorily removed. Next, the swinging control is advanced to the point where the gate swings open on surface noise; it is then backed down to the point where the noise again disappears. (This point will vary with various records used.) Set this way, the suppressor will let even the very softest high frequency passages be heard. A signal only slightly louder than the record noise, that is, one at the masking threshold, will develop sufficient voltage in the swinging section to bias the gate filter to a com-

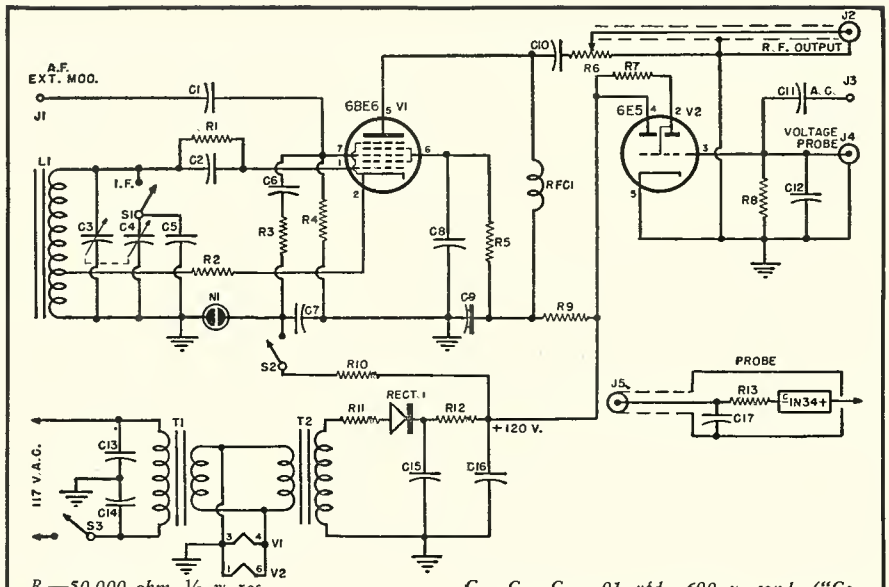
on. Frequency of oscillation can be varied by using different values of C and R with the neon bulb, and since there is considerable variation in the miniature neon bulbs, it may be necessary to use other values than those shown in the parts list. Capacity may vary from .01 to .05 μfd. and resistance from ½ to 3 megohms. Choose values that produce a pleasing tone of about 1000 cycles.

The 1000 ohm carbon volume control provides adequate r.f. attenuation for most purposes. A 2000 or 5000 ohm potentiometer could also be used if the 1000 ohm job is not available. However, if the resistance is too high, it will not be possible to attenuate the signal sufficiently. To secure adequate attenuation it is important to keep all leads carrying r.f. very short and to make all ground returns carrying r.f. to a common point. If needed, additional attenuation can be secured by moving the output lead away from the antenna input of the set being tested.

It is advisable to use an iron core oscillator coil of the midget type and to remove the trimmers from the variable. Frequency can be adjusted if necessary by moving the iron core, and with trimmers removed from the variable the minimum capacity will be less, stability better, and a wider range of frequencies can be covered. A midget coil will have a smaller r.f. field which will decrease stray radiation to nearby parts and make the attenuation more effective. Phono input connectors are used for the r.f. output and also for input to the eye. Connection between the attenuator and output jack should be shielded as should the input to the tuning eye.

Since the front and back panels must be connected together, it might appear at first that it would be difficult to remove both panels from the case. However, this is easily accomplished if sufficient wire is provided to permit the back panel to be turned at an angle so it will slip through the cabinet along its diagonal. Layout for the front panel is shown on page 68, but it may be modified to fit parts that are available if care is taken to allow a minimum of ½" space around the edges of the panel.

Single conductor shielded "mike" cable can be used for making up the output cables. The r.f. probe consists of the parts shown in the diagram assembled in a length of ½" polystyrene tubing. A phone tip jack was inserted at one end and an antenna connector at the other. These connectors were held in place with plastic cement after the parts were assembled. Care must be taken when soldering to the 1N34 crystal diode as it will be ruined by excessive heat. The tuning eye is sensitive enough to detect the output from the oscillator with the attenuator set at maximum, and although the movement will be very small, it is sufficient to give an indication which will permit signal tracing through most circuits without additional amplification. It is most useful as an output meter, as it can be coupled to



R_1—50,000 ohm, ½ w. res.
R_2—100 ohm, 1 w. res.
R_3—200,000 ohm, ½ w. res.
R_4, R_7, R_{12}—500,000 ohm, ½ w. res.
R_5—250,000 ohm, ½ w. res.
R_6—1000 ohm carbon pot. (with switch S_3)
R_8, R_{10}—2 megohm, ½ w. res.
R_9—10,000 ohm, ½ w. res.
R_{11}—50 ohm, 1 w. res.
R_{12}—5000 ohm, 1 w. res.
C_1, C_2, C_6, C_{17}—100 μμfd., 1000 v. cond. ("Silver Mike")
C_3, C_4—2-gang 365 μμfd. var. cond.
C_5—200 μμfd., 1000 v. cond. ("Silver Mike")
C_7—.02 μfd., 600 v. cond.
C_8, C_9—.05 μfd., 600 v. cond.
C_{10}—500 μμfd., 1000 v. cond. ("Silver Mike")
C_{11}—.001 μfd., 1000 v. cond. ("Silver Mike")
C_{12}, C_{13}, C_{14}—.01 μfd., 600 v. cond. ("Ceramicon")
C_{15}, C_{16}—20/20 μfd., 150/150 v. elec. cond.
T_1—Fil. trans. 6.3 v. @ 1 amp. (Allied #62-030 or equiv.)
T_2—Output trans. 5000 ohm pri. to 4 ohm sec. (Allied #62-095 or equiv.). Since trans. is used as a voltage step-up any unit with a ratio of 35:1 can be used
J_1, J_3, J_5—Phone tip jack (Amphenol #78-1P or equiv.)
J_2, J_4—Phono input jack and plug
RFC_1—2.5 mhy. r.f. choke
S_1, S_2—S.p.s.t. toggle sw.
S_3—S.p.s.t. sw. (on R_6)
N_1—Neon bulb
Rect. 1—75 ma. selenium rectifier
L_1—455 kc. osc. coil (Carron #9540 or equiv.)
V_1—6BE6 tube V_2—6E5 tube

Complete circuit diagram and parts list for AM oscillator-signal tracer unit.

any portion of the a.v.c. network of the set under test and will thus replace a vacuum tube voltmeter for routine checking. The .001 μfd. mica condenser in the input circuit to the eye is useful for observations where it is desirable to block a d.c. voltage component.

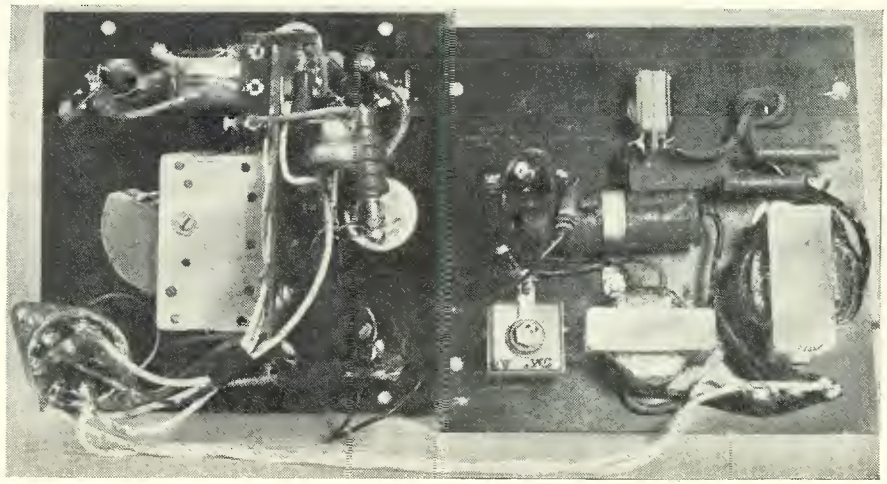
Calibration

Correct calibration will require a little time and patience to do a thorough job. The author used a broadcast station list as reference and marked the oscillator dial settings opposite the station frequencies as they were identified. This type of record is useful when setting up push-button tuning assemblies. A calibration curve should also be drawn. Typical curves for i.f. and r.f. frequencies are shown in the graph. While these curves apply only to the author's instrument, they will serve to illustrate the approximate shape of a curve for an oscillator of this type.

For calibration, use a receiver having a reasonably accurate and easily read dial calibrated in kilocycles. First make sure it is correctly aligned to correspond to the dial calibrations as this will make stations much easier to identify. However, do not rely on dial

(*Continued on page* 127)

Front and rear panel views showing how components are assembled and wired.



AM OSCILLATOR-SIGNAL TRACER

Over-all view of the home-built AM oscillator-signal tracer test unit. The entire instrument is housed in a metal cabinet measuring 6" square.

By LYMAN E. GREENLEE

Built from standard parts, this portable signal generator can be used for 90% of routine AM jobs.

A SMALL portable signal generator covering the broadcast and most-used i.f. frequencies is useful on any service bench as it will be adequate for the routine servicing of 90% of the AM receivers that come into the shop. The instrument to be described is built entirely from standard parts. There are no coils to wind and it can be assembled in a single evening. Its usefulness will far outweigh its small initial cost.

A standard 6" x 6" x 6" metal utility cabinet houses all the parts with plenty of room to spare. The power supply is built on the back cover, and the oscillator proper is on the front panel. A small metal chassis supports the variable condenser and the 6BE6 tube. The 6E5 tuning eye is independent of the rest of the circuit, except for the common filament and plate supply. It may be used with the probe for signal tracing or as an output meter. The combination of oscillator and tuning eye is particularly useful in setting up push-button station selectors on new radios.

The power supply is rather unusual, but it has proved very satisfactory in actual use. An a.c.-d.c. supply is always a problem with test equipment as there is never any satisfactory way to isolate the power line from the balance of the circuit. On the other hand, most conventional power transformers are too heavy and bulky for portable equipment. The combination of a 1 ampere filament transformer with a small output transformer is light in weight, takes up very little space, and provides excellent isolation between the power line and the rest of the circuits. Although the selenium rectifier is operated somewhat above its normal voltage rating, no trouble has been experienced with this component by the author. As a precautionary measure, it might be advisable to connect two rectifiers in series to provide an adequate voltage rating. Very little r.f. feeds back through the power line and with the attenuator set at "Off" it is usually not possible to pick up a signal on a conventional 5-tube a.c.-d.c. midget plugged into the same socket with the test oscillator.

The power supply is simple to build as can be seen from a casual study of the wiring diagram and the photograph of the interior. Components are tied to the panel and leads are made as short as possible. Allowance must be made for clearance so that the parts will have adequate spacing from the sides of the metal cabinet, and everything must be at least ½" from the edge of the panel. The parts layout and short wiring leads help to eliminate feedback through the power line, an important factor in determining the utility of a signal generator.

The oscillator circuit is conventional and uses a coil made for the 6BE6 or 6SA7 tube. The frequency range will depend somewhat on the choice of parts, but with the author's setup it was from approximately 350 to 2100 kc. All wiring should be as short and direct as possible, and parts should be rigidly supported. Actually, very little wiring is required in the r.f. portion of the oscillator circuit; most of the parts being directly mounted to the tube socket and a couple of wiring ties. With a little care in wiring and rigidly mounting parts, frequency drift will be well within the requirements for the most accurate alignment of AM receivers. This instrument may be set to zero-beat with a broadcast station carrier and it will stay in tune for hours at a time with very little noticeable drift. Frequency stability will improve with use. Low loss "Silver Mike" *Cornell-Dubilier* condensers and *Centralab* "Ceramicons" were used in most places, and there are only three paper condensers in the instrument. Note that the most important i.f. frequencies are covered without bandswitching by using both sections of the 365 $\mu\mu$fd. variable in parallel, plus a 200 $\mu\mu$fd. "Silver Mike" condenser and that the change from r.f. to i.f. is made with a standard toggle switch, S_1.

The r.f. output is modulated by a simple neon tube relaxation oscillator which can be turned off by opening S_2. Simple provision for external modulation is supplied through a 100 $\mu\mu$fd. coupling condenser to the 6BE6 grid. An audio test signal of low intensity can also be obtained from the phone tip jack when the audio oscillator is

formers were used in the design shown but any other convenient frequency could serve as well. It may be desirable, however, to detune the circuit from the regular i.f. frequencies somewhat in order to minimize possible interference to regular receivers. The oscillator coil that was used in the circuit shown was merely one of the coils from an i.f. transformer that had been center-tapped.

If it is not desired to make use of the effects available with sharply tuned i.f. coils, the coils in the i.f. can may be loosened and slid closer together to provide greater coupling. As noted earlier, precautions should be taken against overloading the final stages of the system and in any a.c. operated system care should be taken that hum or noise due to ground loops is not present at the input of the preamp.

A number of other interesting applications of this type of circuit might be mentioned. The excellent low frequency response characteristics should make it useful in certain scientific or industrial studies such as vibration analysis. Similarly, its use as a d.c. amplifier is suggested. The audio experimenter may find the circuit of considerable interest both from the standpoint of making condenser-type electromechanical transducers such as phono pickups or microphones in which variations in capacity are converted to frequency variations in the oscillator circuit and consequently slope detected, and from the standpoint of making tests on transducers such as loudspeakers. A suggested procedure for the last is to coat the loudspeaker cone with graphite or some other conducting medium and use the speaker cone as one half of a condenser microphone which, in turn, frequency modulates the oscillator circuit. The other half of the microphone may be a small metal plate which can be moved over the surface of the speaker to investigate the various modes of vibration at different locations. Investigations of this sort should eliminate, to a large degree, any discrepancies or distortions that might occur when using a conventional microphone for sound pickup and should provide very interesting information regarding speaker performance. In connection with this type of operation as well as the preamp circuit it should be noted that precautions should be taken against undesirable frequency modulation of the oscillator circuit by mechanical vibration or microphonics will result when sharply tuned i.f. coils are used in the circuit.

The use of radio frequency energy for uses other than broadcast is an intriguing and ever-expanding field. Such well known applications as industrial heating, high voltage power supplies, and others will undoubtedly be followed by an increasing number of interesting and useful devices, the discovery and application of which should be rewarding to the experimenter. —30—

Mac's RADIO SERVICE SHOP

By JOHN T. FRYE

WHOSE OX IS GORED?

THE wall calendar of Mac's Radio Service Shop was turned to the month of September, and the picture it displayed of a shapely young woman in a Bikini swim suit was appropriately titled "Modern September Morn"; but the bright, hot day itself could have been lifted right from the middle of August.

Mac and his apprentice, Barney, were both busy at the service bench. Mac was installing a new horizontal flyback transformer in a TV chassis, and Barney was stringing a dial cable. No conversation had passed between the two for at least half an hour—a most unusual circumstance, for Mac often declared that only two things could still Barney's wagging tongue: food or unconsciousness. In fact, though, the boy had seemed to be brooding over something all day.

"Hey, Red," Mac said casually as he smoothed out the solder on the high voltage connections to make sure there were no sharp points to aggravate corona discharge, "you seem to be a little on the quiet side today. What's eating you? Is that spavined hot rod of yours missing out on a cylinder or two, or is something wrong in the billing-and-cooing department?"

"In a way, it's the car," Barney replied. "Yesterday I got it back from the garage after having it in there for a complete Fall tune up, and I am thoroughly disgusted with the kind of service I got out of that bunch of jokers."

"Doesn't it run any better?"

"Oh, yes, it runs better. They took care of the major complaints all right; but what burns me are the little things they let slide. Take for example the hood-release catch that is binding and hard to work: they never did a thing to it. Then I told them the windshield wipers were sluggish. They just squirted a little oil on the outside of the wiper motor and told me they thought it would perform better after the oil 'works in.' In a pig's eye, it will! I tried that a long time ago. On top of everything they got smudges of dirt on the upholstery at several places, and the steering wheel was so covered with grease that the front of the white shirt I wore last evening looks as though I went dancing with a coal-heaver instead of Marge."

"Stop," Mac pleaded. "You're breaking my heart!"

"Well, doggone it, it makes a guy mad. It's the same old story, no matter what kind of equipment you want serviced. No one is interested in doing a really good job any more. All the repairmen think about is getting the job out of the shop and getting the money into their hot little hands. Pride of workmanship is as out-of-date and as extinct as, as—as the knee-length bathing suit," he finished as his eye lighted fondly on the calendar.

While they were talking, Barney had finished stringing the new dial cord and had replaced the set in its cabinet. After running the pointer at first quickly and then slowly across the dial to make sure there was no slippage, he started making out the bill. Mac moved over to the little set and began toying with the knobs as he said thoughtfully:

"Things aren't as bad as you paint them, but they are bad enough. Some of the blame, I think, goes on the 'easy money' that is floating around.

(*Continued on page* 152)

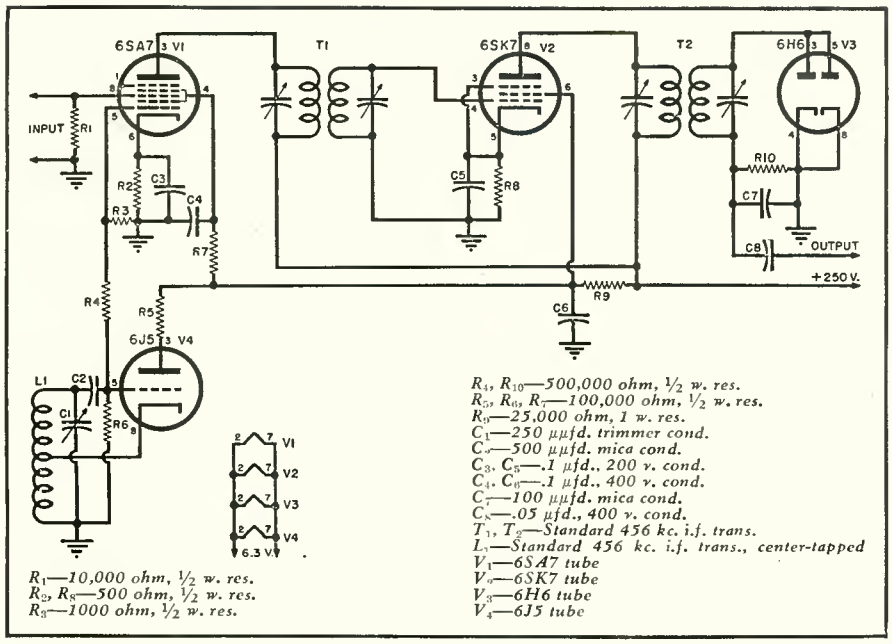


Fig. 3. Schematic diagram of the carrier-type preamplifier described in the text.

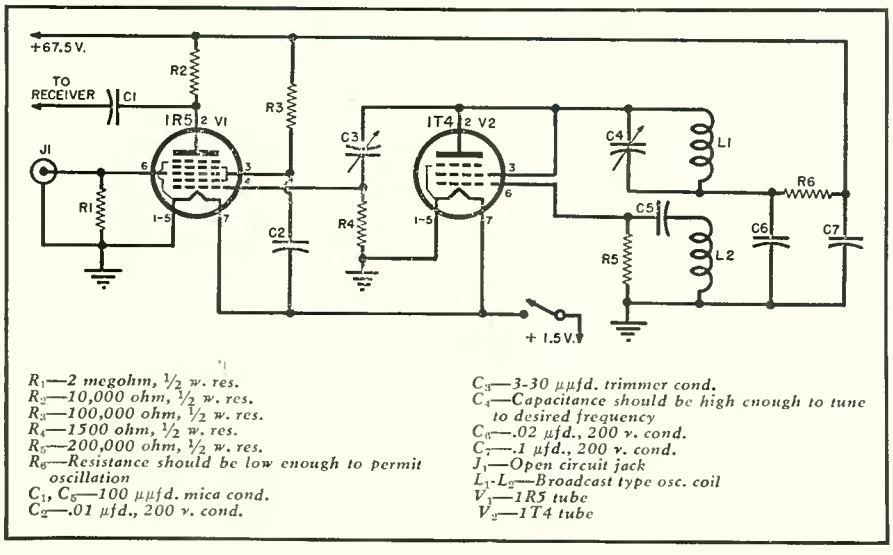
phono oscillator with a low level device such as a magnetic phono pickup, it is usually necessary to use a conventional preamplifier in order to raise the modulation percentage to a suitable level. This, of course, introduces all of the conventional problems of hum and microphonics and represents little, if any, improvement over a straight preamplifier. However, by designing the phono oscillator to use a master oscillator and the reverse of a power amplifier, a very low level modulator in which a small signal input is sufficient to provide adequate modulation of the few millivolts of radio frequency output, improved results are obtained. This eliminates the need for preamplification and thereby materially betters the signal-to-noise characteristics of the system. Two designs of this general nature are shown in the circuit diagrams. Figs. 1 and 4 show a battery operated system using the small one and one-half volt tubes which was designed primarily for use as an impromptu public address system when used in conjunction with a microphone and a suitable receiver. In this case the small transmitter is carried by the person addressing the audience, while the connecting link to the receiver may be a piece of flexible antenna wire. In a setup of this nature relatively long runs may be made without many of the difficulties which usually attend the use of conventional microphone cable, such as hum pickup, twisting, and the possibility of broken connections due to rough use. However care should be taken that the electrical noise level in the vicinity is not high enough to produce objectionable interference as a long run of wire will tend to pick up spurious as well as the desired signal. Use of a twisted pair of wires will tend to reduce this effect.

The same general circuit may be used with a.c. by proper modifications, such as replacing the 1R5 and 1T4 with their higher voltage equivalents such as the 6SA7 and 6SK7 or other suitable tubes. However several general design precautions should be observed. One of these is the fact that the signal output of the master oscillator will usually be considerably greater than that of the modulated stage and as a result it is necessary to keep as little energy as possible from feeding through from the oscillator to the input of the receiver or a low effective percentage of modulation will result even though the modulator is working up to its fullest capabilities. Shielding is one answer to this problem while a simpler and quite effective expedient is to operate the oscillator with as low a plate voltage as practical, thus reducing the possibility of stray signals due to excessive energy radiated by the oscillator. A second factor of importance is to be sure that the modulator stage is working up to its capabilities. Inasmuch as modulation requires use of a non-linear device, the effectiveness of a modulator stage such as this will depend to a considerable degree upon the screen, plate, and grid voltages as well as the r.f. excitation. Similarly, if it is desired to use the device in conjunction with a relatively high output device such as a crystal pickup, care should be taken to prevent overmodulation and consequent distortion.

A second device utilizing the same general principles is illustrated in the photograph and schematic (Figs. 2 and 3). Both the micromodulated transmitter and the receiver are located on the same chassis and are operated from a common power supply. Designed to be used in conjunction with a conventional audio amplifier, this system has several unique features. In addition to the previously mentioned factors of hum and microphonic reduction, this system incorporates extremely good low frequency response, in fact down to zero cycles per second, without the usual problems of decoupling. In addition, the frequency response of the system is a function of the intermediate transformer tuning. High "Q" transformers make it possible to introduce equalization for humps or dips in the response curve of the audio system by means of proper stagger tuning of the various i.f. coils, and thereby achieving unusual equalization curves that would be difficult to achieve by any other method. The single knob shown on the photograph of the unit functions as an unusual form of tone control. This control varies the tuning of the master oscillator over an appreciable range and may be adjusted so that only a portion of the audio range is amplified by the selective i.f. circuits. This is similar to the common practice of slightly detuning a sharply aligned radio receiver in order to achieve better high frequency reproduction but has the advantage that adjacent channel interference does not result.

Conventional 456 kilocycle i.f. trans-

Fig. 4. Diagram of battery-operated transmitter using principles of micromodulation.



MICROMODULATION

Improved versions of the once-popular phono oscillator which can be adapted to serve in many novel applications.

By
GLEN SOUTHWORTH

Fig. 1. Compact, self-contained micro-modulation system, housed in a small file box. Battery-type tubes are used.

Fig. 2. Carrier-type preamplifier. Knob on front controls the frequency of the master oscillator and may be used as a tone or volume control for the unit.

IT OFTEN happens that advances in a particular field are accompanied by new or rarely considered problems. In recent years, the advent of a multiplicity of devices for recording and reproducing home entertainment, such as disc, wire, and tape recorders, as well as the 33⅓ and 45 r.p.m. playback systems, has tended to make the family radio set, once a simple device with only two knobs, an octopus-like affair with numerous wires extending to the associated equipment.

A second problem often encountered by the audio constructor is the necessity for providing noise-free, high-gain amplification for the increasingly popular, low-level output transducers such as the magnetic phono cartridge and the playback head of a tape or wire recorder.

Interestingly enough, both of these somewhat diversified problems may be solved to a considerable degree by an adaptation of the once popular phono oscillator. In its most commonly encountered form, the phono oscillator serves as a wireless coupling link between some device, such as a high output crystal pickup, and a conventional radio receiver. This serves two important purposes. First, no modification need be made in the existing receiver, and second, the pickup device, such as a phono turntable, may be placed at a reasonable distance from the loudspeaker housing thus preventing the undesirable effects of acoustic feedback. In addition, it provides a more convenient location for operation, as in the case of a manual player, or the player may be located remotely in order to eliminate the sound of direct needle noise, a desirable feature with some types of pickups, particularly where relatively low listening levels are desired.

The conventional phono oscillator is usually a one- or two-tube device of inexpensive construction employing a conventional receiver converter tube, such as the 6SA7, as a modulated oscillator operating somewhere in the broadcast band. Although having the aforementioned advantages, there are several drawbacks to the conventional circuit that are not always fully considered. These include the tendency of an amplitude modulated oscillator to vary in frequency, with consequent distortion; the fact that if excessive r.f. power is generated, illegal interference may be caused to adjacent receivers; and the fact that the output of the oscillator must be modulated to a relatively high degree in order to obtain best possible results from the system.

This last mentioned factor is of considerable interest because it is of importance in one method for obtaining stable, hum-free, high-gain amplification. It is a well known fact that many radio receivers are capable of over-all gains in excess of one million. A good communications receiver, for example, can give intelligible reproduction of signals of one or two microvolts. Much of this gain is in the r.f. and i.f. stages of the receiver and due to the fact that the input stages of the receiver operate at frequencies greatly removed from the audio range, interference from sixty cycle hum and microphonics is greatly reduced.

While a conventional radio station may have a power output of thousands of watts, the signal is usually greatly attenuated by the time it reaches the receiver antenna and may be measured in millivolts or microvolts. As a result, it is reasonable to assume that if it is desired to amplify a very weak audio signal it may be practical to convert it to a modulation of an r.f. carrier of a few millivolts intensity and apply it directly to the antenna terminal of the receiver. The importance of having a relatively high degree of modulation is due to the fact that a strong carrier will operate the receiver's automatic volume control circuit thus reducing the gain and destroying the effectiveness of the arrangement. Even though the a.v.c. circuit were disconnected, there is a likelihood that overloading of the final r.f. stages would occur, thereby causing nonlinearity and distortion. This phenomenon is occasionally found in sets which produce considerable distortion when tuned to a strong local station and can be cured by reducing the r.f. input to the receiver. A further difficulty may be encountered in that a strong, weakly modulated signal may suffer undesirable local modulation due to microphonic receiver tubes.

If it is desired to use a conventional

IMPROPER VOLTAGE READING	POSSIBLE TROUBLE
No plate voltage (screen voltage present)	Plate load resistor open; plate pin shorted to ground
No screen voltage (plate voltage exists)	Screen resistor open; screen bypass condenser shorted
Plate and screen voltages are low; positive voltage is measured between grid and ground	Leaky coupling condenser; shorted tube
Plate and screen voltages are high; no cathode voltage exists (it is assumed that cathode voltage is normally present)	Bad tube; no filament supply to tube; no connection of tube filament to socket contact
Cathode voltage (measured with v.t.v.m.) is excessive; plate and screen voltages are high	Open cathode resistor

Table. 1. Voltage readings which indicate trouble in the circuit and their possible causes.

The next check point is *D*, then *E*, etc. The approximate waveforms that should be obtained at these points if the circuit operation is normal are shown in Fig. 10.

When an improperly functioning stage has been localized by the scope tests just described, voltage tests are used to find the faulty component. Voltage readings are generally taken between the socket contacts of the various tubes and ground. Common examples of improper readings, and the troubles they indicate, are listed in Table 1.

Most of the improper voltage measurements listed indicate one of two possible sources of trouble. A resistance or tube substitution check should very quickly show which of the two is the actual cause of the defect.

When voltage or resistance checks reveal no defect, condenser bridging or condenser replacement tests should be made, and results noted.

If no circuit diagram is available, one important point should be kept in mind: Most TV sets have negative as well as positive supply voltages. Normal readings are therefore not as standard as in the case of the familiar a.c.-d.c. radio receiver. If the technician cannot readily determine whether the readings obtained are normal or abnormal, he should replace the relatively few components in the stage that scope tests indicate is operating improperly.

If any component looks suspicious, *i.e.,* if a condenser has wax bulging out of it, or a resistor is discolored (due to overheating) that component should be replaced first, and the results observed.

A note may be added regarding the sync circuit tests in the *Philco* 48-2500. In other circuits, when neither vertical nor horizontal synchronization is present, an incorrect waveform at the output of the sync section, or check point *A*, will generally be found. In the *Philco* circuit, however, this need not be the case. That is, a normal waveform may appear at point *A* (Fig. 7F), and a defect that impairs both horizontal and vertical synchronization may still be present.

This is due to the fact that the separated, *i.e.,* inter-sync separated, sync pulses pass through the same tube. This tube is a 7F8 used as a phase inverter. The two separate triode sections of this tube are used to invert the phase of the vertical and horizontal pulses respectively. If a defect that affects both triodes of the tube occurs, neither vertical nor horizontal synchronization will be obtained. On the other hand, if the existing trouble affects only one section of the tube, only one of the two sync pulses, *i.e.,* the vertical or horizontal pulses, will be affected.

Hum will not show up on voltage or resistance checks. It can, however, be readily localized by scope tests. Two adjacent circuit points should be looked for, at one of which a hum waveform is present, whereas it is absent at the other. The characteristic effect of hum on the (vertical) sync signal is indicated in Fig. 8.

The hum referred to is hum that affects the *sync section only.* This type of hum will impair only the synchronization of the picture and test pattern. Hum in other receiver sections will affect other test pattern or picture characteristics.

There are two possible causes of hum that affects only the sync circuits:

1. Cathode-to-heater short circuit or leakage in a sync tube.

2. Pickup of hum through inductive coupling of grid or plate leads of a sync tube, to wiring carrying 60-cycle alternating current.

The first possibility can be checked by substituting tubes; the second, by visual inspection, *i.e.,* checking to see whether plate or grid leads are too close to filament, line wiring, etc. If this seems to be the case, separating the suspect wires and then noting the results will indicate whether or not the trouble lies here.

Individual sync stages are sometimes unlabeled in set manufacturers' notes. The problem of identifying various sync circuits may consequently arise. In such cases, the following information may prove helpful:

To find the sync separator, look for a stage at whose input the signal is in *negative picture phase, i.e.,* the sync pulse is positive-going. (Detailed information regarding picture phase was presented in Part 1.) Now, we know that the signal must be in *positive* picture phase (negative-going sync pulse) at the *grid* of the cathode-ray tube. (If the signal is applied to the *cathode* of the CRT it will be in *negative* picture phase, *i.e.,* the sync pulse will be positive-going.) The signal will have the same phase at the input to the first sync stage as it has at the cathode-ray tube, if only an *RC* coupling network is present between the two. When the sync signal passes through an amplifier or phase inverter, however, its phase will be reversed. Using this information, we can determine the phase of the sync signal at any point in the sync circuits.

Let us assume that a circuit similar to the one shown in the block diagram of Fig. 11 is present. The signal, we know, will be in *positive* picture phase at the CRT grid and the input to the first sync stage. *This first sync stage cannot, therefore, be a sync separator.* At the next stage, the signal is inverted, and is in *negative* picture phase. *This second stage may be a sync separator.*

If only one sync stage is present whose input signal is in negative picture phase, that stage is the sync separator. When two such stages exist, however, one is a sync amplifier or phase inverter, the other is the sync separator. How can the separator be identified in the latter case?

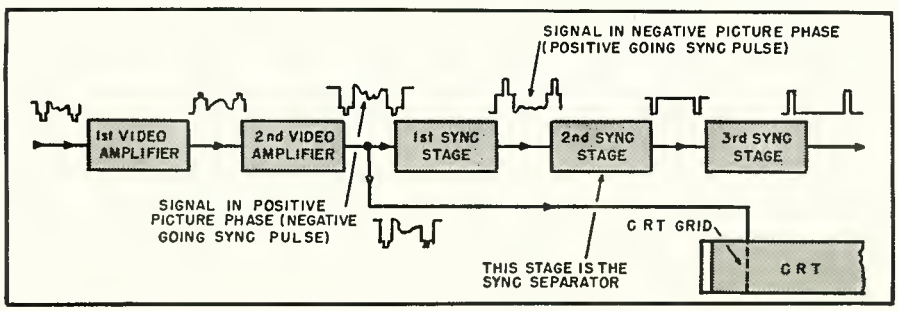
The identification can be made by checking (on the schematic) the screen and plate voltages of the two stages, and noting their method of bias. The stage with the lower plate and screen voltages is the separator. Another clue is the grid-leak biasing (grounded cathode) that is usually employed in the separator. Still another clue is the frequent presence of a sync leveling diode in the grid circuit of the separator.

The remaining stages in the sync section must either be phase inverters or sync amplifiers. In either case, the stages may be treated as amplifiers with varying degrees of gain, and can thus be readily checked for correct operation.

Inter-sync stages are located at or beyond the circuit points where the two sync signals (horizontal and vertical) are separated from each other.

—30—

Fig. 11. Picture phase of the signal at stages in and before the sync circuits.



fine frequency controls on the scope is made.

Since many of the scopes used by technicians have a frequency response extending only to about 50 kc., the horizontal pulses seen on the scope screen will be distorted, *i.e.*, their corners will be rounded off. This is normal, under the circumstances.

The following characteristics should be checked on the scope:

1. Is the pulse as large as it should be? (This check can, of course, be made only when data is available regarding the normal amplitude of the sync pulse at the point being tested.)
2. Is the pulse clean, *i.e.*, has all the video been removed from it?
3. Is any hum associated with the vertical sync pulse? (The effect of hum on the vertical sync pulse is shown in Fig. 8.)

The next scope check should be made at the grid of the last stage preceding the inter-sync circuits. This will be point B_1 when the stage in question is a phase inverter (see Fig. 7A). It will be point B_2 when the last stage is a sync separator (Fig. 7B).

If this check is made at the grid of a phase inverter, the signal will look essentially the same as in the check at *A*, except for a 180-degree phase inversion. The decrease in signal amplitude observed in going from the plate to the grid will normally be small since the phase inverter gain is low.

In sets where B_2 is the grid of a sync separator (Fig. 7B), the signal observed will normally show the presence of video information. Another normal characteristic will be the considerably decreased amplitude of the sync pulse at this point, compared to the pulse amplitude at the plate.

Checkpoint B_2 is generally connected through an *RC* coupling circuit to the plate of a sync amplifier. If it is, the relative amplitude of the sync pulse with respect to the video information present should be noted at this point (see Fig. 9). An incorrect ratio may in some cases indicate improper functioning of the sync amplifier. The cases referred to are those in which the sync amplifier also acts as a limiter.

The question arises, what is an incorrect sync pulse-to-video ratio? In the composite transmitted signal, the sync pulse occupies about ⅕ of the amplitude allotted to the entire signal (see Fig. 9). When the composite signal has undergone limiting action, this ratio may be changed from 1:5 to 1:3, that is, the sync pulse may now take up ⅓ of the total signal amplitude.

It is, of course, difficult to state what the sync-to-video ratio should be at the input to the sync separator in any individual case. This much, however, can be stated: When the signal applied to the sync separator has a sync-to-video ratio of 1:5 and improper synchronization exists, the ratio may be incorrect. If the following conditions are also present, improper limiting in the sync amplifier should be checked.

1. Video signals are present in the output of the sync separator.
2. No other defect can be found.

It might prove very helpful for TV technicians to check the sync-to-video ratios present at the input of the sync separator on any new receiver models that come into their shops. A valuable table can be built up in this way that may come in very handy at some future date.

The source of trouble, in every case, lies *after* the last check point that tests normal, and *ahead* of the check point where the waveform is incorrect or absent. Thus, if the waveform observed at point *A*, the output of the last sync stage, is abnormal or absent, and the waveform at *B*, the input to the stage, is correct, this last sync stage is defective.

If the waveforms at both *B* and *A* are incorrect, a scope check at *C*, the output point of the preceding stage, is made. Waveforms identical in shape and amplitude should normally be present at *B* and *C* since only a coupling network exists between these points. If the check at *B* reveals an abnormal or absent waveform, while the waveform at *C* is normal, the trouble must (commonly) be either an open coupling condenser, a short or change in value of a grid return resistor, or possibly a shorted d.c. restorer diode.

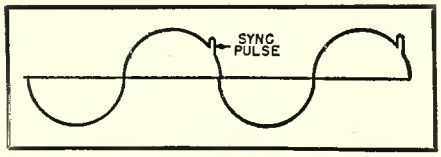


Fig. 8. Effect of hum in the set on the vertical sync pulse waveform.

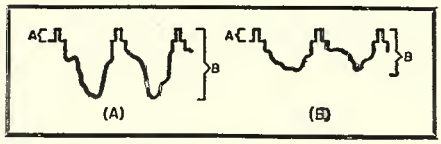
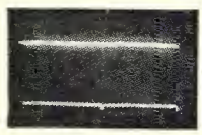
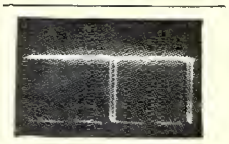
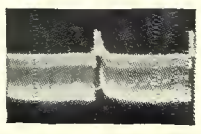
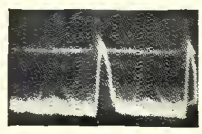
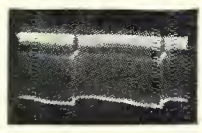
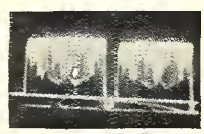


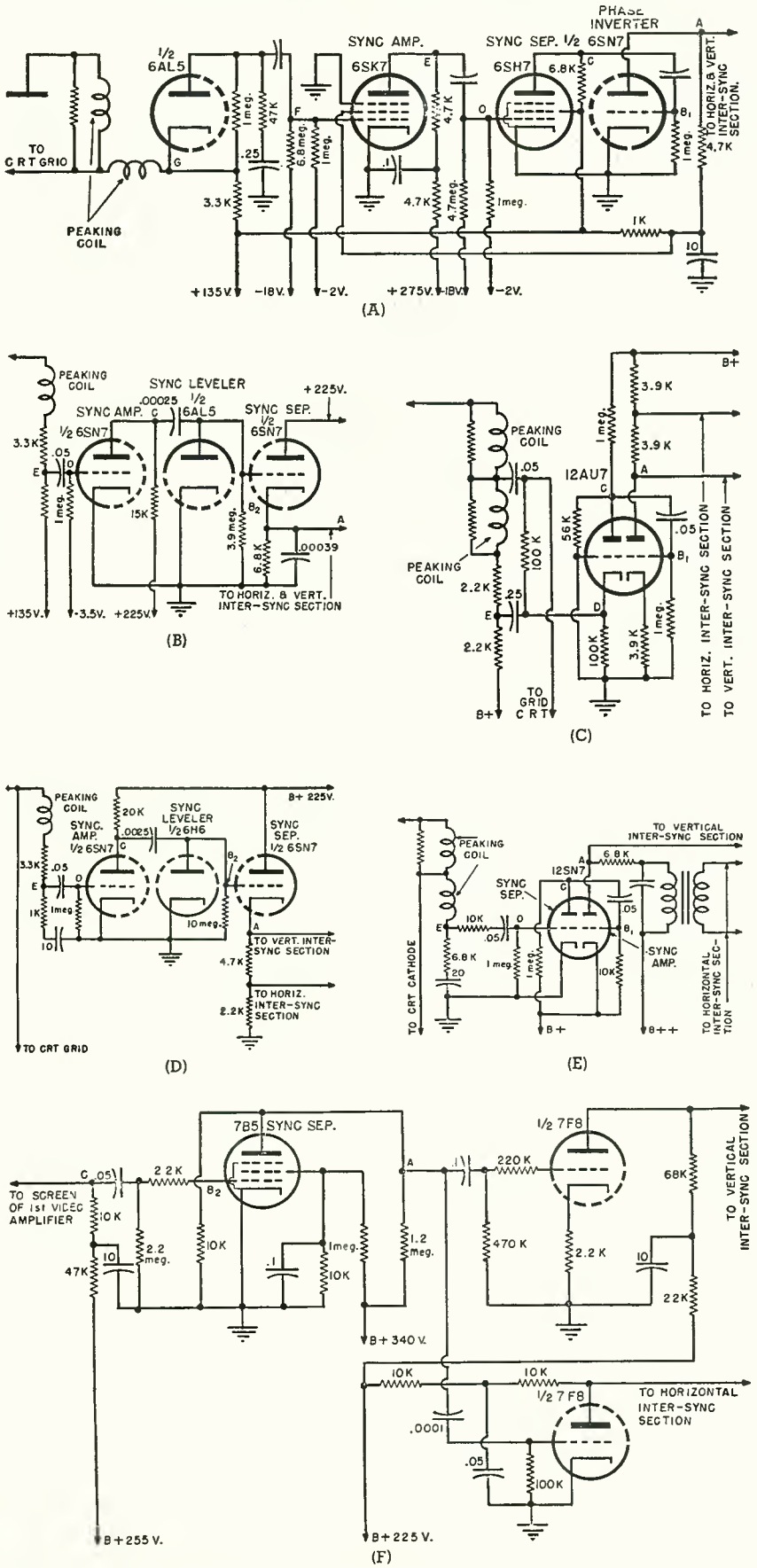
Fig. 9. Checking the video-to-sync ratio. This ratio is equal to A/B. (A) Signal as transmitted, A/B ratio is 1/5. (B) Same signal after limiting. A/B ratio is 1/3.

Fig. 10. Waveforms that should appear at checkpoints A, B, C, etc. in Fig. 7 when the circuit is normal. These waveforms will be seen only in the receivers whose sync circuits are reproduced in Fig. 7. The set manufacturers' notes should be consulted for the normal waveforms at test points in other receivers. The waveforms shown were observed on one particular type of scope. When other scopes are employed the waveforms may not appear the same due to the differences in input circuits and the scope's frequency response.

Circuit Point	Check Point (See Footnote*)		Waveform to Be Expected on Scope	
	1	2	Time Base 30 Cycles	Time Base 7875 Cycles
Output of Last Sync Tube	A	A		
Output of Sync Separator	B_1, C	A		
Input to Sync Separator	D	B_2		
Output of First Sync Tube	E	C		
Input to First Sync Tube	F (RCA-630 only)	D		
Output of Video Amp.	G (RCA-630 only)	E		

* Checkpoints refer to diagrams shown in Fig. 7. Center Column (1) for RCA-630, Hallicrafters T-64, and Motorola TS 18. Column (2) for Crosley 9-404M, Philco 48-2500, RCA-621.

Fig. 7. Conventional sync circuits as used by some of the leading television manufacturers. (A) RCA 630; (B) Crosley 9-404M; (C) Hallicrafters T64; (D) RCA 621; (E) Motorola TS 18; and (F) the Philco 48-2500.



case, causing it to operate improperly.

The authors know of an instance where the normal phenomenon just described was incorrectly attributed to improper functioning of the sync circuits. Actually, the trouble lay in a weak second stage of a two-stage video amplifier. (The sync signals were taken off at the *first* video amplifier, which was operating normally.) The picture, as might be expected, had very poor contrast.

When the technician advanced the contrast control setting the picture's contrast was considerably improved—became almost normal, in fact. Horizontal tearing out, however, now appeared.

The technician assumed that the symptom of trouble was the result of improper synchronization. failing to realize that the impairment of sync was entirely normal at an advanced setting of the contrast control. Technicians are therefore cautioned to reduce the contrast setting when picture tearing is present. If the picture now holds, but inadequate contrast is observed, trouble in some section of the receiver other than the sync is indicated.

Troubleshooting Sync Circuits

Now that we understand the functions of the sync circuits, and the kinds of troubles to expect, let us troubleshoot the section.

The first step would be to check the output of the sync section. This point is the one marked *A* in Figs. 7A to F. It directly precedes the inter-sync separation circuits.

Such a check will immediately determine whether a diagnosis of trouble in the sync section is an accurate one. If trouble really exists in the section, the indication on the scope at point *A* will not be normal (see Fig. 10).

When point *A*, or any other circuit point near the input of a sweep oscillator is checked, the sweep oscillator tube should be removed or disabled to prevent the oscillator signal from obscuring, or being mistaken for, the sync pulse. The feeding back of the sweep oscillator signal to the output of the sync circuits may cause the latter condition to occur.

Regarding the removal or disabling of the oscillator tube—the tube should be removed, if the set is a.c. If it is an a.c.-d.c. type, the input or output circuit of the sweep oscillator may be open-circuited, or the "B" voltage to the tube disconnected, to keep it from functioning.

The sync pulses at point *A*, as well as at other check points, should be examined at two different scope frequency settings, or time bases. The vertical pulses should be inspected with a time base of 30 cycles. Two vertical sync pulses will be seen in this case. The horizontal pulses should be checked with a time base of approximately 8000 or 5000 cycles. Two or three horizontal pulses, respectively, will be seen on the scope when the proper adjustment of the coarse and

hum signal is the same in frequency as the vertical sync signal. This is the condition that normally prevails since the vertical sync pulse at the transmitter and the hum voltage at the receiver are both derived from the line voltage of the same city power supply. If a slight difference in frequency occurs in the hum signal and the vertical sync pulse, however, the hum-caused bar will no longer remain locked into the field being scanned, but will begin drifting across it. Such a slight difference in frequency often takes place when non-local channels are being received, due to the slight frequency differences in the power supplies feeding the transmitter and receiver, respectively. A horizontal bar that moves up or down the screen now becomes apparent.

The technician can, of course, do nothing to remedy this condition.

When the condition just discussed exists, and excessive hum in the sync circuits of the TV receiver is present, the picture may roll vertically. This symptom will be noted only when non-local transmissions are being received. Unlike the symptom cited previously, it can be eliminated by the technician.

Video in Sync Circuits

When video is present in the sync separator output, a horizontal tearing will be observed in those sections of the picture whose black information appears near the right-hand edge of the screen. The reasons for this are as follows:

1. The only video information that can act as a sync pulse is dark information, that is, information going in the same direction as the sync pulse (see Fig. 5).

2. The sweep oscillator is sensitive to synchronization only near the end of the trace (in the case of the horizontal oscillator, this is the right-hand side of the screen). At points farther away from the end of the trace, only very large noise pulses can affect synchronization. Such high-amplitude noise pulses are eliminated by sync circuit limiting.

Video appearing in the sync separator output will not generally affect the picture's synchronization vertically as much as it will horizontally. This is true because the vertical sync pulse has a relatively long duration, and only a large black area near the bottom of the screen can markedly interfere with it. Such a large black area is seldom transmitted.

On the other hand, the passage of video signals through the sync separator will frequently cause a *slight* loss of vertical synchronization, *i.e.*, a loss in interlace. Let us see why this is so.

In the first part of this series we pointed out, in considerable detail, that the equalizing pulses were necessary to maintain proper interlace. These equalizing pulses will be unable to perform their function if video information near the bottom of a field gets through the sync separator. The integrator network may, in such a case, be charged up to different and excessive levels during each field (see Fig. 4). The equalizing pulses will, in this event, be unable to discharge the network uniformly during both fields. Unequal integrator charges will therefore develop during the two fields, upsetting interlace.

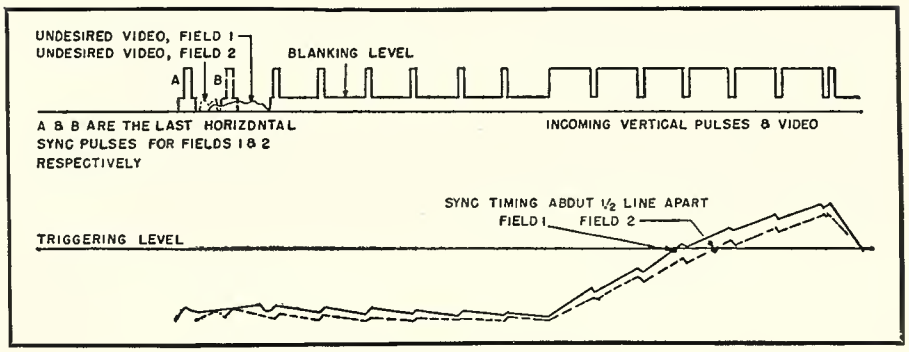


Fig. 3. The integrator will not develop identical charging curves during each field when video signals are applied to its input. Note that the triggering of the vertical oscillator during both fields differs by an interval of time equal, in the case shown here, to the duration of one-half a horizontal line.

It should be noted that proper interlace depends upon a very close time relationship in the integrator network. That is, the triggering level of the vertical oscillator must be reached at the same exact point in the vertical cycle during the first field as during the second. If a difference as small as 1/30,000 second, representing a displacement of ½ a horizontal line or .2% in the two fields, occurs (see Fig. 3), pairing of lines will result (see Fig. 6). It becomes obvious now how easily interlace can be upset.

A loss in interlace impairs picture detail since information contained in the horizontal lines of one picture field overlaps the horizontal scanning lines of the second field. Information in the overlapped sections of the lines is lost (see Fig. 6). The condition is most readily recognized in the test pattern. The tell-tale mottling of the horizontal wedges will reveal the loss in interlace.

Loss in interlace may be caused not only by a defect in the sync separator, but by the improper operation of some other stage. Excessive amplification of the sync signal in some stage may produce the same condition.

We may cite, as an example, a case of very severe impairment of interlace in which one field was displaced vertically about ¼" away from the other field. The trouble was traced to a phase inverter in the sync section. The gain of the phase inverter was about 40, instead of a normal gain of about 1.5. A decrease in the value of the cathode bias resistor was found to be the source of the trouble.

The impairment of interlace was due to the excessively large vertical sync signal that was being applied to the integrator. Since the equalizing pulses do not exert their normal equalizing effect in the presence of abnormally large vertical sync signals, different residual charges existed in the integrator during both picture fields, and interlace was upset.

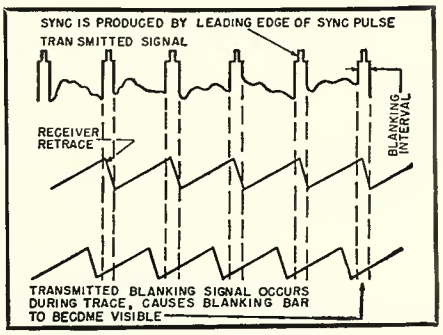


Fig. 4. The TV signal's blanking interval may not be the same at the receiver and transmitter when hum is present in the sync circuits. The center trace shows the deflection waveform produced when no hum is present in sync circuits. Note that the retrace occurs during the transmitter's blanking interval. The bottom trace shows the deflection waveform when hum exists. The receiver retrace occurs before the transmitted blanking signal darkens the cathode-ray tube. Retrace lines become visible as a result.

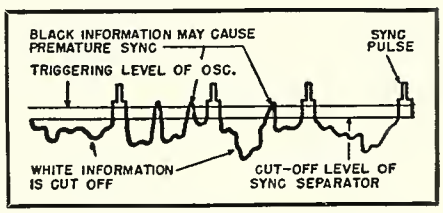
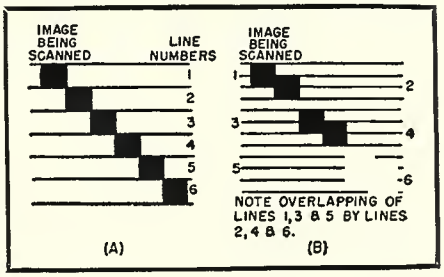


Fig. 5. Only dark video information can trigger the sweep oscillator prematurely.

One word of caution on the problem of picture information getting through the sync circuits. In many receivers, this is a normal condition when the contrast control is turned up too far. Excessively-sized sync signals are applied to the sync separator in such a

Fig. 6. Pairing of scanning lines may be observed when interlace is impaired. (A) Normally space lines. (B) Paired scanning lines.



SERVICING TV SYNC CIRCUITS

By
SOLOMON HELLER*
and
PETER ORNE

Part 2. Concluding the discussion of sync circuits as found in present-day TV sets.

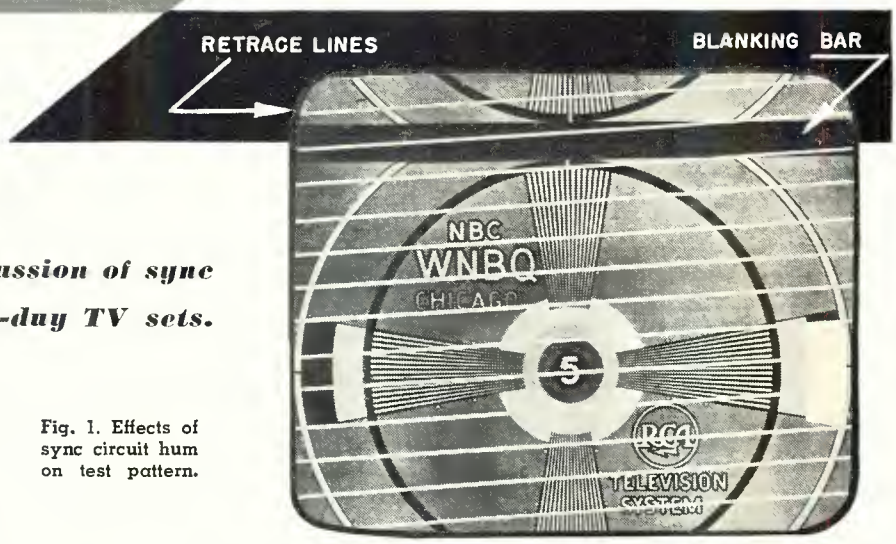


Fig. 1. Effects of sync circuit hum on test pattern.

THERE are certain basic defects which may occur in the sync circuits including an inoperative stage, a weak stage output, hum in the stage, or video in the sync circuits.

When the picture does not hold in either direction, an inoperative stage may have killed the sync pulse. A very small pulse may be transferred in some cases, due to coupling through adjacent wires, but its size will not be adequate for synchronization. The picture may, in the case cited, be stopped momentarily by a careful adjustment of the hold controls. This should not, however, obscure the fact that synchronization is not present.

Symptoms produced by weak output from a stage are more difficult to identify than symptoms associated with no output. Even when the sync pulses are inadequately amplified, the picture may still hold fairly well most of the time, tearing out only when noise pulses or weak input signals are received. Since such a loss in synchronization occasionally takes place in even a normally operating receiver, the service technician must know what to expect of the set under test.

If the technician knows what sync pulse amplitudes should be present at various circuit points, he can readily determine whether or not inadequate sync amplification is present. Such data, however, is not usually included in set manufacturers' notes. If a normally operating set of the same make and model number is available, the required data may be compiled by the service technician himself. Otherwise, voltage, resistance and condenser bridging tests will have to be employed to determine whether or not the gain of a sync stage is below normal.

Hum in the sync circuits may cause poor vertical synchronization. The impairment of vertical synchronization is due to the locking-in of the picture on the maximum hum voltage, instead of the sync pulse (see Fig. 2). Note that the retrace interval in the vertical oscillator is initiated by the sync pulse when no hum is present (Fig. 2A). When hum exists, however, the peak of the hum wave pushes the grid voltage beyond the oscillator triggering level, initiating the retrace prematurely (Fig. 2B). The sync pulse, arriving a short time later, no longer exerts any effect.

Symptoms produced in the test pattern by sync circuit hum are illustrated in Fig. 1. Note the presence of the vertical retrace lines and the blanking bar. The blanking bar and retrace lines become visible because the blanking intervals at the transmitter and receiver no longer coincide (see Fig. 4). Some retrace and blanking information is received, as a result, during the time that the cathode-ray tube is illuminated.

Although sync circuit hum will, as we have just shown, affect the vertical sync pulses, it will have no effect on the horizontal ones. Since hum is a low frequency (60-cycle) signal, and since the differentiating network attenuates all low frequencies, hum will be completely removed from the input to the horizontal oscillator.

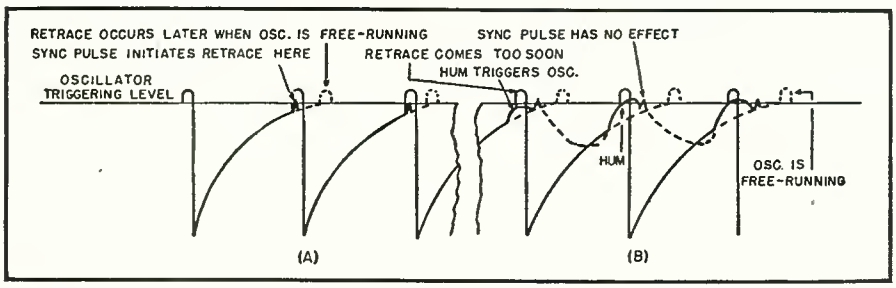
The 60-cycle vertical sync pulse is completely removed by the diffcrentiator in spite of the fact that it is as large in amplitude as the horizontal sync pulse.

There is a symptom associated with hum and improper synchronization that is sometimes noted in non-local transmissions. The symptom referred to is the movement of a dark horizontal bar across the screen. The condition may be explained as follows:

A certain minimum level of hum is present in the power supply of every TV set. This residual hum could be eliminated, but since it is not objectionable enough to warrant the expense of filtering it out, it is permitted to remain. The hum causes a barely noticeable, stationary horizontal bar to appear in the received picture. The passage of the hum signal through the video amplifier to the grid of the cathode-ray tube is responsible for the appearance of this bar.

As long as the bar is stationary, it is scarcely noticed. When the bar begins moving, however, its presence becomes annoyingly apparent. Now, the bar will remain stationary as long as the

Fig. 2. Effects of hum on sweep oscillator grid voltage. (A) Grid voltage waveform when no hum is present. (B) Grid voltage waveform when hum is associated with vertical sync pulse.



* Mr. Heller is co-author, with Irving Shulman, of the new book "Television Servicing," published by McGraw-Hill Book Company, Inc., New York.

and after that the tube is given its full plate voltage and tuned, always with a load. This will prevent exceeding the dissipation of the 2E26. Unloaded, the current will dip to 5 to 10 milliamperes; loaded, it is run at rated maximum, 60 milliamperes.

A test can be made using several crystals. It was found that any part of the 10 meter phone band could be used without retuning. The only requirement is to have the desired crystals on hand for frequency changes.

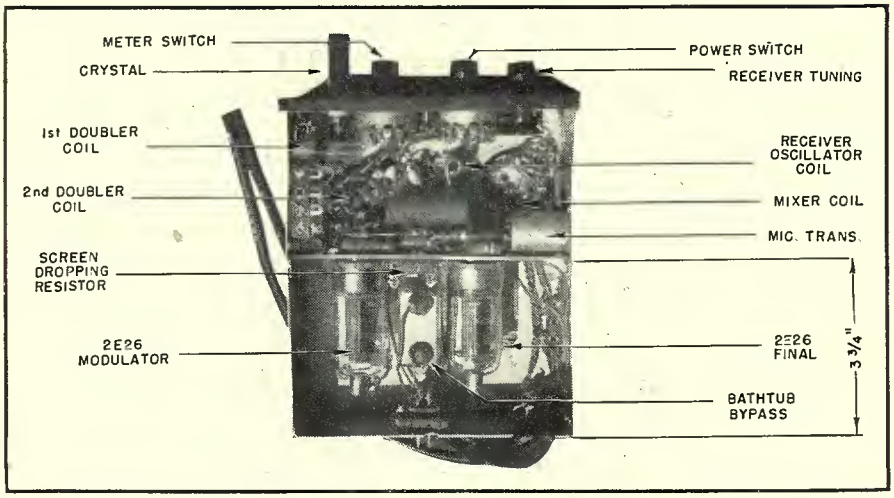
About the PE-103: There has been much comment about the drain on the battery with this unit in operation. Most hams fail to remember that the battery drain depends upon the loading. Unloaded, the drain is less than that of the auto receiver by nearly one half. It is true that if 200 milliamperes is drained it is just about equivalent to putting a screwdriver across the battery terminals. Only slightly over 100 milliamperes are required for the operation of this unit at full 500 volts. The PE-103 has been in operation in the car every day for six months and so far there has been no battery trouble. This unit was modified to provide a negative ground by removing the dynamotor and reversing both the brush and field wires. The 12 volt relay was removed and the top pried off after carefully sawing slits along the pressed on cap. The reel was removed and the wire unwound. It was then doubled and wound back on the spool. This makes a 6 volt relay of the unit. The cap was replaced and pressed on again. With this change the switch on the PE-103 will change from 500 volt output to 250 volts. Inside the unit the green wire to the plug was removed in order to take the constant load from the battery. Another relay was added so that its field is parallel to that of the starting relay and its switching contacts are in series with the "B plus" to the transmitter. Otherwise coasting of the dynamotor will keep the transmitter operating for a few seconds after the transmit switch is released.

A final touch may be placed on the unit by the application of a good grade of flat black paint. This brushes on easily without leaving brush marks. Decals give the proper finish. They are applied directly to the dial face for calibration and to the panel for marking.

The unit will provide good operation only if precautions are taken to prevent noise in the receiver. Note that the filament leads that come into the unit are from the filter in the car radio and that they are shielded from the radio. Nothing comes into the unit without first being shielded.

A good clipper circuit which can be turned on or off at will should be added to the broadcast receiver. Several of these circuits have been adequately explained in other articles.

Generator hash is sometimes difficult to eliminate. Two distinct methods were tried. A twenty turn coil of



Under chassis view. The two tubes shown are in the transmitter section of the unit.

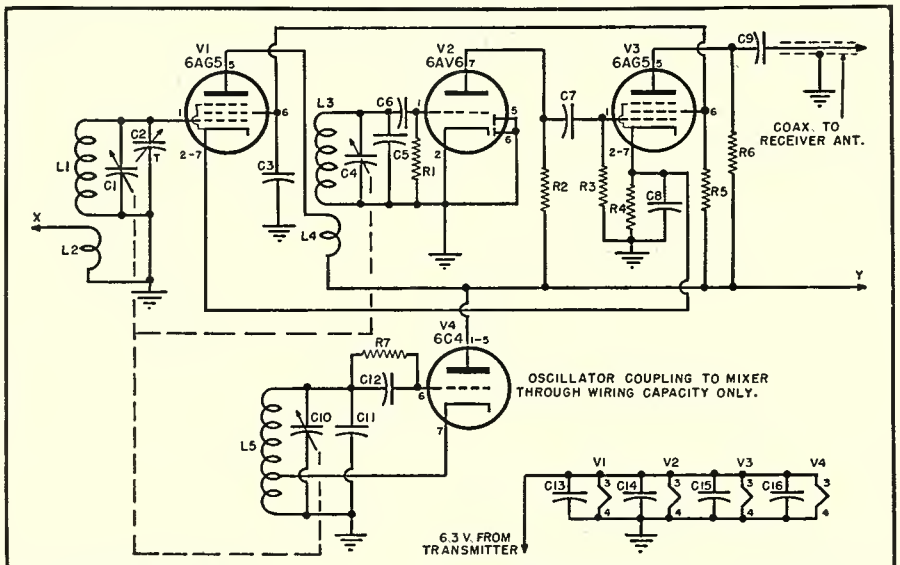
#12 wire wound on a broomstick and placed in series with the input lead will get rid of it. Of course you saw the broomstick off! It may be necessary to bypass the temperature gauge at the point of entry to the motor with a .5 μfd. condenser. Wirewound suppressors will not eliminate noise on this band. Try carbon units or, better still, try the new *Autolite* sparkplugs with the built-in resistors.

More than half the battle for space in the band comes in the antenna. It is not advisable to use a whip made up of sliding sections as considerable difficulty will be encountered in the high resistance r.f. contacts. Use a solid rod, there are several available. Mount the antenna away from the back bumper by mounting it high. The author has a steel whip mounted as a police mount and has, on many occasions, bent the whip nearly double; it springs back into shape.

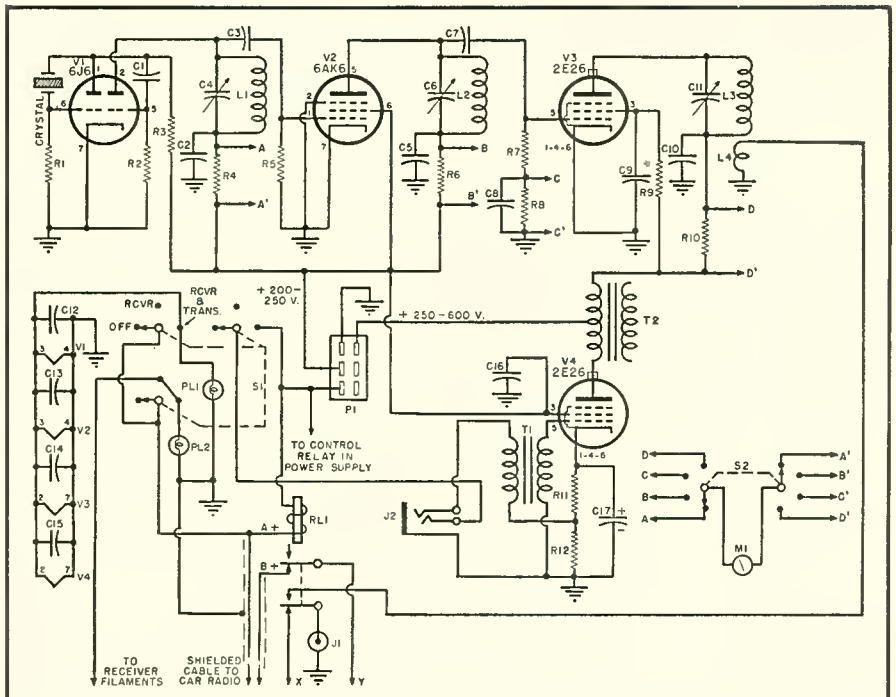
There will be a rather pronounced directional effect during transmission in favor of the direction of motion if the whip is mounted at the rear of the car. It might be well to keep this point in mind when calling.

For those who do not own a car, this unit, along with a companion power supply using voltage multiplying circuits and selenium rectifiers, can be built into a small package to provide a really compact home transmitter. The results should compare favorably with those of any other 40 watt transmitter if loaded with a good and efficient antenna. —30—

Converter schematic. Output feeds directly to antenna post of the car's receiver.



R_1—1 megohm, ½ w. res.
R_2—220,000 ohm, ½ w. res.
R_3, R_4—6800 ohm, ½ w. res.
R_5—150 ohm, ½ w. res.
R_6—22,000 ohm, ½ w. res.
R_7—100,000 ohm, ½ w. res.
C_1, C_4, C_{10}—See text
C_2—4-80 μμfd. mica trimmer cond.
C_5, C_{11}—50 μμfd. feedthrough cond.
C_3, C_8, C_9—.001 μfd. tubular ceramic cond.
C_6, C_7—50 μμfd. tubular ceramic cond.
C_{12}—10 μμfd. ceramic cond.
C_{13}, C_{14}, C_{15}, C_{16}—.002 μfd., tubular ceramic cond.
L_1, L_3—9 t. #18 en., ⅜" diam., 1" long
L_2—3 t. #20 covered, wound to fit inside of L_1
L_4—Same as L_2 (to fit inside L_3)
L_5—13 t. #20 en., ¼" diam., tapped 1.5 t. from gnd. end. This coil will require adjustment in order to locate the 10 m. band on the receiver
V_1, V_3—6AG5 tube
V_2—6AV6 tube
V_4—6C4 tube



R_1—220,000 ohm, ½ w. res.
R_2, R_5—1 megohm, ½ w. res.
R_3—10,000 ohm, ½ w. res.
R_4, R_6, R_8, R_{10}—47 ohm, ½ w. res.
R_7—22,000 ohm, ½ w. res.
R_9—33,000 ohm, 1 w. res. (size depends on plate voltage—this value is for 500 volts)
R_{11}—390 ohm, ½ w. res.
R_{12}—100 ohm, ½ w. res.
C_1, C_3—100 μμfd. tubular ceramic cond.
C_2, C_5, C_8, C_9, C_{12}, C_{13}, C_{14}, C_{15}—.001 μfd. tubular ceramic cond.
C_4—100 μμfd. (max) compression-type trimmer
C_6—20 μμfd. midget var. cond. (from BC-1033 or equivalent)
C_7—50 μμfd. tubular ceramic cond.
C_{10}—.001 μfd., 2000 v. mica cond.
C_{11}—See text
C_{16}—.5 μfd., 600 v. bathtub cond.
C_{17}—20 μfd., 25 v. midget elec. cond.
RL_1—D.p.d.t. relay, 6 v. d.c. coil
P_1—6-prong male plug with chassis mount (Jones)
J_1—Antenna input plug
J_2—Mike jack for T-17 type microphone
PL_1, PL_2—6.3 v. pilot lamp
S_1—Midget rotary three-pole, triple-throw sw. (contacts at rear of sw.)
S_2—Midget rotary two-pole, four-pos. sw. (contacts at rear of sw.)
Crystal—7 mc. crystal to quadruple to 28 mc. phone band
T_1—Mike trans. (unit used was from a war surplus BC 347 interphone amplifier. The trans. is only 1" diam. and 1¼" long. Space is at a premium at this point and only a small transformer can be accommodated. There is space on top of the chassis directly in front of the relay in the event that the builder is unable to locate a small enough transformer to be mounted under the chassis as shown
T_2—Universal output trans., single or p.p. plates to v.c., 6000 to 10,000 ohms, secondary not used (Stancor A-3824. This is a large transformer and a smaller one can be substituted if the constructor desires)
L_1—20 t. #30 closewound on ⅜" rod
L_2—7 t. of B & W "Miniductor" 3012
L_3—8 t. #20 solid covered, closewound ⅞" diam.
L_4—3 t. #20 solid covered, closewound ⅞" diam.
V_1—6J6 tube
V_2—6AK6 tube
V_3, V_4—2E26 tube
Note: C_{10} is a full size bypass and is located above the chassis. It is used as an anchor for the ground end of the tank circuit

Transmitter schematic. Both converter and transmitter can be powered from car radio.

hand tools ordinarily found in the shack.

There are several parts which, of necessity, must be fabricated. The reader may substitute his own pet methods of solution.

The first is the dial and drive assembly.

The shaft, which is turned by the knob on the panel, was made from a ¼" shaft. This shaft was put in an electric drill and an indentation for the dial cable was made with a rat-tail file. The shaft had been cut from an old potentiometer and it was scored by thin cuts for breaking the shaft in desired lengths. One of these cuts was enlarged sufficiently to accept a washer so that the shaft wouldn't pull through the panel bushing. The washer was cut, spread, slipped into the groove, and pinched tight. A two inch dial drum was fitted to the shaft of the tuning condenser by means of a ¼ to ⅜ adapter turned on the drill to fit inside the drum hole.

The dial face was made from a 1/16" piece of clear plastic rubbed with steel wool and backed with a piece of colored paper. This plastic was bolted by means of No. 4 machine screws to the front panel and separated from the panel by the thickness of a No. 4 nut. This provides ample space for the pointer to ride the top of the plastic and between the panel and face.

Other than the cabinet all parts are standard or of the usual amateur construction. The cabinet was folded from thin aluminum, such as is used for transcription discs in broadcast studios. Small rivets were used in forming the chassis and cabinet.

The mechanical layout is clearly shown in the photographs but a careful study should be made in the event that any parts to be used are not exactly as described.

The tuning condenser is taken from a war surplus BC 1206-C and modified so that the condenser plates are double spaced. Do this by removing the proper plates from the rotor and stator. A *Bud* 15 μμfd. three-gang unit can be substituted if desired.

The buffer-doubler (6AK6) tank condenser is a five plate midget condenser from a BC 1033 marker beacon receiver. No modification is necessary.

The final tank condenser is a 24 plate *APC* type midget with half the plates removed to provide double spacing.

Coupling and bypass condensers are of the tubular ceramic type in order to save space.

Note carefully the placement of the PA screen dropping resistor. This is made readily accessible because, should different power supplies be used, the resistor value must be changed to suit the plate voltage applied.

Most important is the order of wiring. After mounting all parts, the filaments should be wired first. The converter was wired and tested before any wiring was started on the transmitter. After that all wiring of the r.f. stages proceeded from the oscillator to the final stage less the coils, the coils being the last to be placed. The author finds that with a small tipped iron there is sufficient room to make changes even with the coils in place.

The modulator stage is then wired, the last part placed being the cathode bypass condenser. After the small compartment is completed the constructor will be relieved to find that there is plenty of space in the compartment holding the final tube and its modulator to provide adequate ventilation.

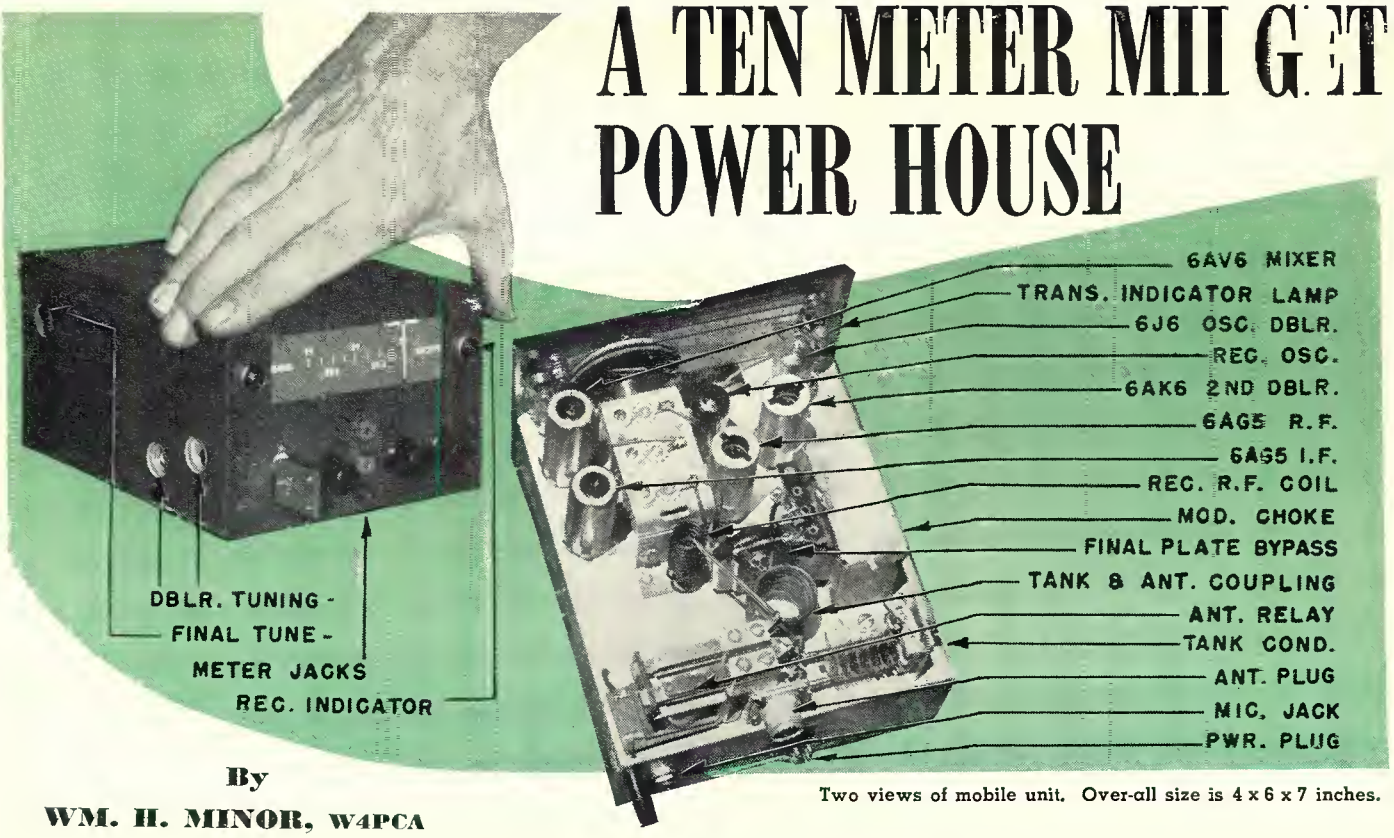
In this model all coils were checked with a grid dip meter to insure proper operation and tracking prior to the application of voltages. However, cut-and-try methods are acceptable. By following the specifications given, little trouble should be encountered. Not one change in the receiver coils was necessary when the original was built. Care should be taken not to tune the buffer-doubler to the third harmonic of the crystal (about 22 mc.).

The receiver was aligned using a signal generator, but a noise generator or even a 10 meter signal will do the work quite well.

The transmitter was tried, a stage at a time, with lowered voltage for tube protection. Under proper voltage the crystal should oscillate without any difficulty whatsoever. The second half of the 6J6 will draw 5 to 10 milliamperes under load. A good method of tuning the oscillator is to tune the tank, watching the plate current of the 6AK6. When the oscillator is in resonance the 6AK6 plate current will read *minimum*. Tune the 6AK6 tank for maximum grid current to the 2E26. This plate current on the 6AK6 should be about 10 milliamperes. Grid current to the final should not exceed 3 milliamperes. Nor should it be too low as downward modulation will result.

The final is first tested with lowered voltage to find the point of resonance

A TEN METER MII GET POWER HOUSE



Two views of mobile unit. Over-all size is 4 x 6 x 7 inches.

By
WM. H. MINOR, W4PCA

Designed for mobile operation, this four-tube converter and four-tube 35 watt transmitter is extremely compact.

THERE is no reason why considerable equipment cannot be - - put in small packages even though standard components are employed throughout. The unit described boasts of "innards" capable of 35 watts input fully modulated, an efficient converter, and an "overcoat" which measures but 4"x6"x7". It is barely larger than most of the commercially available converters and certainly much smaller than ham transmitters of comparable power. It offers a multitude of advantages, the principal of which is that it presents but one package for the complete station. To the family man who cannot monopolize the car and its trunk space this is the real answer.

To answer some of the anticipated questions first.

The full output can be realized only by supplying a power unit of 600 volts d.c. The author uses a PE-103 which will be described later. With only slight modifications the power for both the converter and the transmitter can be taken from the car receiver. This is, of course, at a sacrifice of input power. Any supply of from 250 to 600 volts may be used.

Provision is made for quick frequency shift at the position of normal operation. The unit is crystal-controlled for 10 meter operation, but due consideration is given to the advantages of v.f.o. and there is an equivalent for 75 and 20 fone with v.f.o. incorporated on the drawing board now.

All circuits are metered by an external meter with an internal switch to choose the proper circuit. Provision is made for the receiver to be on while the transmitter is off. There can be no accidental starting of the power unit without first having turned the transmitter filaments on.

One might question the choice of cathode type tubes but the advantage of push-to-talk with zero standby current is seriously outweighed by the ruggedness of construction in the tube, particularly where the mounting is as in this case. Too, the bias problem is more easily solved, with a consequent saving in space. Direct heater filament tubes, such as the 2E30's, would have made the "package" slightly taller.

And, of course, the big question: Does it really work? It does. Before attempting design of the small package, the transmitter was tested for actual operational value. The transmitter was constructed in a confined and only partially ventilated cabinet having but 80 cubic inches of volume. Despite the confinement, to date there has been no serious, or, for that matter, no trouble. It was in operation for a period of four months installed in the trunk compartment of the car and operated while the vehicle was in motion. The plate voltage is 500 volts, plate current 60 ma. Local contacts report operation comparable to a fixed location with "battery B" supply. There is *NO* dynamotor noise transmitted. Contacts have been made in all sections of the U.S. and Cuba. One contact logged with W6CHJ was on Sunday afternoon amid QRM with the report being 5-9 plus 5 db. The car was in motion on a country road and the contact was solid for a period of about a half hour.

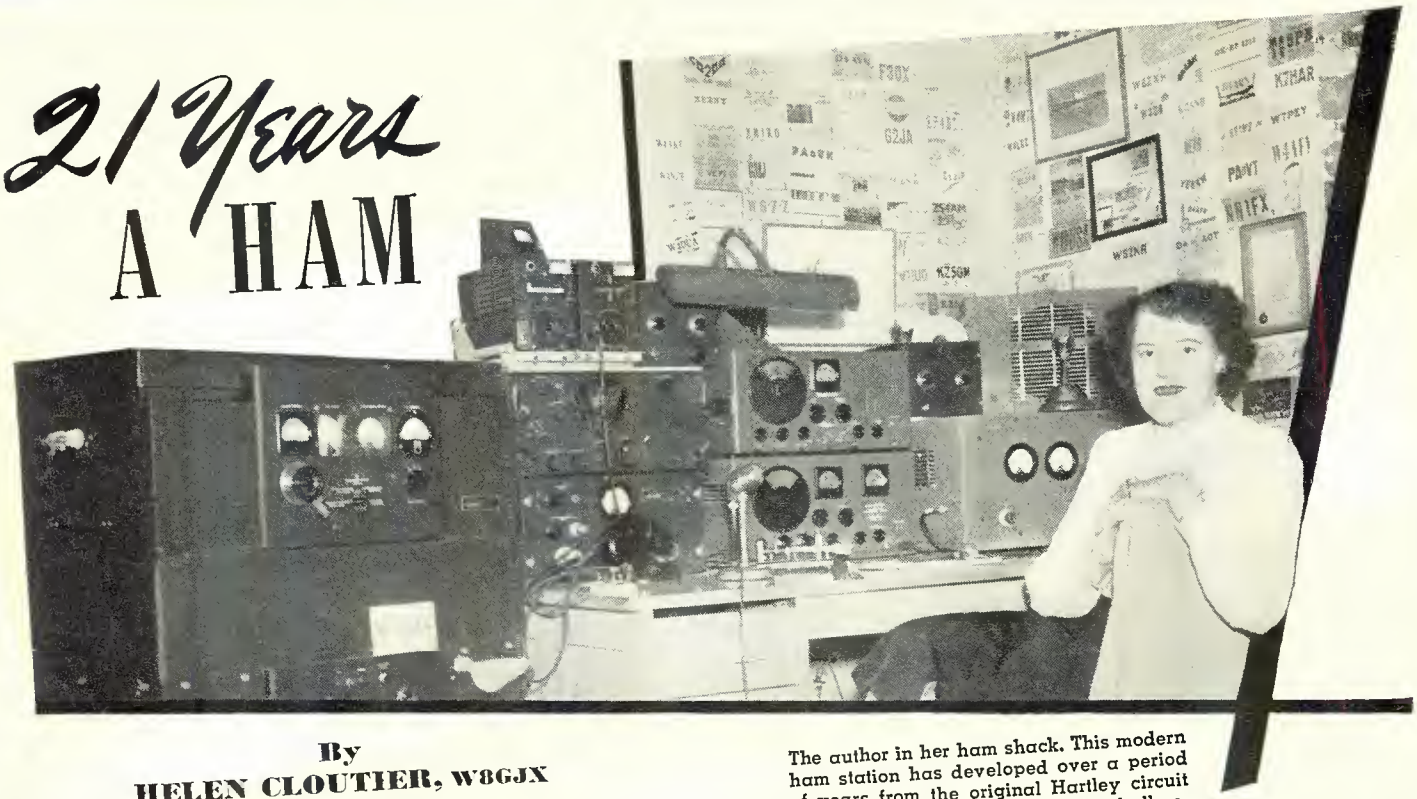
During this period several tests were made, including that of permitting the transmitter to bounce free on the floor while driving on country highway. No effect was noted while making local and long distance contacts. During this test period the frequency, output, and modulation were checked with instruments and there has been no necessity for retuning, with the one exception of the time the whip length and position were changed.

Does your present mobile beat this rig up to this point?

Should you, by this time, have decided to try construction of this unit a good piece of advice is to study the material and drawings until as you construct you can visualize the completed rig. This will take some time but will pay in the long run. There is no room on the chassis for mistakes and it is difficult to start over. There is no room for any additional equipment.

From the standpoint of the ham who is accustomed to vast open areas of working space this unit is not easy to build but there is no work to be done which requires any more than the

21 Years A HAM



By
HELEN CLOUTIER, W8GJX

The author in her ham shack. This modern ham station has developed over a period of years from the original Hartley circuit with 15 watts c.w., a Silver-Marshall receiver, and a doublet to a fully equipped shack with a BC-610 transmitter, a SX-25 receiver and preselector, a 10 meter beam, and a modern antenna rotator.

A youthful hobby has paid big dividends in fun and friendship for this amateur.

"A STORY to go with the cover picture," the Editor suggested, "on how you got into ham radio."

After writing for 10 years, this has been the hardest yarn I've ever attempted.

Perhaps it was the strange noises, the dots and dashes sprinkled with an overdose of QRM or, remotely, it might have been the fact that we were supposed to be hearing the Byrd Expedition, but most probably it was plain, old-fashioned curiosity that made me decide to study radio.

I know that my desire to understand the dots and dashes and to know what they meant hurried along my eager study of the code. Note-throwing in high school may have had a place in the pattern too.

During the summer of 1929, I managed a beauty shop in Frankfort, Michigan and was able to attend a radio school each evening. By September I had my class "C" license and the call W9GJX.

Operating the low-powered transmitter at the school gave me plenty of practice in procedure and plenty of helpful (?) advice from the rest of the students. The instructor, then chief operator of WFK, gave the students a chance to operate the commercial station and learn all the fine points of commercial operating.

When I returned to Manistique, W9GJX went on the air. My first station consisted of a Hartley circuit with about 15 watts c.w. on all bands, a *Silver-Marshall* receiver, and a doublet antenna. With it I worked all states and plenty of DX.

Not satisfied with class "C," theory was the next step. Always difficult for me, schematics, Ohm's Law, and the intricacies of elementary electricity were slowly and painfully digested with the tenacity of a billy goat eating the proverbial cans. Finally, though rather hesitantly, I decided that I could pass the Federal examination.

The train trip to Chicago, our nearest examination point, was a flurry of drawing diagrams, reading the Amateur's Handbook until I was sure I knew nothing at all about any of it. Until the day I received my new class "B" ticket I reviewed the questions and diagrams in my mind and wondered whether I'd answered any of them right.

For the next few years I remember vaguely that I worked and I remember, much more vividly, the many QSO's I had with new-found friends throughout the country. I also recall the hams that suddenly and without warning, knocked on our door and asked for the radio operator.

I am sure that many times during those first years of ham radio my mother wondered what sort of offspring she had been blessed with and perhaps, secretly, wished that I had been a dish-washing, cake-baking kind of girl.

I know she especially wondered about my sanity when, at any hour day or night, I would dash from my bedroom transmitter room and yell frantically that I had just talked to Belgium or England or some other equally remote place.

Mother, at that time, was operating her beauty shop and I was supposed to be working with her. Between appointments and every spare moment I was at the transmitter.

From time to time new additions were made to the station equipment and various visiting hams adjusted the transmitter or suggested changes, some good, some bad but always more expensive, until, before the war, I was running about 200 watts on c.w. and using a *Stancor* 20-P as experimental phone.

Many other interests, playing pipe organ at the local theater, a job I had filled from my freshman year in high school, teaching dancing, operating in Mother's shop kept every minute filled to the brim. But hamming was my relaxation, my recreation, my traveling with the least exertion. I became a member of the ARRL, was net control alternate for the AARS in the ninth district, was made route manager in 1931, ORS in 1931, and was elected to the A1 operators club in the same year.

When I married, strangely enough a non-ham, and moved from Manistique, Dad decided to become a ham so that he could talk to me every day. He studied and passed his class "C" and was ready to go on the air. His call was W9UTY and, after letting his license lapse during the war, later W8ZKR. From 1932 on Dad and I

(*Continued on page* 96)

halving the variable capacitance. Neutralizing will occur at about half-scale setting of the unit.

It will be much easier to obtain clean neutralization if all inductive coupling is eliminated between grid and plate tanks. Keep the grid and plate coils well separated and at right angles to each other. In stubborn cases, enclose the entire grid tank in a metal box. Provide one common ground point on the chassis and tie all returns securely to this point.

Radiophone Operation. The circuit of Fig. 1 is satisfactory for c. w. and FM with the smallest plate tank condenser plate spacing indicated. For plate modulated phone, use the larger values of plate spacing shown. The high electrical ratings of the 304TL permit plate modulation at the full 1-kilowatt amateur input. Connect the secondary of the modulation transformer in series with the "B-plus" lead coming into the 304TL amplifier.

To determine the impedance which the modulation transformer must match, divide the 304TL plate voltage by its plate current (in *amperes*). For example: Where the 304TL is operated at 2000 volts and 480 ma. (960 watts input), the impedance is 2000 divided by 0.480 = 4166 ohms. The audio watts required will be equal to one-half the 304TL power input. (In the preceding example, the 304TL input is 960 watts. The required audio power would be 960/2 = 480 watts). The secondary winding of the modulation transformer must be able to handle the 304TL plate current safely.

In order to keep from exceeding the 300-watt plate dissipation, d.c. plate power input must be reduced when employing *any* form of efficiency modulation. Thus, the maximum d. c. plate power input which may be used with grid bias modulation will be 450 watts, for cathode modulation 666 watts, and for class B linear operation 450 watts. The r.f. power output, per tube, with grid bias modulation and class B linear operation will be approximately 150 watts, and for cathode modulation 366 watts.

Shielding. In the 304TL transmitters we have observed in operation, metal rack-and-panel and enclosed-cabinet construction seemed to provide adequate shielding. With the open-chassis and breadboard layouts, the chance of TVI seemed to be about 50-50. In localities congested with nearby television antennas, it is a good idea to enclose an entire breadboard or open-chassis 304TL final in a well-grounded sheet metal box or in a grounded cage made of copper screen.

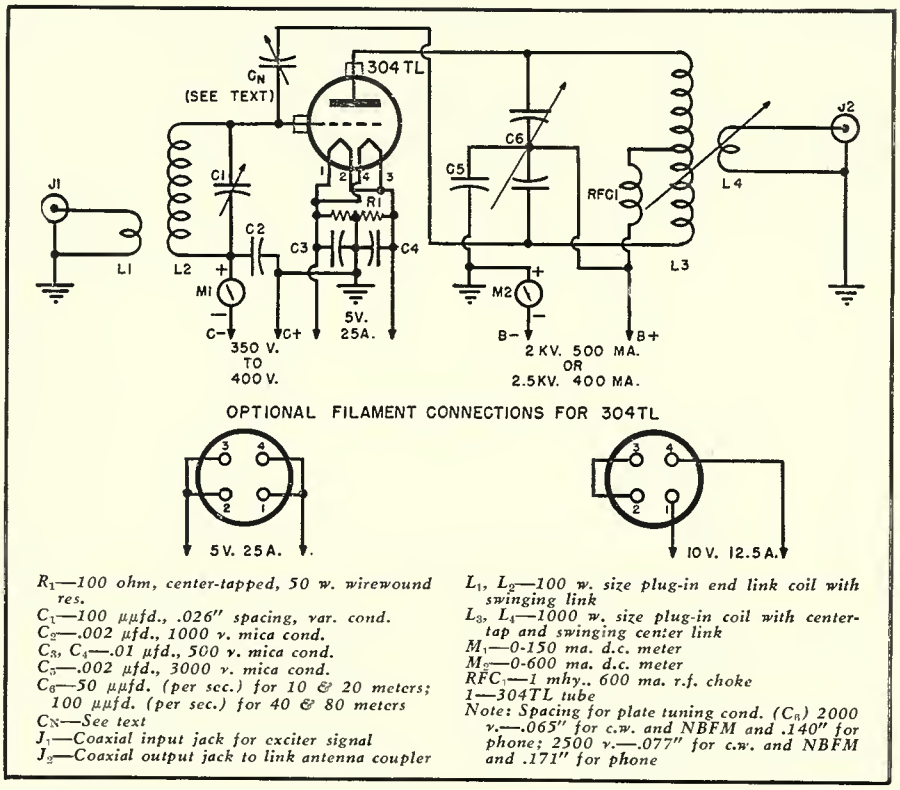


Fig. 1. Schematic diagram of a single-ended final amplifier using a 304TL surplus tube.

Single-Section Operation. The writer found several W6's using only one section of the 304TL by the simple expedient of disconnecting the socket terminals of one of the filaments. This scheme approximately halves the 5-volt filament wattage, interelectrode capacitances, and grid current; but it also halves the plate power input and allowable plate dissipation. The "dead" section hanging in the circuit seemed to cause no mischief, and it stands by for future use when the first section goes sour.

Ventilation. Make no mistake about it, the 304TL runs hot. Plate dissipation and filament power total 425 watts. This is almost as torrid as some sunbowl heaters! Provide for free circulation of air around the tube. Use a motor-driven blower if at all possible. In lieu of a special blower (they are to be had in surplus), an electric fan may be pressed into service. Use heat-radiating connectors for both grid and plate terminals. The *Eimac* HR-6 or *Insuline* 968 connector will fit the grid cap; *Eimac* HR-7 will fit the plate tip.

Use heavy braid or strip for grid and plate leads and heavy, solid wire for all filament wiring. Mount the filament transformer on the 304TL chassis; or, if it must be external, keep it as close as practicable to the chassis.

Audio Application. The 304TL is useful also as a class AB_1 modulator. Table 2 gives the class AB_1 operating characteristics up to the maximum power level of interest to amateurs.

—30—

Table 1. Characteristics of the 304TL as on r.f. power amplifier. In amateur service the plate input should not exceed 1000 watts.

D.C. Plate Voltage	1500	2000	3000	volts
D.C. Plate Current	665	600	500	ma.
D.C. Grid Current	90	85	80	ma.
D.C. Grid Voltage	—250	—300	—400	volts
Plate Power Output	700	900	1200	watts
Plate Power Input	1000	1200	1500	watts
Plate Dissipation	300	300	300	watts
Peak R.F. Grid Input Voltage (approx.)	430	480	575	volts
Driving Power (approx.)	33	36	40	watts

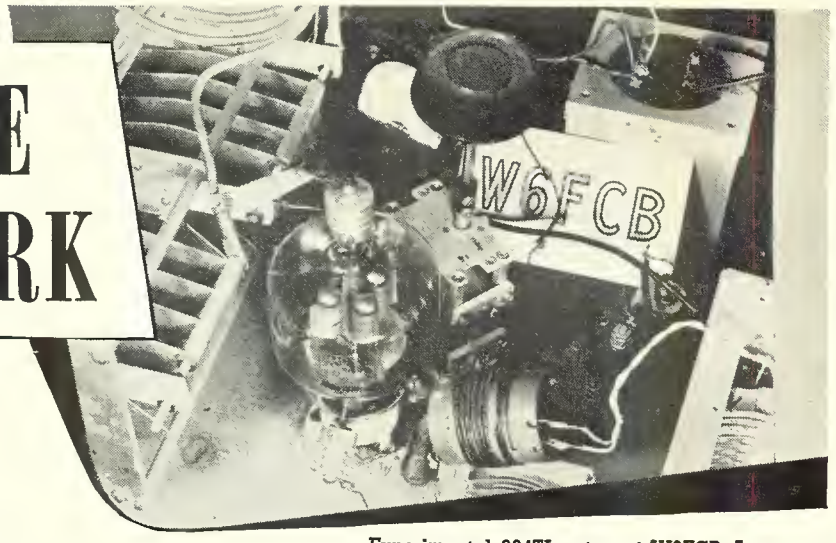
Table 2. Operating conditions for a pair of 304TL tubes in class AB_1. Output up to 730 watts is available with no driving power.

D.C. Plate Voltage	1500	2000	3000	volts
Plate Dissipation (per tube)	300	300	300	watts
D.C. Grid Voltage (approx.)	—105	—160	—260	volts
Peak A.F. Grid Input Voltage	210	320	520	volts
Zero-Signal D.C. Plate Current	270	200	130	ma.
Max.-Signal D.C. Plate Current	572	546	444	ma.
Max.-Signal Driving Power (approx.)	0	0	0	watts
Effective Load (plate-to-plate)	2540	5300	12,000	ohms
Max.-Signal Plate Power Output	256	490	730	watts

PUTTING THE 304TL TO WORK

By
GUY DEXTER

Circuit applications of a popular low-priced surplus market tube.



Experimental 304TL setup at W6FCB, Los Angeles. This breadboard final amplifier was used to determine best operating conditions for the 304TL prior to construction of the "final" transmitter. The driver stage is a 75T. The neutralizing condenser is a standard small transmitter type unit with some of the plates removed.

THERE can be no doubt that the biggest all-time buy in transmitting tubes is the surplus 304TL. At this writing, the 304TL is being offered for 75 cents, brand new. Such a bargain price, undreamed of before and during the War, represents 2000 watts per dollar on the basis of maximum recommended plate power input—or 1333 watts per dollar on the basis of the legal 1-kilowatt amateur input. For less money than a single, comparable kilowatt-type tube normally would cost, a ham now may buy enough 304TL's to last him for 20 years of 3 hours-per-day operation.

From the time of the first appearance of the 304TL on the surplus market, there has been a sustained barrage of questions from amateurs regarding the "official" characteristics of this tube and the best way to build a final amplifier around it. How should the filament prongs be connected? What neutralizing capacitance should be used? Will this tube work on 10 meters? What modulating impedance is presented to the audio stage? What excitation is required? This article aims to supply the desired information and, we hope, relieve the editors and radio writers of the increasing burden of correspondence on this subject. To get the dope, we have made tests, queried *Eimac,* and observed the operation of 304TL rigs in the Los Angeles area.

Maximum allowable plate dissipation of the 304TL in any application is 300 watts. Other maximum ratings are plate voltage 3000 v., plate current 900 ma., and grid current 150 ma. Maximum ratings hold up to 40 megacycles. The maximum ratings of this tube are such that it can handle the amateur 1-kilowatt input with extreme ease.

Typical r.f. operating characteristics, as supplied by *Eimac,* are listed in Table 1. The data appearing in the second and third columns of this table are for power inputs in excess of the legal amateur level of 1000 watts and are given here only to show the tube's capabilities and because this information might be of value in the amateur design of dielectric heaters and similar applications.

The first column in Table 1 shows one set of conditions for 1-kilowatt c.w. or FM operation of a single-ended 304TL final. Personally, we do not believe that this set of conditions will be chosen by most amateurs since a 665-milliampere transformer is not as readily available as a kilowatt-type unit delivering, for example, 2000 v. at 500 ma. or 3000 v. at 330 ma. Amateur experience with this tube indicates that higher driving power is required than is shown in Table 1, especially if the final is to be operated on 10 and 20 meters with full 1000 watts input and good efficiency. For both phone and c.w. operation, all the way to 10 meters, we recommend a d.c. grid voltage of —400, d.c. grid current of 90 to 100 milliamperes, and a 100- to 125-watt *straight-through* driver stage. Skimping in the design of a driver stage for any triode final is a case of penny wisdom and pound foolishness. Examining several successful 304TL rigs in town, we find that best results have been obtained by ignoring what the data sheet specifies for driving power and dumping in plenty of excitation watts. The old amateur rule of the thumb of keeping the driving power equal at least to 1/10 to 2/10 of the final power output is a good guide. The high driving power we recommend will cause very little inconvenience since most hams about to rebuild for higher power already have a rig delivering around 100 watts output which can be used intact to drive the 304TL final. The 304TL definitely demands plenty of grid drive on the ham frequencies.

Average grid-plate capacitance (of interest in neutralization) is 9.1 $\mu\mu$fd. Input capacitance is 8.5 $\mu\mu$fd., and output capacitance is 0.6 $\mu\mu$fd. Readers interested in comparative values will note that the 304TL input capacitance is less than that of either the 810 or 4-250A, and its output capacitance is less than that of either the 810, HK-254, or 250TH.

To those interested in audio applications of the 304TL, this tube is a low-mu job having an amplification factor of 12. Class AB_1 modulator characteristics are given in Table 2.

Special Operating Notes

Circuit. The conventional circuit given in Fig. 1 is recommended for single-ended class C operation of the 304TL. For TVI reduction, it is recommended that a 2nd harmonic wavetrap be connected in the "hot" lead of the coaxial r.f. output line. *L* and *C* values for suitable wavetraps may be determined from the frequency-reactance charts and curves appearing in the amateur handbooks and elsewhere. A conventional push-pull circuit also may be used, and will give less harmonic interference. However, the bias must be increased to reduce the loaded plate current to the value corresponding to 1 kilowatt (or less) input at the plate voltage employed, and the excitation wattage must be increased proportionately.

Neutralization. This subject leads all other questions on the 304TL. Neglecting stray capacitances, approximately 9.1 $\mu\mu$fd. capacitance will be required to neutralize the circuit. The 9.1-$\mu\mu$fd. point must, of course, be reached before the neutralizing condenser is at its maximum capacitance setting. Satisfactory units for the purpose are the screw-in disc-type neutralizing condensers such as *National* NC-500, *Bud* 1002, and *Hammarlund* N-20; and the cylindrical type such as *Johnson* N125. An inexpensive high-voltage neutralizing condenser can be improvised from a dual 50-$\mu\mu$fd. tuning condenser having 0.065" plate spacing. Circuit connections are made to the two stators only, the rotors being left floating. This places the two sections in series, doubling the voltage breakdown and

An OSCILLOSCOPE PREAMP

By
LOUIS E. GARNER, JR.

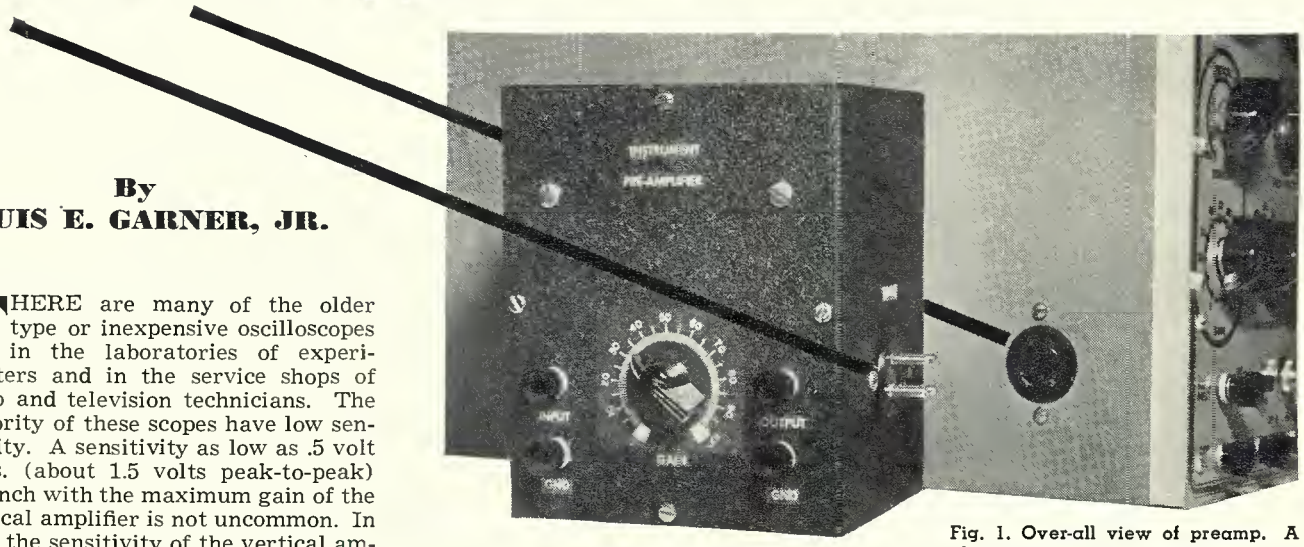


Fig. 1. Over-all view of preamp. A plug and socket are used to connect unit to the oscilloscope proper.

The performance of some older or less expensive type scopes can be improved by using this unit.

THERE are many of the older type or inexpensive oscilloscopes - - in the laboratories of experimenters and in the service shops of radio and television technicians. The majority of these scopes have low sensitivity. A sensitivity as low as .5 volt r.m.s. (about 1.5 volts peak-to-peak) per inch with the maximum gain of the vertical amplifier is not uncommon. In fact, the sensitivity of the vertical amplifier in the majority of these older scopes is only between .1 and .5 volt r.m.s./inch deflection.

In present day television servicing, as well as in experimental work, much higher gain is desired. A sensitivity of at least .1 volt peak-to-peak/inch (about .03 volt r.m.s.) is desirable and a sensitivity of .05 volt peak-to-peak/inch is preferred (about .016 volt r.m.s.).

In addition to the problem of sensitivity, many older scopes suffer from two other disadvantages. The input circuit usually employed in older scopes is shown in Fig. 2A. R_1 often has a value of about 1 megohm.

The comparatively high input capacity (due to leads from and to the front panel control), together with the comparatively low value of the input resistance combine to reduce the input impedance of the scope. Often the scope cannot be used in high impedance or high frequency circuits due to the loading of its input circuit.

Finally, in present day service and experimental work, good high frequency response in the oscilloscope is a must. This is especially true in TV work, where high frequency sync pulses may be observed, and where signals as high as several hundred kilocycles must be passed without appreciable attenuation if the waveform of the signal is to be preserved.

Fortunately, many of the older scopes, while lacking as far as input impedance and gain are concerned, have a sufficiently broad frequency response to be useful. However, this broad frequency response can seldom be utilized in practice due to loss of high frequency signals in the gain control. If the gain control is turned down from its maximum position, the circuit shown in Fig. 2B obtains. C_d is the distributed capacity of the circuit, including the input capacity of the tube.

The upper portion of the gain control, R_{1a}, together with capacity C_d, form a low pass filter circuit. As higher frequency signals are applied to this circuit, the attenuation becomes greater since the reactance of C_d drops while the resistance of R_{1a} remains essentially constant. C_1 is so large that it can be considered a short circuit at high frequencies.

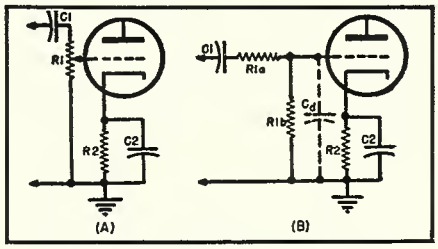


Fig. 2. Input circuits commonly found in older type oscilloscopes. Input capacity (C_d) of these units is relatively high, thereby limiting high frequency response.

This disadvantage is minimized if R_1 can be left in its maximum position, or if R_1 has a very low value (on the order of a few thousand ohms). However, substituting a lower resistance control directly for R_1 is not a solution, since this increases the loading of the input circuit of the scope on the circuit under test.

All three of these faults in older scopes (and less expensive present day scopes) can be overcome by the addition of an easily built preamplifier to the instrument. Such a preamplifier is shown in Fig. 1, and the schematic diagram is given in Fig. 3.

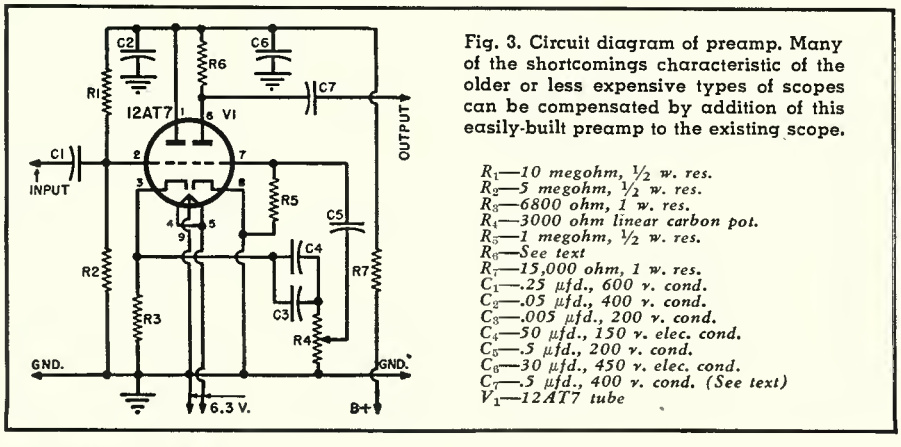


Fig. 3. Circuit diagram of preamp. Many of the shortcomings characteristic of the older or less expensive types of scopes can be compensated by addition of this easily-built preamp to the existing scope.

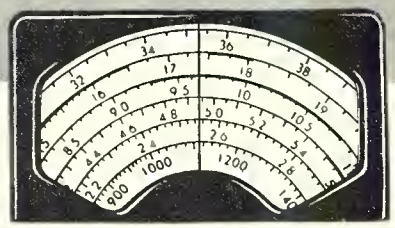
R_1—10 megohm, ½ w. res.
R_2—5 megohm, ½ w. res.
R_3—6800 ohm, 1 w. res.
R_4—3000 ohm linear carbon pot.
R_5—1 megohm, ½ w. res.
R_6—See text
R_7—15,000 ohm, 1 w. res.
C_1—.25 µfd., 600 v. cond.
C_2—.05 µfd., 400 v. cond.
C_3—.005 µfd., 200 v. cond.
C_4—50 µfd., 150 v. elec. cond.
C_5—.5 µfd., 200 v. cond.
C_6—30 µfd., 450 v. elec. cond.
C_7—.5 µfd., 400 v. cond. (See text)
V_1—12AT7 tube

The Circuit

Referring to Fig. 3, the input condenser C_1 is run directly to the grid of the cathode follower input amplifier. Thus, distributed capacities, as well as tube input capacities are kept to a minimum. The input resistance (R_2) is high (5 megohms) and this combined with the low input capacity gives a high input impedance that will cause minimum loading of even high frequency, high impedance circuits.

(*Continued on page* 150)

International SHORT-WAVE



Compiled by **KENNETH R. BOORD**

THIS month's *ISW DEPARTMENT* is dedicated to radio in Turkey. Thanks go to Arne Halvorsen, Oslo, Norway, for relaying this material.

Broadcasting activities in Turkey started in 1927 over two small transmitters operated by the Turkish Postal, Telegraph, and Telephone Administration. These transmitters were in Ankara and Istanbul, two largest cities of Turkey. But the Turkish Government was conscious of the need to extend its broadcasting services not only to the remotest villages in the land, but also to all corners of the world. Thus, in 1933, plans were prepared for the construction of a powerful l.w. and a s.w. transmitter in Ankara. In 1938, the modern Ankara Broadcasting House was officially inaugurated, and a 120-kw. l.w. transmitter and a 20-kw. s.w. transmitter with two non-directional antennas came into operation. They were built by the *British Marconi Company*. Late in the summer of 1949, a 150-kw. m.w. and a large, modern Broadcasting House were brought into use in Istanbul; the transmitter was built by *RCA*. The construction has just been completed in Ankara by the *Marconi Company* of a 100-kw. s.w. transmitter which is expected to soon begin regular broadcasts over six directional antennas.

Parallel to the Turkish Government's efforts to increase the number of transmitters, the number of radio sets is rapidly increasing throughout Turkey; while radio receivers numbered only 7600 in 1935, this figure totaled 285,000 at the end of 1949. It is the Turkish Government's policy to supply each village in Turkey (about 40,000 in all) with at least one radio receiver.

A radio listener's license fee is 10 Turkish liras per year (about 12 shillings) in large towns, and 5 Turkish liras per year in smaller towns and villages. Almost all radio sets in Turkey have three wave bands.

Broadcasting activities in Turkey became a part of the functions of the Turkish Press, Broadcasting, and Tourist Department in 1940. Today, the long- and medium-wave transmitters in Ankara and Istanbul broadcast separate programs in Turkish. The s.w. stations TAQ and TAP in Ankara have been broadcasting news bulletins and commentaries in 13 languages since 1939, and as throughout World War II so today the *Turkish Radio* keeps up its tradition of accurate and impartial news interpretation.

When the *new* 100-kw. transmitter comes into regular operation, the scope and nature of the present programs on s.w. will certainly be extended, with special broadcasts being beamed particularly to the United States, Latin America, Asia, and the Far East. The station is to operate as Ankara II, TAS, 7.285; TAT, 9.515; TAU, 15.160; TAV, 17.840; TAO, 11.880, and TAX, 21.660. Already, tests have been carried out on the 9.515 and 17.840 channels.

Also to begin operation this year are these 20 kw. s.w. stations—Ankara I, TAN, 6.000; TAM, 7.240; TAK, 11.760, and TAD, 17.720. In the meantime, programs for foreign countries on s.w. are listed—Sunday, "Mail Bag" in *English* 1525-1600, and Thursday, "Talks on Turkey," *English*, 1525-1600; Monday and Thursday in Turkish 1545-1600, 1600-1615, all over TAQ, 15.195, which also is used for "Home Program" relays at 0430-0600 daily; TAP, 9.465, is on the air *daily* with news in Urdu 1000; news in Arabic 1030; news in Persian 1045; news in Turkish 1100; news in Greek 1130; news in Rumanian 1145; news in Polish 1200;. commentary in Turkish 1215; news in Bulgarian 1230; news in French 1245; news in Serbo-Croat 1300; news in Hungarian 1315; news in German 1330; news in *English* 1345, and program in Turkish 1400-1500.

Best wishes go to radio officials and station personnel for continued success as services in the field of radio are expanded in Turkey.

* * *

(Note: Unless otherwise indicated, all time is expressed in American EST; add 5 hours for GCT. "News" refers to newscasts in the English language. In order to avoid confusion, the 24 hour clock has been used in designating the times of broadcasts. The hours from midnight until noon are shown as 0000 to 1200 while from 1 p.m. to midnight are shown as 1300 to 2400.) The symbol "V" following a listed frequency indicates "varying." The station may operate either above or below the frequency given.

Personnel of the English Section of OTC2, Leopoldville, Belgian Congo. Known as "The Goodwill Station," OTC2 has just been voted "tops" in a worldwide listeners' survey conducted recently by the International Short Wave Club of London, England.

Leopoldville Is Tops!

I am pleased this month to report the results of the popularity survey just concluded worldwide by the *International Short Wave Club* of London (this club was started upwards of 20 years ago in the United States). Arthur E. Bear, ISWC secretary, tells me that "votes have come into us from members and other listeners from all parts of the world. This census is most comprehensive and should be of valuable assistance to stations in their program planning." The results:

1. OTC, Leopoldville, Belgian Congo, 609. 2. Radio Australia, 446. 3. Swiss Short-Wave Service, Berne, 435.

(*Continued on page* 143)

of the tube, and the actual duration and amplitude of the pulse that drives the plate negative.

In many cases where the vertical irregular black line appears on the cathode ray tube, merely trying several different output tubes may result in finding one particular tube which does not cause this type of television interference. This clearing of the interference by tube substitution is due mainly to slight constructional differences in the tube elements or to different operating characteristics, shifting the frequency of oscillation out of the band being received, or completely eliminating the oscillations.

By basically changing the shape of the plate pulse and thus affecting the plate voltage the objectionable oscillations may either be shifted or wholly eliminated. In some cases merely adjusting the horizontal linearity coil, or the width coil, will eliminate or reduce this type of interference. Most of the television receivers now in use have a means whereby the grid drive on the horizontal output tube can be adjusted. This control is usually in the form of a trimmer condenser which is connected from the control grid to ground. Adjusting this trimmer so that the tube is not driven hard (turning the condenser clockwise for increased capacity) may sometimes minimize or eliminate these oscillations. It should be kept in mind, however, that horizontal width, drive, and linearity adjustments made in order to reduce Barkhausen oscillations should not detract materially from the quality of the picture.

Another method for changing the shape and amplitude of the plate pulse involves feeding an out-of-phase voltage back from the secondary of the horizontal output transformer to the screen grid. The circuit for this type of feedback is shown in the diagram of Fig. 1A. The out-of-phase voltage is fed back in series with the screen from the width coil tap of the transformer's secondary. In Fig. 1B, the voltage from the width coil tap is fed back in parallel with the screen grid.

In those instances where more than

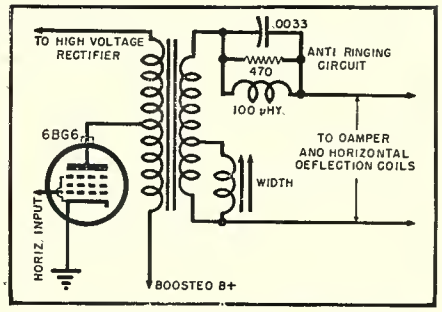


Fig. 3. Diagram of an anti-ringing circuit.

sufficient width and high voltage are available the insertion of a small unbypassed cathode resistor may cause a sufficient reduction in the drive of the tube to eliminate the oscillations.

Recently the *National Union Radio Corporation* has developed a special anti-Barkhausen 6BG6 tube. It contains a specially constructed corrugated baffle which tends to restrict oscillatory action between the screen grid and plate of the 6BG6.

One type of picture distortion which is often encountered takes the shape of one or more white lines which are present near the left side of the picture. See Fig. 6. This white line is present on all stations whether the receiver is operating in a strong signal area or a weak one. This effect is caused by an actual distortion in the linear trace of the horizontal sawtooth. When the retrace starts, the fast changing field causes a high amount of energy to be produced in the horizontal deflection coils. The coils contain an inherent amount of inductance and capacity and when shocked with this burst of energy they tend to set up oscillations at their resonant frequency. Theoretically the damper diode should act as a short circuit during this time by conducting and acting as an extremely low resistance path across the coils, but in some cases enough of the oscillations are produced to still cause interference even at the start of the next trace. This action is shown in Fig. 4. The saw-tooth shows the current flowing in the deflection coils. The square wave is the voltage across the coils. The ripple is caused by the oscillations or ringing produced in the coils.

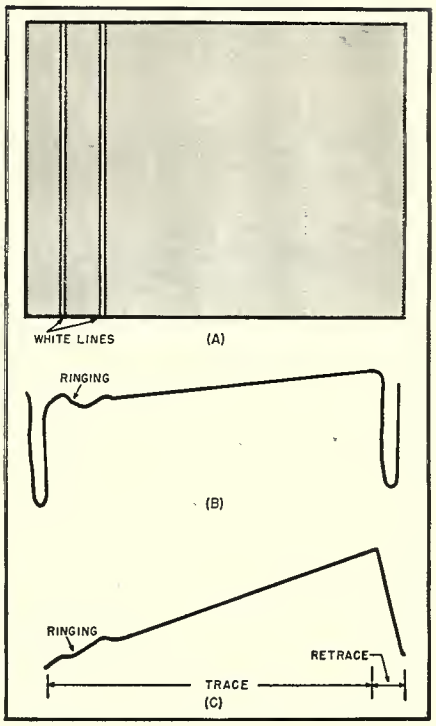


Fig. 4. Effects of ringing. (A) Vertical lines appearing on TV screen. (B) Voltage wave across horizontal deflection coil. (C) Current wave in horizontal deflection coil when ringing is present.

As can be seen when the retrace ends, the ripple is carried on into the start of the next trace. This ripple causes the sweep rate to be modulated, with the whiter area being the time the electrons are moving more slowly across the screen and thus imparting more energy per unit time to the fluorescent material on the cathode-ray screen. By inserting a parallel tuned circuit, resonated to approximately 250 kc., in series with the horizontal output winding, the oscillations are effectively trapped out. This action is shown in Fig. 3. —30—

Fig. 5. Interference (black line) from Barkhausen oscillation.

Fig. 6. Pattern showing ringing effects in horizontal output.

By
DANIEL LERNER* and JOHN HOWELL†
Philco Corporation

TV Interference from Horizontal Deflection Circuits

Interference of this type can be reduced or, in many cases, eliminated with minor circuit adjustments. The new National Union anti-Barkhausen 6BG6 will help.

ONE of the most elusive types of interference encountered by the television service technician is found mainly in areas where the signal strength is relatively low. On the high television channels this interference shows up on the screen as a vertical irregular black line which appears most often at the left hand side of the picture. This effect is shown in Fig. 5. This black line is caused by an internal oscillatory action in the horizontal output tube. This type of interference is the result of a phenomenon known as the *Barkhausen effect*.

The horizontal output tube found in most television receivers, usually a 6BG6, is a tetrode which is driven with a type of waveform that causes the plate current to rise and fall sharply. The plate load on this tube is highly inductive and when the grid of the tube is driven positive the sharp rise in the plate current causes a high drop across the plate load. This drop is of such a magnitude that the plate is momentarily driven negative with respect to the screen grid. (See Fig. 2.)

The electrons, which are traveling between the screen grid and the plate of the tube at the time the plate goes negative with respect to the screen, are attracted back towards the more positive screen. Before the electrons have completed the trip back to the screen, the control grid of the tube goes sharply negative. This returns the plate voltage to a higher positive value than the screen. See Fig. 2 for a diagram of this action. Thus, the electrons are again drawn up toward the plate and the cycle is continued. The time required for an electron, or more usually a group of electrons, to travel from the grid to the plate is called the *transit time*. The electrons flowing in a circular path in the space between the screen and the plate of the tube induce a voltage into the associated wiring which makes the latter act as circuits that are resonant at the frequency of oscillation. This frequency will depend on such factors as the lead lengths, wiring of the tube, the actual physical space between the screen and the plate

Fig. 1. Feedback circuits that are used to reduce effects of Barkhausen oscillations.

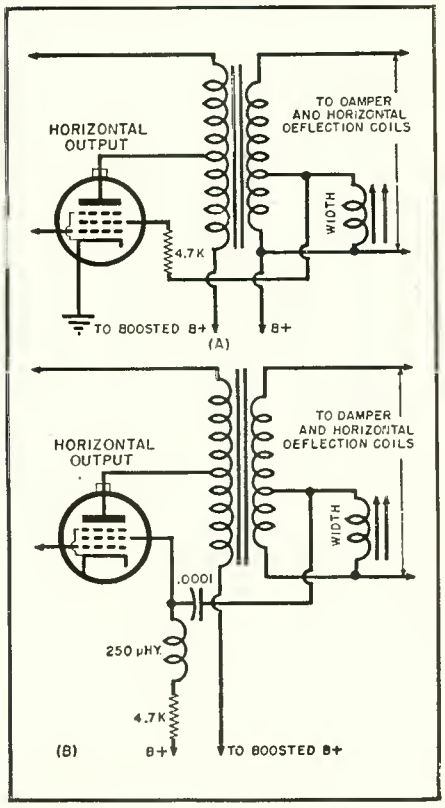
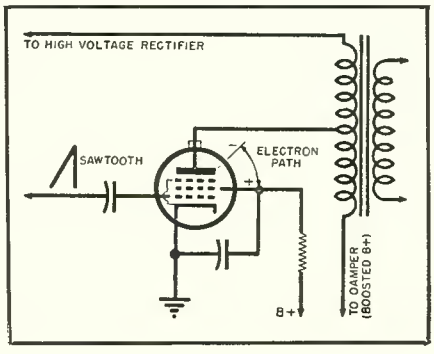


Fig. 2. Oscillations produced in horizontal output tube. Frequency of oscillation depends on lead lengths and the mechanical size, shape, and assembly of tube elements.



* Television Field Service Eng.
† Supervisor of Television Publications, Service Division.

condenser. The ceramic acorn socket is mounted on 1" high ceramic standoff insulators near the rear of the polystyrene base. The two heater r.f. chokes (see Fig. 6) are hung vertically, by means of their pigtail leads, directly from the socket heater terminals to a 2-lug insulated terminal strip mounted along the rear edge of the base. The oscillator assembly is held back of the metal front panel of the instrument case by means of four metal studs screw-mounted to the holes seen in the corners of the polystyrene panel. A *ceramic* flexible shaft coupling is used between the butterfly tuning shaft and the tuning dial shaft, to prevent body capacitance effects. This coupling must not be omitted, since body capacitance can be troublesome at ultra-high frequencies. The ends of the hairpin coupling loop are soldered to two solder lugs held by 6-32 screws to the polystyrene base of the tuning unit. These screws pass through the base under the inductor ring and engage two additional solder lugs under the base to which the coaxial cable is connected.

The microammeter, oscillator assembly, sensitivity control (R_2), and VR90 regulator tube are mounted on the front panel of the metal instrument case. All of the power supply components except the VR90 tube are mounted on the rear panel of the case. Leads between the two panels are bundled into a cable (see Fig. 7).

The instrument end of the coaxial cable passes through a grommet-lined clearance hole in the lower left-hand portion of the front panel, thereby removing the necessity for coaxial plug and jack, and is connected to the hairpin coupling loop inside. Fig. 4 shows how the external coupling ring is made at the far end of the cable: The outer plastic jacket and shield braid of the cable are cut away, leaving only about ¼ inch of shield braid. The internal polyethylene skin is left on the center conductor wire for insulation, except for about ½ inch at the very end of this wire. The bared end is brought around and soldered to the short projection of shield braid. The final result is a closed ring which may be used as-is, or may be squeezed into hairpin shape (as the individual application requires) for better coupling to circuits under test. The ring may be formed easily into other shapes and re-ringed at will, without damage to the wire or insulation. Keep the diameter of the ring not more than 1½ inch.

The reader can use his own ingenuity as regards fabrication of a suitable tuning dial. The author found the pointer-type knob and scale (see Fig. 1) entirely satisfactory. Mounted under the knob is a 2¼"-diameter plate of white Bristol board on which the frequency scale is inscribed in black India ink. The only two name plates, *Sensitivity* and *Coupling* likewise are lettered on white board and cemented to the panel, although these words may be obtained in decals and also in metal name plates.

The instrument is light in weight and therefore easily portable. The carrying handle is a common dime-store drawer pull.

The only precaution in wiring is to keep all leads in the oscillator as short and rigid as practicable. Since the oscillator section is constructed as a unit (see Fig. 6), this will not be difficult.

If a surplus, factory-made butterfly tuning unit is used, the instrument case dimensions must be increased. A suitable size will be 12" high, 7" wide, and 6" deep to accommodate these larger units.

Adjustment and Calibration

There are two simple methods of calibrating the frequency dial of the u.h.f. grid-dip oscillator. One scheme involves the use of Lecher wires; the other requires a signal generator or test oscillator. These methods are described in the following paragraphs.

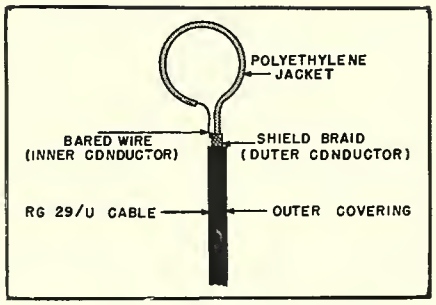


Fig. 4. Construction details on the external coupling ring described in the text.

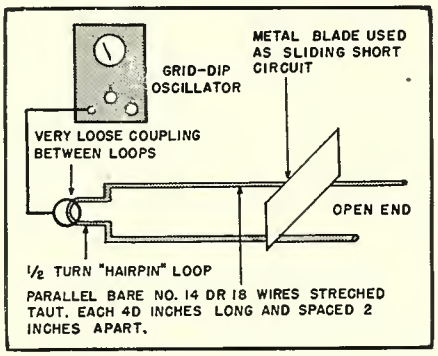


Fig. 5. Lecher wire setup. This is one of the methods for calibrating the unit.

Lecher Wire Method. A simple Lecher frame (see Fig. 5) may be made by stretching two parallel 40-inch lengths of No. 14 or 18 bare copper wire tightly between standoff insulators on a non-metallic baseboard or table top. The wires must be parallel and 2 inches apart throughout their length. A ½-turn hairpin loop, approximately 1 inch across, is formed at one end for inductive coupling to the coupling ring of the grid-dip oscillator. The other end of the wires is open, as shown in Fig. 5. A thin metal blade (brass or copper will be best) is provided for sliding along the two wires as a traveling short-circuit.

(*Continued on page* 120)

Fig. 6. The butterfly tuning unit as it appears completely assembled and mounted on its polystyrene panel. The acorn tube socket is mounted on ceramic standoffs on a polystyrene base. The hairpin coupling loop may be seen bent around the right side of the butterfly ring. Filament r.f. chokes hang from rear of tube socket to the 2-lug terminal strip. The ceramic grid condenser runs from left of ring to grid of tube socket.

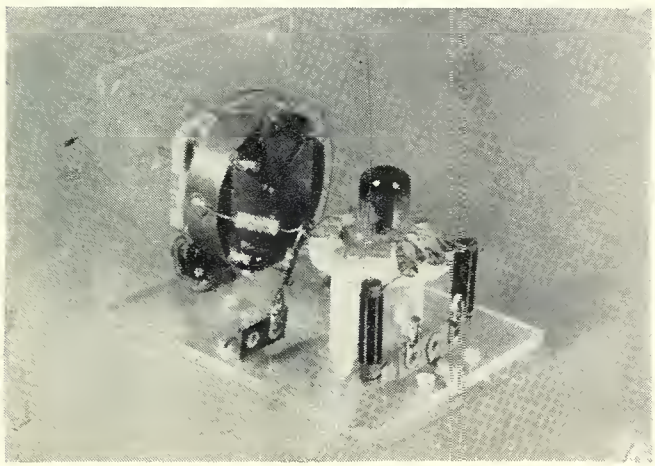


Fig. 7. Inside view of the grid-dip oscillator. The filament transformer, selenium rectifier, and power supply condensers are mounted on the back panel of the instrument cabinet, seen lowered. The meter, r.f. tuning section (see Fig. 6), sensitivity control, and VR90 regulator tube are mounted on the front panel, shown upright. A cable is used to connect the circuits on the two separated panels. See text for complete description.

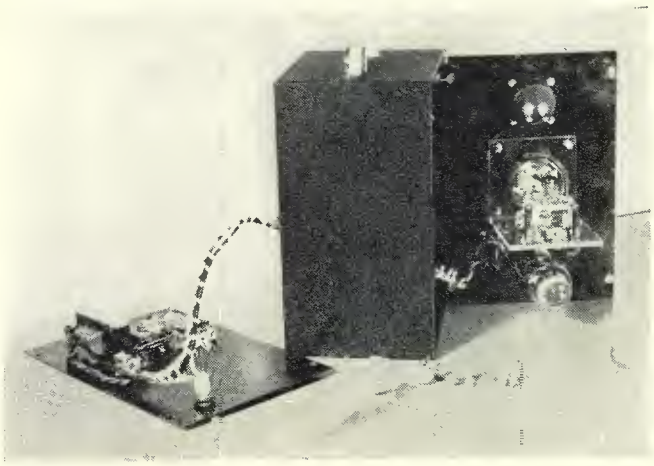


Fig. 2. Over-all view of homemade butterfly unit. The 1¾" diameter brass ring inductor was made by wrapping a ½" wide brass strip tightly around the outside of a standard butterfly tuning condenser so as to make contact with both stators. The rotors, when out of the stators, travel close to metal ring but do not make contact with it. The screw and nut holding the ends of ring together serve as "B-plus" terminal. No connection is made to the rotor plates.

a maximum capacitance of 26 μμfd. per section and a plate spacing of 0.030 inch. The frequency range of the grid-dip oscillator can be extended downward by employing a larger-sized butterfly condenser (50 or more μμfd. per section), if desired.

The inductor ring is made of rigid brass or copper strip ½" wide. This ring is fastened tightly around the outsides of the stator plates of the butterfly condenser, as shown in Fig. 2, and is held securely to the stator-plate posts by means of carefully applied solder. The ring touches each stator assembly at two points. No connections whatever are made to the condenser rotors.

The simple butterfly tuning unit is not hard to build. However, the reader who does not care to undertake the construction can purchase complete factory-built units in the surplus market. One such unit which currently is being advertised in the magazines has a built-on acorn tube socket, is ready for operation as an u. h. f. oscillator, and tunes from 76 to 300 mc. Another unit does not have the oscillator tube assembly and tunes from 300 to 1000 megacycles.

Oscillator Circuit

The complete wiring diagram of the u. h. f. grid-dip oscillator is given in Fig. 3. This circuit will be recognized as similar to the conventional ultraudion oscillator widely used in amateur u.h.f. receivers and transmitters.

In Fig. 3, the grid, plate, and "B-plus" taps are made on the inductor ring. The taps are shown in the drawing in the exact position at which they must be made on the actual inductor ring. That is; "B-plus" is tapped-on halfway between the two stator sections, and grid and plate taps are made on the ring opposite the center of each corresponding stator-plate section. In Fig. 6, the ceramic grid condenser, (C_2, Fig. 3) may be seen soldered to the front "stator half" of the ring. The plate tap lead, extending from a soldered point 180 degrees around the ring, also is visible in this photograph.

The dip meter, M_1, is a 0-100 d.c. microammeter. A meter of this sensitivity is necessary since maximum grid current during oscillation of the 955 tube is about 110 microamperes. The meter is shunted by a 20,000-ohm rheostat, R_2, which permits setting the meter pointer exactly to full scale at any frequency of adjustment. The rheostat acts as a sensitivity control.

The cathode of the 955 acorn tube is connected to one heater terminal at the tube socket. The two heater r.f. chokes, RFC_1 and RFC_2, each have an inductance of approximately 2.2 microhenries. Each is made by close-winding 40 turns of No. 26 enameled wire on a 7/32" diameter bakelite or polystyrene rod 1 inch long.

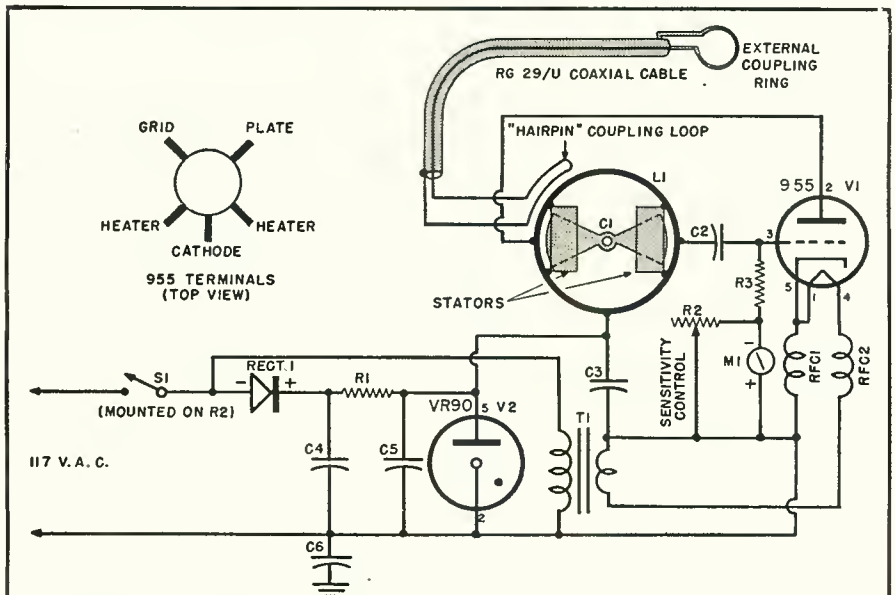
Small-sized ceramic, tubular, fixed condensers are used for grid coupling (C_2) and plate bypass (C_3). Condensers of other types are not recommended for use in these positions.

A half-wave, line-operated power supply is employed. $Rect._1$ is a 100-milliampere selenium rectifier. Since higher plate voltage is not required by the 955 tube in this grid-dip oscillator, there was little point in using a transformer-operated power supply. However, please note that the output and control circuits are arranged so as to prevent shock to the operator. Plate voltage is held constant at an approximate value of 90 volts by the VR90 regulator tube. Resistor R_1 takes the place of a bulkier iron-core filter choke. No portion of the metallic instrument case is connected directly to any part of the power supply circuit. Condenser C_6 serves to place the case at "B-minus" (ground) potential without a direct, dangerous connection. For best stability, the 955 heater is supplied by a small 6.3-volt filament transformer, T_1. The power-line "On-Off" switch, S_1, is mounted on the sensitivity control rheostat, R_2.

The r.f. energy is picked up from the butterfly by means of a "hairpin" coupling loop with its open end placed close to the plate tap on the inductor ring, and the hairpin curved so that its looped end is over the portion of the ring between stators. Arrangement of this hairpin coupling loop is seen easily in Fig. 6. The loop is made of bare No. 16 or 18 solid wire and is spaced ¼ inch from the butterfly inductor ring.

The lower, open end of the hairpin is connected to a length of small-diameter, high-frequency coaxial cable (RG-29/U or RG-58/U). This cable should not be more than 15 inches long. The outside end of the cable terminates in a 1¼-inch ring for coupling to external circuits under test.

Fig. 3. Complete circuit diagram of the home-built u.h.f. grid-dip oscillator unit.



R_1—1500 ohm, 2 w. carbon res.
R_2—20,000 ohm miniature pot. (with sw. S_1)
R_3—10,000 ohm, ½ w. carbon res.
C_1—26 μμfd. (per sec.) midget butterfly tuning cond. (Johnson 25LB15)
C_2—10 μμfd. ceramic cond.
C_3—100 μμfd. ceramic cond.
C_4, C_5—8 μfd., 200 v. midget tubular elec. cond.
C_6—.1 μfd., 400 v. tubular cond.
L_1—Single-turn brass or copper ring (see text)
M_1—0-100 d.c. microammeter
$Rect._1$—100 ma. selenium rect.
RFC_1, RFC_2—Fil. r.f. choke. 40 t. #26 en. closewound on 7/32" diam. plastic rod
T_1—Fil. trans. 6.3 v. @ 1 amp.
S_1—S.p.s.t. sw. (on R_2)
V_1—955 tube
V_2—VR90 tube

Mechanical Construction

The u.h.f. grid-dip meter is built into a standard radio chassis box 9" high, 6" wide, and 5" deep. Fig. 1 shows the external appearance of the finished instrument; Fig. 7 reveals internal arrangement of the components.

The complete oscillator assembly is mounted on a polystyrene panel and polystyrene base (see Fig. 6). The panel is 3" wide and 2¾" high; the base 3" wide and 4" deep. The butterfly tuning unit is mounted on the rear of the panel by means of the two internally-threaded studs built onto the

Home-Built U.H.F. Grid-Dip OSCILLATOR

By
RUFUS P. TURNER,
K6AI

Fig. 1. External view of u.h.f. grid-dip oscillator. A home-made butterfly unit is used.

Covers a higher range (170 to 450 mc.) than any other published circuits. The unit is ideal as an auxiliary test instrument, particularly in amateur and experimental work.

THE grid-dip oscillator needs no sales pressure by this author. Its host of important applications in amateur and experimental work sold it long ago to radio technicians of all classes. An interesting variety of grid-dip oscillators already has appeared on these pages; and another article on the subject would not be justified, except that the instrument described in the present article has a higher-frequency tuning range than is afforded by other home-built units. Also, the frequency range of this instrument can be extended still further, as will be indicated.

Most home-built amateur grid-dip oscillators using conventional *LC* circuits tune up to 30 or 40 megacycles. In a few, the frequency range has been extended to 100 or 200 megacycles. Several factory-built models reach 300 mc., and one laboratory-type instrument, out of the budget range of most amateurs, has a top frequency of 400 mc. The grid-dip oscillator described in this article is intended as an auxiliary instrument to take over where the ordinary amateur-constructed unit leaves off, and to provide an ultra-high-frequency tuning range. Its coverage is 170 to 450 mc. in a single continuously-tuned range. A home-made butterfly-type tuner replaces the more conventional coil and condenser. In other respects, this instrument is similar to most grid-dip oscillators.

How the Butterfly Works

The butterfly tuner, used in several important wartime u. h. f. receivers and test instruments, is a unique arrangement of a variable condenser and variable inductor in parallel, both of which are varied simultaneously. There are no sliding or wiping contacts of any kind in either the condenser or inductor which is an essential point in u. h. f. circuits.

The condenser portion of the unit consists of two separate assemblies of stator plates and a single assembly of butterfly-shaped rotor plates. The name of the unit is derived from the characteristic butterfly shape of the rotors.

The inductor portion consists of a band or ring bonded (often integrally) to the two stator assemblies. The rotor turns within this ring even when it is completely out of mesh with the stators. In commercial butterfly tuners, the stators are projections from the inductor ring.

When the rotor plates are entirely enmeshed within the stator, the capacitance is maximum. As the rotor plates are turned out of the stators, the capacitance decreases. At the same time, the edges of the rotors move close to the inside of the inductor ring in a manner similar to the movement of a motor armature close to the field poles. The metallic mass of the rotors thus gradually fills up the air gap inside the ring as the rotors are turned out of the stators, and brings about a continuous decrease in the inductance of the latter. Thus, the butterfly inductance decreases simultaneously with the capacitance and vice versa. Circuit connections are made only to tap points on the inductor ring, and all sliding or wiping contacts accordingly are eliminated in both the condenser and inductor.

Mechanical arrangement of the butterfly tuner is shown in the photographs (Figs. 2 and 6) and in the circuit diagram (Fig. 3).

The butterfly may be used as a continuously tunable *LC* circuit in tuners, wavemeters, or oscillators. A disadvantage of this type of tuner, which may attract immediate attention, is the fact that the tuning range is limited to a 90-degree rotation of the rotors. This is because the condenser section would be "closed up," giving repeat settings, twice in a normal 180-degree rotation. While this limited rotation will not be of serious consequence in most amateur and experimental applications, full 180- or 270-degree dial rotation may be obtained, if desired, by means of reduction gearing or belt-drive systems which permit the indicating dial to travel through 180 or 270 degrees while the butterfly rotors move through only 90 degrees.

Construction of Tuner

The nucleus of the home-made butterfly tuner used in the u. h. f. grid-dip oscillator is a small *Johnson* 25LB15 butterfly variable condenser. This component, seen clearly in the tuning assembly in Figs. 2 and 6, has

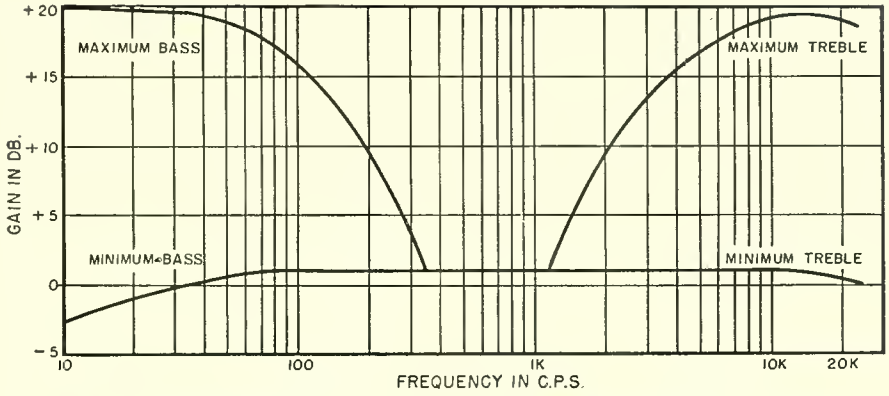


Fig. 4. Measured response of unit. Curves were taken with constant 500 mv. input.

in electrolytic condensers in the control unit will no longer be necessary and can be replaced by two more tubes, either for an expander or a dynamic noise suppressor.

Construction

Two views of the completed unit are shown in Figs. 1 and 5. The chassis, measuring 9¼ inches long by 3 inches high by 4 inches wide, is constructed of 1/16 inch thick aluminum. Aluminum was chosen over iron as giving better electrostatic shielding.

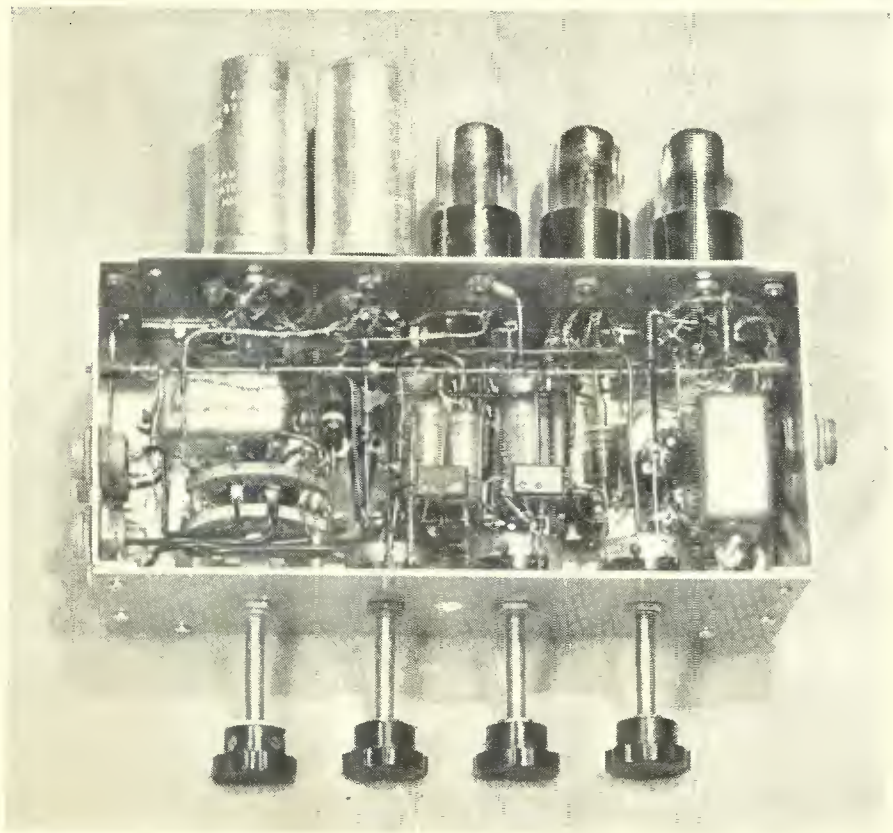
Mounted on the top plate are the terminal boards. TB_1, the input board, is on the left, and the output board, TB_2, is on the right. The voltages from the power supply and the control wires from the relays on the power supply enter the control unit on TB_1 and after switching are fed out to the various equipments in the system on TB_2, as shown on the block diagram, Fig. 2.

The underside of the chassis is shown in Fig. 5. All ground connections in the unit are made to a single bus wire. This wire is mounted at each end on a stand-off insulator, and is grounded to the chassis at only one point, to the bolt fastening the socket for V_1 to the chassis.

The filaments are bypassed to ground by C_{15}, C_{16}, and C_{17}. These condensers can be seen in Fig. 5 immediately to the left of the output connector, stacked on top of each other and secured to the chassis by two long 6-32 bolts.

A cloth-bakelite terminal board, measuring 4 inches by 2½ inches, ⅛ inch thick, is mounted on the bottom of the chassis on ½ inch metal standoffs. Most of the resistors and condensers in the circuit are mounted on this board. The remaining components in the control unit are wired directly from the ground bus wire to the proper tube socket terminal.

Fig. 5. Under-chassis view of control unit. Note the common ground bus wire running the length of the chassis just in front of the sockets. The controls are, from left to right: selector switch, master audio gain, the bass boost, and the treble boost controls.



Operational Adjustments

There are only two adjustments that need be made after the unit is constructed: (1) Balancing the phase inverter, and (2) determining the desired ratio between R_{21} and R_{22}, the two resistors forming the grid voltage divider for the flat frequency amplifier.

If the plate and cathode resistors, R_9 and R_{11} of the phase inverter are 5% tolerance resistors, the circuit will be well balanced. However, if 5% resistors are not available, or an exact balance is deemed necessary, it can be obtained by the following method: With the control unit operating at maximum gain and with the bass and treble controls set at zero, feed a signal of one volt at 60 to 1000 cycles into one of the inputs. Measure the voltage from each output terminal to ground. The measurement can be made with a 1000 ohms-per-volt a.c. meter, since the output is low impedance. If the outputs are not equal, replace R_{11} by other 56,000 ohm resistors until a balance is obtained.

The other adjustment, selecting the values for the flat amplifier grid voltage divider, determines the control unit gain in the flat position. The values given in the parts list for R_{21} and R_{22}, the resistors in this voltage divider, produce the over-all response of the control unit shown in Fig. 4. This response may be changed by varying R_{22}. As the resistance of R_{22} is increased, the gain with no boost will increase, but the difference between no boost and maximum boost gain will decrease. Thus, if R_{22} is made 250,000 ohms instead of 100,000 ohms, the flat response gain will increase from 1 db. to 7.8 db., but the variation in bass and treble boost as the bass and treble controls are turned will be reduced from 19 db. to 12.2 db. R_{22} may thus be chosen to suit the particular installation, although in most cases the given value of 100,000 ohms will be found optimum.

Conclusion

The completed control unit provides a neat and practical solution to the problem of tying together the various elements of an electronic home entertainment system. It provides a central control point with a master audio gain, independent bass and treble boost, and switch selection of AM, FM, phono, and TV audio inputs. It provides a central tie point for all cables in the system, and it is constructed in such a way as to be easily expandable to include more inputs, or such additions as volume expansion and dynamic noise suppression. The control unit can be located as far as 50 feet from the main audio amplifier with little sacrifice in frequency response.

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unit, no shielding is necessary except that provided by the chassis.

As a further precaution against hum, the gain of the control unit is low. In the flat response condition (bass and treble boost controls turned to zero), the gain is only 1 db. In the maximum boost condition, the gain is never more than 20 db. This low gain is justified since all of the inputs are at a relatively high level.

Tube Choice

The tubes for the control unit were chosen mainly on the basis of availability. The 6SN7GT is the cheapest of the dual triodes having separate cathodes. When used in a high-level, low-gain circuit, such as this, the tube presents no great microphonic problem. A d.c. voltage is used for filament power, eliminating filament hum modulation. The 6SN7GT provides a low impedance when used as a cathode follower—a desirable feature. Using d.c. on the filaments results in a hum level of better than 60 db. below 1 volt output.

Referring to Fig. 5, the controls are, from left to right: the rotary input selector switch, the master gain control, the bass boost control, and the treble boost control. A measured response curve of the completed unit is shown in Fig. 4, taken with a constant input of 500 millivolts and with the output measured from ground to one side of the line.

The selector switch is of the rotary wafer type, two decks being used and with space left for the addition of another deck if it is needed later. Each of the present decks is a double-pole, five-position switch, with only four of the positions being used. From the schematic, Fig. 3, it can be seen that section S_{1a} of this switch is used to select the audio input to the master gain control from any of the four inputs. S_{1b} is used to feed "B plus" to the selected unit in the system. S_{1c} serves as a control switch to operate the relays on the power supply chassis which turn on the phono motor and the TV filaments. The second section of the second deck will be used later for the dynamic noise suppressor and is not shown on the schematic. Turning the selector switch thus selects audio from any of the inputs desired, and at the same time supplies that unit with the proper a.c. and d.c. voltages for its operation.

Tone Controls

Since a healthy bass drum note can make an independent oscillator out of a 50 cycle *LC* bass boost network, it was decided that the tone control circuits would be entirely *RC*. Feedback systems were eliminated as being susceptible to positive feedback and oscillation. A large amount of bass boost was desired, to provide an occasional "jukebox" effect, but "boomy voice" was not wanted. These requirements are met by the old reliable *RC* filter in the grid circuit of a tube, and it was decided to use this system.

In the actual circuit used, Fig. 3, R_{19} is the treble control and is connected across the output of a two section network. R_3, the bass control, is also across a double network. R_{21} and R_{22} serve as the divider for the flat response amplifier. When R_3 and R_{19} are both set for zero output, the measured response of the control unit is the flat curve of Fig. 4. When R_3 is varied from zero, the bass response increases up to the maximum shown in Fig. 4, and turning R_{19} does likewise for the treble response. There is no interaction between the controls. The networks have 6 db. down points at approximately 130 and 3250 cycles.

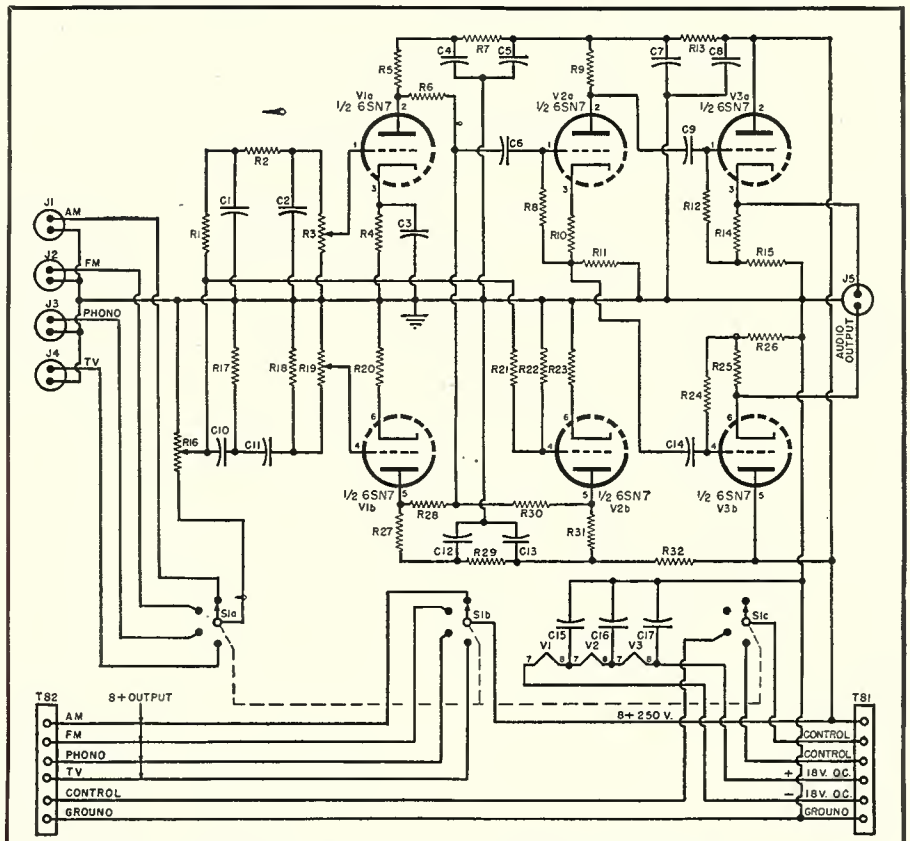
The tone control circuits feed their separate amplifiers directly. The upper half of V_1 is the bass boost amplifier; the lower half, the treble amplifier; and the lower half of V_2, the flat response amplifier. The outputs of these three tone amplifiers are combined through 100,000 ohm isolating resistors in the grid of the upper triode in V_2. This triode serves as the phase inverter for the push-pull output stage, V_3. The split plate-cathode load type phase inverter was chosen because of the large amount of negative feedback inherent in this circuit, giving low distortion.

The output is taken from the cathodes of output tube V_3. By this means, a low impedance, balanced-to-ground, push-pull output is obtained. An output of 5 volts, r.m.s., line-to-ground, can be obtained with less than 1% harmonic distortion.

The control unit obtains power from the system's common power supply. The control unit requires 250 volts d.c. at 30 ma. for the plates and 18 volts d.c. at 0.6 amp. for the filaments. The filament d.c. voltage is obtained from a 2 amp. selenium rectifier. About 100 volts d.c. at 2 amps. is available from this supply, and all of the tubes in the complete system which might introduce hum modulation have their filaments connected to this supply. The filament voltage across each tube is set at 6 volts so that the life of the tubes is increased over that obtained with 6.3-volt operation.

The plate voltage for the control unit is obtained from a conventional full-wave rectifier on the power supply chassis. It is planned eventually to use a series regulator tube in this plate supply, at which time the plug-

Fig. 3. Complete wiring diagram and parts list for the central control system.



R_1, R_2, R_{17}, R_{18}—120,000 ohm, ½ w. res.
R_3—1 megohm pot. (Bass Control)
R_4, R_{20}, R_{23}—4200 ohm, 1 w. res.
R_5, R_{27}, R_{31}—220,000 ohm, 1 w. res.
R_6, R_{28}, R_{30}—100,000 ohm, ½ w. res.
R_7, R_{15}, R_{26}, R_{29}—5000 ohm, 1 w. res.
R_8, R_{12}, R_{21}, R_{24}—1 megohm, ½ w. res.
R_9, R_{11}—56,000 ohm, 1 w. 5% res. (see text)
R_{10}, R_{14}, R_{25}—1500 ohm, ½ w. res.
R_{13}, R_{32}—5000 ohm, 2 w. res.
R_{16}—100,000 ohm pot. (Master Gain Control)
R_{19}—1 megohm pot. (Treble Control)
R_{22}—100,000 ohm, ½ w. res. (see text)

C_1, C_2—.01 μfd., 400 v. cond.
C_3, C_{15}, C_{16}, C_{17}—50 μfd., 50 v. elec. cond.
C_4, C_5, C_{12}—20/20/20 μfd., 450/450/450 v. elec. cond. (in common can)
C_6, C_9, C_{14}—.5 μfd., 400 v. cond.
C_7, C_8, C_{13}—20/20/20 μfd., 450/450/450 v. elec. cond. (in common can)
C_{10}, C_{11}—400 μμfd., 400 v. mica cond.
S_1—Two-deck rotary sw. Each deck d.p. 5-pos. (one pos. unused—see text)
J_1, J_2, J_3, J_4, J_5—Two circuit jack
TB_1, TB_2—Terminal block
V_1, V_2, V_3—6SN7 tube

Central Control for the Home Entertainment System

By
C. R. ELLIS
General Electric Company

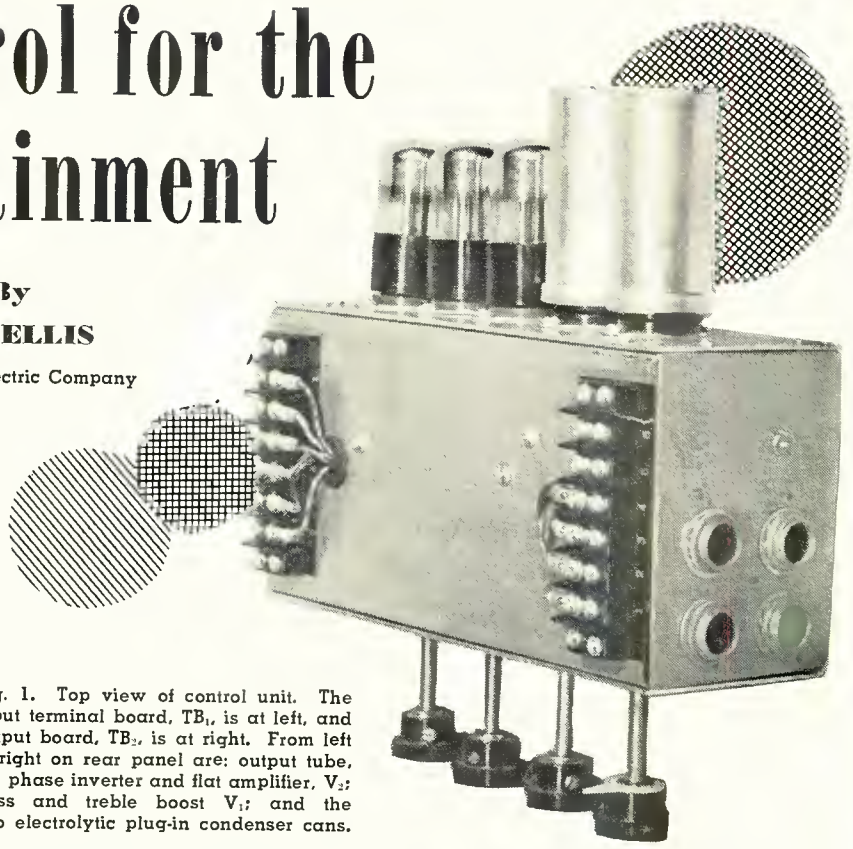


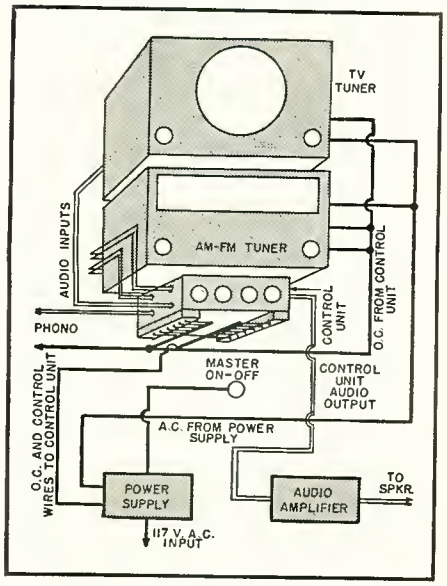
Fig. 1. Top view of control unit. The input terminal board, TB_1, is at left, and output board, TB_2, is at right. From left to right on rear panel are: output tube, V_3; phase inverter and flat amplifier, V_2; bass and treble boost V_1; and the two electrolytic plug-in condenser cans.

Almost every home, with today's variety of electronic equipment, could use a unit of this type. Custom installations are profitable. Don't miss this market.

CENTRAL control adds greatly to the salability and ease of operation of the custom installation of electronic entertainment equipment. A typical custom installation may include AM and FM tuners, a phonograph with preamplifier, a TV set, and possibly a tape or wire recording system. The desirability of such an installation will be enhanced if the customer is able to select and control any unit in the system from one location. From the custom installer's viewpoint, a much easier and neater job can be done during installation if there is a central control station for all interconnecting cables.

A possible method for obtaining a central control point is to drill more holes in the front panel of one of the tuners in the system and add the controls needed to select and vary the several inputs. The tuner front panel must maintain a symmetrical appearance if the system is to look professional, but too often it will be found that some component already on the tuner is directly in the way of such a symmetrical placement. Another drawback is the vibration to which the tuner is subjected as each hole is drilled. Another disadvantage applies only to that strange group of individuals who install radio and audio equipment in their own homes, and who are never satisfied. After trying out several schemes promising "100 db. more bass boost" and "dynamic sidewise music contraction" the author was left with two tuners whose front panels resembled an old cheese. When a new tuner was acquired, it was decided that some system for allowing experiment without damage to the tuner was necessary if the new tuner was to survive.

Fig. 2. Block diagram of home entertainment system employing central control.



Several requirements were established as essential for the new control system. It should be a separate unit on its own chassis so as to be readily changeable. It should provide at least four audio inputs. Any one of these inputs should be easily selected by a rotary switch, which at the same time should supply the necessary a.c. and d.c. voltages to operate the particular unit selected. It should have a master gain control which would give smooth control over the audio gain of the selected unit. Separate, independently acting, bass and treble boost controls were considered desirable, with flat response possible when desired.

Since the audio amplifier used with a custom installation is often some distance from the other equipment in the system, a low impedance output was considered essential. This low impedance output would aid in maintaining the frequency response of the system and at the same time reduce hum pickup. A final requirement was that the control unit should provide the necessary terminal boards for all of the interconnecting cables.

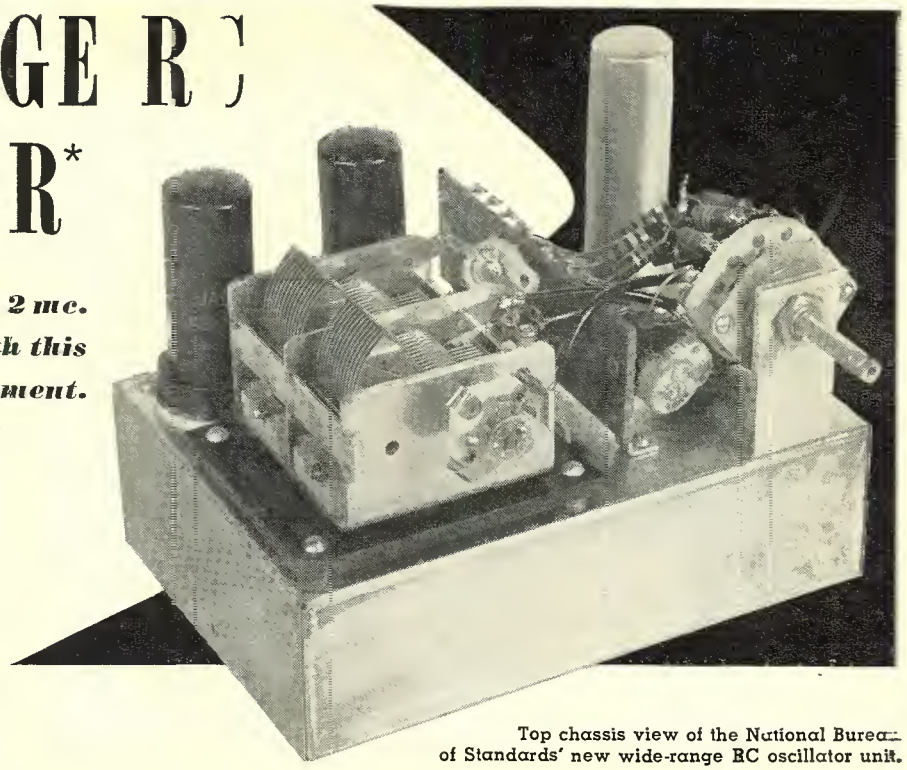
With these goals in mind, the control unit shown in Fig. 1 was designed and constructed. A block diagram of the complete entertainment system is shown in Fig. 2, indicating the cable routes between the control unit and the tuners, phono, power supply and audio amplifier. Two wire shielded cables are used for all audio circuits in order to reduce hum pickup.

Preliminary work on the control unit demonstrated the advisability of modifying one of the original requirements, namely, that all inter-unit cables pass through the control unit. It was found that if any of the a.c. cables were to run through the control, shielding would be necessary at the control unit input stage to reduce hum. This extra shielding was eliminated by running all a.c. leads directly to each unit in the system, through a master "on-off" switch which is mounted under the control unit. Turning this switch to the "on" position supplies filament voltage to the AM and FM tuners, and plate and filament voltage to the power supply and the audio amplifier. The TV filaments, the phono preamp filaments and the phono motor are supplied a.c. through relays mounted on the power supply chassis. These relays are d.c. operated, the d.c. being applied by the selector switch on the control unit.

Since there is no a.c. in the control

WIDE-RANGE RC OSCILLATOR*

Frequencies from 20 cycles to 2 mc. are covered in five ranges with this useful and unique test instrument.



Top chassis view of the National Bureau of Standards' new wide-range RC oscillator unit.

OF PARTICULAR interest to the industry is the announcement of the development, by Peter G. Sulzer at the National Bureau of Standards, of a new resistance-capacitance oscillator.

Applicable in both radio and electrical fields, the new oscillator covers, in five steps, the frequency range from 20 cycles to 2 megacycles. Combining simplicity and compactness with excellent frequency stability over a wide tuning range, the new unit is said to have several advantages over previous *RC* oscillators. In older models the top frequency is about 200 kilocycles; in the new *RC* oscillator, a single amplifier driving a cathode follower provides wide-band operation with small phase shift, low output impedance, and constant output voltage.

The oscillator circuit has two feedback paths; a regenerative cathode-to-cathode loop, and a degenerative cathode-to-grid loop which includes a bridged-T network. Oscillation occurs at the frequency of minimum degeneration. The 15 volt output remains constant to within one decibel at all frequencies, and the output waveform is essentially undistorted. By proper shielding to prevent synchronization with the power line frequency, the *RC* oscillator may be mounted in the same small cabinet with a power supply and an output amplifier.

A *National* type ACN or similar dial may be used. If care is taken in wiring the unit so that distributed capacity is kept low, and if precision resistors are used for the frequency-controlling elements, a complete calibration on one band is all that is necessary with a single point on the other bands set by adjusting the trimmer condensers. Calibration may be carried out in several ways, but probably the simplest is to feed the outputs of this unit and a standard oscillator to the horizontal and vertical inputs of an oscilloscope. Then when a stationary circle or ellipse appears on the screen of the oscilloscope, the two oscillators are operating at the same frequency.

Construction is straightforward with point-to-point wiring used to reduce distributed capacity. It will be noted from the photograph that the variable condenser is mounted on a bakelite sub-panel. This is to isolate the condenser from ground. A bakelite terminal strip is used to facilitate the mounting of the range resistors.

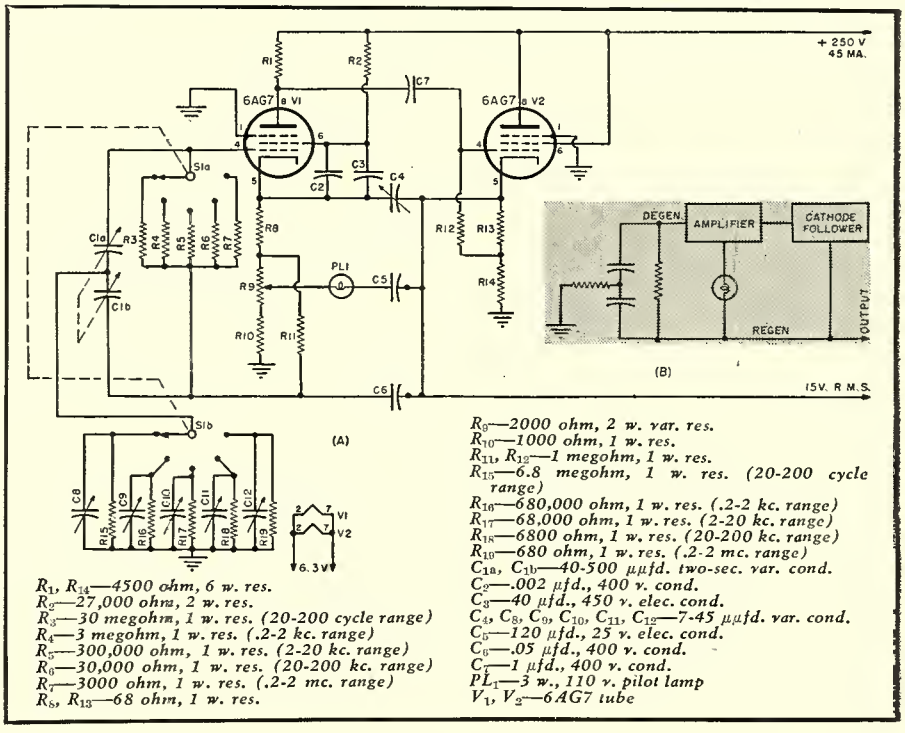
A conventional, well-filtered power supply providing 250 volts at 45 ma. can be used to provide power for the oscillator. Either a 6X5 or a 5Y3GT rectifier tube can be used, depending on the heater windings on the power transformer.

If the 15 volt output of the unit is not adequate, a wide-band amplifier may be used to boost the gain to any desired value. Care must be taken in designing such an amplifier that the gain does not fall off below 2 megacycles, the upper limit of the oscillator.

This unit will be found to be very useful in testing all sorts of audio equipment, and many other applications will readily come to mind.

—30—

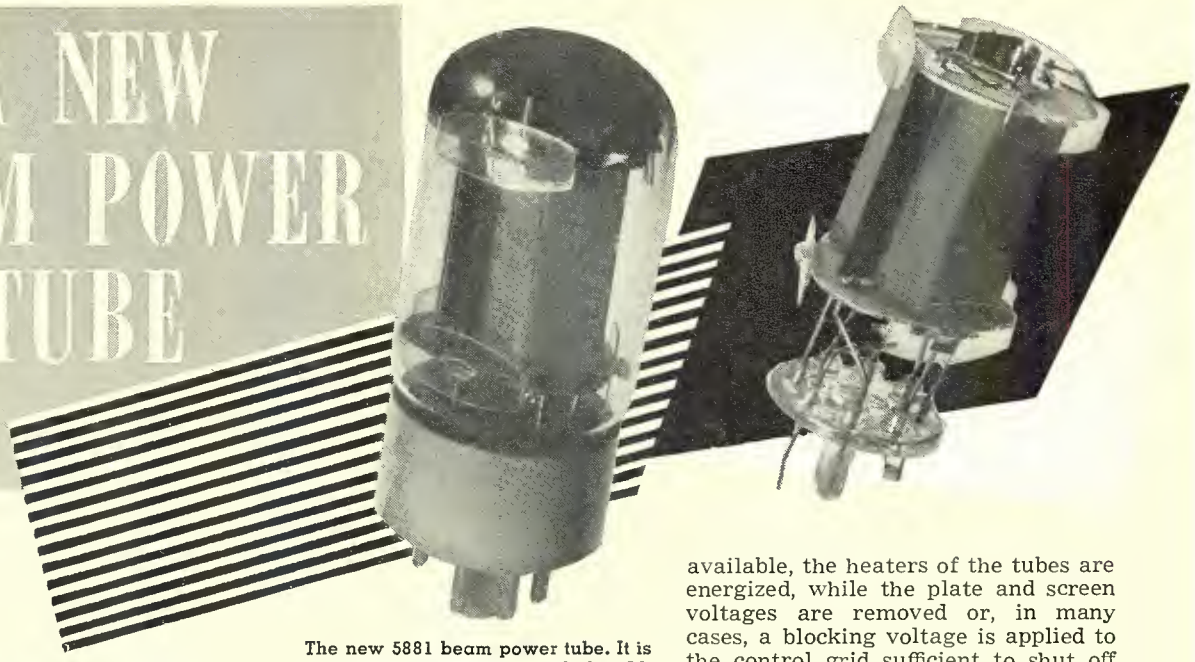
(A) Detailed schematic and (B) simplified block diagram of the new oscillator.



R_1, R_{14}—4500 ohm, 6 w. res.
R_2—27,000 ohm, 2 w. res.
R_3—30 megohm, 1 w. res. (20-200 cycle range)
R_4—3 megohm, 1 w. res. (.2-2 kc. range)
R_5—300,000 ohm, 1 w. res. (2-20 kc. range)
R_6—30,000 ohm, 1 w. res. (20-200 kc. range)
R_7—3000 ohm, 1 w. res. (.2-2 mc. range)
R_8, R_{13}—68 ohm, 1 w. res.
R_9—2000 ohm, 2 w. var. res.
R_{10}—1000 ohm, 1 w. res.
R_{11}, R_{12}—1 megohm, 1 w. res.
R_{15}—6.8 megohm, 1 w. res. (20-200 cycle range)
R_{16}—680,000 ohm, 1 w. res. (.2-2 kc. range)
R_{17}—68,000 ohm, 1 w. res. (2-20 kc. range)
R_{18}—6800 ohm, 1 w. res. (20-200 kc. range)
R_{19}—680 ohm, 1 w. res. (.2-2 mc. range)
C_{1a}, C_{1b}—40-500 μμfd. two-sec. var. cond.
C_2—.002 μfd., 400 v. cond.
C_3—40 μfd., 450 v. elec. cond.
C_4, C_8, C_9, C_{10}, C_{11}, C_{12}—7-45 μμfd. var. cond.
C_5—120 μfd., 25 v. elec. cond.
C_6—.05 μfd., 400 v. cond.
C_7—1 μfd., 400 v. cond.
PL_1—3 w., 110 v. pilot lamp
V_1, V_2—6AG7 tube

* This instrument was developed by Peter G. Sulzer at the National Bureau of Standards, Washington, D. C.

A NEW BEAM POWER TUBE



The new 5881 beam power tube. It is directly interchangeable with the 6L6.

By
C. E. ATKINS
Commercial Engineer
Tung-Sol Lamps Works, Inc.

Design features of a new "ruggedized" alternate for the well-known 6L6 in heavy-duty service.

POWER output tubes get rough treatment. Amplifier designers, in an endeavor to obtain maximum output, frequently operate the tubes at, and sometimes beyond, established ratings. This has been especially true in the case of the 6L6 and its glass equivalents, the 6L6G or 6L6GA. As a result, failures are sometimes too common, particularly in continuous duty service. Some of these tubes have stood up remarkably well, but diffcrent production runs of the same tube type often vary considerably in marginal situations where some special characteristic is being exploited or where it is necessary to rely upon the stability of some certain parameter under extreme conditions.

Power tube failures are usually due to gas. The presence of gas in the tube results in ion bombardment of the cathode so that its emission is ultimately destroyed. Gas difficulties are cumulative inasmuch as a small gas content may result in grid current, lowering the operating bias and thus increasing the plate current. The greater plate current produces more gas ionization and hence more grid current, further decreasing the bias and initiating a run-away condition. Furthermore, the increased plate current results in greater heating of the tube electrodes which, in turn, may cause the release of additional quantities of gas

While gas is frequently the final cause of cathode destruction, it may not be the initial culprit. All tubes can be made gassy if heated sufficiently. There are always at least minute traces of oxygen, nitrogen, carbon dioxide, and other gases in the tube elements and in the glass or metal envelope. The degree of their removal during the manufacturing process is a relative sort of thing, depending upon the temperature and duration of bake-out and bombardment. If a tube in service approaches this temperature, it is likely to become gassy and, of course, the temperature of the electrodes and envelope depends upon the severity of the application. When a power tube is operated at its maximum rating, various kinds of spurious behavior may push the dissipation beyond what is considered safe and normal. Parasitic oscillations are by no means uncommon in power amplifiers, and there is reason to believe that tube design is a factor in their incidence. Grid emission will, of course, initiate the same lethal cycle described in the case of residual gas. In power tubes especially the grid is prone to emit electrons thermionically and, as in the case of gas, the resulting grid current changes the grid bias, often raising the plate current and overloading the tube. Of course, in the case of both gas current and grid emission current, there is a distortion of the grid signal which is also undesirable.

Cathode emission failure is not invariably due to gas ion bombardment. In many applications tubes are employed where standby operation is a feature of the service. In order that electron emission be immediately available, the heaters of the tubes are energized, while the plate and screen voltages are removed or, in many cases, a blocking voltage is applied to the control grid sufficient to shut off the plate current. Many tubes lose their cathode emission when operated for protracted periods under these conditions. This phenomenon has been called "sleeping sickness." It is roughly analogous to the atrophy of body muscles or organs after long periods of idleness.

For a long time there has been a growing demand for a tube with dynamic characteristics like the 6L6 but of a design that would cope more vigorously with the problems encountered in a heavy duty audio output tube. The *Tung-Sol* design and development engineers, after considerable experimentation, have evolved a design which embodies many features which should qualify it as a successful candidate. This is experimental type DT281 (the RTMA commercial number is 5881). It has some intriguing features of interest to the reader.

The tube is short and stocky to insure mechanical ruggedness. With shorter active electrodes alignment is more readily maintained. This is especially important in a beam power tube where electrode configuration has the additional function of beam formation in order to produce the high density electron cloud in the screen-plate space for the suppression of secondary emission from the plate. The electrodes are carefully secured to arrowhead shaped top and bottom micas, on three edges of which mica side-snubbers have been pinned. By this means the walls of the envelope enlist in the support of the "mount" (tube jargon for the electrode assembly). The electrode leads are brought in through a glass disc—called a button stem—instead of the flat vertical press stem employed with the 6L6G-GA. This radial arrangement with liberal spacing of the leads through the stem is insurance against breakdown due to electrolysis in the glass. Also, it is believed to render the tube less sus-

(*Continued on page* 124)

will be for an additional oscillator coil, a relay, and a few tubes.

The parts should be placed so that most of the leads will be as short as possible. The oscillator coils and all of the associated wiring should be mounted solidly so that any possible jarring of the unit will not affect the frequency, thereby causing the relay to close at the wrong time. The shielding of the oscillator coils should be as complete as possible, using solid metal shields wherever possible. The i.f. stage should be wired very carefully. Be sure that none of the grids comes close to the plate leads or the stage will oscillate in the same manner as a tuned-grid, tuned-plate oscillator. A metal type 6SK7 must be used in this stage, and the shell must be grounded, or, again, the stage will have the tendency to oscillate. If the i.f. stage does oscillate, the trouble can usually be corrected by "dressing" the leads of the i.f. transformers. The important leads to adjust are the grid, which is usually green, and the plate, which is usually blue. The detector stage is a diode rectifier and there is nothing particularly critical about it. The lead from the diode detector to the grid of the thyratron should be as short as possible and should not run close to any of the filament leads in order to avoid 60 cycle pick-up.

A signal generator will permit a more accurate alignment of the unit, but the job can be done satisfactorily if one is not available.

The signal generator frequency should be adjusted to 455 kc. The instrument should be connected to the plate of the oscillators through a suitable isolating condenser, such as a 100 $\mu\mu$fd. or any condenser that happens to be on hand. The purpose of this condenser is to isolate the d.c. on the plate of the oscillators from the signal generator. After turning the unit on and turning the gain control to maximum, adjust the i.f. transformer for maximum indication on the tuning eye. In some cases, if there is interference, it may be necessary to remove the oscillator tube from its socket. The i.f. transformers should be adjusted very carefully because the sensitivity is determined to a certain extent by the way that the i.f. transformers are adjusted.

If a signal generator is not available, the unit may be aligned by means of the tuning eye and the oscillators in the unit. With the oscillator tube in the socket, adjust the oscillator frequency by means of the padder condenser until there is an indication on the tuning eye. There may be several indications; therefore, be sure that the strongest possible indication is obtained. Now, adjust the i.f. transformer until the tuning eye closes. It will be necessary to reduce the ouput by means of the gain control in order to obtain an accurate adjustment. Continue the operation of adjusting for maximum deflection of the tuning eye, reducing the gain control until the i.f. transformer is adjusted to its peak output. The capacity operated unit is now completed, aligned, and ready for operation.

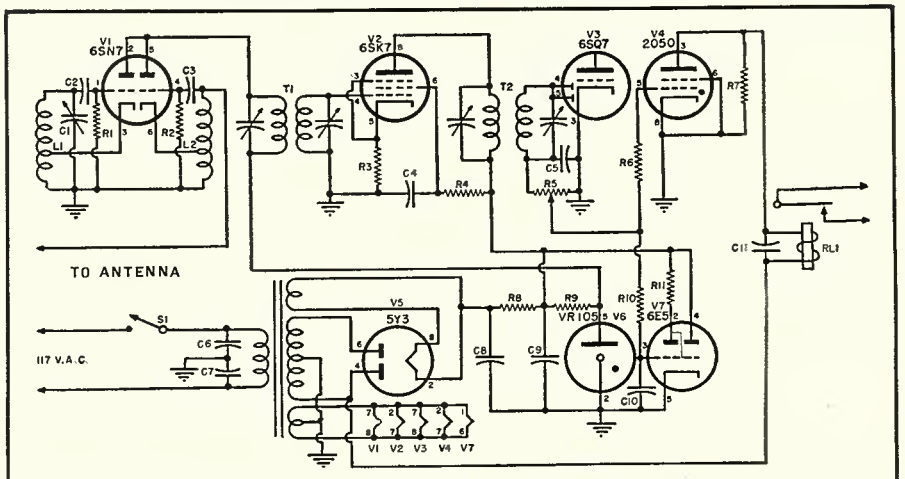
The first step toward the capacity relay operation is the erection of the pick-up antenna. The length and shape of this pick-up antenna are fairly important, and the sensitivity of the unit depends upon the arrangement of the pick-up. The first thing to decide upon is the degree of sensitivity needed for the particular setup. If the unit is used to count the number of people going through a small doorway, or if it is used to light a warning light as they go through the doorway, the pick-up wire should go around one side of the doorway. If the doorway is large, it may be necessary to put the pick-up antenna around the entire door. If more sensitivity is required, the area of the pick-up should be increased by either increasing the number of wires, or by using a flat metal strip instead of a single wire. After the pick-up antenna is connected to the unit, and the unit is turned on, turn the sensitivity control to maximum and adjust the oscillator frequency by means of the padder condenser until the eye closes. Once the eye closes, back the sensitivity control down until the eye is just closed, and readjust the oscillator for maximum indication, being sure that the oscillator is adjusted for the strongest beat note. The unit should perform correctly when the eye is just closed, but the sensitivity may be increased by adjusting the control very carefully. Turn the control all the way off and tune it up until the relay just opens. The unit is now adjusted for the maximum sensitivity. The oscillators will drift a small

Under-chassis view of the r.f. section of the unit. Power supply is on other end.

amount for the first fifteen minutes, therefore, the unit should be allowed to warm up for a short time before making the final adjustments. Grounding the unit is not absolutely necessary, but the adjustment will be more easily made if this is done as it will reduce the effect of hand capacity.

Since this type of unit does not rely upon a light source, it may be set up at a few minutes' notice, and may be used anywhere. The sensitivity of a capacity operated relay of this type is far greater than that of the conventional photocell relay, and therefore, its applications are less limited. With the proper adjustments, the unit should be sensitive to a small person at a distance of thirty feet from the pickup antenna. With this great sensitivity, it is possible for the unit to be operated without the person having the slightest idea that it is being done. The applications and the advantages of this unit are too numerous to list, but it will be found that it can be profitable as well as educational. —30—

Complete schematic diagram of the home-built capacity-operated relay unit.



R_1, R_2—47,000 ohm, ½ w. res.
R_3—470 ohm, ½ w. res.
R_4—10,000 ohm, ½ w. res.
R_5—500,000 ohm pot.
R_6, R_{11}—1 megohm, ½ w. res.
R_7—100,000 ohm, ½ w. res.
R_8—1000 ohm, 5 w. wirewound res.
R_9—5000 ohm, 10 w. wirewound res.
R_{10}—2.2 megohm, ½ w. res.
C_1*—9-180 $\mu\mu$fd. padder cond.
C_2, C_3, C_8—100 $\mu\mu$fd. mica cond.
C_4, C_6, C_7—.1 μfd., 400 v. cond.
C_5, C_9—8/8 μfd., 450/450 v. elec. cond.
C_{10}—.05 μfd., 400 v. cond.
C_{11}—8 μfd., 50 v. elec. cond.
L_1,* L_2†—Standard broadcast osc. coil used with 365 $\mu\mu$fd. var. cond.
T_1, T_2—456 kc. i.f. trans.
S_1—S.p.s.t. sw.
RL_1—S.p.d.t. plate circuit relay, 2500 ohm coil (Potter & Brumfield No. LM-5)
V_1—6SN7 tube
V_2—6SK7 tube
V_3—6SQ7 tube
V_4—2050 tube
V_5—5Y3 tube
V_6—VR105 tube
V_7—6E5 tube
1—Power trans. 350-0-350 v. @ 70 ma.; 5 v. @ 3 amps.; 6.3 v. @ 2.5 amps. (Stancor P-6011 or equiv.)
* Tunes at 1545 kc.
† Tunes at approximately 2000 kc.

CAPACITY OPERATED RELAY

Not simply a novelty but a useful piece of equipment that can be used in many commercial applications.

By
WM. B. DIBBLE,
W9KFY
Television Department
DeForest's Training, Inc.

Tuning the oscillators. Even an old radio chassis can be used as part of the circuit.

WHY be limited to a light source when it is possible to use a relay system which will permit unlimited operation? A capacity operated relay functions when a body comes near the relay and doesn't require the breaking of a light beam. A capacity relay may be used in daylight or at night, and it requires very little time to set up. This type of relay will do anything that a photocell type relay will do, plus many other operations. The relay makes a very interesting experimental subject, but, in addition, it has many commercial applications; such as turning on displays when a customer approaches.

The cost of building such a unit will vary depending on the number of parts that are available in the "junk box." The circuit is basically a superheterodyne, and an old radio will supply almost all of the required parts. If the parts are to be purchased entirely new, the cost would be approximately fifteen dollars. By using an old radio as a basis, the capacity relay can easily be built in one evening.

It may be noted from the diagram that there are two oscillators, one adjusted to operate at a frequency around 1545 kc., and the other operating at approximately 2000 kc. The pick-up antenna is connected to the grid of the high frequency oscillator. These oscillators will heterodyne, or beat, at 455 kc. and the beat frequency is amplified by means of a conventional i.f. amplifier stage. The output of this stage is detected by a diode detector, and is variable by means of a gain control. The output of the detector is applied directly, not through a coupling condenser, to the grid of a grid controlled rectifier, which is called a thyratron. The thyratron will not conduct as long as the grid is held negative by the detected i.f. signal, which appears as a negative bias. As soon as the negative bias disappears, the thyratron will conduct and the plate current will cause the relay to close. After the thyratron conducts, it cannot be cut-off by making the grid negative again, therefore, the plate voltage must be cut-off. The most effective method of doing this is to apply an a.c. voltage to the plate of the thyratron, which will act as a rectifier. To keep the relay from chattering, a filter condenser is connected across it. The resistor that is in series with the relay is used to limit the current to the relay. There is a small a.c. current flowing through the relay at all times to keep it from becoming permanently magnetized. The bias voltage, which is adjustable, will hold the thyratron cut-off until an object approaches the "antenna," then the capacity in the 2000 kc. oscillator circuit will be increased, and the frequency will be decreased. Therefore, there will be no 455 kc. beat signal, and since there is no signal, the negative bias on the thyratron will disappear and the thyratron will begin to conduct, thus permitting the relay to close.

The operation of the unit is dependent upon the frequency of the two oscillators and the frequency of these oscillators is dependent, to a small extent, upon the voltage supplied to the oscillators. For experimental applications, the normal regulation of the power supply is sufficient, but if the unit is to be used in a commercial installation, the voltage that is supplied to the oscillators should be regulated. The most inexpensive method of doing this is by means of a gaseous voltage regulator tube. The regulator tube is filled with a gas, and draws current proportional to the voltage impressed upon it. If the supply voltage were to rise, the regulator tube would draw more current and thus drop the increased voltage across the series resistor. If voltage regulation is not deemed necessary, the regulator tube may be omitted with no other circuit changes.

The physical construction of the unit is comparable to the construction of an ordinary radio. The main difference is that the oscillators must be shielded to provide better stability. If this is not done, there will be considerable difficulty in adjusting the unit. There are no critical circuits involved, and the constructor may use the bargain-counter variety of parts with no ill effects.

If the unit is to be made from an old radio, almost all of the original parts may be used, and the only cost

screen voltage. The carrier is, in effect, turned up and down with the speech. The waveform looks the same as conventional AM on an oscilloscope but looks considerably different on a Panadaptor. As the gain control is turned higher there is a distinct compressor action as it brings up the low portion of the audio and increases the apparent loudness of the received signal. The "W6CXM System" cannot overmodulate because in the positive direction the carrier is turned loose and can only go as high as it was tuned and no higher. In the negative direction the carrier cannot be cut off completely because it is impossible to get zero voltage on the screen. Thus one voltage is not superimposed on another to modulate. The screen is merely turned loose and permitted to rise to a predetermined value which, in turn, allows the carrier to rise to a predetermined peak.

The screen voltmeter becomes a power output indicator and the gain control a power output control. Any power output is fully modulated.

If the screen voltage, as read at the pin jacks, is too high under tune-up conditions, lower the value of the resistor in the cathode of the 6Y6.

This system has been used on 813's, 4D32's, 807's, 1625's, and 861's all with equal success. The tube lineup of the W6CXM modulator may be changed to 6SN7 or 6SR7 with very little difference in the operating results. A 6L6 or 6F6 or any one of the many output tubes may be used in place of the 6Y6, but with less action.

One word of warning. Be very careful if you remove the 6Y6 with the final high voltage on. As there will be only screen current drawn, the drop through the screen dropping resistor will be less and the screen voltage may rise to a dangerously high value. Needless to say, this is very rough on some screen grid tubes.

There is considerably less interference created by this system because the carrier is turned down between cycles of the audio. There are no spurious sidebands created by excessive modulation either.

The efficiency of a system of this type is midway between grid and cathode modulation, and that of conventional plate modulation.

The peak output is approximately the same as the c.w. output at the same voltages. Actually this figure can be somewhat exceeded due to the low average power contained in speech.

In addition to the extreme simplicity of the system, and the few parts needed, the controlled carrier effect will do much to reduce interference to other stations.

This controlled carrier effect allows the user to "whisper for locals, and shout for DX."

The linearity of most screen grid tubes is sufficiently good so that the quality of transmission is satisfactory.

If desired, another 6Y6 may be added to the circuit to protect the final stage in the event of failure of excitation. A circuit of this type was shown in the original article in the June, 1949 issue of RADIO & TELEVISION NEWS. Its use is not essential, however, as the modulator tube itself will serve to hold the plate current of the final to a low value when no speech is applied to the unit.

The amateur with a c.w. transmitter using a screen grid final can operate on phone at low cost by the adoption of this system. It is an ideal method as a large amount of equipment does not stand idle when c.w. is used.

My sincere thanks to W6IKM who helped me on with air with checks as to quality and his enthusiasm which was a real spur. Also, thanks to Ed Soltex, W6NQK, who built this system into an ARC-5 and gave us the results on the job.

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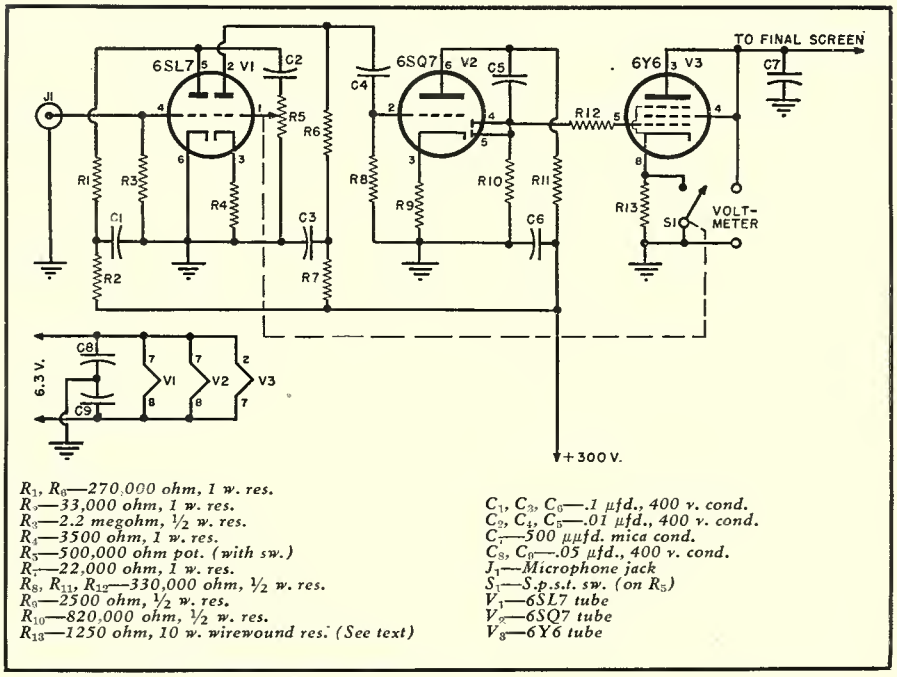

R_1, R_6—270,000 ohm, 1 w. res.
R_2—33,000 ohm, 1 w. res.
R_3—2.2 megohm, ½ w. res.
R_4—3500 ohm, 1 w. res.
R_5—500,000 ohm pot. (with sw.)
R_7—22,000 ohm, 1 w. res.
R_8, R_{11}, R_{12}—330,000 ohm, ½ w. res.
R_9—2500 ohm, ½ w. res.
R_{10}—820,000 ohm, ½ w. res.
R_{13}—1250 ohm, 10 w. wirewound res. (See text)

C_1, C_3, C_6—.1 µfd., 400 v. cond.
C_2, C_4, C_5—.01 µfd., 400 v. cond.
C_7—500 µµfd. mica cond.
C_8, C_9—.05 µfd., 400 v. cond.
J_1—Microphone jack
S_1—S.p.s.t. sw. (on R_5)
V_1—6SL7 tube
V_2—6SQ7 tube
V_3—6Y6 tube

Circuit diagram and parts list covering the speech amplifier and clamp modulator.

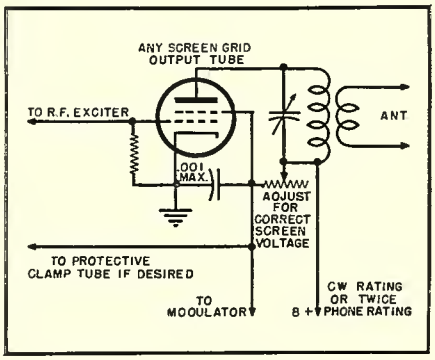

Diagram of W6CXM's modulator. The adjustable resistor must be able to carry 50 ma. (usual value is about 15,000 ohms). Any screen grid output tube can be used, i.e., the 813, 807, 4D32, 861, 1625, etc. If, for example, an 807 is used the high voltage should be approximately 1300 v.

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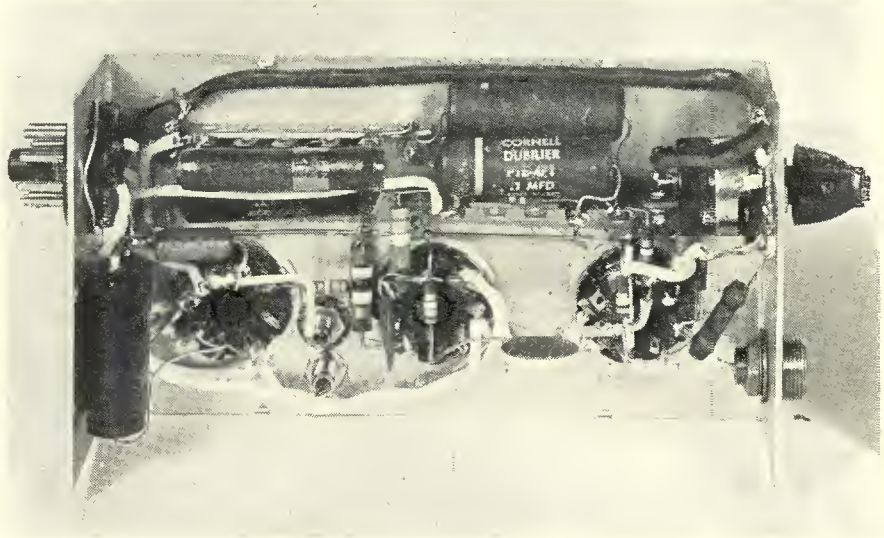
Under-chassis view of the modulator unit showing correct layout of component parts.



MODULATE A KW. WITH 3 TUBES

An improved version of the "Screen Modulated Final" published in June 1949. It is an easy-to-build unit.

By
J. D. KLINE,
W6CXM

Over-all view. The entire unit, with the exception of the power supply, is built on a 6¼ x 3½ x 2-inch chassis.

FOR want of a better name, this system will be called the "W6CXM System." The unit is built on a chassis 6¼"x3½"x2" and there is plenty of room. The chassis has a male octal plug in the rear so that the whole unit may be plugged into the front panel of an existing c.w. transmitter merely by mounting an octal socket on the panel and changing the screen resistor. The bottom is easily removed for making any necessary tests, measurements, or repairs. The tube lineup is a 6SL7 into a 6SQ7 into a 6Y6. There is plenty of gain for a low-level mike. With the input grid open and the gain control turned up there is no instability, hum, or objectionable noise.

The 6SL7 is a simple resistance-coupled amplifier. The plates of both sections are decoupled plenty so the speech is clear and stable. The volume control is between the triode sections of the 6SL7 and provides adequate control of the gain. The 6SQ7 acts as an audio rectifier and rectifies the speech, supplying about —70 volts to the grid of the 6Y6.

Special pains were taken to insure that the leads were as short as possible in order to reduce hum and r.f. pick-up. Ceramic disc coupling condensers were used in order to reduce stray capacity and pick-up. The filaments were bypassed and a separate ground bus run through the middle of the chassis in order to provide a connection for the condenser and resistor grounds. A switch is provided on the gain control to facilitate tuning up and operating on c.w. Pin jacks are provided to check the actual screen voltage on the final tube being modulated. This makes the tune up procedure simple.

The operation of the W6CXM modulator is described in the following:

The 6Y6 is connected across the screen of the final amplifier. This screen must be fed from the high voltage through a series dropping resistor and *not* from a bleeder. There must *not* be a bypass condenser larger than .001 μfd. from this screen to ground. The screen current of this final should not be more than about 40 mils.

A 0-500 volt voltmeter is connected to the pin jacks in the modulator and, with the gain control turned down and its switch off, the final series screen dropping resistor is adjusted until the desired screen voltage is obtained. As the gain control is turned up part way, the screen voltage, as indicated on the meter, will drop to a low value (50 to 100 volts) causing the final plate current to drop and, of course, the carrier and antenna current as well. As the microphone is used, the speech is amplified, rectified, and the 6Y6 draws less current and the screen voltage should rise to a value which is nearly as high as that originally tuned. The final should be tuned up to c.w. ratings, not Class C plate modulated rating. The higher the plate voltage (within limits) the higher the value of the screen dropping resistor and thus the better the action of the W6CXM modulator.

Of course the plate and antenna current will be swinging with the

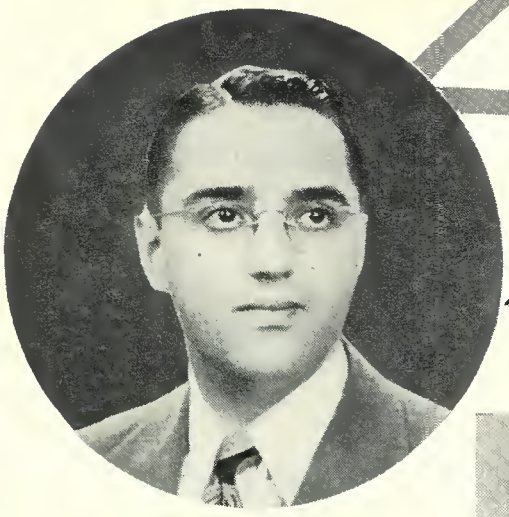
After the author's article "Screen Modulated Final" appeared in the June 1949 issue of RADIO & TELEVISION NEWS, the correspondence he received made it apparent that there were several important points not brought out in the original article:

That this is not ordinary screen modulation
That it is AM and is to be received as such on an AM receiver
That no transformers are necessary to modulate at least 95%
That it is a system of controlled carrier
That it will work with most screen grid tubes (807, 813, etc.)
That a high gain speech amplifier should be an integral part of the unit
That the final amplifier received too much of the readers' attention. The important part was the modulator itself
That the explanation of the adjustment was not clear and concise
That excessive screen current of the final caused the most trouble
That definite compressor action is apparent with gain turned up
That over-modulation is impossible.

As a result of these questions and misunderstandings, the author has designed a completely new system with the following requirements in mind:

A high gain amplifier should be built-in
The adjustment should be simplified and clarified
The entire unit should be separate and complete
The unit should have stable and quiet operation
Uniform frequency response is required
Ability to modulate from 5 watts to 1 kw. with same tubes
Ease of repair and test
The plate voltage of the stage being modulated should be able to run as high as twice the Class C plate modulated value. In any event it should be at least as high as c.w. ratings.

THE AI-VISER



1 Advertising Can Build Your Radio and Television Business

IRVING SETTEL, the author, is a well-known figure in the retail advertising field, having served various retail organizations over a twelve-year period. He is the retail advertising manager for a large chain of stores and maintains a close association with many of the outstanding retail organizations throughout the country. He is also a columnist and contributor of articles on retail advertising for several leading trade publications as well as an instructor in retail advertising at Pace College in New York. He has written a textbook on the subject for the retail advertiser. Mr. Settel is drawing on his vast experience in the advertising field in the preparation of these specialized articles which have been designed for radio-television dealers.

KNOWLEDGE of the principles of advertising is required by every radio and television merchant who hopes to maintain a successful business organization. A well integrated promotional program is often the "life blood" of trade and profits. Its importance lies in the fact that it creates a demand for merchandise being offered. It reaches for and attracts potential customers far outside the normal passerby market. It builds business. It subsequently lowers costs. It can mean the difference between success and failure of your business.

It is essential that we acquire an understanding of this amazing business stimulus. We must become sufficiently familiar with its tenets to profit from its versatility. As owners and managers of large or small radio and television stores, we are often required to pass judgment upon promotional plans or to approve budgets. We may often find the opportunity to create or assist materially in the creation of advertising material.

Consequently, a knowledge of every phase of the subject will greatly facilitate the execution of such work. For rightly directed and prepared advertising can prove to be a tremendous "shot in the arm" for your business. However, it is wise to remember that money can be squandered in advertising just as quickly as in any other field of endeavor. Careful execution is necessary for success.

This series, then, will be devoted to the dissemination of sound principles of advertising for the specific use of the radio and television retailer. Tips, thought-starters, ideas, etc., will be offered. Each feature will contain illustrations of successful promotion used by successful merchants. In addition, both the theoretical and practical aspects of advertising will be presented. Technical information will be offered in simple, non-technical language. It will be our purpose to assist in the stimulation of sales and the explanation of your business.

Essentially, the aim of all advertising is to *sell* merchandise. Since all of us are interested in increasing business, a brief discourse related to the functions of advertising is appropriate as a curtain raiser.

"Why do we advertise?" Many a radio and television merchant has asked this question and with good reason. Advertising, effective or otherwise, costs money. Very often, results for short periods of time are difficult to ascertain. When we employ salesmen, we can easily determine which of these men earns his "salt." We merely look at his sales record.

Such immediate judgment cannot be pronounced in the case of advertising. As sales increase, the responsible source is temporarily concealed. It is not until longer periods of time have elapsed that the business stimulant becomes obvious. Then, the merchant may scratch his head in amazement at this mysterious force. His question has been answered with action rather than theory.

Types of Advertising

Advertising can be divided into two broad classifications:

1. Institutional Advertising.
2. Promotional Advertising.

Institutional advertising is designed to build the reputation of the business as a whole. Its main purpose is to promote the retail radio and television merchant as reliable, alert, and progressive. It tends to establish the general impression that here is a store which is well equipped and supplied with merchandise. Institutional advertising may speak of policies such as deadlines for returnable merchandise. It may outline the various conveniences which the business offers to customers, such as payment plans, etc.

Promotional advertising sells specific merchandise. It may announce special events or merely offer the merchandise to the public at regular prices. Promotional advertising always includes descriptions of items and prices. It makes up the bulk of the radio and television dealer's advertising. It is very popular because it creates *immediate* sales.

While promotional advertising is necessary for day-to-day business, it is wise not to neglect occasional institutional ads. Always try to include a few during the year. Many retailers mix the two, alternating them fairly regularly. Some use one institutional each month along with two or three promotionals per week.

Your schedule should depend upon your own circumstances. If you are running strictly a "price" store, emphasis should be placed upon promotional ads. If you have a "class" unit, institutional ads should be used with greater frequency.

We can see from the preceding paragraphs that advertising is important both to the development of a business as an institution and to the immediate selling of the products.

Let us analyze an advertisement as an instrument of selling. If you were to look through any daily newspaper, we would soon realize that competition for the reader's attention is tremendous. Each page contains a multitude of advertisements and each advertisement competes with all the others. As a result, we can readily understand that in order to gain the reader's interest, an ad must possess some element of *difference*.

(*Continued on page* 93)

Television GETS BOOST

Details of a unique "survey plan" being offered by an up-and-coming Bakersfield, California TV dealer.

(Above) Over-all view of the "survey" truck and demonstration trailer with the hydraulically-operated TV tower, and (Right) close-up of trailer with details of antenna mount. The antenna can be raised to a maximum of 75 feet with the optimum height registered on an indicator. In addition, the compass direction can be read and noted for future reference.

ALTHOUGH Bakersfield, California is 120 miles from the nearest television transmitter, the citizens of that thriving city are enjoying video programs just as are their neighbors in Los Angeles.

Because Bakersfield is definitely a "fringe" area there is always a chance that a receiver installation will not be successful. In order to reduce the possibility of failure, one alert firm has developed a unique service for prospective television receiver buyers.

Television Engineering Co. of Bakersfield has a demonstration and installation test unit which travels to the prospect's home and provides a complete and accurate picture of television reception possibilities in that location.

The mobile unit consists of a trailer unit which can be pulled either by a car or truck. The interior of the demonstrator is fully carpeted, has venetian blinds, and indirect lighting. The windows have been blacked out for daylight viewing. A recirculating 800 cubic-foot-a-minute air cooler insures comfortable viewing even in the warm California climate. During chilly weather an electric heating element replaces the cooler. A special hydraulic jack of the push-pull closed cylinder type is installed inside and behind each wheel and allows the trailer to be leveled in less than 15 seconds from the time the unit pulls up in front of the customer's door.

A hydraulically operated antenna tower is mounted between the trailer and the car, with pressure being used to elevate and lower the antenna. The antenna lead is marked at five foot intervals. An adjustable wire pointer, mounted on a mirror under the skylight, allows split-hair calibration of the antenna direction, a fact which is tabulated for future reference.

With the customer seated before the demonstration receiver, the antenna is raised (to a maximum of 75 feet) until the best picture is obtained on the cathode-ray tube. The point of best reception for that particular channel is noted on a special form along with the compass direction and relative signal strength. The same procedure is then followed for other channels operating in the area. The entire demonstration on a single channel takes from 15 to 30 minutes from the time the trailer is in operation at the test location. It takes approximately 10 minutes to hook up the trailer to the house power line, level the unit, and make all of the preparations necessary to start the demonstration. An additional 10 to 20 minutes is required to run tests on all of the other available channels.

Television Engineering Co. charges $5.00 for one of these demonstration calls. If the customer purchases a set, the demonstration fee is applied to the cost of the receiver installation. The Installation Data Card is filed in the company's offices so that further testing at the time of installation is unnecessary.

Since the company specializes in demonstrations, installations, and tests exclusively most of their calls are referred to them by Bakersfield television dealers. The company takes the responsibility for aligning all receivers before installation and servicing them for 90 days after installation.

Television Engineering provides service between the hours of 5 and 10 p.m. by appointment, made either through a dealer or by the customer direct. Tests are also offered to TV set owners whose present installations are, for some reason, inadequate.

According to Ralph F. Yeomans of the company, the original mobile test unit cost approximately $3000 but, as he points out, most of this sum was spent on the original engineering and experimentation work which took a month of his time and nearly two hundred hours of machine shop work. He estimates that additional units would run around $750 for truck or trailer mounting and $850 for the trailer unit.

Service technicians operating in similar fringe area districts can take a leaf from *Television Engineering's* book. The operation has proven profitable and has given Bakersfield residents clearer and more satisfactory television reception.

It should be emphasized that the $5.00 charge is for "survey services" only. Installation and maintainance charges are handled by the company in the usual way. The policy of applying the charge toward the permanent installation has proven sound because, in the long run, it saves the company hours of time when that information is readily available in their files and the antenna can be installed without any cut-and-try.

—30—

proper shading range? The picture must be capable of covering a series of shades, ranging from white to black. To check the over-all shading of the test pattern, adjust the set contrast control (also known as the picture control on some sets) until the two diagonal wedges in the test pattern of Fig. 2 reveal their different shadings. The innermost section of each wedge is black, with each additional section a lighter shade of gray. In this chart, the shading becomes lighter the farther away we move from the center. In the pattern of Fig. 3, the shading range is indicated by the five concentric circles at the very center of the chart. Again, each should be distinguishable from the other.

In making the foregoing test, the settings of the contrast and brightness controls are most important. The best setting for the brightness control is at the point where the white vertical retrace lines just disappear. The proper setting of the contrast control is at the point where the greatest number of shading circles or wedges are recognizable from each other. Too high a setting of the latter control will cause the picture to become too dark; too low a setting will give the picture a light, washed-out appearance (Fig. 5).

5. *Are the circles in the test pattern round or oval?* Nearly every type of test pattern has some circular design in it. The primary purpose of this design is to determine whether or not the picture is being properly laid out on the screen. If, for example, the electron scanning beam within the cathode-ray tube is traveling slowly over some portions of the image and faster over other portions, then the viewer will see a picture in which some of the objects are squeezed or crushed together while other objects are stretched out.

Did you ever see a television picture in which the actor's head was too small for the rest of his body? If you did, then you have witnessed an example of the above mentioned fault. Technically, this condition is referred to as poor linearity. On a test pattern, poor linearity will reveal itself by circle deformation.

If the circles appear "egg-shaped," the beam is not traveling at a uniform pace over the screen. Vertical non-linearity is indicated by the circle being "egg-shaped" in the vertical direction. See Fig. 6. By the same token, horizontal non-linearity is indicated by having the circle egg-shaped in the horizontal direction. See Fig. 7. Some sets possess special linearity controls with which adjustments can be made to correct any non-linearity present. In many other sets, no separate linearity controls are available and marked non-linearity indicates a very definite need for repair.

The relative importance of linearity is sometimes grossly misstated. No difficulty should result if the following practical points are clearly understood.

1. The set should be capable of producing a linear pattern on any station by proper adjustment of its controls. It frequently happens that after this adjustment has been satisfactorily made, the test pattern for one or more of the other local stations will appear slightly "egg-shaped." This indicates that the patterns sent out by different stations are not all perfectly linear. However, if the pattern can be properly adjusted for one station, the set linearity can be considered good.

2. A small amount of non-linearity is not objectionable because it will not be noticed during the regular broadcasting period.

6. *Does the picture stay locked in?* There is very little enjoyment to be derived from watching a television program when the picture periodically slips vertically or ends up as shown in Fig. 8. In recognition of this fact, television set designers have developed special automatic controlling circuits for the purpose of keeping the picture locked-in even under weak signal conditions. It is in the interest of the buyer that he check carefully the lock-in stability of a television receiver. To do this, perform the following tests.

1. With a station tuned in, and an image appearing on the screen, snap the station selector switch to the adjacent channel where there is no station, and then snap the switch back to the station channel. The picture should appear instantly and slip right into synchronism. If your set uses a con-

(*Continued on page* 130)

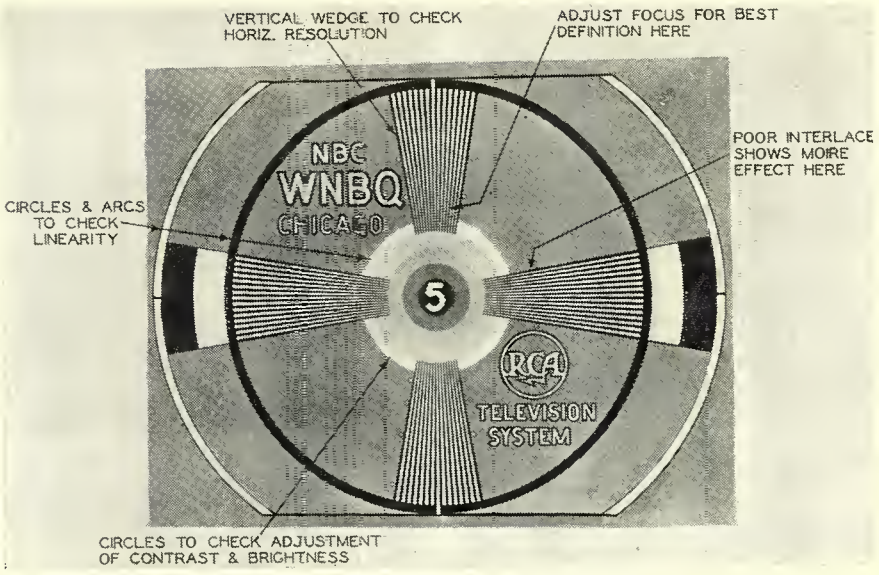


Fig. 3. Test pattern used by NBC and many of its affiliated stations.

Fig. 4. Moire effect seen in the horizontal wedges indicates an imperfect interlace.

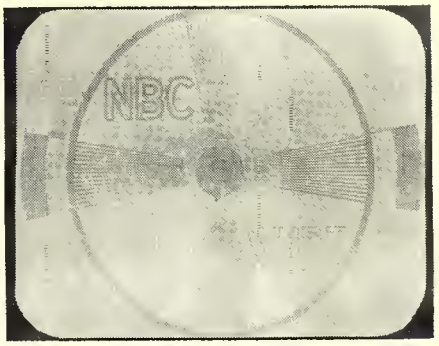


Fig. 5. Malfunctioning contrast control. The picture needs more black-to-white contrast.

Fig. 6. An example of vertical non-linearity.

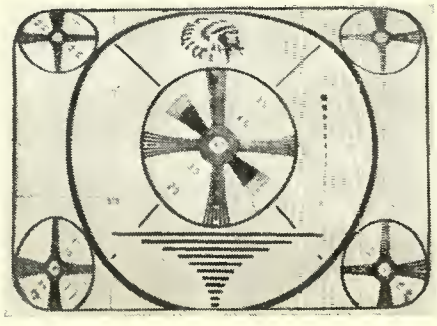
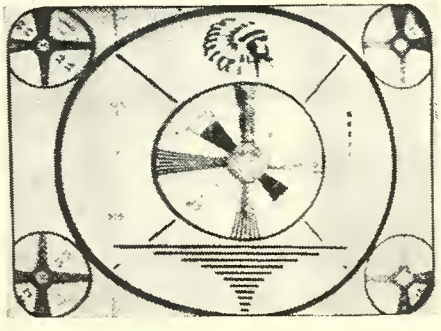
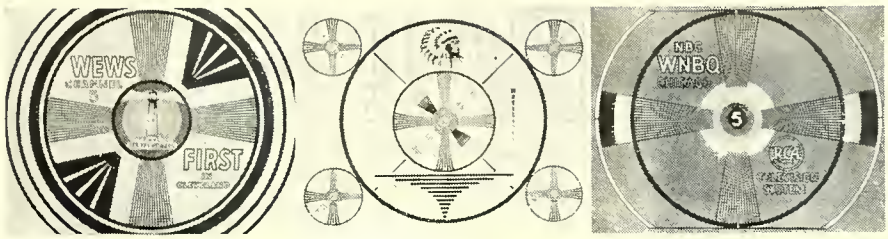


Fig. 7. Example of horizontal non-linearity.





(A) (B) (C)

Fig. 1. There are many types of test patterns. These are most often used designs.

reasonably in focus at the picture edges. This means, using Fig. 2, that the various lines in the wedges can be distinguished from each other and that the small numbers in each circle can be read.

2. *How much detail does the picture possess?* Once the picture is in focus, you can next determine whether or not the set is capable of showing all the fine detail that is being transmitted by the broadcast station. To do this, we use the two vertical wedges in the center circle of the test pattern (Fig. 2). The numbers close to the wedges (*i.e.*, 20, 30, 35, and 45) stand, respectively, for 200, 300, 350 and 450 line resolution. Between each of these numbers is a small dash which indicates where an intermediate value would fall. Thus, the dash between 20 and 30 stands for 25, the dash between 35 and 45 is for 40, etc. At the center of the picture, the number 30 is placed, indicating 300 lines.

Now, these figures have a special significance that requires a deeper insight in television circuit theory than can be given at this time. However, they can be employed without this additional knowledge to reveal a very important aspect of set ability. Look at the two vertical wedges and see how far down each wedge you can see the various lines distinctly. When you reach the point where the lines blend together, the width of the lines (in the wedges) at this point represents the finest detail which this set is able to reproduce. Any detail finer than this will appear blurred and indistinct.

It is evident from what has just been said, that it is desirable to have the lines discernible as far down the wedge as possible. If the test pattern of Fig. 2 is being received, the top vertical wedge (in the center circle) should show the lines distinctly up to a point slightly above the figure 35. In the remainder of the top vertical wedge, the lines will blend together. Technically speaking, the vertical wedge should show a line resolution of 325 or perhaps slightly more lines. This is the most that can be expected of any set since this represents all that the broadcast station is permitted to transmit by the Federal Communications Commission.

In many sets, none of the lines in the top vertical wedge will be distinguishable from each other and it will be necessary to examine the bottom vertical wedge (still at the center of the pattern) to find the point where the lines can be seen separately. Note the number (either 20, 25, or 30) that is closest to this point. If the number is less than 25, the ability of the set to present fine detail is poor.

Note carefully that to determine the ability of a set to indicate fine detail, we used only the two vertical wedges at the center. The horizontal wedges will be used to reveal another feature of set performance and will be discussed presently.

Another pattern which is widely used is the one shown in Figs. 1C and 3. This pattern is used by all *NBC* television stations and many of their affiliates. On this chart, the two vertical wedges at the center of the pattern are identical. The lines in these wedges, however, possess different spacings than the lines in similar wedges in the previous test pattern. The *NBC* pattern does not have any numbers on it (other than the channel number) but it does possess two white dots along each side of the *top* vertical wedge. If the lines are not distinguishable up to the dot closest to the center, then the set resolution is poor. The lines should be distinct at least down to this white dot and preferably down to the center of the test pattern.

While on the subject of resolution, one fact should be borne in mind. When a live program originates at the local station, the picture received will be sharp and clear. However, when a live program is received from another city via the coaxial cable, some of the sharpness and crispness will be missing. The reason for this is quite simple. The bandpass of the coaxial cable is only 2.7 mc. as compared to the 4.0 mc. that a station can transmit. As a result, some of the finer detail is blurred when the signal is sent over the inter-city cable. In time, officials of the *Bell Telephone System* expect to have the bandwidth of the cable extend the full 4.0 mc.

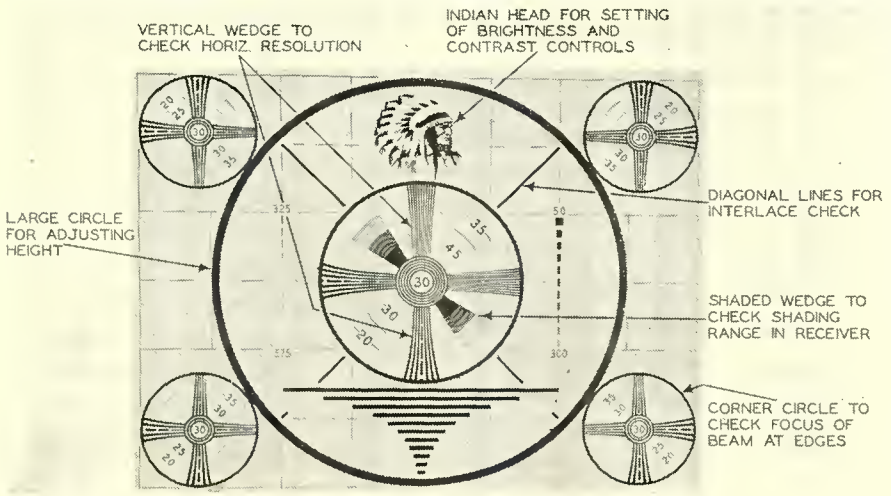
3. *Are the scanning lines properly placed?* Every television picture is made up of approximately 490 usable horizontal scanning lines and every television receiver, irrespective of its quality, has about this same number. When a receiving set has been carefully designed and is operating properly, each horizontal line will be set off in space by itself, separated slightly from the lines directly above and below it. However, it can readily happen that due to some fault within the set, some lines will tend to overlap neighboring lines, resulting in relatively wide blank spaces between adjacent lines. This will have the effect of making the picture structure seem coarse, spoiling to some extent the picture detail, and requiring that the viewer sit farther back from the set in order not to see the line structure.

To determine whether a set is suffering from this defect (known as poor interlacing), examine the two narrow diagonal lines in the center portion of the pattern (Fig. 2). Poor interlace will be evident by the jagged appearance of these lines. In the *NBC* test pattern, poor interlacing shows up at the ends of the two horizontal wedges closest to the center of the chart by producing a moire effect here. Fig. 4 shows this moire effect very distinctly, producing the illusion that the lines at the edge of each horizontal wedge appear to curl up at the ends. Compare Figs. 3 and 4 to fix in your mind this peculiar indication. *Note:* The same effect can also be observed at the ends of the horizontal wedges in the test pattern of Fig. 2.

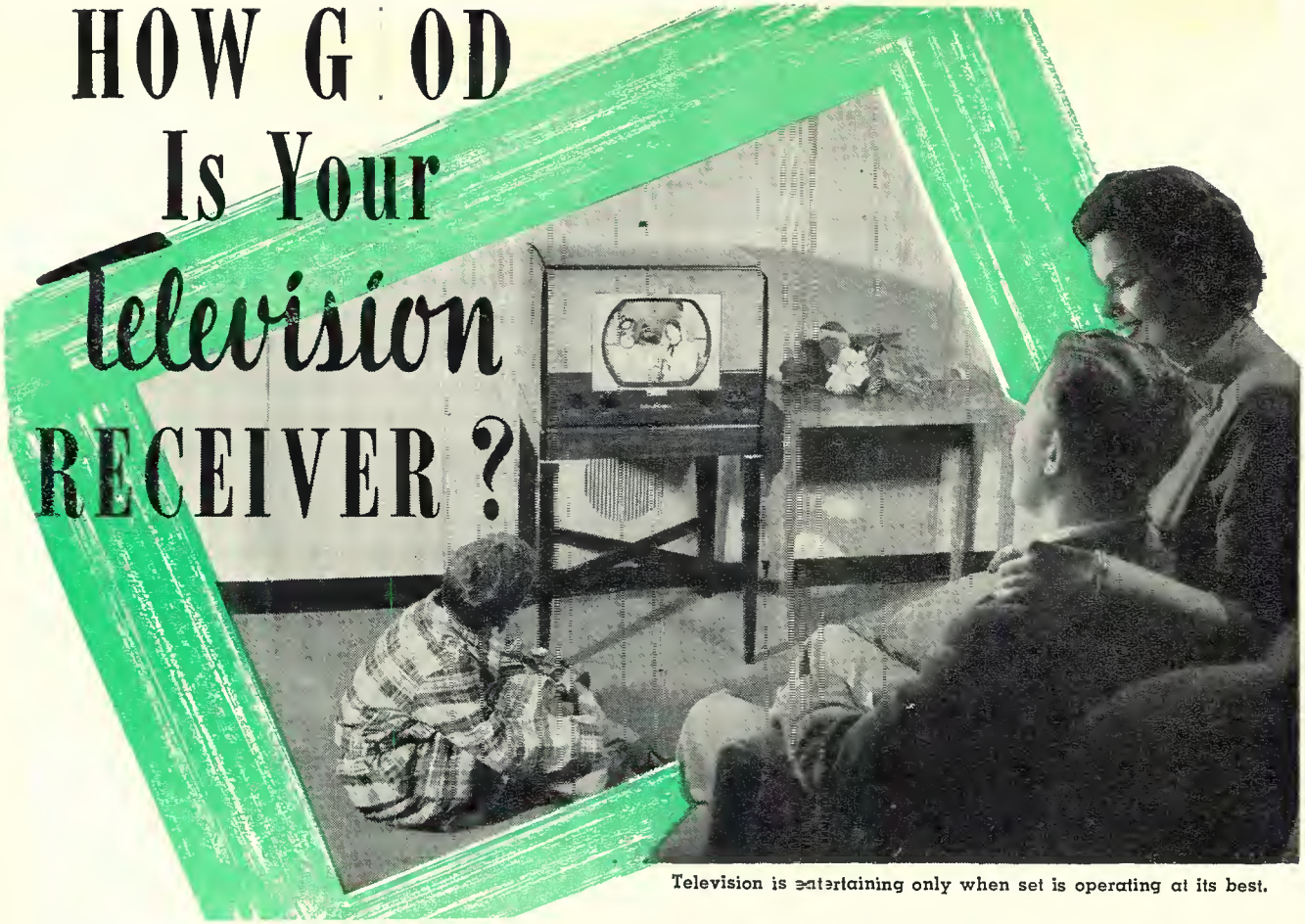
(If you are still in doubt concerning this moire effect, consult your womenfolk. They have been wearing moire silks for years and are familiar with the moire pattern).

4. *Does your picture possess the*

Fig. 2. The Indian head test pattern. Most important markings are clearly identified.



HOW GOOD Is Your Television RECEIVER?



Television is entertaining only when set is operating at its best.

By MILTON S. KIVER
Pres., Television Communications Institute

Whether you have a television set or are shopping for one, it is important for you to master these tests for judging the performance of the receiver.

MANY people (including experienced radio technicians) approach television with the attitude that here is an instrument that is wonderful and strange, and inconceivably complex. That a television set is a wondrous achievement of science is something with which few of us will argue. That it is also strange and inconceivably complex, there are many who will take issue. True, there are many things about a television set that are unquestionably complex. But there are many important aspects that can be made understandable, even to the layman, with the proper guidance and instruction. Judging the over-all performance of a television set from a careful examination of the picture it produces falls within this latter category.

The central point of interest in a television receiver is the picture that appears on the cathode-ray screen. This picture will tell you all you might possibly want to know about the television set behind it. It will tell you if the set has the proper bandpass, it will tell you if the horizontal and vertical sweep circuits are operating properly, it will tell you if enough voltage is being generated, it will tell you if the set is sensitive, it will tell you a basketfull of facts—*if you know how to interpret what you see.*

It is the purpose of this article to indicate those features of a television picture which will reveal, to a considerable extent, just how good the circuit behind the picture is.

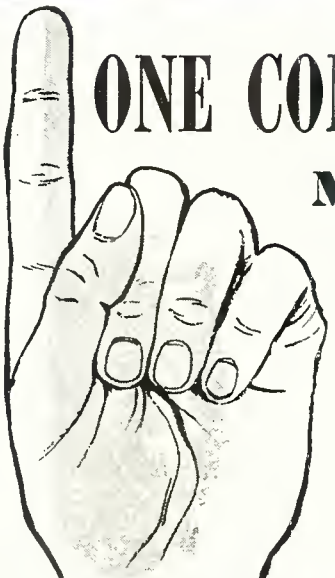
In order to reach any definite conclusions and to be able to check your results, all tests should be made using a test pattern. These patterns, of which several are shown in Fig. 1, have been specially prepared to reveal to the television technician just how well the set is functioning. Each line and each marking possesses a certain significance, designed to reveal a different aspect of receiver performance. On the other hand, ordinary scenes (especially movies) and fancy station identification cards reveal only the most gross and obvious faults of a set, even to an expert, and these should never be employed to judge receiver performance critically.

The test pattern shown in Fig. 1B (and in greater detail in Fig. 2) is one of the most frequently used by television stations. It is the most comprehensive one, containing more markings than any of the other patterns. For this reason it will be used in this article. Another pattern, designed by *NBC* (Fig. 1C), will also be discussed since it, too, is widely seen.

1. *How well does your set focus?* When a picture is in focus, it stands out sharp and clear. If it is out of focus, it appears fuzzy and indistinct. Nearly all television sets are provided with a focus control for adjusting the focus of the picture. Sometimes this control is on the front panel of the cabinet; sometimes it is on the back of the chassis. As this control is rotated, the picture will pass from an out-of-focus condition to in-focus and then out-of-focus again. If the in-focus condition is reached only when the control is turned completely to one end, then some part in the focus control circuit is at fault.

In the test pattern of Fig. 2, a small circle containing vertical and horizontal wedges is located in each of the four corners of the image. By checking the distinctness of the wedges in each circle, it is readily possible to determine how well the picture focuses at the edges of the screen. Generally speaking, it will be found that image detail is not as sharp here as it is at the center of the image. This is true of nearly all sets on the market. Make certain, however, that the image is

ALL RANGES WITH THIS ONE CONTROL



Model 630

Just *one* knob—extra large—easy to turn—flush with the panel, controls all ranges. This one knob saves your time—minimizes the chances of "burn-outs" because you don't have to remember to set another control. You can work fast with Model 630 with your eyes as well as your hands. Look at that scale—wide open—easy to read, accurately. Yes, this is a *smooth TV* tester. Fast, safe, no projecting knobs, or jacks, or meter case. Get your hand on that single control and you'll see why thousands of "Model 630's" are already in use in almost every kind of electrical testing

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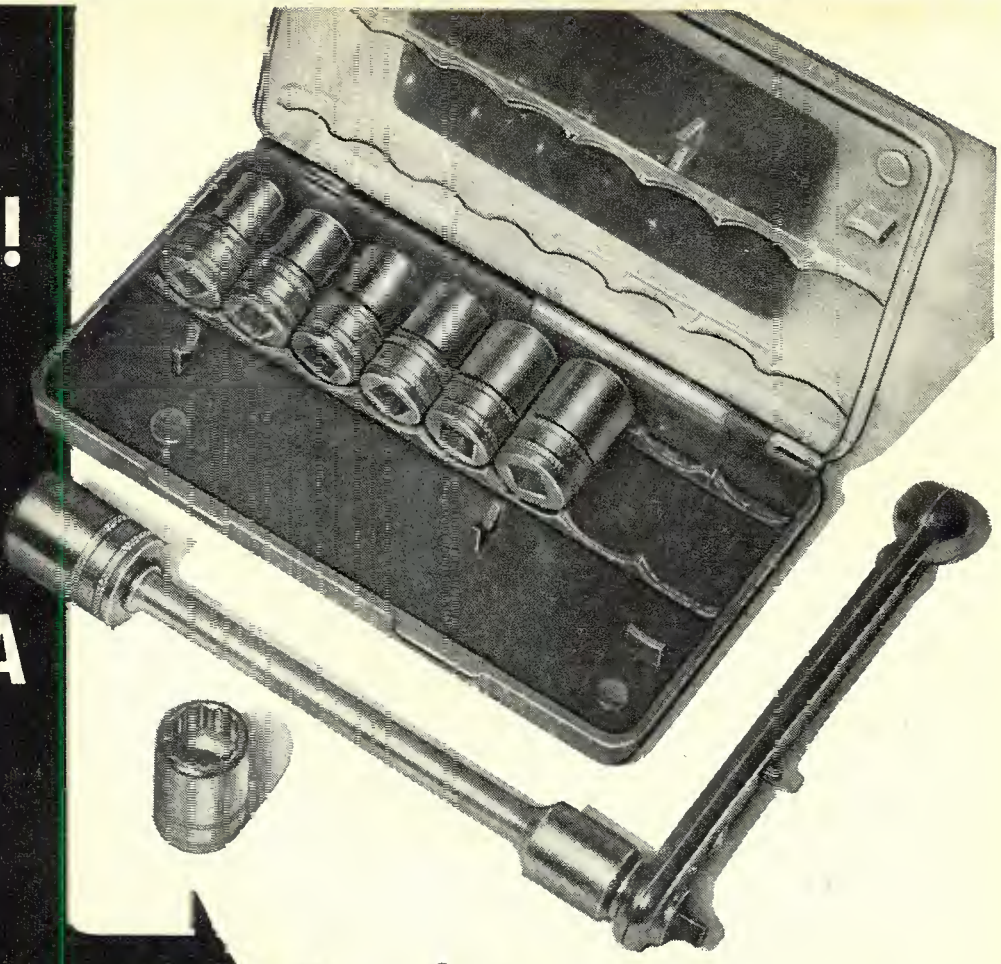

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3. Convenient 4-inch socket extension for hard-to-reach screws and nuts
4. Incorporates offset screwdriver with 2-way ratchet action
5. 3¾", easy-to-hold handle, convenient for tight spots
6. Good-looking, plastic case . . . pocket-size

Here's the cleverest and most efficient tool kit you've seen in many a moon!

Eight snug-fitting, interchangeable wrench-heads snap onto a precision-built ratchet handle. You'll find a thousand time-saving uses for this implement around your shop.

In fact, this fine quality tool seemed like such a "natural" for service jobs of all kinds that Sylvania decided to make it available to Service Dealers . . . at a special low price of only $2.50 complete. And no strings attached . . . nothing else to buy.

Of course, the supply is limited. To make sure you get yours, order now from your Sylvania distributor . . . he has a supply on hand. If your distributor can't supply you, send check or money-order for $2.50 to Sylvania Electric Products Inc., Dept. R-1209, Emporium, Pa.

SYLVANIA ELECTRIC

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

NOW READY! A Sensational New Line Of

1951 MIDWEST TELEVISION

Complete CHASSIS *and* BEAUTIFUL CONSOLES *Featuring the* New MAMMOTH 19½ Inch PICTURE TUBE

FACTORY-TO-YOU on 30 DAYS TRIAL

"VIDEO GRAND" 19½-Inch Picture (225 sq. in. image) Television-Radio-Phonograph Console

EASY TERMS

"CONSTELLATION" 19½" Television Console with BIG 12" Panasonic Speaker

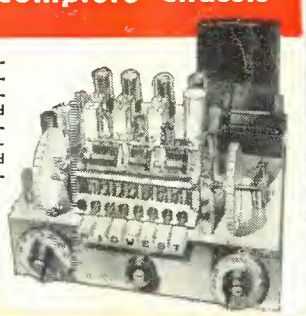
NOT A KIT!

This is A Completely Assembled Receiver

Never before hove you seen such tremendously BIG clear pictures, such luxurious cobinets, such sensotionally low Foctory Prices as Midwest offers in its 31st Anniversory Line of 19½-Inch ond 16½-Inch Television receivers. They are ovoilable in complete reody-to-use chossis for custom instollation in your own cabinet...or in luxurious console cabinets with Television only or in TV-Radio-Phonograph combinations. A l ore offered on Midwest's famous 30 Days Trial right in your own home.

Plus Powerful New 1951 World-Ranging 5-Band MIDWEST SERIES 16 RADIOS In Beautiful Consoles and Complete Chassis

An entirely new line featuring the powerful Series 16 AM-FM Five-Band Radio Chassis and the magnificent Symphony Grond Radio-Phonograph with 3-Speed Automatic Inte mix Record Player.



EASY TERMS

MIDWEST RADIO & TELEVISION CORP.
DEPT. 37-B, 909 BROADWAY, CINCINNATI 2, OHIO

SEND COUPON TODAY *For This NEW 1951 4-Color*

FREE MIDWEST RADIO-TELEVISION CATALOG

• WRITE IN NAME AND ADDRESS (PLEASE PRINT) ON COUPON OR 1c POSTCARD •

MIDWEST RADIO & TELEVISION CORP.
Dept. 37-B, 909 BROADWAY • CINCINNATI 2, OHIO

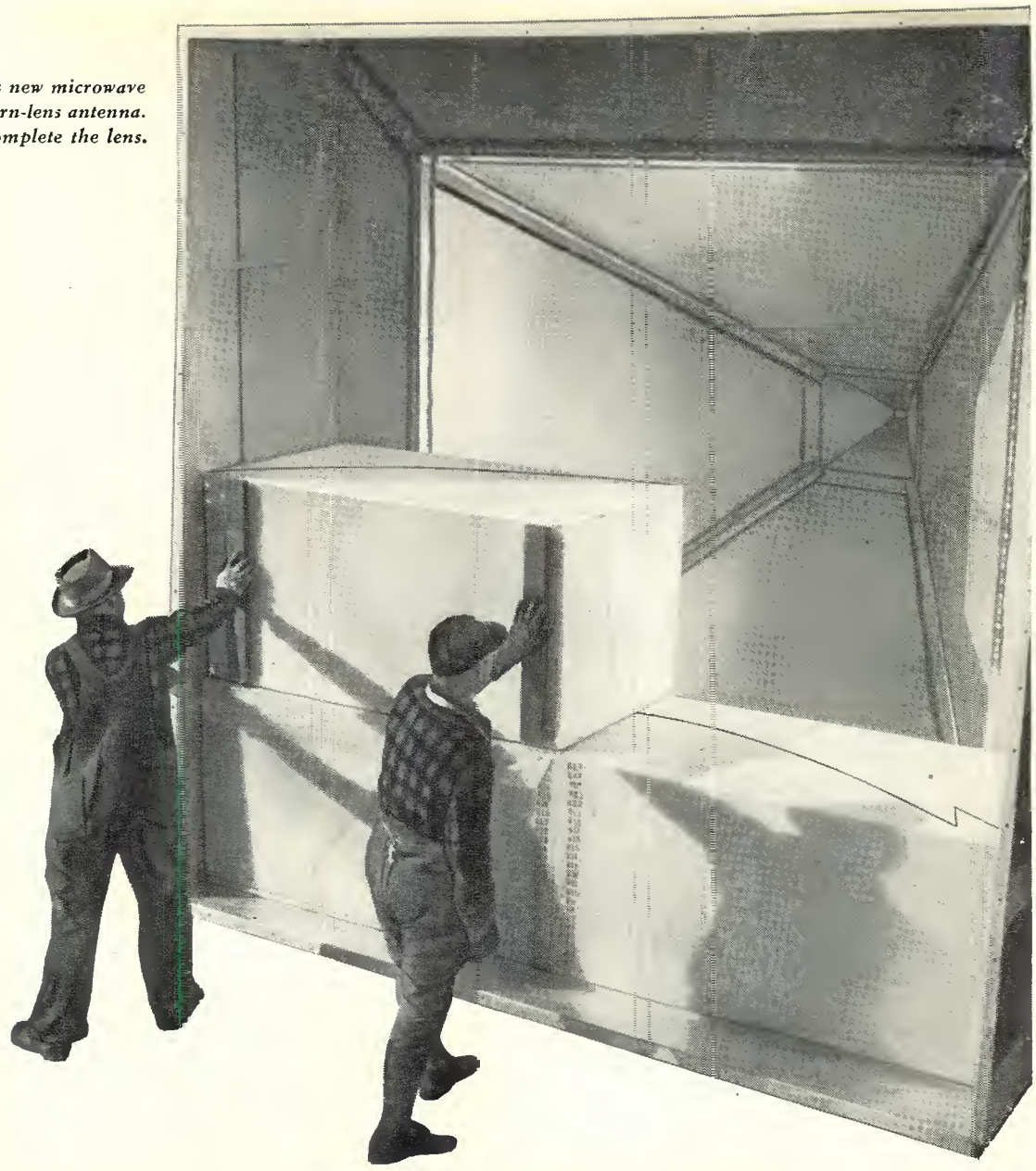
Please send me your new FREE 1951 Catalog.

NAME _____

ADDRESS _____

CITY _____ ZONE ____ STATE _____

Mounting Bell's new microwave lens in a horn-lens antenna. Other blocks will complete the lens.



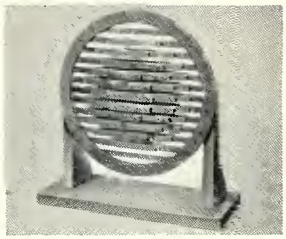
A focus on better, low-cost telephone service

In the new microwave radio relay system between New York and Chicago, giant lenses shape and aim the wave energy as a searchlight aims a light beam.

Reasoning from the action of molecules in a glass lens which focuses light waves, Bell Laboratories scientists focus a broad band of microwaves by means of an array of metal strips. To support the strips these scientists embedded them in foam plastic which is virtually transparent to microwaves. Rigid and light in weight, the plastic is easily mounted on relay towers.

This unique lens receives waves from a wave guide at the back of the horn. As they pass across the strips, the waves are bent inward, or focused to form a beam like a spotlight. A similar antenna at the next relay station receives the waves and directs them into a wave guide for transmission to amplifiers.

This new lens will help to carry still more television and telephone service over longer distances by microwaves. It's another example of the Bell Telephone Laboratories research which makes your telephone service grow bigger in value while the cost stays low.

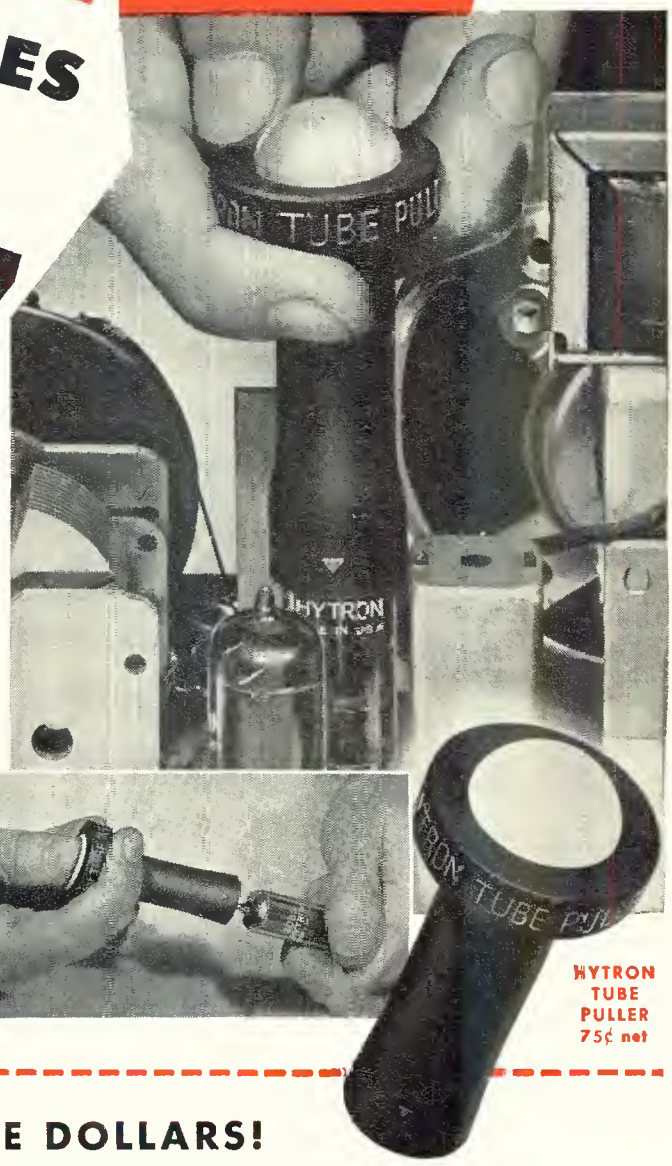


Laboratory model of the new lens. A similar arrangement of metal strips is concealed in the foam plastic blocks in the large picture.

BELL TELEPHONE LABORATORIES

Working continually to keep your telephone service big in value and low in cost.

PULL MINIATURES PAINLESSLY!



WHY STRAIN, fry, and slice your fingers? Why break tubes? Pull or insert 7-pin miniatures the e-a-s-y way. With economical Hytron Tube Puller. Result of two years' research.

Positive grip pulls first time from meanest sockets. Special Neoprene rubber resists heat. Does not harm tube. Adjusts automatically to varying tube diameters. Tube Puller works by suction and friction on *top* of tube. Removes even tiny 6AK5 and 6AL5 from shielded sockets. Reaches into tightest spots — to pull or insert.

Only 75¢! You cannot afford to be without this temper-time-and-money saver. Get *your* Hytron Tube Pullers from your Hytron jobber today.

It's Easy! **TO PULL:** Push Tube Puller onto top of 7-pin miniature. Just enough for firm grip, and without depressing release button at top. Pull straight up and out; no need to bend pins by violent rocking. Hold tube securely in one hand. With other, push release button quickly. Compressed air pops out tube. Or, holding down release button, remove Tube Puller by rocking it. To insert: Align arrow on skirt of Tube Puller with keyway of tube. Push tube into Tube Puller. Using arrow as guide, insert tube. Push button quickly to release. Maintain pulling action at peak. Wipe inside of Puller occasionally with clean cloth to remove dirt and grease.

HYTRON TUBE PULLER 75¢ net

THEY COST PENNIES, BUT SAVE DOLLARS!

OVER 50,000 SERVICEMEN know! These Hytron tools pay for themselves again and again. Save time . . . temper . . . dollars — daily. Read what they'll do for you. Write for complete Tool Catalogue. Better still — get these tools from your Hytron jobber today!

PIN STRAIGHTENERS, 7-Pin and 9-Pin — 55¢ net ea. You merely press tube gently into Hytron Straightener until button base seats squarely. Presto, pins are straight! Fast . . . safe. Avoiding one broken tube pays for Straightener twice over. Precise, stainless steel insertion die. Comfortable knurled aluminum holder. For hand, bench, or tube tester use.

AUTO RADIO TOOL — 24¢ net. Substitutes for control cables of universal auto radio. Quickly, precisely turns set on/off, tunes, adjusts volume and tone, re-aligns dial. Square also fits splines. Vee fits spade and other key fittings. Minimum backlash. Compact. Bright zinc plated. Non-rolling large handle for fine adjustments.

SOLDERING AID — 49¢ net. Fork tip effortlessly, quickly unwraps "mechanically solid" joints. Straddles wire, grips, unwraps, pulls it free. Guides new wire, holds it firm while soldering. Spade tip reams solder from lug hole; pushes other wires aside. Tips are hardened, twist-proof, insulated, hard-chromed to shed solder. Tool handles like pencil. Reaches tight spots. Has dozens of other uses.

TUBE LIFTER — 15¢ net. *Lift* 'em all the e-a-s-y prybar way: Tubes (GT, G, standard, lock-in, metal). Vibrators and plugs (Jones, Amphenol) — and knobs. A natural for compact auto radios, etc. Slotted end lifts lock-ins, snap-in trimounts . . . easily, safely. Of stainless steel with comfortable rolled edges.

TUBE TAPPER — 5¢ net. Handy combination pencil, eraser and tube tapper. Discovers microphonism, shorts, and opens in tubes, etc. Compact, non-metallic, rugged. Doubles in brass for writing orders, etc.

OLDEST MANUFACTURER OF RECEIVING TUBES

HYTRON

RADIO AND ELECTRONICS CORP.

MAIN OFFICE: SALEM, MASSACHUSETTS

By SERVICEMEN — A HYTRON TOOL for SERVICEMEN

HYTRON RADIO TUBES

CREI Practical Training Shows You the Way to Greater Earnings in

TELEVISION & FM SERVICING.

TODAY THE CATHODE RAY TUBE can be the crystal ball that forecasts your future. Is the picture clear and bright—or is it fuzzy and out of focus?

Are you going to learn *now* how to install and service all types of TV and FM receivers? There can be no doubt that TV is the important field for greater earnings: 83 stations on the air (many more authorized); two million new sets in 1949; twelve million predicted by 1953; practically every area in the nation soon to be in range of a TV station. Technicians with specialized TV-FM training will inevitably have the inside track installing and maintaining all these sets.

CREI offers just the specialized training you need. It's a streamlined course for the top third of the men in the field—thorough and complete. It gives practical answers to the technical problems you run into while servicing today's intricate TV and FM equipment. It is up to date, constantly revised to cover new developments as they are adopted by the industry.

Start your training now and apply your knowledge immediately. The profitable work, passed up yesterday because it was over your head, can be yours tomorrow. Make this year the turning point in your TV career! Write today for complete FREE information. The cost is popular, the terms easy.

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

THE THREE BASIC CREI COURSES:

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

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

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

ALSO AVAILABLE IN RESIDENCE SCHOOL COURSES

CAPITOL RADIO ENGINEERING INSTITUTE

An Accredited Technical Institute Founded in 1927

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Washington 10, D. C.

Branch Office:
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FREE BOOKLET plus SAMPLE LESSON

CAPITOL RADIO ENGINEERING INSTITUTE
Dept. 119-B, 16th & Park Rd., N. W. Washington 10, D. C.

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

Check the Field of Greatest Interest:
- ☐ TV, FM & ADVANCED AM SERVICING
- ☐ PRACTICAL TELEVISION ENGINEERING
- ☐ PRACTICAL RADIO ENGINEERING
- ☐ AERONAUTICAL RADIO ENGINEERING
- ☐ BROADCAST RADIO ENGINEERING (AM, FM, TV)
- ☐ RADIO-ELECTRONICS IN INDUSTRY

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

ADDRESS.....

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

If Residence School Preferred, Check Here ☐

Some of the leading manufacturers, jobbers, and distributors of audio equipment have contracted for demonstration rooms. Those in attendance will be able to see and hear new audio products and developments with a maximum of privacy.

The annual convention of the A.E.S. is being held in conjunction with the exhibit and technical sessions have been planned for all three days of the "Fair."

* * *

PAUL MC KNIGHT DEELEY has been elected a director of the *Cornell-Dubilier Electric Corporation* of South Plainfield, New Jersey.

A vice-president of the company since 1932, Mr. Deeley previously was associated with *Cornell Electric Manufacturing Company.* He is a recognized authority on radio engineering and was responsible for the design and installation of the first radio broadcasting station in Mexico.

During World War II, Mr. Deeley was in charge of the capacitor division of the War Production Board and was responsible for the distribution of that critical component.

* * *

FEDERATED PURCHASER INC. has recently opened a branch store in Newark, New Jersey, at 114 Hudson Street . . . **THE ELECTRIC AUTO-LITE COMPANY** has expanded its industrial wire manufacturing facilities with the opening of a new plant at Hazleton, Pa. . . . **HUDSON RADIO AND TELEVISION CORP.,** a newly-organized radio and electronic distributor, has begun operations at 212 Fulton Street, New York 7, New York . . . Increased demand for the company's line of antennas and accessories has forced **TECHNICAL APPLIANCE CORPORATION** to build a new addition to its Sherburne, New York plant . . . **SYMPHONIC RADIO & ELECTRONIC CORPORATION** of Cambridge, Massachusetts, has moved to new and more spacious quarters at 160 Washington Street, North in Boston. The new location will permit the company to step up its production of radios and record players.

* * *

ROBERT A. ELLIOT has been named to fill the newly-created post of jobber sales manager by *Standard Coil Products Co., Inc.* of Chicago.

In his new position, Mr. Elliot will have complete charge of jobber sales, advertising, and merchandising for both the domestic and foreign markets.

He is well-known in the electronic industry, having been associated with the *Radio Corporation of America* for the last 17 years in posts both in this country and abroad. Mr. Elliot, who has already mapped out an aggressive sales campaign for the jobber field, will headquarter at the company's Chicago offices.

* * *

SPRAGUE ELECTRIC COMPANY of North Adams, Massachusetts and *Philips Industries, Inc.* of Hartford, Conn., have announced the formation of the *Ferroxcube Corporation of America* with headquarters at 50 East 41st Street, New York, N. Y.

Robert C. Sprague has been named president of the new corporation while John P. Adams has been elected vice-president in charge of sales. T. James Read is the manager of the factory, which is located in Saugerties, New York.

The new corporation will manufacture "Ferroxcube," a new ferromagnetic ferrite, particularly useful as a core material in high frequency coils and transformers.

The new product was originally developed by the *Philips Research Laboratories* in Holland.

* * *

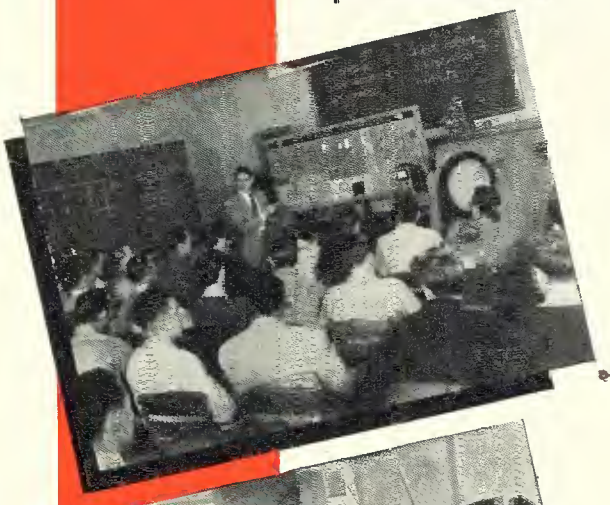
THE INTERNATIONAL ORGANIZATION FOR STANDARDIZATION has accepted an invitation to hold its 1952 general assembly in the United States.

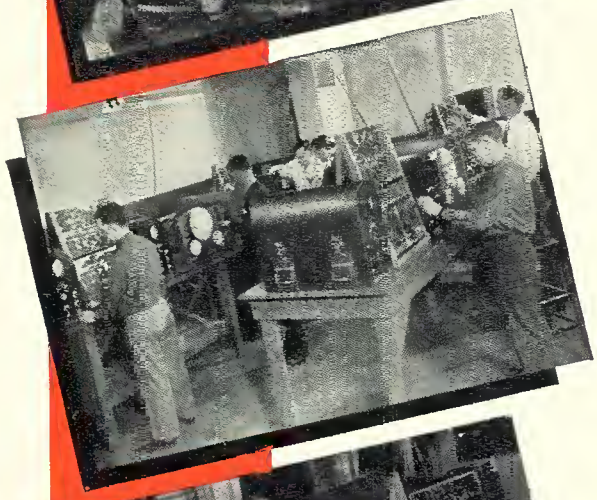
Delegates of the 29 countries that are members of the ISO will be guests of the American Standards Association. As U. S. member, the ASA presents the viewpoint

(*Continued on page* 129)

"IN WAR OR PEACE YOU ARE ESSENTIAL AS A TELEVISION ENGINEER"

U. A. Sanabria
president and founder of American Television Inc.





American Television trains you for the following fascinating and highly paid jobs:

- TELEVISION TRANSMITTERS. Operation including AM and FM Radio
- TELEVISION RECEIVERS. Installation, Maintenance, etc.
- TELEVISION ENGINEERING. Electronic Development, Research and Design
- RADAR, Sonar, Loran, etc.
- COMMUNICATIONS. F.C.C. Licenses
- INDUSTRIAL ELECTRONICS

Our Graduate Placement Bureau has a continual demand for men for these positions.

NOW IS THE TIME TO GET INTO TELEVISION!

Today, *more than ever*, you are needed to fill the expert technical requirements of the huge electronic industry. Choose the job that interests you most and learn it thoroughly in "America's Foremost Television Training Organization," American Television. Every facility for actual practical television experience is available to you in our "million dollar laboratories."

Approved For Veteran Training

MAIL NOW FOR FREE BOOKLET AND COMPLETE INFORMATION

AMERICAN TELEVISION
5050 N. BROADWAY CHICAGO 40, ILL.

Please rush your new booklet "TELEVISION AND YOU" without obligation.

NAME_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

☐ Veteran ☐ Non-veteran

AMERICAN TELEVISION

WORLD'S FOREMOST TELEVISION SCHOOL

Within the INDUSTRY

ARTHUR L. CHAPMAN has succeeded E. E. Lewis as general manager of the *Colonial Radio and Television Division* of *Sylvania Electric Products Inc.*

In his new position Mr. Chapman will be responsible for the production and sales of all products of the division in addition to his duties as general manager of the company's Parts, Wire and Plastics Division at Warren, Pa. He will maintain headquarters in Buffalo, New York.

Mr. Chapman has been associated with *Sylvania* since 1933 and has held posts in the material inspection department, the radio tube plant, and the wire and weld plant.

* * *

J. Y. SCHOONMAKER of Dallas, Texas, was recently elected national president of "The Representatives" of Radio Parts Manufacturers, Inc. for the 1950-51 term. He served as first vice-president of the national group last year.

Serving with Mr. Schoonmaker are: Wilmer S. Trinkle of Philadelphia, first vice-president; Norman B. Neely of Hollywood, second vice-president; Russ Diethert of Chicago, third vice-president; and Leroy W. Beier of Chicago, secretary-treasurer.

The new Board of Governors includes R. W. Farris of Kansas City, Irvin I. Aaron of Milwaukee, Robert E. Breuer of New York, Samuel K. Macdonald of Philadelphia, David N. Marshank of Los Angeles, Leslie M. DeVoe of Indianapolis, and William E. McFadden of Columbus who served as national president last year.

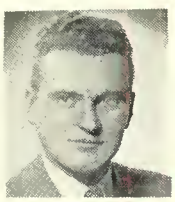
* * *

BEN FARMER has been named sales manager of *The Rauland Corporation* of Chicago . . . *Illinois Transformer Company* has appointed **ALBERT L. TUTTLE** to the post of sales manager for both the parent company and the *Precision Transformer Division* of the organization . . . **CAPT. HOWARD T. ORVILLE,** prominent Navy aerologist, has resigned after 29 years' service to become director of engineering for the *Friez Instrument Division of Bendix Aviation Corporation* . . . **NICHOLAS J. GIORDANO** has joined *Air King Products Co., Inc.* as a field service engineer . . . **P. O. KRUMM,** director of purchases at *Sentinel Radio Corporation* for 18 years, has purchased a controlling interest in the *Niles Cabinet Company* and has left *Sentinel* to take an active part in the management of the cabinet firm . . .

L. M. SANDWICK has joined *Scott Radio Laboratories, Inc.* of Chicago as merchandising manager . . . The Transformer and Allied Products Divisions of *General Electric Company* has a new manager of sales, **WILLIAM S. GINN** . . . The board of directors of *Tracerlab, Inc.* has elected **ADMIRAL LEWIS L. STRAUSS** and **CHARLES E. COTTING** to membership on that body . . . *General Electric Company's* regional manager for the Tube Divisions in the Chicago area is **G. L. ROARK** . . . **ERNEST KELLER,** vice-president and sales manager of *Anchor Radio Corporation,* has been named chairman of the TV Booster Committee of RTMA . . . **JUSTIN J. McCARTHY,** formerly New York district manager for the Lighting Division of *Sylvania Electric Products Inc.* has been promoted to special sales representative to promote the sale of TV picture tubes in the New York-Philadelphia area . . . **F. F. ROEHLL** has been named national sales manager of *Eutectic Welding Alloys Corporation* . . . *Jerrold Electronics Corporation* has appointed **SYDNEY J. MASS** to the post of advertising and sales promotion director . . . The commercial engineering department of *Du Mont's* Tube Division is now being headed by **ROBERT G. SCOTT** . . . **J. P. SOMMER** has been named public relations consultant to the *Television Research Institute* . . . **JOHN A. WOOD,** formerly sales representative for the *Pacific Wholesale Company* of San Francisco, has joined the distributor sales staff of the Radio Tube Division of *Sylvania Electric Products Inc.*

* * *

RICHARD A. MALMBERG has been appointed renewal sales manager of the *Hytron Radio & Electronics Corp.* of Salem, Massachusetts. In this capacity, he will be in charge of the company's replacement tube sales.



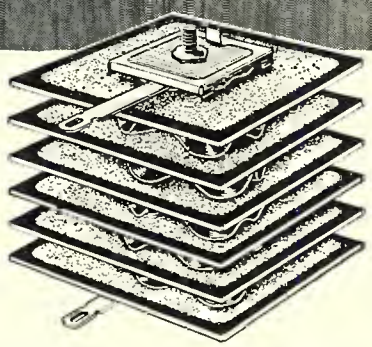
Mr. Malmberg, who specialized in radio communications engineering at Harvard and M.I.T., has a broad background in distributor sales. He was formerly associated with *Fisher Radio Corp.* where he was sales manager.

* * *

THE AUDIO ENGINEERING SOCIETY is sponsoring the nation's second "Audio Fair" at the Hotel New Yorker, New York City, on October 26, 27, and 28.

Rooms and suites comprising the entire 5th and 6th floors of the hotel have been reserved for exhibitors.

The Choice of Power in TELEVISION



A Beauty **IN PERFORMANCE** with the same excellent service and high efficiency after many months of daily use in radio and television receivers as well as all types of electronic equipment.

A Beauty **IN FLEXIBILITY** of Design which allows this versatile rectifier to be used in many combinations in television receivers having 7 inch to 24 inch screens. Heavy and heat producing components are eliminated by use of the selenium rectifier.

A Beauty **IN FEATURES** with the Universal Locating Lug; the Universal mounting stud, Center cooling spacers and rugged mechanical construction.

A Beauty **IN APPEARANCE** with each unit carefully inspected for maximum eye appeal.

A Beauty **TO PROCURE** with large stocks of all models from the 65 ma to the 450 ma available for prompt shipment.

A Beauty **FOR THE REPLACEMENT MARKET** with customer good will and satisfaction guaranteed by no "return-calls."

If YOU are not already using the Sarkes Tarzian Centre-Kooled Selenium Rectifier—write today for complete information.

Sarkes Tarzian, INC.

RECTIFIER DIVISION, 415 NORTH COLLEGE AVE., DEPT. A, BLOOMINGTON, IND.

ASK YOUR DISTRIBUTOR FOR YOUR "CENTRE-KOOLED PIN-UP" REPLACEMENT GUIDE

BUY NOW! CONCORD OFFERS LOW PRICES COMPLETE STOCKS

HANDSOME - BARGAIN PRICED 6-TUBE RADIO-PHONO

LOOK 47.50

This is a REAL BUY! For price, looks, and performance it can't be matched anywhere Designed originally to sell for over $70.00, CONCORD now offers this handsome, walnut cabinet, 6-tube superhet combination radio-phonograph for a low, low $47.50 Radio features include beam power output, automatic volume control and Alnico PM speaker for clear natural reproduction of bass and treble tones. Two dual-purpose tubes give the equivalent of 8-tube performance. Has a built-in loop antenna and a continuously variable tone control Its top quality 78 RPM record changer plays both 10 and 12 inch records automatically. Has featherweight tone arm with crystal pickup. Edge-lighted dial and controls are set apart from the record changer lid so that the radio can be operated without disturbing the cover Tube complement consist of (2) 12SK7GT, 12SA7GT, 12SQ7GT, 35L6GT, 35Z5GT. Overall size: 22-1/2"x16"x10-3/4". Operates on 105-125 volts, 60 cycle AC. Comes complete with tubes. Don't miss this BUY. Order TODAY!

1-646R--Shpg. wt. 37 lbs..... **47.50**

68% OFF on Name AUTO ANTENNAS

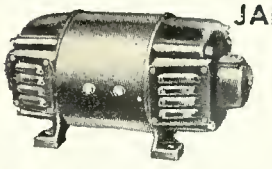
Model 4553 - Fig. A. An all purpose 96" 3 section side cowl antenna. Made of triple-chrome-plated brass with bakelite insulators Rattle-proof. Complete with 36" Hi-Q low loss cable which has inner polyethylent insulation with vinylite jacket for protection against oil, carbon and water. List $5.45.
99-9699R--Your Cost, Each...1.98. Lots of 3, Each **1.79**

Model 4566. As above except 65" long. List $4.45
99-9698R--Your Cost, Each...1.49. Lots of 3, Each **1.39**

Model 4801 - Fig. B This is the popular Uni-Mount Antenna. Fits all types of cars...old and new. Is mounted under the hood. No drilling of holes into car body necessary. Rustproof triple-chrome-plated. 60" high. With 36" cable as above. List $4.45.
99-9694R--Your Cost, Each...1.49. Lots of 3, Each **1.39**

Model 4541 - Fig. C. The latest swivel antenna. For convex or flat surfaces of every type car Triple-chrome-plated, rustproof. Bakelite insulators 62" high. Has 48" cable as above. List $5.25.
99-9697R--Your Cost, Each...1.89. Lots of 3, Each. **1.75**

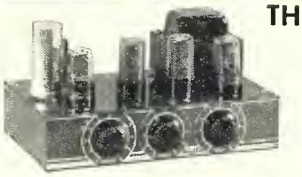
A B C



JANETTE 300 W CONVERTER

Price and Quality combine to make this one of our fastest selling converters. It is ideal for use as AC power supply for all types of electrical appliances, including electrical signs, power tools, X-rays, etc. Mechanical features: Input 115 volt DC, output 110 volt, 60 cycle AC, single phase. Has 300 volt ampere capacity. Sleve bearings are of phosphor bronze, lubricated with oil-saturated wool yarn to insure long wear. The frame is constructed of rolled, welded steel - lightweight, strong and rigid The core is a laminated construction of special electrical steel. Has compound wound (shunt and series) field coils which are layer wound of enameled copper All brushes are made by internationally known manufacturers have radial, box type holders. Operates smoothly at 3600 RPM., no load speed Oil cups are easily accessable for maintenance. Finished in grey enamel. Overall size: 12-1/2"x7-1/4"x7-1/4". Truly a terrific buy!

99-9401R--Shpg. wt. 47 lbs.. ..... **49.50**



THE FAMOUS CONCORD MUSIC LOVERS AMPLIFIER

SPECIAL 29.50

The Concord Music Lovers Amplifier was especially designed by Concord engineers to give the newcomer to high-fidelity listening an inexpensive yet good quality unit. Its high quality output and thrilling reproduction of music are unequaled at this low price.

The normal rated output of this fine amplifier is 8 watts, and at this rated output there is a harmonic distortion of only 2% Has three inputs: magnetic cartridge input, crystal cartridge input, and one for a radio tuner. A built-in pre-amplifier allows use of new variable reluctance pickup. Has individual, continuously variable bass and treble tone controls, each calibrated with flat response position. The bass control gives 10 DB boost - treble control gives 12 DB boost and 14 DB attenuation. There is also a separate volume control. Its frequency response at rated output is 40 to 15,000 + 1 DB The tube complement consists of (2) 6V6, 6SL7, 6SC7, and a 6X5 rectifier Operates on 117 volts AC, 60 cycles Attractively finished in brown hammerloid. Has large easy-to-handle plastic control knobs Overall size: 10-1/2"x6"x 5-1/4". Complete with tubes.

2-295R--Shpg. wt. 10 lbs..... **29.50**

TONE ARM with VARIABLE RELUCTANCE CARTRIDGE

LIST $15.95 ONLY 4.45

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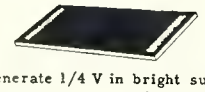

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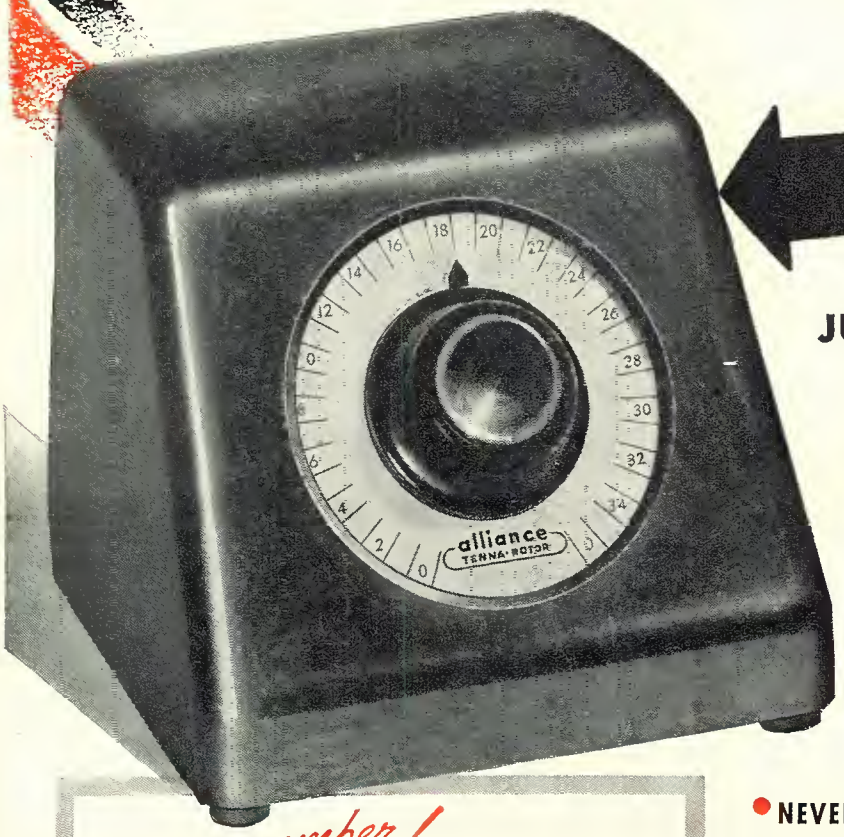

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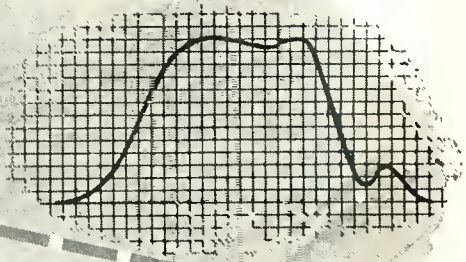

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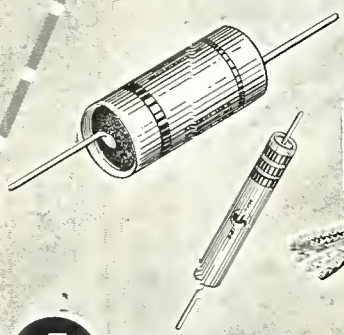

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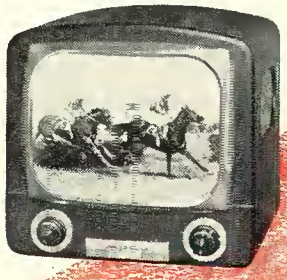

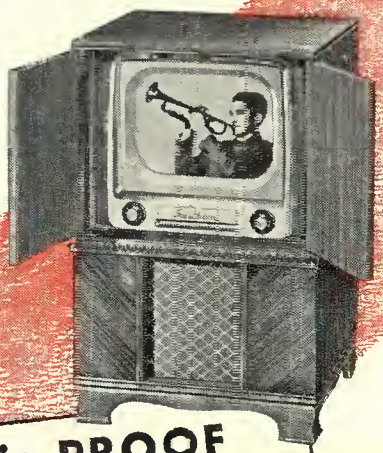

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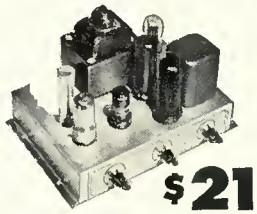

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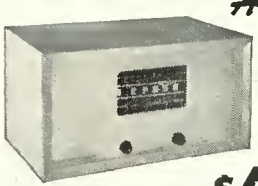

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TROUBLESHOOT With This Condenser Substitution Box

By LEON A. WORTMAN

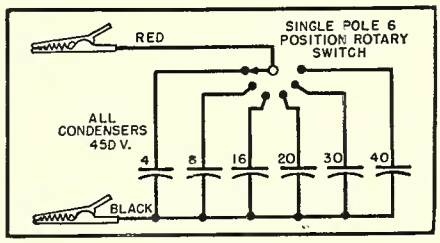
Details for constructing a handy servicing "tool" which will eliminate the awkward juggling of parts.

HOW often have service technicians picked up a handful of electrolytics and, one condenser at a time, probed the inner entanglements of chassis wiring in a clumsy attempt to find the best cure for hum troubles. After trying futilely to make a heavy condenser stay in place, hanging from one end of a tube socket terminal to the head of a grounded screw, the author reached the end of his rope. But the end of this rope proved to be the beginning of a bit of organized troubleshooting.

This "organization" effort involved the construction of an electrolytic substitution box. The time expended for the construction was about one hour. The effort saved in the short time that the box has been in use staggers the imagination. Its use has allowed the author considerable time to devote to other endeavors far more useful than clumsy condenser juggling.

The parts required are the same handful of condensers which have been used all along, a rotary selector switch, some wire, alligator clips, insulating grommets, and a box to house all these elements.

The photographs and the wiring diagram clearly show the constructional details. Be sure to observe correct condenser polarities. The two wires which exit from the corners of the box are the condenser terminations. One

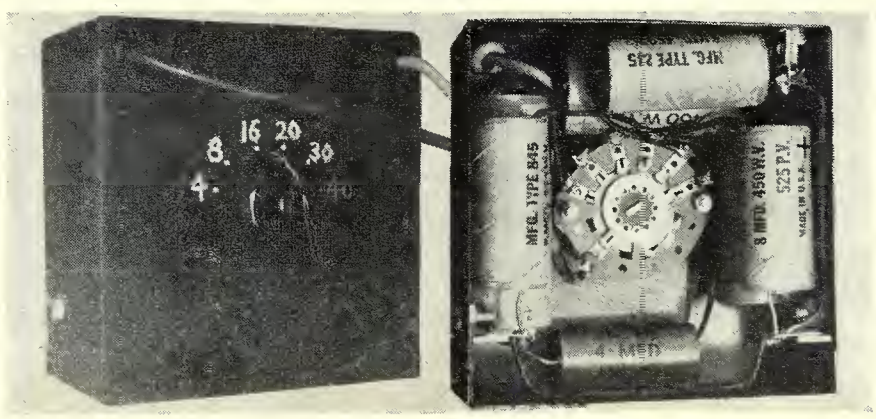


Wiring diagram of the substitution box.

of the wires is red to indicate the positive terminal, the other wire is black, indicating the negative terminal. Test probe wire is highly flexible, durable, and well insulated and is therefore recommended for this application. Alligator clips with colored rubber shields are attached to the free ends of the red and black flexible wires.

When localizing hum, the rubber shields of the alligator clips can be gripped and handled as test probes. When the hum has been localized, attach the alligator clips to the circuit under test. The different condensers are connected into the circuit by rotating the selector switch. The switch knob points to numbers marked on the box with decals, or white paint. The numbers relate to the value of the condenser being substituted for optimum hum reduction. Thus, by simply reading the number, you know at once what condenser to use. —30—

Front panel and rear views of the condenser substitution box built by the author.



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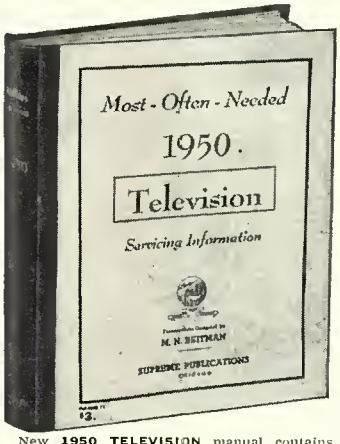

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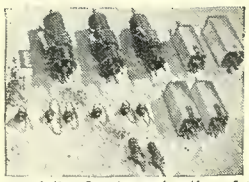

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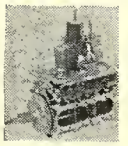

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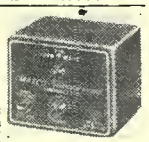
Stock No. HA-22
FOR 7-10-12 INCH TUBES

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.

201R1 width control. Net	$0.44
201R3 Linearity control	.44
206T8 Syncrolok	.99
Deflection yoke for 10 and 12" tube. Net	2.49
Deflection yoke for 16" tube	2.49
Focus coil, 247 ohms, for 10, 12 or 16"	1.95
Vertical deflection output trans, 10, 12, 16"	1.49
Vertical oscillator transformers	.99
Horizontal scanning output transformer (Flyback) supplies H.V. and feeds horizontal scanning coil of deflection yoke. Either 9.5 or 13 K.V...	2.95
Alnico V Ion trap	.49
Picture tube sockets with leads	.49

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.

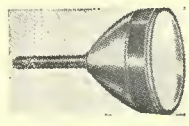
Astatic AT-1 "Channel Chief" TV Booster. Equal to two ordinary boosters. Two tuned circuits. Dual controls tune picture and sound. Attractive wood cabinet, 8½x6½x7¼". Shipping weight 6 lbs. Net price $29.10.

GENERAL ELEC. 16AP4 $29.95

Brand new General Electric 16AP4 metal television picture tubes. All in original factory cartons. Ship. wt. 25 lbs. Only a limited quantity to sell at the low price of $29.95.

45 R.P.M. RECORD CHANGER $8.95

Crescent 45 RPM automatic record changer. This small changer (10⅛x7¼) is for the 45 RPM RCA etc. records only. It has a 50-10,000 CPS crystal cartridge with perm needle. Changes records in less than 2 seconds. Plays 8 to 10 records. McGee's red hot August price is only $8.95 each, while our stock lasts. Ship. weight 8 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 doys
★ 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 most 16" all glass picture tubes. Over-all length 20¾"; greatest bulb diameter, 16¼". It 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 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 is not on tubes for obvious reasons.

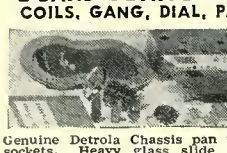
BUY YOUR RADIO KITS AT McGEE FOR LESS

MODEL 6-ACX6
2 BAND CHASSIS KIT

6 TUBE AC SUPERHET KIT BROADCAST AND SHORTWAVE MATCHED PARTS $11.95

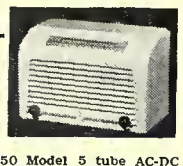
A complete kit of parts, tubes and ready punched chassis to build a fine 6 tube, 2 band AC power tranaformer type radio chassis. (No cabinet.) We furnish all pieces as well as a printed diagram and photograph. Chassis size 14x7½x7". Receives standard broadcast and 6 to 18 MC shortwave. 3 gang tuning condenser used on both bands. 90 mil power transformer and 7C5 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. Ship. wt. 14 lbs.
Stock No. 6-ACX6. Net price $11.95.
10" Heavy duty PM speaker, $3.95 extra. 8" Heavy duty PM speaker, $2.95 extra.
12" Heavy duty PM speaker, 4.95 extra.

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 awitch 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.

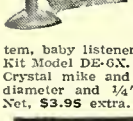
NEW 1950 MODEL 5-TUBE SUPERHET RADIO KIT MODEL N5-5 $9.95



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 voluma 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.

NEW MODEL 5-TUBE A.C. Self Powered Broadcast Tuner Kit $9.95

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 1650kc) 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 a diagram and photo, with tubes: 6SK7 R. F., 6SA7 converter, 6SK7 I.F., 6H6 detector, 6X4 rectifier. Connect to audio amplifier, ideal for use with our XX-34, TM-15 or S-2020 amp. kits. Chassis size: 9¼ x 6¼ x 4½" high. Shipping weight 8 lbs. Broadcast tuner kit, Model BT-38. Net price $9.95.



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 1300 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, $6.25. 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.

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-puli 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 6 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

30 WATT MUSICAL INSTRUMENT AMP. KIT $34.95

Model MM-35, McGee's new 1951 model wide range musical public address amplifier kit. A complete kit of parts to build a top quality dual purpose amplifier. Inputs for two instruments and one mike input. Dual tone control with separate bass and treble boost. Leatherette covered case, with plastic speaker grill. Super heavy duty 12" PM speaker. Response 40 to 15,000 CPS. 6 tubes in all, with push-pull 6L6 (30 watts) output tubes. This is a complete kit, including tubes and diagram. It is the most versatile musical amp. that we know of. Shipping weight 26 lbs. Stock No. MM-45. Net $34.95. MM-45WT, above musical amplifier, wired and tested, $49.95.

18 WATT WIDE RANGE AMP. KIT $19.95

Inputs for Tuner—Phono—Mike
Controls—Response 20-20000 CPS

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. Uses 200 mil power transformer, super wide range broadcast quality shielded output transformer, that may he connected to any 4 or 8 ohm PM speaker. Chassis size, 9¼ x 9¼ x 6" high. Tube line up is, 3-7F7 and 2-7C5, plus rectifier. The circuit has very low resistance, well regulated power supply. Separate bass 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 cost of the kit. Super wide range amplifier kit, complete with tubes, less speaker, Model S-2020. Shipping weight 16 lbs. Net price $19.95. Crystal mike and desk stand $4.95 extra.

GENERAL ELECTRIC PICK UP SCOOP, $5.95

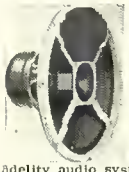
Precision Ball Bearing Arm—with separate 1 and 3 mil needles For the critical music listener, who wants the finest microgroove tone arm built; we offer the General Electric, ball bearing tone arm Model UPX-0004. It is equipped with a G.E. RPX-041 removable needle, variable reluctance cartridge with replaceable 1 mil sapphire stylus, (for 33⅓ or 45 RPM records). The arm is precision built with ball bearing mounting to give no drag on those valuable long playing records. Only 6 to 8 grams needle pressure. With each pickup we supply at no additional cost, a 3 mil G.E. sapphire needle, so that you may also use this arm on standard 78 RPM records. The total value of this combination offer is over $11.00. Shipping weight 1 lb. Stock No. X-0042. Sale price only $5.95.

McGEE RADIO COMPANY

Prices F.O.B. K.C. Send 25% Deposit with Order, Balance Sent C.O.O. With Parcel Post Orders, Include Postage

TELEPHONE VICTOR 9045. WRITE FOR FLYER
1422 GRAND AVE., KANSAS CITY, MISSOURI

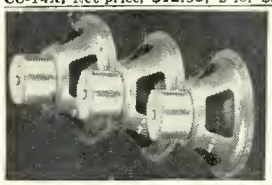
NEW 1951 MODEL 12-INCH "COAXIAL" SPEAKER



- WIDE RANGE RESPONSE—40 to 17,500 CPS.
- ONLY 2 WIRES TO CONNECT TO ANY AMP OR RADIO
- NEW HEAVY DUTY CONSTRUCTION

"WHY PAY MORE?" SALE PRICE **$12.95** Model CU-14X

McGee announces our new 1951 model 12-inch coaxial PM speaker, designed for the critical music listener; for use with high fidelity audio systems and radios. This new model reproduces all music and voice with a natural quality. It is improved over our last model in that the 12" woofer now has a heavy duty 31 oz. Alnico 3 magnet. This reproduces the lower musical register down to 40 cycles. The coaxially suspended tweeter has a specially designed cone for the higher register of music and voice. It will respond up to 17,500 CPS. The high pass filter is attached and combined impedance will hook up to any 8 ohm output transformer. It will connect in place of any ordinary speaker, (only two wires to connect). Why pay $20 to $40 for a speaker? McGee has them made to their own specifications, thousands and passes the savings on to you. We have sold over 10,000 coaxial speakers. Why pay more than McGee's price? McGee's 12", 20 watt wide range coaxial PM speaker, Model CU-14X, Net price, **$12.95**; 2 for **$25.00**. Shipping weight 10 lbs.



10 INCH SUPER HEAVY DUTY

PM speaker, 32 oz. magnet. Sale price $4.95. 3 for $13.95.

We made a special purchase on several hundred 20 watt, 10", 32 oz. Alnico 3 magnet PM speakers. Deep throat and easy moving cone. Ideal for all high fidelity sound systems and radio replacement. The magnet on this speaker is usually used on a 15" size. Very efficient, good high and bass response. You'll appreciate it when you get your hands on this speaker. Attractive copper finish, 8 ohm voice coil. Stock No. 1025PS. Weight 7 lbs. Net price $4.95 each.

Order three of these and use them in a cluster of three. They will take 60 watts of audio and have more cone area than any 15" speaker. For high power, top quality P.A. work. Think this over. 3 No. 1025PS speakers for only **$13.95**.

12 INCH WIDE RANGE P.M. MODEL 1202-X $9.95

A 12" curvelenier cone 25 watt wide range P.M. speaker, 14½ oz. Alnico V magnet 1¼" 8 ohm voice coil. Response 35 to 12500 C.P.S. A very fine speaker for music lovers. Amplifier and general P.A. use. Ship. wt. 7 lbs. Model 1202-X net **$9.95** each; two for **$19.00**.

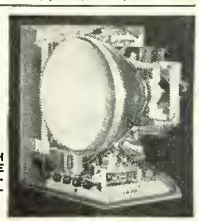
15 INCH

32 oz. Alnico 3 25 watt PM Speaker $10.95 each, 2 for $19.95.

A special purchase makes this value possible. A top quality 15" 25 watt Alnico 3 magnet PM speaker with 8 ohm voice coil. Very rugged for all radio & public address use. Good bass and high frequency response. Speaker similar to those used in juke boxes. A limited quantity to sell at the low price of only **$10.95** each. Two for **$19.95**. Stock No. 15-8S. Shipping weight 10 lbs.

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.

RADIO AND RECORD PLAYER $14.95

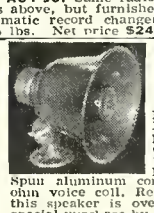
For your children's room. Buy this superhet radio and record player. Here is what you get: A full 5 tube superhet broadcast chassis all wired and tested. Walnut cabinet, 78 RPM phono motor and crystal pickup. All you do, when you receive your set is drill mounting holes in cabinet. We are offering you 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.**

REG. $54.00 LIST 25 WATT DRIVER AND TRUMPET $23.95

This trumpet and driver is especially designed for all outdoor speaker uses; churches, sound trucks, etc. It is the most popular size sold today. McGee offers you more for your money. Each speaker is fully guaranteed.

Model XX-100, all weather proof 31½ foot trumpet, made of aluminum castings and spinnings, 19" bell trumpet can be used with any standard driver. Regular **$29.00** list. Ship. weight 15 lbs. Net price **$13.50.** Model RM-30, standard 15 ohm, 25 watt driver for use with above trumpet. Quality second to none. Shipping weight 6 lbs. Net **$12.50.**

Combination offer. Buy the XX-100 trumpet and RM-30 25 watt driver, both for **$23.95.**



10 WATT PAGING SPEAKER $11.95

Model 10-XNP, 10 watt paging speaker with built-in weather-proof driver. Spun aluminum construction, 8 ohm voice coil. Regular net on this speaker is over $15.00. A special purchase by McGee makes this **$11.95** price possible. Shipping weight 4 lbs.

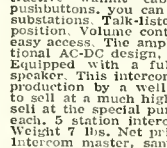
10 STATION INTERCOM MASTER $19.95; SUBS, $3.95 EACH

Super heavy duty, 10 station intercom master, designed for continuous service. A powerful AC transformer type with 80 rectifier, 6V6 output and 6SJ7 driver. 5" speaker with 2.15 oz. Alnico V magnet, Housed in a walnut cabinet 14" long, 6½" deep and 7½" high. Designed to install as a 3 wire system. 10 push button station selectro on front, with separate all station call switch. Talk-listen switch has silent position. Made to sell for a much higher price. McGee made a fortunate purchase and passes the bargain on to you. Shipping weight 12 lbs. **Stock No. 2520.** Net **$19.95** each. Remote station with call back switch, for use with the above master, **$3.95** each; 10 for **$35.00.** 3 wire intercom, cable **$1.75** per 100 ft. **$7.50** for 500 feet. **$12.60** per 1000 ft.

5 STATION INTERCOM MASTER 1950 MODEL Special Purchase SALE PRICE $14.95

5 station intercom master station, in an attractive walnut cabinet, 10x5½x6". 5 pushbuttons, you can call any one or more substations. Talk-listen switch has a silent position. Volume control on front panel for easy access. The amplifier is of the conventional AC-DC design, with plenty of power. Equipped with a full size Alnico V PM speaker. This intercom master is new 1950 production by a well known factory. Made to sell at a much higher price by 3000 to sell at the special purchase price of **$14.95** each. 5 station intercom master No. 2700. Weight 7 lbs. Net price **$14.95.**

Intercom master, same as above, except in addition to the 5 station switch a 6th push-button is added to call all stations at once. Stock No. 2701. Net price **$16.95** each.

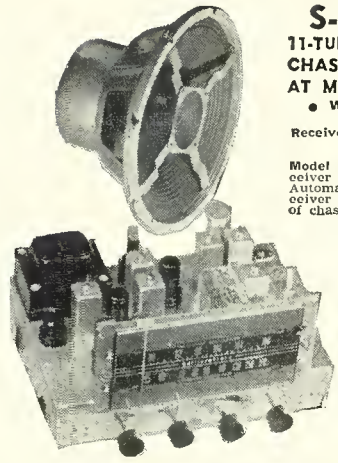


SUB STATIONS FOR ABOVE $3.95 EACH

Molded walnut plastic substations for use with Model 2700 and 2701 masters. Full size Alnico V magnet PM speaker, spring return call-back switch, size 5½x8½x3¼". Shipping weight 2 lbs. each. Mounts either on the wall or may be set on desk top. Very attractive. Net price **$3.95** each. **5 for $18.95.** Uses regular 3 wire intercom cable. Plastic 3 conductor cable, 100 feet **$1.50**, 500 feet **$7.50**, 1000 feet **$12.60.**

MODEL CN-1232 12 INCH 25 WATT PM $5.95

Another McGee red hot special 12" 32 oz. Alnico #3 ring magnet PM, 8 ohm voice coil speaker. Made by Consolidated. A regular **$17.00** list. Shipping weight 8 lbs. Model CN-1232. Net price **$5.95** each, 4 for **$22.00.**



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 **$32.50** list 12" coaxial (CU-14X) 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.**

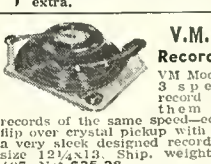
Pre-amplifier for 5-56 $3.95

Dual purpose preamplifier for either 5-56. 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.

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.

Aero made for Stewart-Warner with Webster swivel action cartridge, permanent needle. Base size 12½x13½". 12 lb. Net **$10.95.** 2 for **$21.00.**



V.M. 3 SPEED Record Changers

VM Model 407 deluxe 3 speed automatic record changer—plays them all—intermixes records of the same speed—equipped with a flip over crystal pickup with twin needles—a very sleek designed record changer—base size 12¼x13. Ship. weight 12 lbs. VM-407. Net **$35.28.**

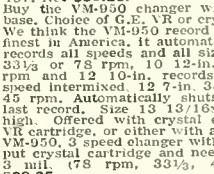
Buy the VM-930 changer with or without base. Choice of G.E. VR or crystal cartridge. We think the VM-950 record changer is the finest in America. It automatically plays all records all speeds and all sizes; 12 10-in., 33⅓ or 78 rpm, 10 12-in., 33⅓ or 78 rpm and 12 10-in. records of the same speed intermixed. 12 7-in. 333 or 12 7-in. 45 rpm. Automatically shuts off after the last record. Size 13 13/16x11⅞x7¼ in. high. Offered with crystal cartridge, G.E. VR cartridge, or either with a base.

VM-950, 3 speed changer with standard output crystal cartridge and needles for 1 and 3 mil. (78 rpm, 33⅓, 45 rpm). Net **$28.35.**

VM-950GE, 3 speed changer with the new RPX-050 magic button, all-in-one variable reluctance cartridge with stylus. Net **$31.27.**

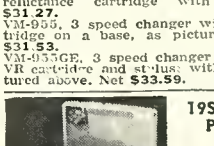
VM-955, 3 speed changer with crystal cartridge on a base, as pictured above. Net **$31.53.**

VM-955GE, 3 speed changer with RPX-050 VR cartridge and stylus, with base, as pictured above. Net **$33.59.**



78 R.P.M. RECORD PLAYER $11.95

Self-Contained Amplifier and Speaker. Here is a red hot value. A complete record player with its own amplifier built in. It has a 1.5 oz. Alnico V PM speaker. Extra heavy duty 78 rpm phono motor. The amp and speaker are concealed under the attractive plastic base. This is a complete built-up player and has better tone and more power than you would expect for a player of its size. Only 100 to sell. Stock No. E-100P. Sale price, **$11.95.**



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 play-back 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.**

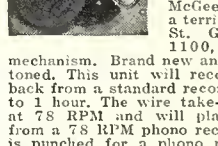
G.E. RECORD PLAYER ATTACHMENTS SALE PRICE $6.95

General Elec. 78 RPM Record Players to attach to any radio or amplifier. Heavy duty motor and standard crystal phono pick-up. Volume control and off-on switch. Shpg. weight 8 lbs. (No pre-amp necessary.) 78 RPM Model, Stock No. GE-78, **$6.95.** 33⅓ RPM Model, Stock No. GE-33 has Webster crystal pick-up with needle. Net, **$6.95.** Buy 3 for **$19.50.**

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 3⅞x4¼ x3". Suggested diagram furnished. Shipping weight 8 lbs. Net Price A-403, **$6.95.**

$19.95 BUYS A NEW St. George Wire Recording Mechanism ONLY 200 TO SELL



McGee offers you at a terrific saving, the St. George Series 1100, wire recording mechanism. Brand new and factory cartoned. This unit will record and play-back 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.** 60 minute spool. Net price **$2.79.**

McGrade Intercoms Master and Sub $14.95

McGrade Intercom. Master and substation, housed in small matching walnut plastic cabinets, 5½x8x3½ in. Sloping front for desk or wall installations. Furnished with 50 feet of interconnecting wire. Substation may be used up to 1000 feet from master station. These units are new and factory cartoned. Complete with tubes. Made to retail at $29.95. A lucky purchase enables us to offer these to you for only **$14.95.** include postage for 8 lbs. **Stock No. MB-3S.**

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.

RECORDING TAPE

A data sheet covering "Hifitone" sound recording tape may now be secured by writing to *Duplitex Laboratories* at 1770 West Berteau Avenue, Chicago 13, Illinois.

In addition to listing the advantages of this new tape, the bulletin carries information on the available reel diameters, tape lengths, and recording times. Other pertinent data of interest to tape users is also included.

GENERAL RADIO PARTS

General Radio Company, 275 Massachusetts Avenue, Cambridge 39, Massachusetts, is currently distributing copies of its comprehensive catalogue covering parts and components for electronic equipment.

The new catalogue lists and describes variacs, r.f. chokes, rheostats and voltage dividers, plugs and jacks, capacitors, decade-resistance units, bandpass filters, wavemeters, shielded transformers, decade attenuator units, wave filters, coaxial connectors, many types of dials, amplifiers, oscillators, capacitance and inductance bridges, v.t.v.m.'s, and various other types of equipment.

Copies of this 22-page reference and buying manual are available on request.

MICROPHONE CATALOGUE

A copy of the new *Electro-Voice, Inc.* catalogue 110 is currently available from the company at Buchanan, Michigan.

The colorful new publication presents up-to-date information and specifications on the company's line of dynamic, crystal, velocity, and carbon microphones of the omnidirectional, unidirectional, bidirectional, and differential types.

A valuable addition to the catalogue is a microphone selection guide which indicates the type of unit recommended for the varied applications in broadcasting, recording, p.a., communications, and sound level measurement. Technical information on the operation of various types of microphones is also included.

ACME TRANSFORMERS

A completely revised catalogue, the SD 179, covering step-down transformers and voltage and frequency-compensating units has been issued by *Acme Electric Corporation* of Cuba, New York.

The step-down units described have been especially designed to permit the operation of various types of standard equipment from 230 volt a.c. lines. The voltage and frequency changing units are intended for 50 cycle current areas to permit proper functioning of 60 cycle equipment.

RECORDING PAMPHLETS

Pocket-size pamphlets on sound recording tape, designed to be distributed by retailers to their customers, have been made available free by *Minnesota Mining and Manufacturing Co.* of 900 Fauquier Street, St. Paul 6, Minn.

The company, which manufactures the "Scotch" brand of sound recording tape, has announced that limited quantities of these 12-page pamphlets are available to dealers on request.

Entitled "You Don't Have to be a Recording Expert," the new booklet tells how magnetic sound recording tape works, provides suggestions on the care and use of sound tape, describes techniques for erasing and splicing tape, and lists uses for recording tape in homes, offices, schools, and churches.

CUSTOM UNITS

Shallcross Manufacturing Company of Collingdale, Pa., has issued a four-page flyer which lists some of the specialized components, sub-assemblies, and instruments that they are prepared to fabricate for manufacturers.

Included are high-stability precision resistors, multi-position selector switches, hermetically-sealed networks, high-range kilovoltmeter multipliers, and other custom-built units.

A copy of the flyer is available on request.

STEPHENS BOOKLET

Of interest to audio enthusiasts and service technicians engaged in custom installation work is the new 8-page booklet issued by *Stephens Manufacturing Corporation* of 8538 Warner Drive, Culver City, California.

Entitled "Installation Instructions and Suggested Uses for *Stephens* Tru-Sonic High Fidelity Audio Equipment," this 8-page booklet contains construction details on *Stephens* cabinets and general information of interest to the technician. Also included are wiring diagrams on the company's speaker systems, plus suggestions for most efficient wiring of speaker systems in general.

WIRE DISPLAY

Columbia Wire & Supply Co., 2850 Irving Park Road, Chicago 18, Illinois, is currently offering a sales-building

News that reaches you in less than a second!

How mobile television vans flash pictures from the field

No. 8 in a series outlining high points in television history

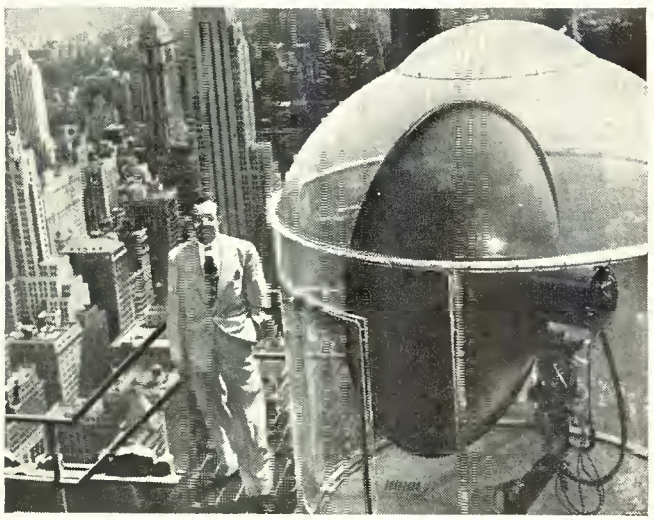
Photos from the historical collection of RCA

Mobile television van *operating "in the field"—note complete camera facilities, and microwave relay apparatus.*

• A fire starts miles away from your home, yet you are on the scene in a jiffy—perhaps as fast as the first hook-and-ladder!

This is television reporting—virtually, by any practical measurement, instantaneous—and making all other methods of news coverage seem slow. Behind it are basic research developments from RCA Laboratories.

"Eyes" of the mobile television vans which gather spot news are supersensitive RCA image orthicon television cameras, which "see" in the dimmest light. This sensitivity, since the light at a news event is usually outside human control, is a definite *must.*



Bowl-shaped antennas *at the parent television station pick up the microwave beam from the remote mobile van.*

Developed by RCA scientists on principles uncovered by the invention of its parent the *iconoscope*, an image orthicon pick-up tube is essentially three tubes in one. A phototube first converts the visual image into an electron image. This is then "scanned" by the electron beam of a cathode-ray tube—creating a radio signal. An electron multiplier next takes the signal and amplifies its strength for the trip through circuits to the transmitter.

Such compactness is characteristic of every operation inside a mobile television van, and RCA engineers have designed equipment—which might fill entire rooms in a standard studio—to fit the limited space of a truck. Yet every studio facility is present, even monitoring equipment and cameras that can swing quickly from a wide-angle view to a close-up.

Interesting, too, is the technique by which these mobile television vans flash what the camera sees back to the point from which it is telecast. Sharply focussed directional radio beams are used to carry the signal with a minimum loss of power.

More and more, as television spreads across the country, you may expect it to play a larger part in getting news to the public *fast.* And you may expect, from RCA laboratories, developments which will continue to increase the effectiveness of mobile television vans.

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

display stand to introduce its "Anaconda" line of television wires and cables.

The stand will accommodate an assortment of reels carrying all the necessary wire and cable types for a complete television installation or service work.

For full details on this display offer and the wire and cable types the stand will carry, write direct to the company.

TRANSFORMER CATALOGUE

The seventh edition of the *Stancor* Television Catalogue and Replacement Guide is now available from the *Standard Transformer Corporation*, 3580 Elston Avenue, Chicago 18, Illinois, or from any of the company's distributors.

This new 26-page booklet lists complete specifications and list prices of all *Stancor* transformers and related components for TV replacement or conversion, indexed for use in 618 television chassis and receiver models made by 64 manufacturers.

When writing for copies of the new catalogue, please specify Form 338.

POWER SUPPLIES

Literature describing the company's new "Varicell" d.c. power supplies is now available from *Superior Electric Company* of Bristol, Conn.

The 4-page booklet outlines the problems confronting the user of ordinary storage batteries and d.c. power supplies and then goes on to point out how the "Varicell" unit can solve these problems.

The publication explains in detail the workings of the unit and its operation. A circuit drawing, ratings, outline dimensions, stabilization and regulation data are also included.

In requesting copies of this booklet, please address all requests to R.F. Greene at the company.

TACO ANTENNAS

A comprehensive publication covering antennas and antenna accessories has been issued by *Technical Appliance Corporation* of Sherburne, New York, as its catalogue 32.

This 20-page booklet carries valuable data on various reception problems encountered by service technicians with suggestions for eliminating the trouble. In addition, the company's complete line of antennas is pictured, along with descriptive detail and performance graphs.

Accessories listed and described include such items as sectional masts, mast coupling units, mast straps, swivel brackets, adapter sleeves, chimney mounting units, U-bolts, guy anchors, guy ring supports, insulators, standoffs, etc.

A completely revised and up-to-date price list is included with the new catalogue.

WALL CHART

A handy industrial wall chart, measuring 18 by 25 inches, has just been issued by *Aircraft-Marine Products, Inc.* of 1615 N. 4th Street, Harrisburg, Pa.

The new reference chart simplifies the selection of the proper solderless terminal types by presenting all pertinent information in quick, easy-to-read form. The chart includes application and cost factors, uses, appearance of the terminal on wire, as well as details on numerous special construction features. Additional sections are devoted to tooling, splices and connectors, automatic machines, and special *AMP* processes.

"HEADLINERS FOR HAMS"

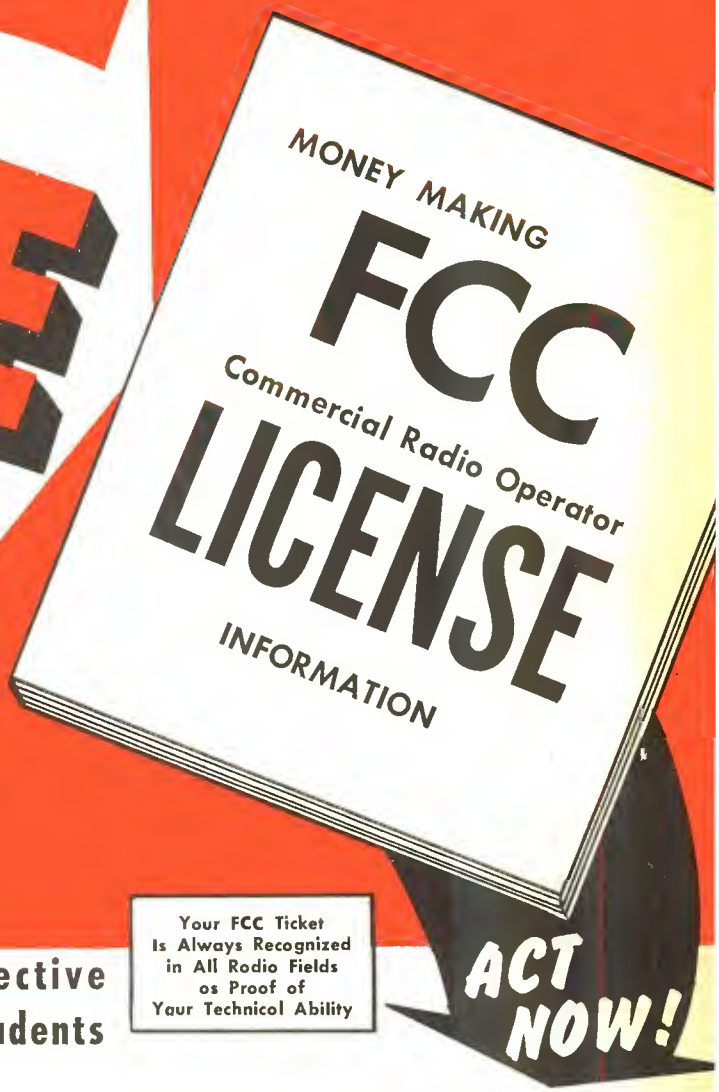
A new edition of "Headliners for Hams," a handy reference folder containing the latest technical data on 30 tubes of particular interest to radio amateurs, has been announced by the *RCA Tube Department*.

In addition to listing operating characteristics, the new folder gives socket connection diagrams on all listed tubes. Copies are available from *RCA* tube distributors.

—30—

Some of the estimated 1300 persons who gathered recently to protest a New York City plan to license radio and television technicians. Sponsored by John F. Rider Publisher, Inc., the Associated Radio-Television Servicemen of N. Y. Inc., the American Legion, and the National Electronic Distributors Association, the capacity crowd heard several speakers discuss the industry's objections to this type of licensing bill.

FREE



TELLS HOW—

WE GUARANTEE
TO TRAIN YOU AND COACH YOU AT HOME UNTIL YOU GET

YOUR FCC LICENSE
if you have had any practical radio experience—amateur, Army, Navy, radio repair, or experimenting

Your FCC Ticket Is Always Recognized in All Radio Fields as Proof of Your Technical Ability

ACT NOW!

TELLS HOW— Our Amazingly Effective JOB-FINDING Service Helps CIRE Students GET BETTER JOBS

GETS JOB WITH CAA

"I have had a half dozen or so offers since I mailed some fifty of the two hundred employment applications your school forwarded me. I accepted a position with the Civil Aeronautics Administration as a Maintenance Technician. Thank you very much for the fine cooperation and help your organization has given me in finding a job in the radio field."

Dale E. Young, 122 Robbins St., Owosso, Mich.

GETS PUBLIC UTILITIES JOB

"I have secured the position of Radio Technician with the Toledo Edison Company. I want to thank you once more. The help you gave me was much more than would ordinarily be expected—both in obtaining my license and in finding employment."

Norman W. Stokes, Jr., Rt. 11, Box 612, Toledo 7, O.

GETS DEVELOPMENT ENGINEERING JOB

"I wish to express my thanks for the Applications-For-Employment you recently prepared for me. I received 3 telephone calls and one letter. As a result I am now employed in a development engineering capacity."

K. E. Fosberg, 26 Soley St., Charlestown, Mass.

GETS BROADCAST JOB

"I have accepted a position with KWAD. I secured this position through the help of your Job-Finding Service and I had at least six other offers. I am sincerely under obligation to you."

Fred W. Kincaid, Box 241, Wadena, Minn.

TELLS HOW— Employers Make JOB OFFERS Like These To Our Graduates Every Month

Telegram, April 7, 1950 from Chief Engineer, Broadcast Station, Pennsylvania: "Immediate opening for engineer. Automobile and First Phone a must. If graduate available, please forward name and address."

Letter, April 14, 1950 from Chief Engineer, Broadcast Station, Montana: "Immediate opening for Engineer-Announcer. Basic salary $2.50 . . . real future for right man."

Letter, January 30, 1950 from Chief Engineer, Broadcast Station, Tennessee: "Have opening for operators. If you have men, please have them contact us."

These are just a few examples of the job offers that come to our office periodically. Some licensed radioman filled each of these jobs; it might have been you!

HERE'S PROOF FCC LICENSES ARE OFTEN SECURED IN A FEW HOURS OF STUDY WITH OUR COACHING AT HOME IN SPARE TIME

Name and Address	License	Hrs. of Training
James A. Gram, 11 West Main St., Cuba, New York	1st class telephone	34
Ernest K. Hudson, Box 1001, Caldwell, Idaho	1st class telephone	71
Howard J. Kischassey, Rt. 2, Box 736, El Cajon, Calif.	2nd class telephone	49
Ralph I. Nichols, 510 Elm St., Kerrville, Texas	2nd class telephone	34
Elbert L. Risinger, P.O. Box 122, Bedias, Texas	1st class telephone / 2nd class telegraph	34
Harry R. Rogers, R.R. 6, Lafayette, Indiana	2nd class telephone	50

Ours is the only home study course which supplies FCC-Type Examinations with all lessons and final tests.

Mail This Card Now
NO POSTAGE REQUIRED

Get All 3 FREE

☐ I want to know how I can get my FCC ticket in a minimum of time. Send me your FREE booklet, "How to Pass FCC License Examinations" (does not cover exams for Amateur License), as well as a sample FCC-type exam and the amazing new booklet, "Money-Making FCC License Information".

☐ I want to know how greater technical knowledge will bring promotion, better pay, security. Send me complete information, free, about CIRE Courses A, B, and C, with coaching and training under personal supervision of Carl E. Smith, E.E., at home in my spare time. (See our ad on next page.)

Be sure to check here if you have FCC Commercial License ☐ Yes ☐ No

NAME_____

ADDRESS_____

CITY_____

ZONE____ STATE_____

Veterans check for enrollment information under G.I. Bill. ☐

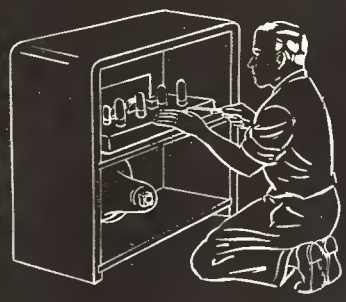
CLEVELAND INSTITUTE OF RADIO ELECTRONICS

Desk RN-21, 4900 Euclid Building, Cleveland 3, Ohio

(Address to desk to avoid delay) Approved for G. I. Training

SEE OUR AD ON NEXT PAGE

Where Will You be in ELECTRONICS IN 1951?



Study NOW for a Better Job Then!

IF YOU Want • A BETTER JOB • BETTER PAY • SECURITY
ADD TECHNICAL TRAINING TO YOUR PRACTICAL EXPERIENCE

These CIRE Courses Are the Solution to Your Problem of Promotion, Better Pay, Security

A—Master Course in Radio Communication — 4 courses in 1.

1. Complete Training and Coaching in the Fundamentals of Radio.
2. Complete Training and Coaching for the FCC Commercial License Examinations.
3. Complete Training and Coaching for the Jobs Which Require an FCC License.
4. Complete Training and Coaching for Broadcast Station Engineering and Operation.

B—Advanced Course in Radio Communication Engineering

A genuine college-level radio-engineering course, completely mathematical in treatment. For the advanced radioman with considerable practical experience and training.

C—Special Television Engineering

An advanced college-level course for the radioman who has had formal training equivalent to A or B.

You Will Easily Handle Professional Problems Like These with Carl E. Smith's Coaching-Training

1. An FM station feeds 3 kw power into an antenna with a power gain of 4 and height of 500 feet. Find the field strength at 25 miles and a height of 30 feet.
2. Design an H pad to match 250 ohms to 600 ohms with 15 db loss.
3. Find the values of reactances to be used in a T network matching a 230 ohm transmission line to an antenna with impedance $100 + j85$. Phase shift to be -90 degrees.
4. Design a low-pass m-derived filter to cut off at 1000 cps and have an infinite attenuation at 1200 cps.

This Famous Broadcast RADIO ENGINEER Personally Supervises Your Training

CARL E. SMITH, E.E.

Let Carl E. Smith, Nationally Known Radio and Consulting Engineer, through an amazingly complete home-study plan of coaching and training, teach you to handle radio-television-electronic engineering, successfully at home, in your spare time.

Then
Use Our Amazing Free Job-Finding Service to Get the Better Job—Better Pay—Security Your Increased Knowledge Entitles You to Have

LOOK AT THE BENEFITS THESE STUDENTS HAVE GOT!

"Since beginning the course, I have been appointed Director of Engineering of WLOS and WLOS-FM, and feel this course is responsible."
W. M. Chambers, Radio Station WLOS, Asheville, N. C.

"I should like to thank the Institute for all the good things that have come along my way since I started taking your course. I have received several raises in pay and have been promoted to Assistant Engineer."
Frank Schoales, Asst. Eng., CHEX, Ontario, Canada.

"After working at WHIZ for two years doing control room engineering, my 1st class ticket has already netted one raise in pay, with more to follow. Thanks for a well planned course and for the School's cooperation."
John P. Armstrong, 1349 Newman Drive, Zanesville, Ohio.

"I have recently completed your Nelson's Master Course, and have found it to be an excellent course in radio. It is a fine course for beginners in radio, and equally good for anyone already in the radio field desiring a review in basic radio, as well as a wealth of up-to-date material in all phases of radio communication."
Robert J. Schilling, Chief Engineer, Radio Station WIMS, Michigan City, Ind.

These Benefits Can Be Yours, Too!

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
4900 EUCLID BLDG. • CLEVELAND 3, OHIO
Approved for Veteran Training Under the "G.I. Bill of Rights"

TEAR OUT AND MAIL THIS CARD NOW!
Be Sure to Fill Out Reverse Side

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN UNITED STATES

2c POSTAGE WILL BE PAID BY

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
DESK RN-21
4900 EUCLID BLDG.
CLEVELAND 3, OHIO

FIRST CLASS
PERMIT NO. 8685
(SEC. 34.9 P. L. & R.)
CLEVELAND, OHIO

The Ad-Viser

(*Continued from page 37*)

How can we gain attention over all these obstacles? Simply by employing the basic rules of *emphasis*. Startling effects can be obtained with proper use of emphasis . . . sales stimulating effects which have been utilized by some of the most successful merchants of our day. Some of the best include the following:

Use of *white space* to surround the copy.

Use of *unusual photographs.*

Use of *color.*

Use of illustrations of *unusual size or shape.*

Use of *unusual layouts.*

Holding Attention

After attention has been been obtained, it is necessary *to maintain* that attention long enough to give the reader a message. The message, of course, is supposed to produce the action which is the main purpose of our efforts. In other words, the factors *attraction, attention,* and *action* are the mysterious elements within the ad which finally produce sales.

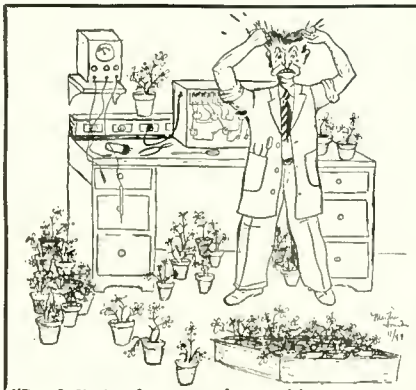
However, the merchandising picture is far from complete even with the most successful newspaper advertising. Combination promotions or tie-ins are important. Good merchandising calls for the use of window displays, store displays, direct mail pieces, radio advertising, etc. Each should be coordinated with newspaper advertising. Some excellent tips on typical tie-ins include:

1. Make "blow-ups" or large photostats of your newspaper ad and place them in your window, or on your counters or floor.

2. Display the same merchandise in your window or in your newspaper ad under the words, "As Advertised."

3. Get numerous "tear sheets" of your ad from the newspaper and display them prominently throughout the store.

The importance of tie-in promotions cannot be overemphasized. Advertising relies a great deal upon frequency and consistency. —30—



"But I distinctly remember writing one gross germanium diodes on the requisition!"

NIAGARA ONE OF AMERICAS GREAT ELECTRONICS STORES

NIAGARA'S Renovation SALE!

5 FLOORS CRAMMED WITH ELECTRONIC BARGAINS
OPEN DAILY (EXCEPT SUNDAY) TO 6 P.M.

THE RACE IS ON!
BC—728A

Last time these RCVRS were advertised we sold 3,000 in one month! A lucky buy brings you 500 more. So Hurry—Hurry—Hurry!

BC 72B PORTABLE RECEIVER CHASSIS

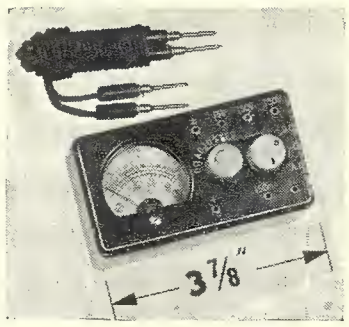
6 tube, 4 channel chassis—pushbutton controlled. 2 to 6 mc. covers marine, fire, police, aircraft and amateur freq's. Has T.R.F. and Audio Stages. All coils slug tuned in a very sensitive superheterodyne circuit. Small, compact and very desirable. Easily converted to broadcast. Schematic furnished. **$2.50**

Uses battery type tubes.

Cat. No. N-105. LESS TUBES. . . . . Postpaid in U.S.A.

Kit of 6 tubes: 3—1T4, 1—1R5, 1—1S5, 1—3S4. Special. **$4.72**

TINIEST V.O.M. IN THE WORLD



NIAGARA **exclusively** presents the "Universal Baby Tester," measuring 3⅞"x2⅛"x1-5/16"!! Contains a sensitive 0-240 microameter with the following ranges:

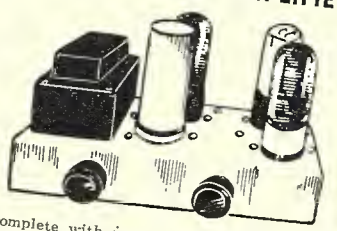
- 0-15 V AC or DC
- 0-150V AC or DC
- 0-750V AC or DC
- 0-150V DC MA.
- 0-100,000 ohms

Ohms adjust and DC-AC-OHMS switch. Includes 1 pair test leads. Will fit into your watch pocket. Fully guaranteed.

Cat. No. N-258. Special. $8.95

BIG SALE!

SCOOP VALUE
5 WATT AUDIO AMPLIFIER

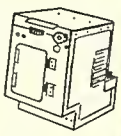


Complete with speaker and 3 tubes. Hi-impedance output for XTAL mike or Phono-Pickup. Volume and tone controls. 5 W. amplif. with 5" speaker. **$8.95**

Same as above with 8" speaker. **$9.95**

SPECIAL SCOOP
ARC 5/R—28
2 METER RECEIVER

HOTTEST 2 METER RECEIVER available today. 4 channel XTAL controlled with relays, easily converted. Covers 100—156 MCS. Supplied with all tubes, 4—717A, 1—12A6, 3—12SH7, and 2—12SL7 gt. Originally $65.00. Brand new—original cartons **$19.95**



WOW!

SMASHING REDUCTION
PHILCO R.F. SIGNAL GENERATOR
Model 7070

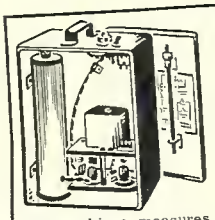
Designed for precision alignment and many other tests. Max. frequency stability, ample output, portable. 6C4 RF osc.—½ of 7F8 cathode follower—½ of 7F8 audio osc.—6X5GT rect. Six bands of RF from 100 KC. to 110 MC. ALL FUNDAMENTALS. Calibration accurate to within 1% of scale. Complete with shielded output lead and instruction book. 110 V. 60 cycle AC only. 20 lbs. A $185.00 value for only. **$39.95**

MORE LINES!

RENOVATION SPECIAL
1500 Volt—300 MA Power Supply Kit

Complete with punched chassis 19½" rack panel, tubes, choke, transformers, hardware etc.
WHAT A BUY!. **$24.95**

GOLD PLATED SPECIAL



234-258 MCS cavity oscillator. Fully wired. Can be used as 1 meter transceiver, signal generator, etc. Complete with tuning wrench, 2 955 acorn tubes, whip antenna, canvas cover, circuit diagram. Black wrinkle finish cabinet measures 9½x6½x6¾, weight 10 lbs.
While they last. **$1.89**

SALE!

BARGAIN LIST

BC-221 Used—Exc. XTAL and BOOK	$75.00
MN 25C Radio Compass—Used L.N.	
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BC-603 RCVR—BC-604 XMTR.	14.95
EXC Either	14.95

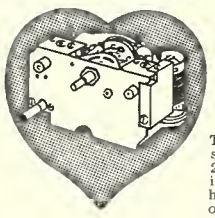
DOES YOUR TV SET DROOP FROM INTERFERENCE BLOOP

Banish interference with Niagara's Hi-pass filter! Positive protection against interference from amateur transmitters, diathermy, and all other devices generating radio frequency interference below 40 MCS. Designed for 300 ohm leadin. No loss in brightness or clarity. Available built up or in easy to assemble kit form. Complete instructions and test report included. Hi-pass kit. **$1.95**

Wired and tested. **2.95**

Plus 15c postage and handling in USA. Money back if not satisfied.

HEART OF THE BC-221
FREQ. METER



This VFO Sub-Assembly, used in BC-221 Freq. Meter, is ideally suited for home construction of:

1—Amateur V.F.O.
2—Freq. Mtr. Foundation
3—Portable Transmitter
4—Replacement for BC-221

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.

N-276.
New Low Price. **$4.95**

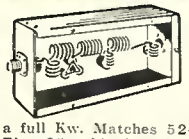
BIGGER BARGAINS!

T-17 MIKE

Lowest Price Ever! Slightly used, guaranteed perfect and clean. Single button carbon handmike. Light, efficient. 200 ohms. Press-to-talk switch. 5-ft. rubber cord with PL 68 plug attached.

Cat. No. N-249.
Used 2 for $1.00. New $2.50 each

LOW PASS FILTER



Don't be blamed for TVI! Tests have proven that Niagara's low pass filter attenuates all frequencies above 40 MC. May be used on all bands from 10 to 160 meters. Will easily handle a full Kw. Matches 52-72 ohm line.
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21 Years A Ham

(*Continued from page 56*)

kept two daily schedules on 80 meter c.w., and after the war we worked ground-wave on ten meters.

The years after leaving home were filled with running a beauty shop, operating my dancing school, raising a family of two boys, photography, and hamming.

Then came the war and a request that I teach radio for the AAF.

I was glad to have the opportunity of putting my radio experience to some good use. While teaching, I took the ground course along with the classes and did a bit of flying. When the war ended CAP asked me to teach for them, and W9GJX went back on the ham bands as W8GJX.

It was good to be back on the air, good to renew acquaintances with old c.w. friends and the new experience of working on ten meter phone was thrilling. Exposed as they had been for years, Jack, Jack Jr., and Chuck had never shown any interest until I swapped my dream of a mink coat for a BC-610 transmitter and an SX-25 receiver and pre-selector plus a ten meter beam and *Premax* "Roto-Mount." Then, when they could hear voices instead of dots and dashes, their interest perked up.

The whole family could enjoy it now and that, in itself, made my hobby more enjoyable to me. Now they could listen in, could take the mike and talk for themselves. Unconsciously they learned the "slanguage" of the phone bands.

Ham radio has given me many wonderful leads for stories for another of my hobbies—writing. After one develops a "nose for news" and an ear for a likely story, it is only another way to learn about the unusual, a new way to conduct an interview.

One such story started with a chat with W4OB in Tampa, Florida. Pat is a ship's pilot for passenger boats and freighters coming into Tampa Bay from the Gulf of Mexico. We drifted into many lengthy conversations about his duties as a ship's pilot and after daily QSO's I decided that here was material for a different sort of a story. On a later trip to Florida I contacted Pat, took pictures on the island where the men live between trips to the mainland and I had a story that made the front pages of 23 Florida newspapers.

Through radio I met Nat McKelvey of Tucson, Arizona, a prominent non-fiction writer, and we talked shop. The net result of some of these almost daily chats was collaboration on several stories that sold to national magazines, and a fine friendship.

I met His Honor, Mayor Earl Mead of Huntley, Montana, became an "official Dogcatcher" by appointment and another story was born.

I have certificates that prove I'm a member of the WAA (Worked All Alamagordo, New Mexico—the home of the A bomb), that I'm a member of the Black Eyed Pea Net of North Carolina, and a member of the Rag Chewers Club, the YLRL, and that I've worked so many stations in Orlando that I not only got the promised box of delicious fruit from them for working 15 stations but am now working on a key to the City Hall. Incidentally, I received the second box of fruit sent out by the Orlando Radio Club, the first box was sent to a KZ station.

My latest project is to get a "Polecat Certificate." I've exchanged insults with some of the W7 polecats but have not yet contacted the required number to entitle me to a full-fledged membership in that exclusive fraternity.

Somewhere toward the end of 1949 an idea began to incubate. The little red man began to needle me. "You've been class 'B' for 20 years, why don't you start out 1950 right. Or maybe you're too dumb anyway." This red gremlin promoted a trip to Chicago, the class "A" examination and, on February 2, two weeks and a half after taking the examination, my class "A" ticket arrived.

All this, in turn, promoted me to that popular niche on 75 meter phone, a buzzard on the "Buzzard's Roost Net," and to the Michigan Emergency Net.

The present routine of the day in-

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☆

Major in Electronics

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B.S. Degree in 36 Months

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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:

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

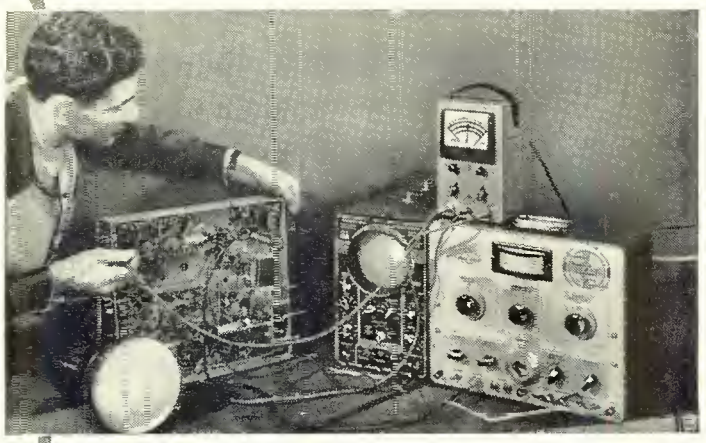
Typical job objectives:
Design Engineer
Electronics Research Engineer
Radio Engineer
Sound Engineer
Application Engineer
Field Engineer
Patent Attorney (with additional training in law)
Salesman of Electronic Equipment
Manufacturing Supervisor
Communications Engineer
Industrial Electronics Engineer
Television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

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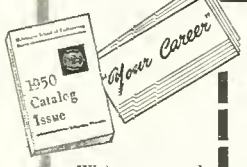

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☐ Check if World War II Veteran

cludes, operating my beauty shop, managing a 10-room home, three meals a day for the three men of the family, writing non-fiction and working on my seventh book of fiction, hamming, chasing BCI, and photography.

Yes, the old adage holds true, "To be a ham, you don't have to be crazy, but it sure helps!"

Ask any ham! —30—

NICE WORK!

ELEVEN members of the Milwaukee School of Engineering Amateur Radio Club contacted 225 hams in the United States, Canada, and Alaska recently during a 24-hour test made in Milwaukee as part of the ARRL Field Day activities.

The MSOE station, W9IIHX, used equipment furnished by the Club and augmented by its members. The school loaned a 2½ kva. a.c. generator driven by a gasoline engine to provide the necessary power for the operation of the "emergency" radio communications setup.

Wives of members helped the hams through their 24-hour vigil by preparing meals at the site of the test on the outskirts of Milwaukee. —30—

CONDENSER CHECKER

By NORRIS C. McKAMEY

WHILE several circuits of condenser checkers using "magic eye" tubes to indicate leakage have appeared in print this particular circuit seems to surpass such units in sensitivity.

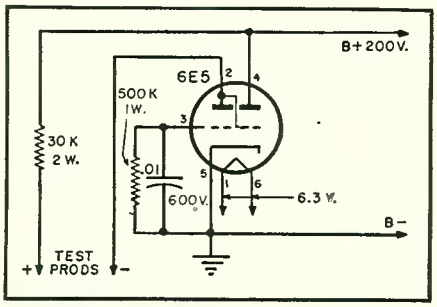
The sensitivity of the usual circuit seems to be limited, to a certain degree, by the value of the resistor in the target lead. This resistor usually has a value of one megohm and the sensitivity is, therefore, limited to one megohm. While this is entirely adequate for testing leakage of electrolytic filter condensers, it is not sensitive enough to give a leakage check on paper, mica, air, or oil-filled tubulars.

The circuit shown in Fig. 1 will indicate leakage of well over 100 megohms thus making the tester suitable as a condenser leakage checker for all types of units.

In operation, the shadow of the 6E5 will close on contact with a shorted condenser and when checking a leaky or intermittent unit the shadow will flicker. It will also give some visual indication of the values of resistors. Different values of resistance will cause the "magic eye" to display different degrees of closing.

The shadow closes when the test prods are shorted. The proper polarity of the test prods must be observed when checking electrolytics otherwise a false indication will be registered on the tube. —30—

Fig. 1



1000 KC crystal BT cut	$3.95
3" scope shield	1.29
2 speed dial drive for ¼" shaft ratios 5:1 1 to 1	.39
ATC 100 mmfd air trimmer screwdriver shaft	.29
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500 watt 12.5 ohm power rheostat	3.49

R-H-S
SPECIALS OF THE MONTH

50 mmfd 5 KV GE vacuum condenser	$1.49
2v, 6v, 12v vibrators any type	.98
Rotary switch GE Mycalex, 2 deck SP3T	.39
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2 mfd 3000v oil condenser Aerovox	3.25
3 mfd 4000v oil condenser Micamold	3.95
24 mfd 1500v DC 3KV flash. Excellent for speed lamp	3.95

TUBES!! BRAND NEW! STANDARD BRANDS! NO SECONDS! COMPARE! TUBES!!

0A3/VR75	$ 1.05	3C24/24G	$ .39	227A/5C27	$2.49	812	$2.45	8014	$19.95	0A2	$1.29	5Z4	$ .74	6SN7GT	$ .89	12SL7	$ .55
0B3/VR90	.89	3C31/C1B	3.49	249C	1.75	812H	6.90	8020	.89	0A4G	.95	6A3	.92	6SQ7	.47	12SN7	.57
0C3/VR105	.74	3C45	12.75	250R	5.95	813	6.85	8025	3.69	0B2	1.52	6A4LA	1.09	6SB7GT	.49	12SQ7	.59
0D3/VR150	.48	3CP1	1.39	250TH	18.95	814	2.25	9001	.39	0Z4	.61	6A6	.79	6SS7	.49	12SR7	.55
1B22	2.95	3CP1-S1	2.25	250TL	18.95	815	2.25	9002	.32	01A	.41	6A7	.65	6ST7	.72	12Z3	.72
1B23	8.75	3DP1	3.10	274B	5.50	816	1.05	9003	.49	1A3	.57	6A8	.75	6SU7GTY	1.25	14A4	.79
1B24	4.95	3DP1-S2A	4.75	274B	1.95	826	.39	9004	.34	1A4P	1.05	6AB7	.79	6SV7	.74	14A7	.59
1B26	2.95	3D21A	.98	276A	6.95	828	9.95	9005	1.49	1A5GT	.65	6AC5GT	1.15	6T7G	.89	14B6	.67
1B27	24.50	3E29	9.95	293A	2.98	829B	9.95	9006	.18	1A6	.78	6AC7	.98	6T8	.85	14F7	.72
1B29	2.75	3FP7	1.15	304A	3.95	830B	3.19	9007	.29	1A7GT	.72	6AD7G	1.09	6U5G	.62	14F8	.79
1B32	4.75	3GP1	4.45	300B	9.95	832	4.95	C6A	7.95	1AB3	.72	6AE6G	.79	6U6GT	.63	14H7	.59
1B30	24.96	3HP7	2.89	304TH	3.65	832A	7.95	C6J	4.45	1B3/8016	1.29	6AF6G	.81	6U7G	.49	14J7	.87
1B38	32.50	4-65A	14.21	304TL	1.29	833A	33.95	CI00D	1.49	1B4	1.19	6AG5	.74	6V6	.89	14N7	.85
1N21 Xtal	.59	4-125A	26.95	305A	24.95	836A	1.25	CK502AX	2.95	1B5/25S	.79	6AG7	.98	6V6GT	.57	14Q7	.53
1N21A Xtal	.89	4-250A	29.95	307A/RK75	6.95	837	1.15	CK503AX	2.95	1B7GT	1.05	6AH6	1.19	6W4	.63	14R7	.65
1N21B Xtal	1.39	4AP10	3.95	310A	6.95	838	2.35	CK505AX	2.25	1C6	.74	6AK5	1.25	6W7G	.77	19	.74
1N22 Xtal	.89	4B22/FL5B	9.95	316A	.45	841	.33	CK506AX	2.25	1C7G	.84	6AK6	.80	6X4	.55	24A	.57
1N23 Xtal	.79	4B24/EL3C	4.75	323A/B	24.50	843	.27	CK507AX	2.25	1D5GP	.95	6AL5	.75	6X5GT	.51	25L6GT	.55
1N23A Xtal	.79	4B25/6CF	7.50	327A/5C37	2.49	845	3.75	CK512AX	2.25	1D7G	.89	6AQ5	.65	6Y6G	.63	25Z5	.52
1N23B Xtal	2.95	4B26/2000	4.95	328A	12.95	849	29.50	CK571AX	8.50	1D8GT	.89	6AQ6	.59	6Y6G	1.05	25Z6GT	.49
1N27 Xtal	1.69	4B28	2.95	331A	12.95	851	13.95	CK1003	.15	1E5GT	1.29	6AR5	.54	6ZY5G	.59	26	.46
1N34 Xtal	.79	4B32	9.95	350A	1.98	852	6.25	CK1006	.63	1E7G	1.19	6AT6	.47	7A4/XXL	.55	28D7	.39
1N34A Xtal	.85	4C27/CV92		350B	1.69	860	6.95	E1148	.29	1F4	.72	6AU6	.69	7A5	.59	30	.49
1P23	2.95		49.50	368AS	2.39	861	10.95	EF50	.69	1F5G	.72	6AV6	.45	7A6	.59	31	.57
1P24	.79	4C35	22.50	371A	.45	864	.29	F123A	7.95	1G4GT	.75	6B4G	.89	7A7	.69	32	.85
1P36	2.69	4D22	9.95	371B	.39	865	1.45	F127A	22.50	1G6GT	.65	6B6G	.72	7A8	.69	32L7GT	.85
1S21	3.79	4D32	12.95	388A	.79	866A	1.05	F128A	89.50	1H1G	.63	6B7	.87	7AG7	.69	33	.65
2AP1	4.95	4E27/257B		393A	3.49	866JR	1.05	F606	37.50	1H5GT	.65	6B8G	.59	7B4	.53	34	.32
2AP5	4.95		14.95	394A	3.49	869B	26.50	F660	49.50	1H6GT	.87	6BA6	.61	7B5	.65	35/51	.52
2C21/RK33	.35	5AP1	1.79	417A	8.95	872A	1.25	F862	397.50	1J6GT	.78	6BE6	.59	7B6	.55	35A5	.65
2C22/7193	.19	5AP4	1.79	434A	2.95	874	.89	FG17	3.95	1L4	.57	6BF6	.54	7B7	.55	35B5	.55
2C26A	.19	5BP1	2.29	446A	1.25	876	.35	FG27A	8.75	1LA4	.75	6BG6G	1.45	7C4	.34	35C5	.59
2C34/RK34	.27	5BP4	2.39	446B	1.79	878	1.69	FG32	7.95	1LA6	.95	6BH6	.59	7C5	.48	35L6GT	.62
2C39	24.50	5CP1	1.39	450TH	19.95	884	1.39	FG57	12.95	1LB4	1.05	6BJ6	.59	7C6	.79	35W4	.43
2C40	2.45	5CP7	3.49	450TL	44.50	885	1.39	FG81A	3.29	1LC5	.74	6C4	.45	7C7	.59	35Y4	.47
2C43	8.95	5C22	49.50	527	9.75	902	3.39	FG105	8.95	1LC6	.91	6C5	.51	7E5	.67	35Z3	.55
2C44	.98	5D21	18.95	559	.98	905	2.59	FG172	29.50	1LD5	.79	6C6	.57	7E6	.54	35Z4	.44
2C46	6.95	5FP7	1.19	562	97.50	908	7.95	GL146	8.95	1LE3	.75	6C8G	.69	7E7	.59	35Z5	.49
2C51	5.75	5GP1	2.69	703A	11.95	909	1.49	GL434A	2.69	1LG5	.89	6D6	.48	7F7	.59	36	.67
2D21	1.25	5JP1	24.45	701A	2.95	919	1.95	GL451	.89	1LH4	.79	6D8G	.72	7H7	.59	37	.35
2E22	1.19	5JP2	8.95	702A	2.69	923	.72	GL502A	1.85	1LN5	.78	6E5	.69	7K7	.89	38	.39
2E24	4.69	5JP4	24.45	703A	2.39	927	1.09	GL562	49.50	1N5GT	.71	6F5	.47	7L7	.65	39/44	.28
2E26	3.39	5J23	12.95	704A	1.05	930	.79	GL592	14.95	1P5GT	.58	6F6	.59	7N7	.65	41	.49
2E30	2.29	5J26	12.95	705A	.89	931A	3.59	HF125	14.95	1Q5GT	.57	6F6GT	.57	7Q7	.54	42	.47
2J21A	7.95	5J30	49.50	706B	24.95	954	.19	HF300	19.95	1R4	.49	6F7	.65	7R7	.65	43	.47
2J22	8.45	5LP1	11.95	706CY	16.95	955	.24	HY114B	.79	1R5	.79	6F8G	.82	7S7	.85	45	.49
2J26	6.50	5NP1	2.49	706FY	42.50	956	.24	HY115	.79	1S4	.82	6G6G	.72	7V7	.75	45Z3	.55
2J27	10.95	6C21	18.95	706GY	42.50	957	.22	HY615	.15	1S5	.59	6H6	.43	7W7	.79	45Z5	.51
2J30	3.50	6F4	5.79	707B	14.95	958	.22	KC4	37.50	1T4	.65	6H6GT	.42	7Y7	.79	46	.64
2J31	8.49	6J4	4.59	708A	3.59	959	.49	KU610	6.95	1T5GT	.72	6J5	.47	7Y4	.48	47	.65
2J32	12.95	7BP7	4.49	709A	3.95	991/NE16	.22	ML101	49.50	1U4	.72	6J5GT	.42	7Z4	.54	48	1.49
2J33	18.95	9GP7	8.95	710A/8011	.85	1603	1.98	REL21	.98	1V	.65	6J6	.89	12A	.49	49	.85
2J34	18.95	9JP1	5.95	713A	7.95	1613	.49	RK30	7.95	2A3	.92	6J7	.63	12A6	.24	50A5	.74
2J36	97.50	9LP1	13.95	714AY	3.52	1614	1.29	RK35	4.15	2A4G	1.07	6J7GT	.59	12A7	.89	50B5	.63
2J37	12.75	9LP7	3.49	715A	6.49	1616	.59	RK33	.24	2A5	.64	6K5GT	.79	12A8GT	.49	50C5	.59
2J38	9.95	10BP4	18.95	715B	6.85	1619	.24	RK34	.27	2A6	.69	6K6GT	.49	12AH7GT	.91	50L6GT	.65
2J39	19.95	7DP4	17.95	715C	22.45	1622	1.49	RK48A	14.95	2A7	.69	6K7	.46	12AL5	.79	50Y6	.59
2J40	24.50	10	.25	717A	1.55	1624	.98	RK59	1.49	2B7	.75	6K8	.79	12AT6	.52	53	.87
2J46	43.50	12DP7	11.95	721A	2.25	1625	.18	RK65	24.50	2V3G	.54	6L5G	.85	12AT7	1.02	56	.45
2J48	15.75	12GP7	12.75	722A	2.95	1626	.24	RK72	.59	2X2	.37	6L6	1.10	12AU6	.65	57	.44
2J49	39.50	12HP7	12.75	723A	6.75	1629	.25	RK73	.59	2X2A	.65	6L6G	.99	12AU7	.98	58	.49
2J50	22.50	12LP4	22.50	723A/B	12.95	1630	.98	RK21A	2.39	3A4	.34	6L6GA	.97	12AV6	.54	59	.85
2J54B	22.95	15E	1.19	724B	2.69	1631	.85	RK31A	8.95	3A5	.79	6L7	.79	12BA6	.59	70L7	.99
2J55	5.50	15R	.59	725A	6.45	1632	.79	V70D	7.35	3A8	1.75	6L7G	.87	12BE6	.59	71A	.62
2J61	24.50	16AP4	42.50	726A	4.95	1633	.69	VR78	.29	3B7/1291	.29	6N7	.79	12C8	.47	75	.53
2J62	34.50	16CP4	42.50	726B	29.50	1634	.75	VR91	1.10	3D6/1299	.29	6Q7	.69	12F5GT	.55	76	.37
2K25	19.75	19T8	.87	726C	49.50	1636	2.95	VR92	.69	3LF4	.79	6R7	.69	12H6	.31	77	.43
2K28	24.95	22DP4	8.95	730A	8.95	1638	.65	VT127A	1.98	3Q4	.58	6S7G	.79	12J5GT	.34	78	.44
2K29	24.50	28D7	.39	750TL	79.50	1644	.98	VT158	14.95	3Q5GT	.67	6S8GT	.85	12J7GT	.67	80	.43
3AP1	4.59	30 SPEC	.25	800	1.69	1654	2.39	VU39	2.95	3S4	.65	6SA7	.49	12K7GT	.52	82	.84
3B22/ELIG	1.35	35TG	5.95	801A	.25	1665	1.19	VU111	.49	3V4	.72	6SC7	.59	12K8	.55	83	.87
3B23/RK22	4.85	43 SPEC	.19	802	3.89	1851	.89	WL468	5.95	5R4GY	1.15	6SD7GT	.44	12Q7	.55	83V	.87
3B24	1.59	53A	5.95	803	3.10	1000	.79	WL530	12.75	5T4	.79	6SF5	.52	12SA7GT	.67	84/6Z4	.59
3B24W	2.89	75TL	5.95	804	6.45	1961	4.99	WL531	1.75	5U4G	.72	6SF5GT	.49	12SC7	.57	85	.62
3B25	4.39	100R	.89	805	3.65	2050	1.19	WL532	1.89	5V4G	1.05	6SF7	.55	12SF5	.55	89Y	.35
3B26	1.49	100TH	9.95	806	29.95	2051	.39	WL578	.89	5W4	.79	6SG7	.59	12SF7	.49	117L7/M7	1.21
3B27	1.95	121A	2.65	807	1.49	8005	4.59	WL616	37.50	5X4G	.57	6SH7	.49	12SG7	.52	117N7	1.29
3B28	7.95	203A	5.95	808	1.29	8011	.49	WL619	18.95	5Y3GT	.41	6SJ7	.52	12SH7	.35	117P7	1.19
3BP1	2.59	211	.39	809	2.25	8012	1.29	WL677	34.50	5Y4G	.51	6SK7	.52	12SJ7	.57	117Z3	.53
3C22	39.50	212E	49.50	810	9.55	8013	1.39	WL681	22.50	5Z3	.52	6SL7GT	.52	12SK7	.67	117Z6	.69
3C23	5.95	215A	.19	811	2.10												
		217C	6.75														

SELENIUM RECTIFIERS
FULL WAVE BRIDGE TYPE

Input 0-20v AC Type No.	Current	Output 0-14.5V DC Price
20D1	1.2 Amps	$ 2.49
20E1	2.4 Amps	3.49
20F1	6.4 Amps	4.95
20K1	13.0 Amps	8.95
20J1	17.5 Amps	11.95
20K2	26.0 Amps	17.95
20K3	39.0 Amps	24.95
20K4	52.0 Amps	29.95
20K5	65.0 Amps	35.95
0-40v AC	**Current**	**0-34v DC**
40D1	.6 Amps	$ 2.95
40E1	1.2 Amps	3.89
40F1	3.2 Amps	5.25
40K1	6.0 Amps	9.95
40J1	9.0 Amps	12.95
40K2	12.0 Amps	18.95
40J2	18.0 Amps	22.45
40K4	24.0 Amps	32.50
40K5	30.0 Amps	34.95
40J4	36.0 Amps	39.50
0-120v AC	**Current**	**0-100v DC**
40D1A	.6 Amps	$ 7.85
40E1A	1.2 Amps	10.76
40F1A	3.2 Amps	16.65
40K1A	6.0 Amps	24.75
40J1A	9.0 Amps	32.95

CENTER TAPPED RECTIFIERS
Single Phase Full Wave Bridge

10-0-10v AC	Current	0-8v DC
10D1	1.2 Amps	$ 1.89
10E1	2.4 Amps	2.25
10F1	6.4 Amps	3.87
10K1	12.0 Amps	4.95
10J1	16.0 Amps	7.95
10K2	24.0 Amps	10.75
10K3	36.0 Amps	14.75
10K4	48.0 Amps	17.75
10K5	60.0 Amps	19.95
10K6	72.0 Amps	25.57
10K7	84.0 Amps	27.95
10J6	96.0 Amps	32.50
10K10	120.0 Amps	42.50

Let us bid on your special selenium rectifier wants in any quantity

TRANSFORMERS—115V 60 CY
HI-VOLTAGE INSULATION

6250v or 3850v or 2600v @ .056 arms	$13.95
2700v @ 2 MA; 6.3v @ .6A; 2.5v @ 1.75A	4.95
2500v @ 15 MA	3.49
1600v @ 4 MA; 350-0-350v @ 150 MA; 6.3v @ 3A; 2.5v @ 2A	4.45
1540v @ 5 MA; 340-0340v @ 300 MA	4.35
1120-0-1120v @ 500 MA; 12v CT @ 14A; 2.5v @ 10A; 17v @ 2.5A; 32v @ 25 MA; 115/230 Pri	16.95
925v @ 10 MA; 525-0-525v @ 60 MA; 2X5v @ 3A; 6.3v CT @ 3.6A; 6.3v @ 2A; 6.3v @ 1A	5.55
700-0-700v @ 300 MA	7.95
500-0-500v @ 175 MA	4.55
430-0-430v 340 MA; 6.3v CT @ 6.3A; 5v @ 6A	4.85
425-0-425v @ 75 MA; 6.3v @ 1.5A; 5v @ 3A	3.65
415-0-415v @ 60 MA; 5v CT @ 2A; 115/230 Duel Pri	4.97
405-0-405v @ 150 MA; 6.3v CT @ 2½A; 5v @ 3A; 2.5v CT @ 5A	4.3
400-315-0-100-315v @ 200 MA; 2x6.3v @ 9A; 5v @ 3A; 2.5v @ 2A	5.35
500-385-0-385v @ 200 MA; 3x6.3v @ .6A; 5v @ 3A; 2.5v @ 2A	4.75
325-0-325v @ 12 MA; 255-0-255v @ 240 MA	4.25
300-0-300v @ 65 MA; 6.3v @ 2.5A; 6.3v @ 1A; 2x5v @ 2A	3.25
80-0-80v @ 225 MA; 5v @ 2A; 5v @ 4A	2.97
0-17.4/21.6/25.8v @ 400 MA; 8.4v @ .5A; 2.6v CT @ 2.5A Pri 115/230	3.85
18 or 38v @ 15A. $8.75 13.5v CT @ 3.25A.	2.17
12.6v CT @ 10A; 11v CT @ 6.5A	6.35
3x10.3v CT @ 7A. $6.95 6.3v @ 1A	.77
6.5v @ 12A; 6.3v @ 2A; 115v @ .1A	3.50
6.4v @ 10A; 6.3v @ .6A	2.77
6.5v @ 8A; 6.5v @ 6A; 2.5v @ 1.75A	4.17
6.3v @ 1A; 2.5v @ 2A. $2.29 4-0-4v @ 1A	.87
6.3v CT @ 3.5A; 2.5v CT @ 3A	2.97
5v CT @ 20A; 10 KV INS	8.95
.6v @ 15A BMS	1.47

TRANSFORMERS—220v 60 Cyc

512.5-0-512.5 @ 427 MA	$ 5.35
3x5v @ 6A; 4v @ .25A	2.95
3x6.3v CT @ 3A; 6.3v CT @ 1.6A	2.95
10v CT @ 6.5A; 6.3v CT @ 2.5A; 6.3v CT @ 1.8A 220/440 Pri	3.95
Step Up/Down 110/220 500 watt	10.95
Step Up/Down 110/220, 220/440 600 watt	14.95

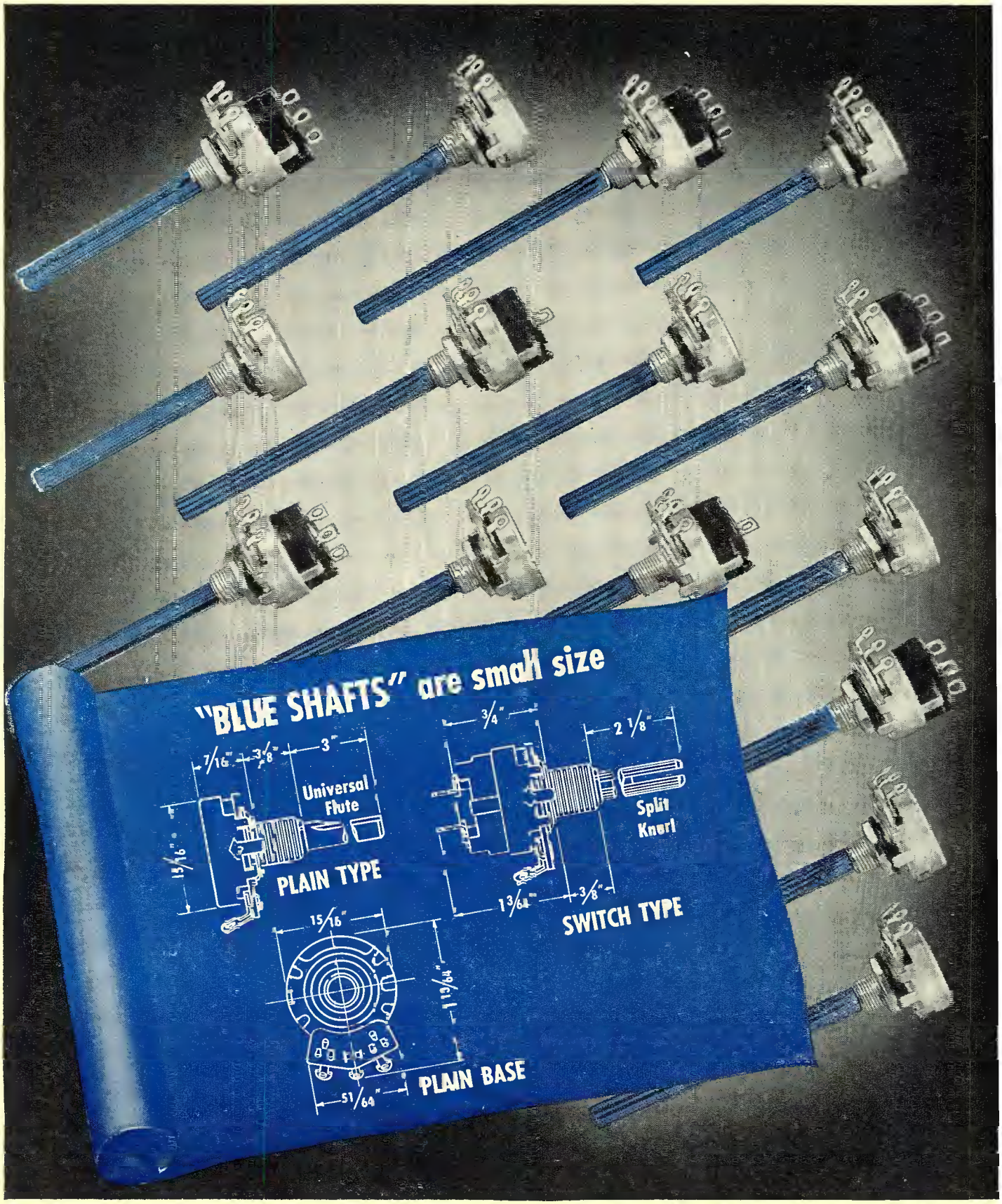
EQUIPMENT SPECIALS

APN-1 Altimeter Xceiver	Like New	$ 7.95
ATR Inverter 12v DC in 110v AC Out 125 w Int. 100 w Cont.	New	14.95
AN/CRW-2 UHF Receiver	New	5.95
BC357 Beacon Receiver	Good	3.45
BC433 Receiver	Good	24.94
BC456 Modulator	Good	1.98
BC434A Control Box/BC433	Used	1.95
BC458 Transmitter	New	8.95
BC602A Control Box/SCR522	Used	.39
BC778 Gibson Girl	Good	3.95
BC958-121 Xmitter 100-158 MC	New	39.50
BC1016 Tape Recorder	New	459.50
BC1206A Beacon Receiver	Good	4.95
CF1 Navy Unit w/200KC Crystal	New	14.95
DM 19 Dynamotor 12v DC in 500v 200 MA Cont. Out	Good	4.95
EE8 Foundation Unit	Good	4.95
MN26C Compass Receiver	Good	24.95
M110 Dynamic Chest Mike	New	3.95
PE94 Dynamotor/SCR522	Good	1.98
PE97A Vibrator Power Supply	New	6.95
PE104 Vibrator Supply	Excellent	24.95
R89/ARN5 Receiver	New	9.95
R89/ARN5 Receiver Less Tubes, Covers	Good	4.95
SCR518 Altimeter Complete	New	39.95
T17 Carbon Mike	New 1.98 Used	1.29
TU25 Tuning Unit/BC223	New	1.79

FILTER CHOKES HI V INS

.025 HY @ 1.36A.	$1.98	10 HY @ 200 MA.	$2.15
.05 HY @ 15A.	7.95	10/20 HY @ 85 MA	1.49
.065 HY @ 2.5A.	2.49	13 HY @ 130 MA.	1.55
1 HY @ 5A.	6.95	13 HY @ 250 MA.	2.95
2 HY @ 175 MA.	1.49	14/3.5 HY @ 40/400 MA	6.95
3 HY @ 50 MA.	.39	15 HY @ 25 MA.	.59
3/30 HY @ 250 MA	3.65	15 HY @ 70 MA.	1.15
5 HY @ 70 MA/.2 HY 350 MA Duel.	2.39	28.5 HY @ 125 MA.	1.98
5.3 HY @ 775 MA	9.95	200 HY @ 10 MA.	2.95
10 HY @ 55 MA.	.89	325 HY @ 2 MA.	2.95
10 HY @ 100 MA.	1.49	600 HY @ 1 MA.	2.95

Announcing CENTRALAB'S



NEW Blue Shaft CONTROLS

Centralab now offers service engineers... today's finest replacement controls . . . quickest for servicing . . . at today's most favorable prices

8 Reasons why "Blue Shafts" are better

1. Blue Shaft controls are complete, ready-to-use units — factory assembled and tested including switches. No time lost fussing with assembly — smooth action guaranteed.
2. Blue Shaft Controls are *small size* — only 15/16" diameter — meet any modern service requirement.
3. Shafts — Standard Model B — 3" long — universal fluted — full length mill. Model BSK — 2⅛" long with split knurl.
4. Switches — positive throw in both "on" and "off" positions. Terminals — surfaces elevated to eliminate danger of shorting to cover legs . . . ⅛" hole diameter for quick wiring . . . hot tin dipped for easy soldering.
5. Contact Spring gives you double wiping contacts on both resistor and center terminal ring . . . to insure noiseless operation.
6. Blue Shaft resistors are made of special resistance material bonded to high quality phenolic for smooth operation, low noise level, outstanding humidity characteristics.
7. Insulator's high dielectric strength permits breakdown test at 1000 volts R. M. S. *Dust and dirt can't get in.*
8. Blue Shaft Controls are produced and *guaranteed* by Centralab — the company that *introduced* carbon-type controls to the radio industry 25 years ago!

"Blue Shafts" offer complete range of all values

Service engineers! Centralab's new Blue Shaft controls are an exclusive *service item* and are available in a complete line of plain and switch types. Resistance ranges from 500 ohms to 10 megohms in a wide variety of tapers and tapped units suitable for any circuit.

Blue Shaft Controls are available packaged singly, in handy plastic boxes containing 12 — and in a special metal cabinet containing 22 controls—*No extra charge for the cabinet.* Ask your nearest Centralab distributor for complete details on all Blue Shaft controls.

Check These LOW PRICES on Popular Size Controls!

Cat. No.	Ohms Max. Resistance	Taper	Circuit Location	List Price
B-60	500,000	C-2 (audio)	Volume or Tone	$1.00
B-60-S*	500,000	C-2 (audio)	Volume or Tone	$1.50
B-70	1 megohm	C-2 (audio)	Volume or Tone	$1.00
B-70-S*	1 megohm	C-2 (audio)	Volume or Tone	$1.50

*Switch Type

Get More Information . . . You can get complete information on the entire Blue Shaft line of replacement controls from Centralab's new Bulletin No. 42-106. Ask your jobber or write direct.

Centralab® CRL

CENTRALAB DIVISION OF GLOBE-UNION INC., 910 East Keefe Avenue, Milwaukee 1, Wisconsin

Please send me Blue Shaft Control Bulletin No. 42-106 ☐ Include new Centralab Catalog No. 27 ☐

Name.....

Company Name.....

Address.....

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

Please!

Your Distributor's Name.....

Address.....

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

Better Business Bureau Moves To Curb TV Evils

New York launches vigorous campaign against "gyp" television companies.

Hugh R. Jackson, president of the Better Business Bureau of New York, presenting the BBB video program.

Robert C. Sprague, Radio-Television Manufacturers Assn.'s prexy, urging industry acceptance of plan.

By ROBERT HERTZBERG

A DETERMINED campaign to stamp out the growing evils in the selling and servicing of television sets and to educate the buying public in methods of self-protection was launched recently by the Better Business Bureau of New York City, Inc. Similar drives are being started by affiliated Bureau organizations in other large cities.

The drive in New York City got off to an auspicious and heavily-publicized start with a meeting in the Engineering Societies Auditorium attended by a capacity crowd of more than a thousand dealers, service technicians, representatives of TV manufacturers, and civic officials.

Hugh R. Jackson, president of the Better Business Bureau of New York City, presented an action program on behalf of the Bureau and its cooperating organizations. The program, as presented, has two major objectives: First, to establish and maintain standards for advertising and selling within the industry in order to reduce faulty and misleading practices; and second, to inform the public, principally through a consumer booklet, of the basic facts they should know about the purchasing and servicing of television sets.

"Radio and television represents the largest single category of complaints handled by the Better Business Bureau," declared Mr. Jackson. "In the first five months of this year, we re-

A representative group of dealers, technicians, factory and sales representatives, and other interested parties attended the BBB meeting held recently in New York.

YOUR OPPORTUNITY IS HERE NOW! LEARN

TELEVISION

RIGHT AT HOME!

By the new method of

TRANSPONDENCE

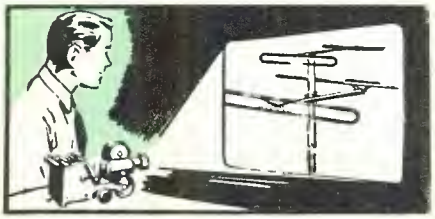
training on film and tape recordings

Now the De Forest-Sanabria Corporation—a division of the world's largest television training school—brings class-room instruction to you right in your own home! You actually hear your instructor's *recorded* voice. At the same time you watch "blackboard" size projected pictures, diagrams and illustrations. It's the quick, easy way to equip yourself for the big earnings in television—today!

LOOK . . . You get the tape recorder and projector right at the start of your course!

HEAR your instructor

It's even better than the classroom, because you can repeat the instructor's lectures until they're thoroughly understood.



SEE 2000 illustrations

You learn quicker when you see diagrams and illustrations in *blackboard* size.

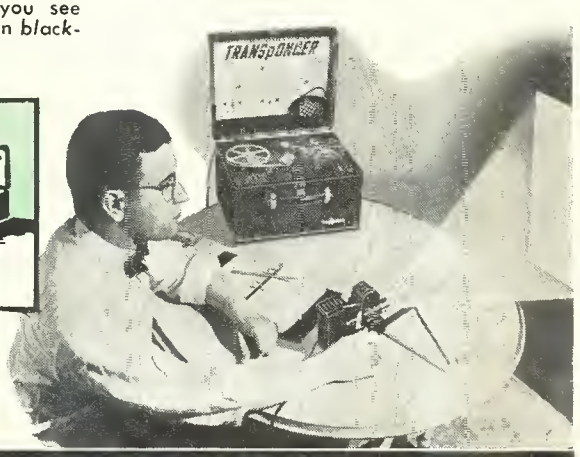
You get the famous "TRANSPONDER" precision built, high fidelity tape recording machine with your very first lesson—and a powerful projector with which you can view diagrams and illustrations enlarged to a size that makes them easy to see and understand.

READ from reference library

You receive complete books, pamphlets and manuals to supplement your instructor's lessons.

ASK your questions on tape

Tell your instructor about anything that puzzles you and get his answers back pronto.



BE A SUCCESS . . . ACT NOW!

Millions of television set owners are demanding qualified television technicians to service their sets. There is a tremendous shortage of such qualified men today and will be for many years to come. Get in on the ground floor of this booming industry and be prepared to accept a steady, big pay job for life. We can qualify you quickly, easily, surely—and help get you a job when you complete your course. Send for illustrated booklet that gives the complete details.

The De Forest-Sanabria Corp.

An affiliate of American Television, Inc.

5050 North Broadway, Chicago 40, Illinois

MAIL COUPON TODAY!

De Forest-Sanabria Corporation
Dept. RN-9
5050 Broadway, Chicago 40, Ill.

FREE BOOK TELLS HOW

Dear Sirs:

Please send me copy of your free illustrated booklet which describes the new TRANSPONDENCE method of learning television at home under the direction of Dr. Lee de Forest and U. A. Sanabria.

NAME_____ AGE_____

ADDRESS _____

CITY_____ STATE_____

(Mail in envelope or paste on a postcard.)

ceived 233% more complaints than during the same period of 1949. Yet the number of television sets in use in this area during the same period increased by only 110%."

That a housecleaning within the industry has been long overdue is readily acknowledged by most persons concerned with selling and servicing television receivers. However, many of the men attending the meeting felt that the broom should have been wielded by the industry itself, and with much less fanfare. Informal opinions, expressed by those attending the meeting, included such reactions as: (1) The "gyps" at whom the campaign is aimed won't take any notice of it and won't reform unless law enforcement agencies crack down on some of the worst actors in the crowd and make examples of them; (2) The Radio-Television Manufacturers Association and not the Better Business Bureau should have taken the action; (3) The heavy newspaper publicity resulting from the campaign lowers public confidence in the TV sales and servicing firms at a time when favorable rather than unpleasant publicity is needed; (4) The Better Business Bureau has done a good job in getting competing elements in the sales ends of the business together and making them aware of the dangers of fraudulent practices; and (5) The Better Business Bureau campaign will probably stall off the long-threatened city licensing of television technicians.

In connection with the campaign, the Better Business Bureau introduced two valuable publications setting forth desirable objectives for both consumers and dealer-technicians. The first publication, "Standards for Advertising and Selling of Radios, Television Receivers, Television Service, Home Appliances," lists both acceptable and unacceptable terminologies used in newspaper, video and radio broadcasting, direct mail, window displays, counter cards, tags, etc.

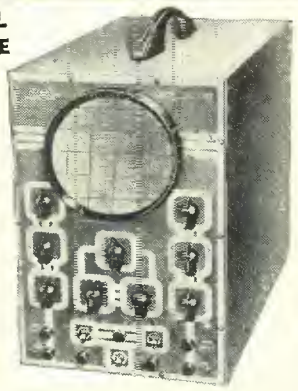
The group attending the meeting was equally enthusiastic over the second publication, "Things You Should Know About the Purchase and Servicing of Television Sets," the Bureau's consumer guidebook. The consensus was that it is a fine, straight-from-the shoulder job and will save TV sales and technical personnel, as well as consumers, from a lot of grief.

In response to a request for details on how service technicians could obtain copies of the two BBB publications, Richard E. Patterson, director of public relations, advises that the consumer booklet is available to New York customers at their TV dealers. Persons living outside of New York may obtain a copy by writing directly to the Better Business Bureau of New York City, Box No. 732, New York, N. Y., enclosing ten cents to cover cost of mailing.

The advertising and selling standard is available from the same source but its distribution is limited to advertisers, newspapers, radio and TV stations. —30—

Here are great new values from Lafayette on famous EICO precision instruments & kits

5" PUSH-PULL OSCILLOSCOPE



Model 425-K, KIT, only $39.95

All-new laboratory-precision scope gives you all the extra sensitivity and response for precise servicing of TV, FM & AM receivers.

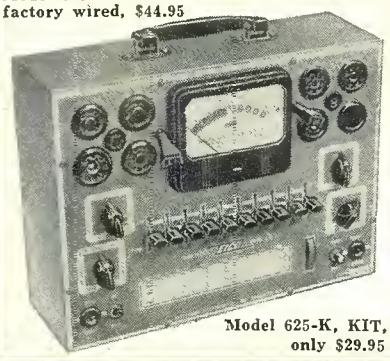
Push-pull undistorted vertical and horizontal amplifiers. Boosted sensitivity .05 to .1 rms volts/inch. Useful to 2.5 MC. TV-type multivibrator sweep circuits, 15 cps — 75 KC. Z-axis intensity modulation feature. Dual positioning controls move trace anywhere on screen. Complete with 2-6J5, 3-6SN7, 2-5Y3, 5BP1 CRT. Handsome 3-color etched rubproof panel; rugged steel case. 115 v., 60 cycle AC. 8½ x 17 x 13". **Model 425, factory wired, $69.95**

NEW TUBE-TESTER

The brand new professional tube tester and merchandiser EICO Service-Engineered for unbeatable value!

Large 4½" full-vision meter. Tests *conventional and TV tubes* including 9-pin miniatures. New lever-action switches—tests *every* tube element. Illuminated "Speedroll Chart". 2 grid caps. Short and open-element tests. Spare socket for new tubes. Protective overload bulb. Electronic rectifier. Handsome 3-color etched rubproof panel; rugged steel case. 115 v., 60 cycle AC. 12½ x 9½ x 4¼".

Model 625.
factory wired, $44.95



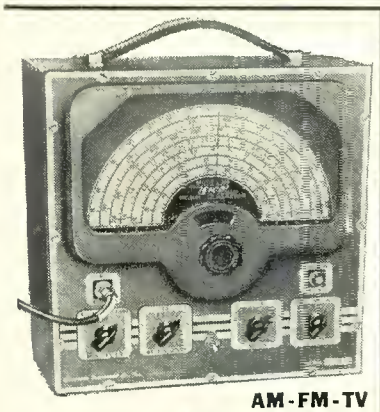
Model 625-K, KIT, only $29.95

HIGH PRECISION VACUUM TUBE VOLTMETER

Model 221-K, KIT, only $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 5 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 case 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" x 6" x 5".

Model 221 factory wired, $49.95



AM-FM-TV SIGNAL GENERATOR

A laboratory-precision generator EICO Service-Engineered with 1% accuracy.

Extremely stable, frequency 75 KC — 150 MC in 7 calibrated ranges. Illuminated hairline *vernier tuning*. VR stabilized line supply. 400-cycle pure sine wave with less than 5% distortion. Tube complement: 6X5, 7F7, 6C4, VR-150. Handsome 3-color etched rubproof panel; rugged steel case. 115 v., 60 cycle AC. 12 x 13 x 7".

Model 315-K, KIT, only $39.95
Model 315, factory wired, $59.95

HIGH VOLTAGE PROBE

A new professional EICO-engineered HV probe carefully designed and insulated for extra safety and versatility. Extends range of VTVMs and voltmeters up to 30,000 volts. Lucite head. Large flashguards. Multi-layer processed handle. Complete with interchangeable ceramic multiplier to match your instrument. **Model HVP-1, only $6.95.**

NEW SIGNAL GENERATOR

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.

Model 320-K, KIT, only $19.95
Model 320, factory wired, $29.95

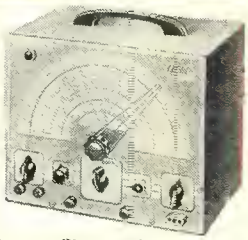
VOLT-OHM MILLIAMMETER

Complete Pocket Kit

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.

Model 511-K, KIT, only $14.95
Model 511, factory wired, $17.95

NEW TV-FM SWEEP SIGNAL GENERATOR



• Crystal marker oscillator with variable amplitude. • Covers all TV and FM alignment frequencies between 500 kc. and 228 mc. • Sweepwidth variable from 0-30 mc. with mechanical inductive sweep. • Extremely wide sweepwidth allows gain comparison of adjacent RF TV Channels. • Provides for injection of external signal-generator marker. • Phasing control included. • 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" x 8" x 6¾". 5 Mc. Crystals available each $3.95.

Model 360-K, KIT, only $29.95
Model 360, factory wired, $39.95

A double-guarantee *covers every Eico unit — the manufacturer's and Lafayette's. Send your order now — shipment will be made within 24 hours.*

ORDER NOW!

LAFAYETTE RADIO

send all mail orders to New York please.

NEW YORK, N. Y.	NEWARK, N. J.	BOSTON, MASS.
100 SIXTH AVE.	24 CENTRAL AVE.	110 FEDERAL ST.
WAlker 5-8883	MArket 2-1661	HUbbard 2-7850

LAFAYETTE RADIO 100 Sixth Avenue, 13. N. Y.
(Radio Wire Television Inc.)

Please send me the following EICO instruments:
(List Model Number as shown in ad).....

.....

Name.....

Address.....

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

Spot Radio News

(*Continued from page* 18)

view of the situation offered to the Commission. In a sizzling 100,000-word report, *CBS* declared that . . . "It is clear from the record . . . that the *CBS* system is now superior in every significant aspect to either the *RCA* or *CTI* color system. . . . The present . . . performance of the *RCA* and *CTI* units is in many respects grossly degraded. Their over-all picture quality is low. . . . Their brightness and contrast are inadequate."

In the opinion of *CBS,* its system is . . . "excellent now and can be even better in the future . . . and not dependent on the future embodiment of a single direct-view, tri-color tube or horizontal interlace." *CBS* also pointed out that its system is . . . "plainly convertible."

Blasting away at the *RCA* declaration of continued interest in color, *CBS* stated that . . . "It is clear that so long as there is anything left to be done in the field of color television, *RCA* cannot be relied upon to press the development."

According to *CBS,* it would begin colorcasting within a matter of days after a decision was made in its favor, and within three months would expand its network color shows to about 20 hours weekly. Should the Commission decide on the other systems, prompt color programming would begin too, said the *Columbia* execs.

FCC found a hostile report, in the brief from *CTI,* too. According to the Pacific Coast inventors . . . "Nothing has occurred during the course of these hearings to alter *CTI's* belief in the fundamental superiority of line-sequential operation. . . . Its proposed system is completely compatible with existing black and white operations. The use of a direct-view, tri-color tube will eliminate many, if not most of *CTI's* past reception problems. . . . Viewed . . . from the standpoint of its fundamental advantages and recalling that its past and present apparatus limitations are all by the way of being remedied by the rapid development of this art, *CTI* . . . believes that its proposed system may now be safely standardized."

The FCC also received a caustic letter from Dr. Allen B. DuMont, who although not offering any color system, felt that his opinions and the data offered by Dr. Goldsmith during the hearings should be weighed carefully before a decision is made. According to Dr. DuMont, color TV is not ready for commercial use, and the proposed systems do not provide a complete solution. In the opinion of this pioneer TV specialist, the *RCA* system was at present confined to the application of the three-tube, dichroic-mirror setup, the *CBS* method was incompatible and expensive to apply, and the *CTI* approach has not as yet been proved compatible and, in addi-

★ 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

MINICAPS PIGTAIL

Mfd.	Volt	Price
30	450	$0.49
30	300	.45
30	350	.48
40	450	.50
40	525	.70
16	350	.35
16	525	.45
16	450	.40
16	100	.24
20	25	.20
20	80	.25
20	450	.40
24	350	.30
8	400	.30
8	150	.15
10	150	.20
10	50	.15
4	50	.10
4	150	.14

as 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

RF CHOKES

1MIHY/125 MA. $0.23
1.9-1MIHY ..... .10
2.5MIHY/500MA .89
3.2MIHY ..... .10
3.3MICHY ..... .10
3.65MIHY ..... .10
5.2MIHY/200MA .39
5.5MIHY/500MA .98
6.4MIHY ..... .10
10MIHY/350MA. .39
20MIHY ..... .18
94MIHY ..... .10
115MHY/150MA .39

MANY OTHERS

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Dyn, Mike & Hdset-comb: Used in R19 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, TS13B 75c

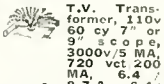
VARIABLE CERAMICONS

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

Xfrmr Specials

9V/1.6A $1.60

Pri 110V-80V 60cy. Sec. 1250V/2MA, V/4A, 650VCT/85, 2.5V/1.75, 6V/.6. $4.95

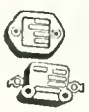


T.V. Transformer, 110v 60 cy 7" or 9" scope, 3000v/5 MA, 720 vct 200 MA, 6.4 r 8.7 A, 6.4/.6A, 5/3A, 1.25/.3A. New $3.95

29c ea.
10 for $2.75

MFD.	VOLT
6	400
50	400
40	450
30-20	150
50-25	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



MICA CAPACITORS
SOLAR XMB
TAPPED POLES

Mfd.	Price
2500 V Test	
.00001	$0.35
.000025	.35
.00003	.35
.0005	.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.

AC CONDENSERS

75-84	125	1.30
20-24	110	1.00
26-30	110	1.00
31-37	110	1.00
38-42	110	1.00
43-48	110	1.00
43-65	110	1.25
50-75	110	1.25
72-87	110	1.25
86-96	110	1.45
88-106	110	1.50
107-129	110	1.75
124-138	110	1.75
130-150	110	1.75
130-180	110	1.90
161-180	110	1.75
158-191	110	2.00

Write for many others.

TELEVISION CONDENSER

Mfd	Volt	Price
5000	1.5	$1.20
1000	3	.85
500	6	.45
2000	6	1.35
225	15	.30
800	15	.98
1000	15	.85
500	15	.95
6000	12	1.35
9000	12	2.00

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 Resist Price $6.95

Trans. 2300V/4Ma. 2.5/2A. 2-1 Mfd 7500V Pyr. 2X2 Tube. Socket. 1-100000 ohm Resist. $8.49

Pwr. Supply contains Trans. 820VCT 200 MA. Dual 10HY 200 MA Choke, 2—7MFD 200V. 5T4 Tube. Socket. Price . . $8.95

Contains Xfmr 550-550V 250MA, 6.3V/1.5A, 200 Bias. 2—10HY Chokes 2—4 MFD 1000V Cond. All for $10.95

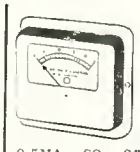
Xfmr. Pwr. Supply Kit Xfmr 115V 60 Cy Sec. 2100VCT 150 MA. 7.5V/4A 2.5V 10A &2—6 HY 150MA 2-2MFD 1500V. $10.95

Birtcher Tube Clamps

926—16	926—C15
926—B1	926—C13
926—B2	
926—B8	
926B—16	11c ea.
926A—14	100 far
926C—19	$10.50
926A	
926—C1	1000 far
926—A11	10c ea.
926C—24	

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 A31 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



0-5MA SQ 2" Metal Case or 0-10 volt movement readsite meter 98c

SERVO AMPLIFIER

A-5 Automatic Pilot. Less tubes contains sockets, bathtub cond, trans audio, etc. Special ..... 95c ea.

MICROWAVE

WRITE FOR FLYERS OF SURPLUS PLUMBING AND ACCESSORIES

COMMUNICATIONS EQUIPMENT COMPANY *for your needs*

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
.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
100	4000	29.00
.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	2TT	.15
2x1	4ST	.16
2	2ST	.20
.5	2TT	.15
.5	2ST	.15
400VDC		
2x.25	3ST	.21
2x.1	3ST	.21
2x.1	2TT	.20
3x.1	2ST	.25
.1	2TT	.19
.5	1TT	.19
1	2ST	.23
2	2ST	.26
600VDC		
.1	2BT	.20
.1	2ST	.21
2x.1	3ST	.27
2x.1	2BT	.25
2x.1	2ST	.26
3x.1	ST	.25
2x.25	2ST	.23
.25	3TT	.20
1	2ST	.30
2x1	3ST	.35
2	2ST	.40
2	2BT	.39
1000 VDC		
1	2ST	.45

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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 c VCT/220 Ma. 6.4/8.7A, 6.4/.6, 5V/3A, 1.25/.3. $2.95

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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

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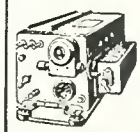
TU 18A 3-4.5 MC. . $2.25
TU 25 3.5-5.2 MC. 2.25



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: Less Tubes. Rec. or XMTR. . $3.95 ea.

RU/GF (SCR 183) REC. TUNING UNITS

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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

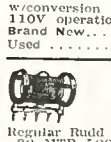
Meter Cabinet

For BC221 Freq. Meter. Brand New Wood. 14½H x 10½W x 10D. Value $20.00. Only $2.95

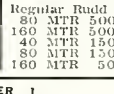
VFO FOR BC 221 FREQ. MTR.

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 605 INTERPHONE AMPLIFIER



Easily converted to an ideal intercommunications set for office—home—or factory. Complete w/conversion diagram for 110V operation. **$4.49**
Brand New..... $4.49
Used 3.95



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Regular Rudd Roxed
80 MTR 500 watt
160 MTR 500 watt
40 MTR 150 watt
80 MTR 150 watt
160 MTR 50 watt
} $1.49 ea.

400 MA 12 HY Choke 90 ohms Herm. sealed Special $3.75

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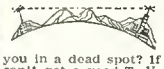

Are you in a dead spot? If you can't get a good T. V. Picture here is a sig. Corp. Ant. mast 30' high of rugged plywood construction to solve your problem. It telescopes into 3 ten ft. sect. for easy stowage. Easy to mount. Comp. with stakes & rods. Each **$19.95**

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Pri: 115V Sec. 7.5VCT/2.5A, 10VCT/6.5, 10VCT/13A $10.95
Pri: 1200V/125MA, 2.5 VCT/6A, 6.3VCT/1A. $7.95
Pri: 110V Sec: 2.5V/5A, 2.5V/5A for 866 Tubes. Price $2.95

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Tinn #1, 3, 4, 6, 7A. Lock Type Rubber 6c ea. 10 for 55c.

Line FILTER, GE 100 Amp Filter w/2x5Mfd 50V oil cond. Operates on 110V AC DC. $1.98

Aircraft Radio Transmitter CRV 52233, 28VDC ATB Equip. RCA less T. U. As Is $39.95

R-9A APN4 Loran Rec' Power Supply 400 cy 31FS Quad. Tuned switches connect etc. N. G. As Is. Less tubes. . . $14.95

ID6 APN4 Scope 5" Loran. Full of Resis. Micas Basic Assy for Scope. N. G. As Is. Less Tubes. $12.95

BC433 Mod or unmod CW Reception 200-1750KC in 3 bands 14 or 24V & 115V AC ADF. Radio Compass As Is. Less Tubes. Poor Condition . . . $11.95

BC929 A3RP1 Scope Indicator containing Ant., Switch & Motor w/Tubes 2—6H6GT, 2—6SN7, 1—6JH6, 1—6X5, 1—3BP1, 1—2N2, P/o SCR 729 & APN2. New $25.95
w/Conver. Dia. to 110V 60 cy.

Motor Driven Yagi Switch 24V 1800 RPM. Price $3.95

8C434 CONTROL BOX

Remote Control for 433 Radio Compass contains 0-5MA Meter, Dial Control $3.95

BC659 Transmitter & Rec. including Power Supply (less Tubes, Vibrator & Condenser) 27-39 MC. FM Xtal Controlled P/o SCR 610 Operates 6-12-24 volts, PE120 Output 90V 40MA, 150V 40MA, 6V 250MA 1.5V 900MA. $20.95

LM Freq. Meter. No calibration Book used. Fair As Is. Less Xtal.
Special $24.95

TVI Line Filter 110VAC 1 Amp Reject Range .15-150 MC Chassis Mt. Herm sealed 1¾"x1¼"x2". Price 69c

GP7 Aircraft XMTTR. Good Condition. As Is. Less T. U. $19.95

Avail. in Stock. Dual XMTTR & Dual Rec. Triple Rack Mounts MT63—MT 65MT71 Bent & Banged Up. Sold As Is. No Refund. Repairable $1.00 ea.

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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

VARIABLE TRIMMER CONDENSERS

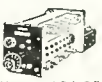
20 MMF Sic	
15 MMF #86	
50 MMF C-CO	19c
60 MMF #205	ea.
40 MMF #746	
5 MMF #112	
3-25 MMF	

Large Quantities Available

5CR-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 pre-selected crystal controlled frequencies in the spectrum of 100-156 Mc. This spectrum covers facsimile, air navigation aids, airport control, railroad, police, urban telephone, as well as the amateur band 144-148 Mc. October 1948 Radio News gives details for converting the SCR-522 receiver section. BC-624, Transmitter section, BC-625, is voice amplitude modulated and has an output of 8-9 watts. Good Condition As Is
Tubes As Is: 2—832, 3—12A6, 1—6G6, 2—6S47, 1—12J5GT, 3—12SG7, 1—12C8, 1—9002, 3—9003, 1—12AH7GT $33.95

ARC3 complete Audio Modulation XFMR pkg. T103 Carbon Mike to Grid $0.95
T102 6J5 to PP 6L6 Grids (Modulation) $1.15
T104 Mod. XFMR PP 6L6 to 8S2 or 8S8 Plates. . . . $1.49
COMPLETE KIT OF THREE $2.98



ARR2 Haming Receiving

Tunes 234-258 MC. 4—6AK5, 6—9001, 1—12AL6. Ideal for 2-6-10 Mtr. Conv. w/Dyn Tubes as is $5.95. Less Dyn. Tubes as is $3.95

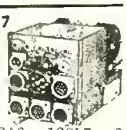
GIBSON GIRL

The Emergency Radio Transmitter. Send SOS signals automatically on 500KC. 150-mile range. No batteries required. Has hand-driven generator, tubes, wire. New. It's only $3.25

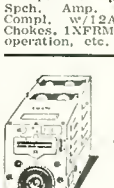
RECEIVER BC-733-D

Localizer receiver of the blind landing system. Companion to the glide path receiver. Also contains 90 cycle band-pass filters. 108.3 to 110.3 mc. by relay selection of crystals in the local oscillator. Wide pass-band on 6.0 mc IF's ideal for FM. Has a wonderful AVC system using rectified output of an RF oscillator as power supply for 100 volt 10C bias. With relays, and 10 tubes: 3—717A, 2—12SG7, 1—12SQ7, 1—12A6, 1—12AH7, 2—12SR7. Condition: Used, excellent. (Tubes As Is.) **$4.95**
Only $4.95
w/DYN $6.95

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

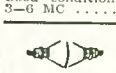


ARC/5 Transmitters 40 Watt Output These Famous V.F.O. Drivers Available

3—4 MC $5.95
Used. Good condition.

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.
3—6 MC $6.95



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2¼"l. x 1¾W Type NS1 10c ea. 10 For 95c

6V Input Dynamotor

Output 150V /75 MA or 12V Input, 500V /50MA Out . . $3.49

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COMMUNICATIONS EQUIPMENT CO.

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tion, required expensive receivers. Dr. DuMont did agree that the ultimate development of the direct-view tube was on the horizon, but felt that substantial time might be required for the project.

As the conclusions of the three color systems were being surveyed, the FCC also received an impartial report, which had been on the way for many months, the Condon report. Prepared at the suggestion of Senator Johnson, the report had been heralded as a document which would tell the whole story of color TV. It did, in part, offering a review of the situation, but revealed no solution to the problem. According to the report, the *CBS* system was superior in its color fidelity reproduction, an advantage which appeared to be lost when the method was converted to electronic control. *RCA* color was stated as being approximately equal to the resolution of black and white, but uneven color balance seemed to upset fidelity somewhat. The *CTI* system was described as being deficient in apparent vertical resolution and also subject to registration difficulties. It was the committee's opinion that the *CBS* system did offer an advantage, in that it was furthest developed. However, the *RCA* system was quite flexible and there was substantial opportunity for improvements within the confines of scanning standards, which had been proposed. The *CTI* system offered greater possibility for possible future development than the *CBS* method, according to the experts.

THE COLOR DECISION possibilities received their first official reviews, from two Commissioners, during a talk and an interview, reviews which caused many to cup their faces and wonder. The talk, by Commissioner Webster, was replete with comments which set off rows of queries about the future of color and other related problems.

Speaking before American Taxicab Association in Atlantic City, and covering the problems of the taxicab industry, the Commissioner expressed concern for the amount of official attention now given to the needs of their industry and others of the same type, in comparison to television and broadcasting. According to the Commissioner . . . "Taxicab operators, too, have problems before the Commission. Goodness knows, we take a great deal of time now to look into your problems. There are numerous other radio services, some of which have many more difficult problems than you. When do we have time to look after them? Is broadcasting and television the only radio service that should be given close attention by this Commission? I have difficulty answering that question, myself, because I appreciate as everyone does the vital importance of that service to the public."

Continuing his analysis of the puzzling condition, the Commissioner re-

marked . . . "Am I doing justice to you and other radio services when I tell you that back in Washington I am forced to devote 90% of my time to problems involving broadcasting and television." The Commissioner then declared that he was faced with quite a dilemma, for he wondered . . . "What do we do about the numerous outstanding policy problems constantly before the Commission. . . . ? The number of such problems flowing before the Commissioners is so great that only a few can be decided with the degree of celerity they merit."

Commenting on the effect the recent hearings had on available time, the FCC technical expert said . . . "Now after seven months . . . we are even yet talking color television and all that goes with it, even though the color phase of the hearing has just ended. Remember, we now have the stupendous job of making a decision. Decisions of this magnitude are just not made overnight."

Sharply rebuking those who insist on setting up timetables for decisions, the Commissioner declared that . . . "None of them has apparently given any consideration to the physical capabilities of the individual Commissioners and the staff to digest the record, study the matter thoroughly, discuss it among themselves, and render a formal decision. They forget that during all of that time we should also be attending to other important business of the Commission."

In the opinion of the Commissioner, there was only one solution to the problem and that was . . . "to delegate to individual Commissioners, or groups, limited responsibilities of decision in specialized fields of communications." He felt that the staff reorganization, which is now underway, would alleviate the situation somewhat.

The interview, which revealed more optimistic information about color, occurred during a two-session renomination hearing of Commissioner George Sterling. (We are very happy to disclose that Sterling was renamed Commissioner for a seven-year term at a subsequent session of the Senate.) In a quiz period which bristled with blazing queries about the freeze, clear channels, the ultra-highs, and color, the Commissioner spoke quite frankly. The color question, he declared, would be solved this Fall. The freeze, he felt, would become a thaw before the year was out, and it would not be long before the higher bands became a standard region for many new television stations as a supplementary service to present band operations. It was his belief, too, that the very-high band allocations, now in effect, and those that will be placed on the record will stand for a long, long time, and should not be considered as an interim appointment.

CITIZENS RADIO SERVICE rules may soon be liberalized according to a proposed amendment. In the sug-

gested revision, operation of citizens radio stations would be permitted by any person authorized by the station licensee, where manually operated telegraphy transmitting by any type of Morse code is not involved. This rule modification would thus permit operation of radio-controlled devices, such as model aircraft equipment.

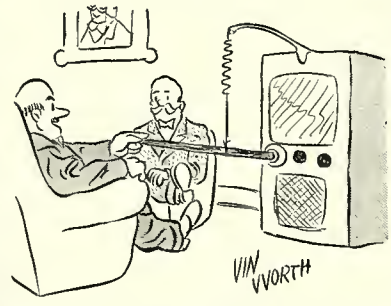
Eligibility requirements for the special industrial radio services are also being revamped, according to the FCC. In an effort to eliminate the filing of applications by those whose communications needs could not possibly be met by a special industrial grant, a short description of the nature and purpose of this service has been included in the new proposal, together with prohibitions against its use in connection with sales, advertising, or delivery purposes; the elimination of point-to-point communications between base stations and a prohibition against communications with cars operating in cities.

THE TRANSCONTINENTAL TV microwave system, only a short while ago a drawing-board item, is now well on its way to becoming quite an actuality. Authorization by the Commission has paved the way, with permission being granted for the construction of 55 relay stations between Omaha and San Francisco at a cost of over twenty million dollars. This link, which it is expected will be completed in '52, will join the New York to Chicago to Omaha net, the eastern portion of which is now being completed, while the western section will be inaugurated in about a year from now.

The indicated cost of the complete coast-to-coast hookup has been cited as over thirty-seven million dollars.

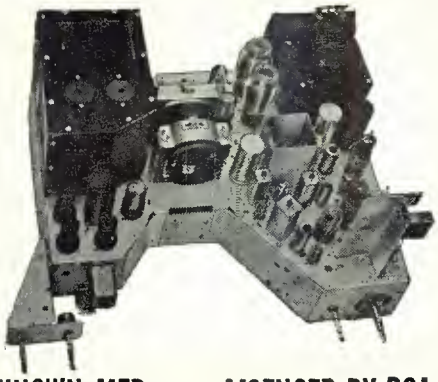
TV's dominant possibilities received an enthusiastic appraisal recently from FCC Vice-Chairman Paul A. Walker, during a talk before the Massachusetts School of Art. Commenting on the . . . "world of possibilities for the teacher . . ." the Commissioner declared that television will prove to be "effective in the teaching of science, drawing, painting, languages, and current events."

There's quite a glorious road ahead for TV. . . . . L.W.



"A very good idea, Cedric. It should be a boon to the TV trade!"

#630 Chassis Still the Best in TV
NOW . . . More Outstanding than Ever!



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STANDARD 10" & 12½" (29-tube chassis) engineered in strict adherence to the genuine RCA No. 630. **DELUXE 16" & 19"** (31-tube chassis) have added features of voltage doubler, keyed AGC and 70° defection systems. **CHASSIS** delivered (as pictured) ready to play with all tubes, hardware, knobs and choice of 5"x7" or 12" speaker (less CRT). Kit delivered complete with 29 tubes and instructions (less CRT).

19"—31 TUBE DELUXE CHASSIS Ready to plug in & play (less CRT) **$167.97**

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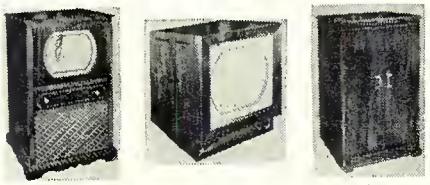
10" or 12½" STANDARD CHASSIS 29 tubes, ready to play (less CRT) **$149.62**

10" or 12½" STANDARD KIT Complete with all parts, 29 tubes, and easy step by step instructions **$124.44**

STANDARD GUARANTEED PICTURE TUBES

10BP4	$ 17.46
12LP4A (Black)	24.72
14LP4 (Rectangular Black)	26.38
16AP4 (Round Metal)	34.14
16DP4A (Round Glass Black)	34.14
16RP4A (Rectangular Black)	36.63
17AP4 (Rectangular Black)	39.78
19CP4A (Round Glass Black)	56.74
19AP4A (Round Metal Black)	56.74

QUALITY CUSTOM-BUILT TV CABINETS



Open Face H—42", W—26", D—24" | Table Model H—27", W—24", D—24" | Deluxe H—42", W—26", D—25"

Genuine mahogany, Hand rubbed finish, cut drilled, ready for any 630-type chassis (16" to 19"), including bracket supports and rectangular or round lucite mask or safety glass.

POPULAR TYPE TABLE CABINET $ 39.65
OPEN FACE CONSOLE CABINET 69.50
DELUXE TWO-DOOR CABINET 89.50

PARTS FOR #630 IN COMPLETE SETS

VIDEO AND I.F. KIT (19 items)	$ 7.84
ELECTROLYTIC CONDENSER KIT (6)	7.37
TUBULAR CONDENSER KIT (37)	4.28
CERAMIC CONDENSER KIT (28)	3.37
MICA CONDENSER KIT (11 condensers)	1.38
CARBON RESISTOR KIT (107 resistors)	4.98
WIREWOUND RESISTOR KIT (4 resistors)	2.31
OCTAL WAFER SOCKET KIT (13 sockets)	.72
MIN. WAFER SOCKET KIT (10 sockets)	.63
MIN. MOLDED SOCKET KIT (2 sockets)	.22
KNOB KIT, decal included (8 knobs)	.98
BRACKET AND SHIELD KIT (18 brackets)	8.63
TERMINAL STRIP KIT (19 strips)	.59
VARIABLE CONTROL KIT (9 controls)	$.83
COMPLETE TV TUBE KIT, less CRT (29)	24.37

* 630 CIRCUIT DIAGRAM AND VALUABLE TV CONVERSION MANUAL INCLUDED WITH EACH ORDER

#630 TV PARTS . . . TOP QUALITY . . . LOW PRICES
FOR KIT BUILDERS, REPLACEMENTS AND EXPERIMENTERS

The following television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheses indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

RCA FRONT END TUNER, compl. w/tubes		$ 22.49
STANDARD TURRET TUNER, com. w/tubes.		22.49
ESCUTCHEON PLATE, for either tuner		.69
COMPLETE SET OF KNOBS, incl. decals		.98
COMPLETE SET OF KNOBS, (Gold) "		1.49
POWER TRANSFORMER, 295ma,	201T6	9.97
VERTICAL OUTPUT TRANS.	204T2	2.69
VERTICAL BLOCKING TRANS.	208T2	1.32
HORIZONTAL OUTPUT TRANS.	211T1	1.95
HORIZONTAL OUTPUT TRANS.	211T3	2.49
HORIZONTAL OUTPUT TRANS.	211T5	3.89
FOCUS COIL, 247 ohms,	202D1	2.29
FOCUS COIL, 470 ohms,	202D2	3.42
DEFLECTION YOKE, 60°	201D1	2.97
DEFLECTION YOKE, 70°	206D1	3.98
SOUND DISCRIMINATOR TRANS.	203K1	1.12
1st PIX I.F. TRANSFORMER,	202K2	1.08
2nd PIX I.F. TRANSFORMER,	202K3	1.08
1st & 2nd SOUND I.F. TRANS. (2)	201K1 ea.	1.02
HORIZONTAL DISCRIM. TRANS.	208T8	1.49
FILTER CHOKE, 62 ohms		1.47
CATHODE TRAP COIL,	202K4	1.08
WIDTH CONTROL COIL,	201R1	.44
WIDTH CONTROL COIL,	201R4	.48
WIDTH CONTROL COIL, (keyed AGC)		.79
HORIZONTAL LINEARITY COIL,	201R3	.39
HORIZONTAL LINEARITY COIL,	201R5	.49
3rd & 4th PIX COILS, (2)	202L1 ea.	.39
FILAMENT CHOKES, (5)	204L1 ea.	.09
VIDEO PEAKING COIL,	203L1	.18
VIDEO PEAKING COIL,	203L2	.18
VIDEO PEAKING COILS (2)	203L3 ea.	.18
VIDEO PEAKING COILS, (2)	203L4 ea.	.18
ION TRAP BEAM BENDER, (single)	203D1	.79
ION TRAP BEAM BENDER, (double)	203D3	.98

VOLTAGE DOUBLER PARTS

LUCITE SUB-CHASSIS, formed & drilled	3.94
3 - 20K H.V. FILTER CONDENSERS, set	2.22
RESISTORS, set of 7	.88
TUBULAR & MICA CONDENSERS, set of 3	.46
TERMINAL & WIRE STRIPS & CLIPS	.48

(Instructions, illustration and diagram included.)

VARIABLE CONTROLS

PICTURE & SOUND, 10K ohms 1 meg. & switch	1.14
VERTICAL & HORIZ, 50K ohms 1 meg.	1.04
BRIGHTNESS CONTROL, 50K ohms	.44
HORIZ. CENTERING, wirewound, 20 ohms	.57
HEIGHT CONTROL, 2.5 megohm	.48
VERTICAL LINEARITY, 5000 ohms	.44
VERTICAL CENTERING, wirewound, 20 ohms	.96
FOCUS CONTROL, wirewound, 1500 ohms	.98
HORIZONTAL DRIVE, 20K ohms	.44

MICA CONDENSERS—85° C OPERATION

270 MMFD— 500 W.V. (7) ea.	.12
390 MMFD— 500 W.V. ea.	.12
470 MMFD— 500 W.V. ea.	.12
680 MMFD— 500 W.V. ea.	.16
4700 MMFD— 500 W.V. ea.	.29

ELECTROLYTIC CONDENSERS — 85° C

40—10-80MFD—450-450-150 VOLTS	1.37
40—40-10MFD—450-450-450 VOLTS	1.49
80—50MFD—450-50 VOLTS	1.49
40—10-10MFD—450-450-350 VOLTS	1.37
20—80MFD—450-350 VOLTS	1.49
250—1000MFD—10-6 VOLTS	.98

TUBULAR CONDENSERS—85° C

.002 —600V	.09	.005—400V	(3) ea.	.07
.0025—600V	(2) ea. .09	.01 —400V	(5) ea.	.09
.004 —600V	.11	.015—400V	(2) ea.	.11
.005 —600V	.11	.05 —400V	(5) ea.	.12
.01 —600V	(2) ea. .12	.1 —400V	(2) ea.	.14
.05 —600V	(6) ea. .15	.001—1000V		.14
.1 —600V	.17	.004—1000V	(2) ea.	.14
.25 —400V	(2) ea. .21	.035—1000V		.18
.05—1000V	$.18			

CERAMIC CONDENSERS

10 MMFD, 10% Tolerance	.12
51 MMFD, 10% Talerance	.12
56 MMFD, 10% Talerance	.12
82 MMFD, 10% Tolerance (2)	.12
1200 MMFD, nat less than rated capacity	.14
1500 MMFD, nat less than rated capacity (21) ea.	.14
6800 MMFD, nat less than rated capacity	.19

WIREWOUND RESISTORS

5000 ohms, 5 watts	.22
VOLTAGE DIVIDER, 1360/250 ohms	.74
VOLTAGE DIVIDER, 5300/2-500 ohms	.89
VOLTAGE DIVIDER, 6750/12/93 ohms	.72

PUNCHED CHASSIS PAN, cadmium plated	$ 4.87
630-KIT, screws, nuts, rivets, washers	1.69
HI VOLTAGE CAGE ASSEMBLY, complete	3.73
VOLTAGE DIVIDER SHIELD & COVER, "	1.79
ELECTROLYTIC COND. SUB-CHASSIS	.94
SOUND DISCRIMINATOR SHIELD	.19
SPEAKER MOUNTING BRACKET	.59
TUBE CRADLE BRACKET	.57
DEFLECTION YOKE BRACKET	.29
DEFLECTION YOKE MOUNTING HOOD	.59
FOCUS COIL BRACKETS per set	.49
CATHODE TRAP COIL SHIELD	.39
CHASSIS MOUNTING BRACKETS Set of 4	.44
BRIGHTNESS & HOLD CONTROL BRACKET	.59
WIDTH CONTROL BRACKET	.16
TUNER SHAFT BRACKET	.17
TERMINAL STRIPS, 4-LUG set of 11	.48
TERMINAL STRIPS, 3-LUG set of 2	.08
TERMINAL STRIPS, 2-LUG set of 2	.06
TERMINAL STRIP, 1-LUG	.02
ANTENNA TERMINAL STRIP	.19
3-SCREW TERMINAL STRIP	.19
CORONA TERMINALS 2 sets	.08
CORONA RING	.09
TUBE SHIELD & CLIP 2 sets	.22
MINIATURE WAFER SOCKETS (10) ea.	.07
MINIATURE MOLDED SOCKETS (2) ea.	.12
OCTAL WAFER SOCKETS (13) ea.	.07
CATHODE RAY TUBE SOCKET, 18" leads	.39
H. V. RECTIFIER, SOCKET ASSEMBLY	.79
H. V. KINESCOPE LEAD, with clip	.39
TV 6' LINE CORD, with both plugs	.29
INTERLOCK SAFETY CONNECTOR (input)	.17
OVAL PM SPEAKER, 5"x7"	1.98
12" PM SPEAKER, heavy Alnico #5 magnet	5.63
SPEAKER CONNECTOR PLUGS set of 2	.18
AUDIO OUTPUT TRANSFORMER (6K6)	.69
12½"—CRT MOUNTING BRACKET SET	1.38
16"—CRT MOUNTING BRACKET SET	2.98
UNIVERSAL MOUNTING BRACKET SET	4.97
PLASTIC SLEEVE, for insulating 16" CRT	1.88
PLASTIC RING, for insulating rim 16" CRT	1.97
PLASTIC SLEEVE, for insulating 19" CRT	1.96
PLASTIC RING, for insulating rim 19" CRT	2.08

H.V. FILTER CONDENSERS (Cartwheels)

10KV — 500 MMFD	.48
15KV — 500 MMFD	.67
20KV — 500 MMFD	.79

CARBON RESISTORS

½ WATT, 5% TOLERANCE, 10, 150(5), 3900, 4700, 5600, 10K(2), 18K, 680K(2), 820K OHMS, 1.2 & 1.5 MEG ea.	.08
½ WATT, 10% TOL., 3.3, 39(3), 330, 560(3), 680, 1800, 2700(2), 3300, 4700, 6800(4), 8200(4), 10K(3), 22K, 27K(2), 47K, 56K, 100K(3), 150K, 270K, 470K(3) OHMS, 1(2), 2.2(2), 4.7, 6.8 MEG ea.	.06
½ WATT, 20% TOL., 100(2), 1000(9), 3300, 22K(3), 100K, 150K, 220K(2), 330K, 470K(3) OHMS, 1(3), 10 MEG ea.	.04
1 WATT, 5% TOL., 2.2, 39K, 47K OHMS ea.	.12
1 WATT, 10% TOL., 1800, 3300, 4700(2), 10K(2), 18K, 22K, 27K, 39K OHMS, 1 MEG ea.	.09
1 WATT, 20% TOL., 10K OHMS ea.	.07
2 WATT, 10% TOL., 100, 270 OHMS ea.	.14
2 WATT, 20% TOL., 2200(2) OHMS ea.	.10

#630 TV TUBES—STANDARD MAKES

6J6	R.F. Amplifier	.98
6J6	R.F. Oscillatar	.98
6J6	Converter	.98
6BA6 (2)	1st and 2nd Sound I.F. ea.	.78
6AU6	3rd Sound I.F.	.89
6AL5	Saund Discriminatar	.78
6AT6	1st A.F. Amplifier	.69
6K6GT	Audio Output	.69
6AG5 (4)	1st, 2nd, 3rd, 4th Pix I.F. ea.	.78
6AL5	Pix. Det. & DC restorer	.78
6AU6	1st Video Amplifier	.89
6K6GT	2nd Video Amplifier	.69
6SK7	1st Sync. Amplifier	.59
6SH7	Sync. Separator	.98
6SN7	2nd Sync. Amp. & Hor. Dis	.69
6J5	Vert. sweep osc. dis.	.59
6K6GT	Vertical sweep output	.69
6AL5	Hor. Sync. Discriminator	.78
6K6GT	Hor. Sweep Oscillator	.69
6AC7	Hor. Sweep Osc. Control	.98
6BG6G	Horizantal Sweep Output	1.97
5V4G	Reactian scanning	.98
1B3/8016	High Voltage Rectifier	1.39
5U4G (2)	Pawer Supply Rectifier ea.	.69

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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.

INSULATED TERMINALS

Three new miniature insulated terminals are currently being marketed by *Cambridge Thermionic Corporation* of 463 Concord Avenue, Cambridge 38, Massachusetts.

Designed to meet the requirements of the miniaturization programs now being carried out by manufacturers of electrical and electronic equipment, the terminals are available in three lengths of dielectric and with voltage breakdown ratings up to 5800 volts.

The X1980XA is the smallest of the group, having an over-all height of only ⅜" including the terminal. Insulators are grade L-5 ceramic, silicone impregnated for maximum resistance to moisture and fungi.

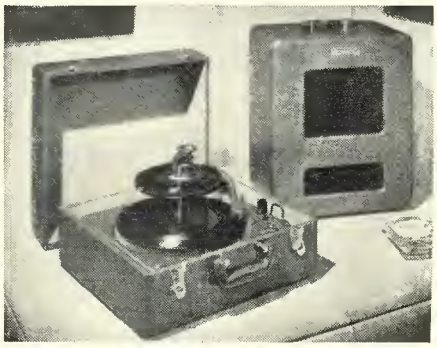
Complete details are available on request from the company.

PORTABLE CHANGER

Webster-Chicago Corporation of Chicago has introduced an automatic portable record changer that can be plugged into any radio or television receiver or used in conjunction with the company's new portable amplifier.

The new Model 100-641 is housed in a lightweight carrying case and is capable of playing all three speeds of records in all three sizes, with one simple control. It incorporates the company's velocity trip for fast record change and minimum record wear, a balanced tone arm to provide light needle pressure and increased record life, and an automatic stop when the last record has been played.

When combined with the company's



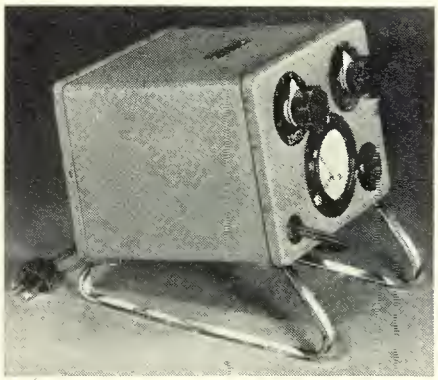
Model 166 amplifier unit, the new changer is suitable for use as a portable music system for public places.

ISOLATION TRANSFORMER

A new voltage adjusting isolation transformer for service technicians has been announced by the *Halldorson Company* of 4500 Ravenswood Ave., Chicago, Illinois.

The new unit, the Model N-202, gives the technician close control over the line voltage on his bench yet isolates it from his work, a particularly important feature when servicing high voltage TV circuits.

Included among its features is the provision for varying the voltage in approximately 1½ volt steps by means of two switch knobs on the panel. If the line voltage at the input is the standard rated 117 volts, it can be varied through a wide range of from



about 95 to 145 volts. At 90 volts line voltage it can be varied from 75 to 115 volts. The rated capacity at 117 volts input is 500 watts. A voltmeter with high accuracy to 2½ per-cent registers the output voltage.

The unit is compact and weighs only 21 pounds. Literature on the new transformer is available on request.

LOW-LOSS CONDENSERS

A line of vitreous enamel condensers is now being marketed by *Vitramon, Inc.* of Stepney, Connecticut.

Available in sizes ranging from .68 $\mu\mu$fd. to 1000 $\mu\mu$fd. at 500 volts, d.c., the new units are a laminant of a low-loss ceramic dielectric and metallic silver, sintered to produce a monolithic block with unusually stable temperature characteristics.

According to the company, the properties of the materials and the small size insure low losses for all frequencies at temperatures from —55 to 200 degrees C. The units are finished to meet Army-Navy requirements.

V.T.V.M.-NULL DETECTOR

The Freed Transformer Company, Inc. of 1718-36 Weirfield Street, Brooklyn (Ridgewood) 27, New York is currently making deliveries on its new null detector and vacuum tube voltmeter, the Model 1210.

The unit has been designed for a.c. bridge measurements. It provides simultaneous measurement of the voltage across the unknown and the bal-

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181-JA7

ance of the bridge. The v.t.v.m. has ranges of .1, 1, 10, and 100 volts. The input impedance is 50 megohms shunted by 20 μμfd. The frequency

range is from 20 to 20,000 cycles. The null detector gain is 94 db. It has selective circuits for 60 cycles, 400 cycles, 1000 cycles, and a frequency range of from 20 to 30,000 cycles.

AUTO AERIAL

Snyder Manufacturing Company of 22nd and Ontario Street in Philadelphia has added a new auto radio aerial to its line of such units.

The new "Redi-Mount TC-8" is characterized by its ease of installation. According to the company, interior mechanical work has been completely eliminated in favor of a simple drilling operation, insertion, and tightening.

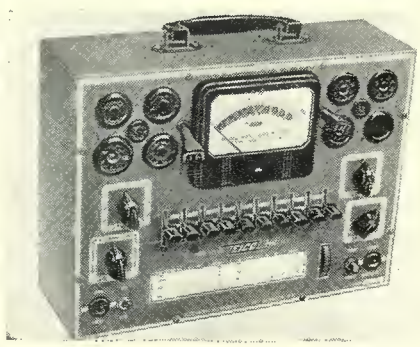
This model consists of a three-section staff which extends to a full 58 inches. The admiralty brass staff is chrome plated as are the solid brass appointments. Other features include waterproof neoprene chambers and polystyrene, polyethylene, and bakelite insulation throughout. Each aerial comes complete with u.h.f. polyethylene lead-in cable with aircraft fittings.

Catalogue sheets on the Model TC-8 as well as on other auto aerials in the company's line are available on request.

TUBE TESTER KIT

Of special interest to service technicians is the new *Eico* Model 625K tube tester kit just announced by *Electronic Instrument Co., Inc.* of 276 Newport Street, Brooklyn 12, New York.

Featuring individual switches for the separate testing of every tube element, the new unit tests conventional receiving and TV tubes including 4, 5,



6, large and small 7, octal, loctal, noval, *Hytron,* VR and magic eye tubes as well as pilot bulbs.

The kit is supplied complete with all electronic and mechanical components in addition to a comprehensive step-by-step instruction sheet, schematic, and pictorial diagrams. This same instrument is also available factory-wired.

KNURLED SHAFT

Clarostat Mfg. Co., Inc. of Dover, N. H., has added the new Type FKS-¼" or finger-tip knurled and screwdriver-slot unit to its line of "Pick-A-Shaft" control accessories.

The new unit will snap on to any Type AM or AT control. It is particularly suitable for use with those controls found at the rear of many TV sets such as those controlling horizontal linearity, horizontal and vertical size, horizontal and vertical position, and vertical hold. Since adjustments are rarely required, the knobs have been omitted.

CORNER CABINET

Designed for the music lover and high quality enthusiast, the new Model 418 Corner Cabinet just introduced by *Stephens Mfg. Corp.* of Culver City, California, is characterized by functional beauty and high efficiency.

The new unit incorporates two powerful permanent magnet speakers and

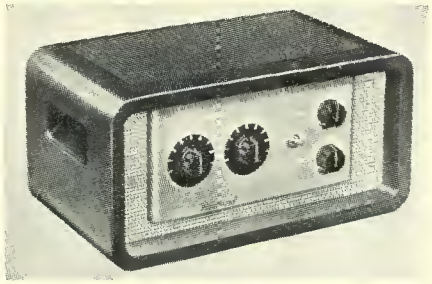
an efficient horn and driver system in an enclosure of adequate size for optimum low frequency loading. Provision is made for the use of the new *Stephens* "Tru-Sonic Hy-Son" super high frequency reproducer system. Components include two Model 103LX 15" low frequency drivers, one Model 824H 2 x 4 800 cycle horn, a new "Tru-Sonic" Model 108 high frequency driver, and a Model 800X crossover network. The cabinet measures 41" wide, 23" deep, and 36" high. It is available in either blonde or mahogany finish.

P.A. AMPLIFIER

The first of a new series of p.a. amplifiers, known as the "Green Gem" line, has been introduced by *Rauland-Borg Corporation* of 3523 Addison Street, Chicago 18, Illinois.

The initial amplifier is the Model 1916, rated at 16 watts at 5% or less harmonic distortion (measured at 100, 400, and 5000 cycles), 20 watts peak output. The new unit provides two microphone inputs, one phono input, electronic mixing and fading on all

three inputs, and tone control. The frequency response is ± 1 db., 40 to 20,000 c.p.s. Output impedances of the



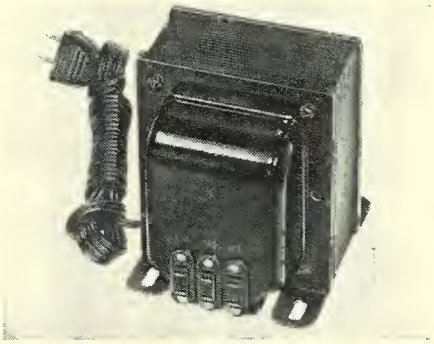
amplifier are 4, 8, 16, 250, 333, and 500 ohms.

The amplifier is housed in a dark green hammerloid-finished case while the control panel is finished in metallic bronze. Complete details on the Model 1916 and other units in the "Green Gem" line are available from the company.

TEST TRANSFORMER

A new isolation testing transformer has been added to the line of components manufactured by *Standard* ston Avenue, Chicago 18, Illinois.

This new *Stancor* unit is rated at 350 watts and is large enough to han- *Transformer Corporation* of 3580 El- dle almost any TV or radio receiver on test. The transformer may also be



used to correct a high or low line voltage.

Three standard receptacles provide output voltages of 105, 115, and 125 with a 117 volt a.c. input from the line.

COAXIAL SPEAKERS

A recent development in loudspeakers, incorporating the "Radax" principle of high fidelity sound reproduction, has been revealed by *Electro-Voice, Inc.* of Buchanan, Michigan.

The new-type, coaxial, two-way, high-fidelity loudspeakers provide wide-range response combined with low distortion factors in a single, compact speaker unit, according to the manufacturer. A single magnetic structure and voice coil are outstanding features of the new units. The high-frequency cone or propagator is coupled solidly and the bass cone compliantly to a single voice coil. Lower frequencies are produced by the bass diaphragm which is specifically designed for optimum reproduction throughout the range assigned to it. Upper octaves are radiated solely from the high-frequency propagator,

How to Choose Your School to Gain the Most Profitable Career in ELEVISION RADIO-ELECTRONICS

Well-paid jobs await properly trained engineers and technicians. Be sure you invest your time and money in the right technical institute!

Over $1 billion will be spent in the U. S. for 5 million TV receivers this year alone. And TV, as gigantic as it is, is but one part of the great electronics industry. Technically qualified men are needed now, not only for expanding industry jobs, but the activated armed services, too, are seeking and giving preference to technically trained men. Electronics is *the new field,* where know-how is rewarded with excellent jobs and lifetime careers.

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WHAT TO LOOK FOR. Judge a school by its reputation in the industry, by the demand for its graduates, the professional standing of its faculty, the quality of its courses, the size and adequacy of its buildings and labs, the personalized help it offers, the length of time it has been in existence, and by its accomplishments. CREI invites your investigation and comparison.

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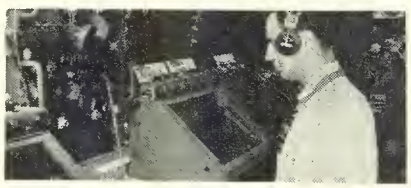

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DEMAND FOR CREI GRADUATES. While CREI makes no job promises, the Placement Bureau generally has on hand more requests than it can fill. CREI graduates are today filling important engineering, development and operational posts throughout the world and in every branch of electronics.

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- Bendix Aviation Corp. • RCA Victor
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UNLIMITED SCOPE. In the Residence School you are grounded thoroughly in the fundamentals required for television, radar, guided missiles, and all other important fields of communications and electronics. Thus as a CREI graduate you need not confine your career planning to a limited field. Dozens of career opportunities and interesting, well-paid jobs are within your grasp.

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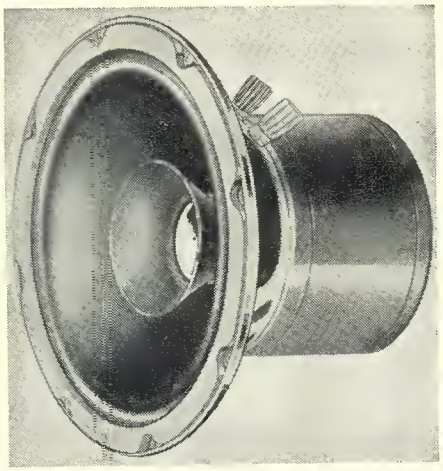
because the low-frequency cone is completely decoupled from the voice coil at these frequencies by a mechanical crossover.

Units available in the line at the



present time include one 8", two 12", and one 15" speakers. Catalogue 111 contains full information on these components.

NEW BLOW TORCH

The Lenk Manufacturing Co. of 30-38 Cummington Street, Boston 15, Mass., has announced the availability of a new blow torch for all types of soldering operations.

The new "Superheat Gun Grip Alcohol Blotorch" will produce a flame of over 2700 degrees F. This high temperature permits silver soldering, brazing, and sweat fitting work, as well as all soft soldering operations. An unbreakable, bakelite gun-grip handle gives this unit flexibility and ease of operation. A built-in safety stand permits the torch to be set in various positions on a work bench,

thus leaving both hands free. A new type of sliding windshield allows the torch to be used both indoors and outside with equal efficiency.

SUBMINIATURE RELAYS

The company's line of subminiature telephone-type series MT relays is now available fitted with from one to four model 1SM1 microswitches, according to word received from *Potter & Brumfield* of Princeton, Indiana.

These new units provide an assembly $1\frac{7}{16}$" x $1\frac{15}{16}$" x $1\frac{1}{16}$" with contacts up to four form C (4-pole, d.t.) rated at 5 amps, 115 volts, 60 cycle resistive load, or 3 amps at 24 volts d.c. Maximum inrush is 12 amps for ½ second.

This relay is claimed to be able to withstand better than 50 G's vibration.

The 1SM1 microswitch is molded bakelite enclosed to protect the con-

tacts and springs from most environment conditions. The relay may be used unhoused or hermetically sealed in the model "M" deep drawn steel can which measures 1" x 1 1/16" x 2 3/32". The hermetically sealed assembly can be fitted with either plug-in or solder terminals.

TINY BATTERY

Yardney Electric Corporation of 105-107 Chambers Street, New York 7, New York is currently marketing its Model No. A1-HR-1 "Silvercel" rechargeable storage battery which is less than 1 cubic inch in volume and weighs well under 1 ounce.

This new unit is capable of discharging 5 amperes up to 20 minutes and can be discharged at rates up to 30 amperes. In addition, the new bat-

tery is spillproof, substantially shockproof, and is completely free from corrosive fumes, vapors, or spray.

A data sheet covering the Model No. A1-HR-1 will be forwarded on request.

AMPLIFIER-SYSTEM

The Electronic Workshop, Inc. of 351 Bleecker Street, New York 14, New York, has recently introduced a new wide-range, low-distortion amplifier system, the Model A-20-5.

The four input channels, including an equalizer-preamplifier for any of the available magnetic phono cartridges, have independent level adjustments. A four-position treble cutoff filter reduces the high frequency noise and distortion. A loudness-compensated volume control is provided, as well as separate bass and treble

(*Continued on page* 168)

Grid-Dip Oscillator

(*Continued from page* 49)

In use, follow this procedure: (1) Switch-on the grid-dip oscillator and allow about 30 minutes for full stabilization. (2) Fasten the oscillator coupling ring in a stationary position about ¼ inch from the Lecher wire coupling loop. For best coupling, the ring and loop should be flat with respect to each other. (3) Set the oscillator butterfly condenser for maximum capacitance, that is, with the rotor plates entirely enmeshed within the stators. (4) Set sensitivity control R_2 for full-scale deflection of meter M_1. (5) Starting at the hairpin end of the Lecher wires and moving toward the open end, slide the edge of the short-circuiting blade along the wires, pressing down firmly enough to insure good contact with both wires (but not hard enough to distort the wires) and keeping the blade edge always horizontally perpendicular to the two wires. (6) At one position of the blade along the wires, meter M_1 will deflect sharply downward. At the point of lowest meter dip, mark the exact position of the blade along the wires. Mark under the wires on the base or on a stationary sheet of paper. (7) Continue to slide the blade along until the next position is found at which the meter dips sharply. Mark this second position of the slider. (8) Measure the distance between the two points, as accurately as possible, in inches. (9) Determine the frequency in megacycles by dividing this number of inches into 5905. Mark this frequency at the present setting of the oscillator tuning dial. (10) Set the oscillator butterfly condenser to minimum capacitance, that is, with the rotor plates turned completely out of the stators. Repeat Step 4 to 9 inclusive to determine the frequency of the oscillator at this dial setting.

The two dial frequency points thus obtained will be the lower- and higher-frequency limits of the tuning dial and should be close to 170 and 450 megacycles. In order to determine the intermediate dial frequencies, it will be necessary to rotate the dial in small steps, and after each rotation to run the short-circuiting blade down the wires to check the frequency. With care, definite points such as 200, 300, and 400 mc. can be located. Table 1 shows the separation which should be measured along the Lecher

Table 1. Separation which should be measured along Lecher wires between meter dip points for desirable dial frequencies.

FREQUENCY (mc.)	SEPARATION (inches)
170	34.75
200	29.55
250	23.63
300	19.70
350	16.90
400	14.79
450	13.15

SEPT. SPECIAL
8MFD 2000 V. DC
C.D. DYKANOL
CAPACITOR
$2.95 EA.

PEAK ELECTRONICS CO.
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SELECTED AND GUARANTEED SURPLUS AT A FRACTION OF ORIGINAL COST.
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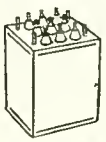
SEPT. SPECIAL
FILTER CHOKE
8 HENRY 175 MA
120 OHMS
$1.49 EA.



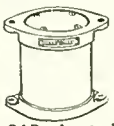
POWER TRANSFORMER
550 Volts CT. 125 ma. 5 V. @ 2A, 6.3 V @ 4A Pri 117 V 60 cy. Fully cased $1.95 ea.

POWER SUPPLY KIT
Uses transformer described and illustrated plus (1) 150 ma choke, (1) dual oil capacitor, and (1) socket. All for only $2.99

POWER TRANSFORMER
Pri 110 V 60 cy. Sec 880 V CT @ 100 ma. 6.3 V @ 4 A, 5V @ 3 A. Fully cased.....$2.49 ea.

POWER TRANSFORMERS
Hermetically sealed. Pri 110 volts 60 cy.
1020 volts CT 400 MA, 6.3V 10A, 5V 3A....$5.95 ea.
175V 50 Ma..... .69 ea.
940 volts CT, 125MA, 6.3V 8A, 6.3V, 2.5A, 6.3, 1.2A, 6.3V, .5A, 5V, 3A..... 3.95 ea.
1110 volts CT 60 MA, 920 volts CT 160 MA, 6.3V, 18A, 6.3V, 1.25A, 5V2A, 5V2A..... 4.95 ea.
300 volts CT 300 MA, 2.5V7A, 2.5V7A, 6.3V, 1.5A. 2.75

CHOKE BARGAINS
6 Henry 50 ma 250 ohms, open frame.....3 for $0.99
6 Henry 80 ma 220 ohms, open frame..... .69
8 Henry 150 ma 140 ohms, open frame..... .99
6 Henry 400 ma 97 ohms, fully cased..... 3.69
4.3 Henry 445 ma 39 ohms, fully cased..... 4.25
10 Henry 350 ma 125 ohms, tapped, full case.. 2.95
15 Henry 250 ma 290 ohms, tapped, full case. 2.20
20 Henry 36 ma 350 ohms, fully cased ..... .69
12 Henry 250 ma 190 ohms, fully cased..... 2.00
5 Henry 170 ma 110 ohms, fully cased..... 1.35

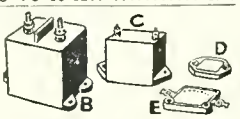


HIGH CURRENT MICAS
Type G4 Ceramic Cose 3¾" High, 5" Diameter Toleronce 5% or Better.

CAP MFD	Amps I Mc	KV DC	Price Each	CAP MFD	Amps I Mc	KV DC	Price Each
.08	60	4	$27.50	.009	40	15	$29.50
.1	70	4	29.50	.0007	40	15	29.50
.65	60	5	24.50	.01	43	15	29.50
.037	45	6	26.50	.0025	23	20	29.50
.02	40	9	29.50	.0031	26	20	29.50
.02	55	10	29.50	.004	30	22	33.50
.0117	40	14	24.50	.0033	25	25	35.50
.0075	30	15	24.50	.001	15	20	29.50
	G1				G2		
.00024	4	6	3.95	.01	25	7	7.95

HIGH VOLTAGE VACUUM CONDENSERS
6 MMF 32KV, EIMAC VC 6-32.....$4.50
12 MMF 32KV, EIMAC VC 12-32..... 4.95
50 MMF 32KV, EIMAC VC 50-32..... 5.50

BAKELITE CASED MICAS



MMF	VDC	Price	MMF	VDC	Price
D .001	600	$ .18	C .001	3 KV	$ .90
E .01	600	.26	C .002	3 KV	.95
D .02	600	.26	D .005	3 KV	.70
E .027	600	.26	C .005	3 KV	1.24
C .01	1 KV	.45	C .006	3 KV	1.50
C .07	1 KV	.55	D .002	3 KV	.70
D .02	1200	.35	C .0001	5 KV	.70
C .024	1500	.65	C .0005	5 KV	.85
C .033	1500	.75	C .0015	5 KV	1.60
C .015	2 KV	.80	C .003	5 KV	1.90
C .02	2 KV	.90	C .005	5 KV	2.50
D .002	2500	.45	C .002	6 KV	2.90
E .005	2500	.55	B .002	8 KV	5.95
C .025	2500	1.25	B .0005	8 KV	2.90
			B .0012	8 KV	4.50

SCR522 Transmitter/Receiver complete with tubes and separate dynamotor power supply. Excellent condition $36.50

MOTOR AND GEAR BOX
Type RL42B Motor 24 volts DC, 1/8 H.P.—1 min. with gear reduction box.....$2.25 ea.

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250 ohm 100 watt.....$0.75
500 ohm 100 watt..... .75
12500 ohm 150 watt..... .95

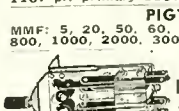
METER MULTIPLIERS
2 Meg 1/5 of 1% Cage enclosed 2 KV.....$3.95
2 Meg ½ of 1% Tubular 2KV 1.95
4 Meg ½ of 1% Tubular 4KV 3.75

IN218 SILICON DIODES. $0.35 ea.; 10 for.....$2.90

HEAVY DUTY CERAMIC RF SWITCH
Single Pole 11 pos. .....$0.99 ea.
UTC type PA 5000 ohm plate to 500 ohm line and 6 ohm voice coil. 10 watt. 60 to 10,000 cps +1 OB. CLOSE OUT AT $1.99

GENERAL PURPOSE TRANSFORMER
Ideal for Bias, Isolation, Stepdown, etc. 2 isolated 110v pr. primary 110v at 900 ma sec. Now $1.49 ea.

PIGTAIL MICAS
MMF: 5, 20, 50, 60, 100, 250, 300, 400, 500, 750, 800, 1000, 2000, 3000.....$0.08 ea.



MOSSMAN SWITCHES
4 Pole Single Throw... $0.95

PRECISION 1% W.W. RESISTORS
Ohms: 2K, 2500, 5K, 8500, 50K, 95K, 750K. .25 ea.

PANEL METERS
BRAND NEW Government Surplus

2" GE 0.5 Ma (Amp Scale).....$1.95
2" Simpson 0-5 MA, Basic, Square..... 2.25
2" Westinghouse 0-10 MA..... 2.25
2" Simpson 0-20 MA (Amp. Scale)..... 1.95
2" Sun 0-25 MA (0-100 Scale)..... 1.95
2" GE 0-50 MA 2.45
2" Sun 0-50 MA. Square (0-100 Scale)..... 1.95
2" GE 0-1 Amp RF 1.95
2" Simpson 0-2 Amp RF (Square)..... 1.95
2" GE 0-4 Amp RF 1.95
2" GE 0-250 MA AC..... 3.50
2" Sun 0-20 Volts DC..... 1.75
2" Weston 0-20 Volts DC..... 2.45
2" GE 0-30 Volts DC (1000 ohms/volt)..... 2.95
2" Triplett 0-300 Volts AC..... 2.95
2" GE 0-30 Amps DC..... 1.95
2" GE 0-25 Volts AC, Linear (0-100 Scale)..... 3.50
3" Westinghouse 0-2 MA 3.75
3" Westinghouse 0-15 MA (Square)..... 3.75
3" Westinghouse 0-20 MA..... 3.75
3" Western Electric 0-80 MA..... 2.75
3" GE 0-200 MA DC 3.75
3" Triplett 0-75 Amps AC..... 2.95
3" GE 0-15 Volts AC..... 3.95
3" GE 0-1 Amp DC..... 3.95
3" Westinghouse 0-2 Amps DC..... 3.95
3" Westinghouse 0-1 MA (Basic) KV Scale..... 3.95
3" Westinghouse 0-750 VDC 1000 Ohms/v..... 4.50
3" Weston 0-150 V AC Model 301..... 5.95
3" Weston 0-1 Volt DC, Model 301..... 3.95
3" Simpson 75-0-75 Microamps..... 6.75
3" GE 0-300 MA DC Square..... 3.95
3" GE 0-100 MA DC Square..... 3.95
3" GE 0-5 MA DC Square..... 3.95
3" GE 0-30 MA DC Square..... 3.95
3" GE 0-20 MA DC Square..... 3.95
3" GE 0-2 Amp DC Square..... 3.95
3" GE 0-300 VAC Square..... 3.95
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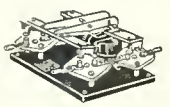

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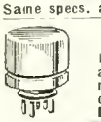

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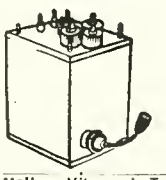

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6	mfd	600 vdc	.79	1	mfd	5000 vdc	4.50
3/3	mfd	600 vdc	.79	.1/.1	mfd	7000 vdc	2.25
8x8		600 vdc	1.39	2	mfd	6000 vdc	9.95
10	mfd	600 vdc	.89	1	mfd	7500 vdc	6.50
4	mfd	1000 vdc	.95	.01/.01	mfd	12 kv	5.75
10	mfd	1000 vdc	2.50	2	mfd	7500 vdc	12.75
2	mfd	1500 vdc	1.25	65	mfd	12,500 vdc	12.95
6	mfd	1500 vdc	2.95	2	mfd	18 kv dc	49.55
1	mfd	2000 vdc	1.45	1	mfd	15 kv dc	15.95
2	mfd	2000 vdc	2.25				

FILAMENT TRANSFORMERS
110 v 60 CY Pri. Cased.
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5 Volt 4A, 6.3V, 3A.. ..... 2.45
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1050V @ 20MA, 20V 4.5A, 2.5V 5A.....$2.95

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16 mfd 450 volt electrolytic (EB9160)..... 3 for .99
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7 MFD 330 VAC Oil Cond..... .69
25 ohm 675 watt Rheostat..... 2.95

wires between meter dip points for desirable dial frequencies.

For best accuracy when using the Lecher wire method of frequency measurement, a very loose coupling must be employed between the oscillator coupling ring and the Lecher wire coupling loop. Also, the measuring scale should be marked off in inches and tenths, rather than in inches and sixteenths found on an ordinary ruler or yardstick.

If a commercial butterfly tuner, instead of a home-made unit, is employed in the grid-dip oscillator, the dial end frequencies will differ from the 170 and 450 mc. values given in the foregoing discussion. So will the intermediate points. For example, dial frequencies for the available 100-to-300 mc. butterfly would be 100, 150, 200, 250, and 300 megacycles.

Signal Generator Method. The apparatus setup for this method of calibration is shown in Fig. 8. Any reliable signal generator or test oscillator which will supply fundamentals up to 50 megacycles or higher can be used. Harmonics of the signal generator dial frequencies will be used, since no oscillator ordinarily available to the non-professional experimenter will furnish fundamentals in the frequency range of the u.h.f. grid-dip oscillator. A generator having high (1-volt) output will be desirable. An audio amplifier will be necessary for good zero-beat indication, since the crystal mixer output will be rather low.

After both the signal generator and grid-dip oscillator have warmed up, (1) set the signal generator to 50 mc. (2) Tune the grid-dip oscillator until a beat note is heard near the low-capacitance setting of the butterfly tuning condenser. At zero beat, the dial of the grid-dip oscillator will be set to

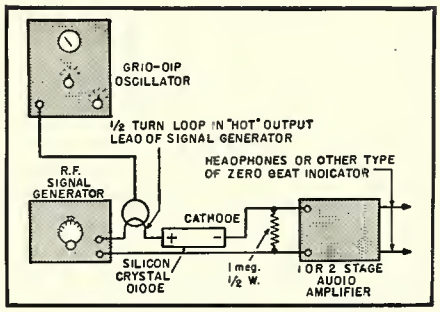

Fig. 8. Setup for checking oscillator frequency by the signal generator method.

450 mc. which is the 9th harmonic of 50 mc. and may so be marked. The full output of the audio amplifier will be required in order to recognize zero beat closely at this high-order harmonic. (3) If the dial of the grid-dip oscillator is rotated slowly and carefully toward the direction of maximum capacitance, the next beat note will be at the 400-mc. setting of the butterfly, the next to that at 350, then 300, etc.—beats along the dial occurring every 50 megacycles apart.

These frequency points may be marked on the dial. The last such point will be at 200 mc. To determine the lowest-frequency dial setting which corresponds to full maximum capacitance of the butterfly, set the latter at maximum capacitance and tune the signal generator slightly lower than 50 mc. until a new beat note is detected. At zero beat, the dial of the grid-dip oscillator will be set to a frequency equal to four times the signal generator frequency.

As a final verification, one or two dial points then may be checked roughly by the Lecher wire method, described in the preceding section, to insure that the proper signal harmonic has been employed. —30—

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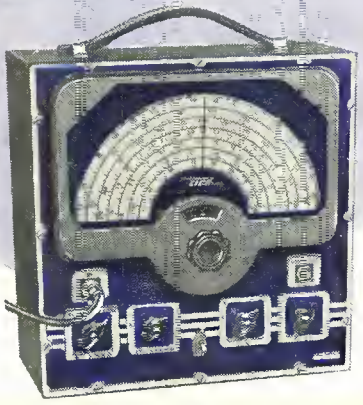

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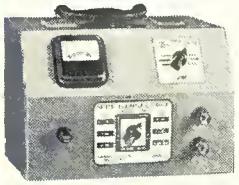

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New Beam Power Tube

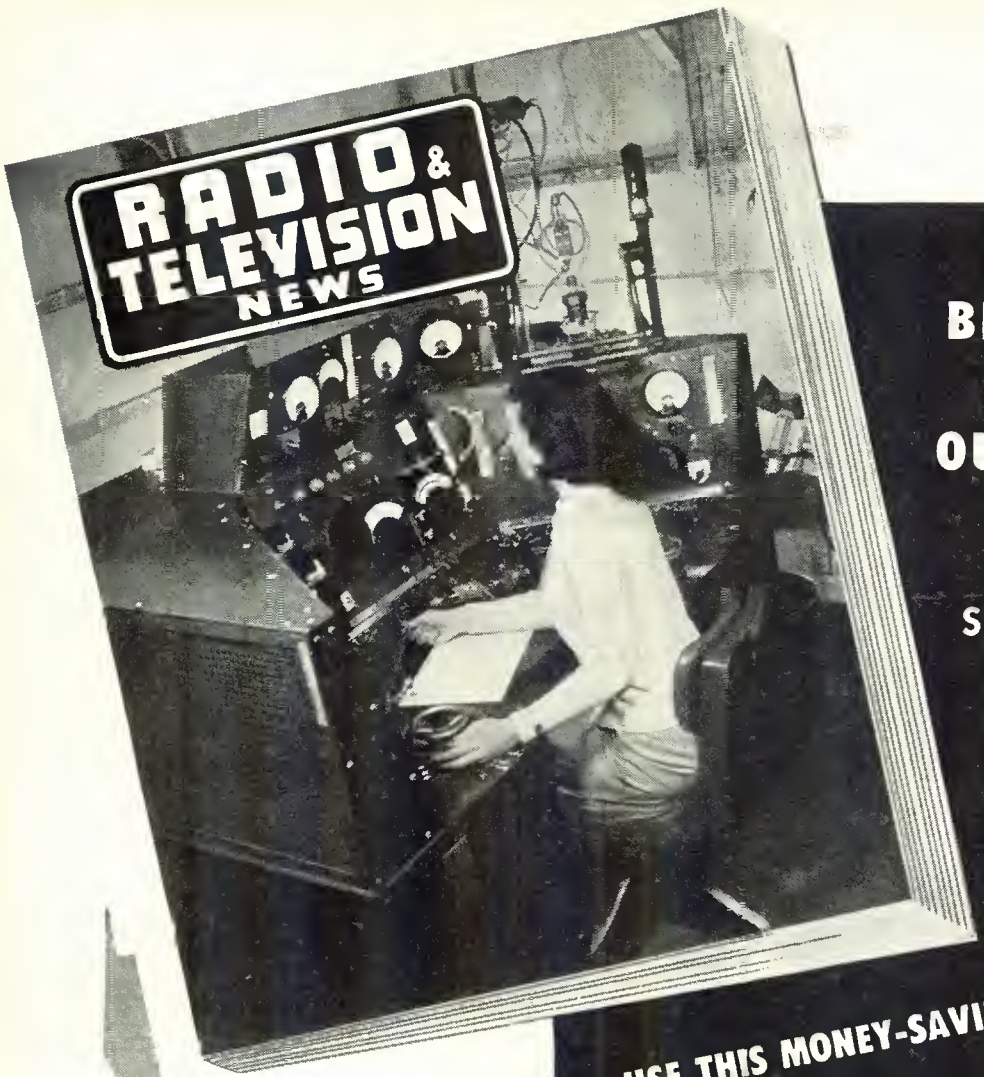
(*Continued from page 42*)

ceptible to certain kinds of parasitic oscillation.

Extra precautions have been taken to deal with gas. The tube is, of course, carefully baked, adroitly bombarded, and thoroughly pumped. The massive plate of carbonized nickel is three times thicker than commonly used. It is painted with zirconium which aids in the adsorption of gas during the life of the tube. Stray gas molecules coming in contact with the zirconium surface, adhere to the metal and are prevented from entering the active interelectrode space to interfere with the thermionic operation of the device. To clean up exhaust gases and effect the continual removal of gas from the tube by chemical means, a pure barium getter is used. Three getter flags are currently employed.

To deal with grid emission, the grid electrodes are given special treatment. Thermionic emission, so essential in a cathode, can be dangerous and damaging when it emanates from other electrodes in a tube. All metals emit electrons thermionically if they become hot enough. The free electrons in a metal, which render it conductive and contribute to many of its metallic properties, are in a state of agitated, continual movement. They are prevented from jumping out of the metal at its surface by the action of electric forces at this boundary, which tend to keep the electrons inside the metal. When heat is imparted to the metal the electrons become increasingly agitated and may develop sufficient momentum to jump out of the metal in spite of the surface force tending to keep them inside. This surface force varies with the different metals, being low for some and high for others. The lower this force the more suitable the metal may be for use as a cathode to supply electrons thermionically. When thin layers of different metals are built up in a special laminated fashion, the surface forces are still further reduced. In the oxide coated cathodes now extensively used, some such arrangement is provided which results in relatively efficient electron emission.

Now the control grid is necessarily close to the cathode. There is never more than a few thousandths inch between the cathode surface and the grid wires. Accordingly, it is very easy for cathode material to condense on the grid wires after evaporation from the cathode. This may occur in the process of tube manufacture or later during the life of the tube. The sensitive cathode materials may form films on the grid wires, providing a fairly efficient source of thermionic electrons. The grid's proximity to the cathode makes it vulnerable in another respect. There is considerable heat energy in the cathodes of power tubes and this naturally has an elevating effect upon the grid tempera-



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ture. Because of the temperature the grid can assume, plus the likelihood of its surface being contaminated by cathode material, it is easy to see why grid emission is a common occurrence. Of course, the emitted current is minute, being on the order of a few microamperes instead of the milliamperes or even amperes emitted from the cathode. However, where there is a lot of resistance in the grid circuit this is all that is necessary to cause a lot of trouble.

In the 5881, grid emission has been dealt a severe blow by the use of gold-plated wire on this electrode. Cathode materials do not effectively contaminate gold-plated grid wires and hence the possibility of grid emission is greatly reduced when the grid surface is gold. Furthermore, gold itself is not an efficient electron emitter. Naturally the standard power tube practice of copper side-rods, carrying heat away from the grid to a "black body" radiating member in the ends is used here.

The screen grid, being farther from the cathode, is not as vulnerable as the Number One grid, although it is by no means immune to the same diseases. Since it takes current, it develops heat on its own account, unlike the control grid which is heated by other electrodes in the tube. Small amounts of emission current can often be tolerated, but there is always a limit. In the 5881 the screen grid is painted with a special carbon suspension which is quite porous and, of course, very black. Its color, as any physics student knows, increases the radiation of heat away from it so that it can run cooler. The porosity of the carbon coating is useful when the tube is used under circumstances where *secondary* emission from this electrode may be harmful. It is believed the secondary electrons are trapped in the porous labyrinth. Also, the porosity is necessary to facilitate de-gassing this electrode during the manufacturing process.

Cathode failure (or "sleeping sickness") during standby periods is combated by using a cathode sleeve of high purity, grade A, electrolytic nickel. It is generally more difficult to process cathodes with this type of sleeve, but exhaustive tests indicate a much greater stability than with the nickel alloy cathode sleeves commonly used in electron tubes.

The 5881 carries ratings similar to the 6L6 except that the allowable screen dissipation is 3.0 watts instead of 2.5 watts, while the maximum plate dissipation is 23 watts instead of 19 watts for the 6L6. The tube has a low loss micanol base. Preliminary tests give results which augur well for the future of the type.

Editor's Note: This new 5881 tube is now in production and will be made available to all retail outlets some time in September. The list price will be $3.50 each, slightly more than the cost of the 6L6.

—30—

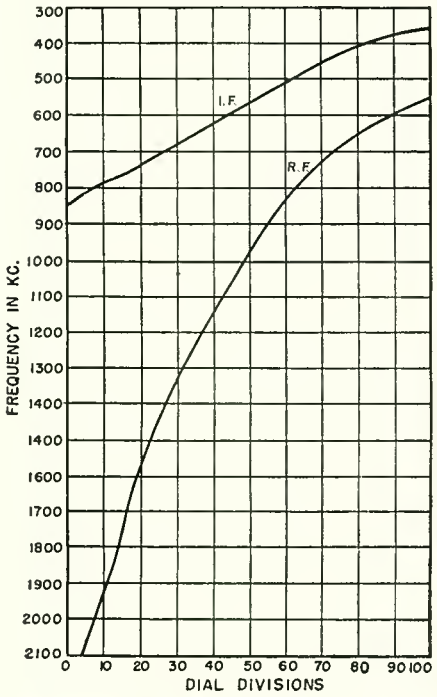
Oscillator-Signal Tracer

(*Continued from page 69*)

calibrations for station identity; the only absolute check will be to listen for the announcement. The oscillator should be looscly couplcd to the receiver by bringing the output connection to within about 6 inches of the antenna post or loop. Turn the attenuator on the test oscillator down low but not quitc off. If another test oscillator is available, it may be used for checking, and it is very convenient to tune the other oscillator to 100 kc. to provide 100 kc. marker points throughout the broadcast band.

Start calibrating at the low frequency end of the band, at 600 kc. and after identifying a 600 kc. station on the receiver, tune the signal generator to zero-beat with the station carrier—a whistle will be observed on cither side of the zero-beat point. This must bc done with modulation off. After locating 600 kc., tune the receiver to 1200 kc. without disturbing the oscillator tuning and pick up the harmonic of the 600 kc. signal from the oscillator (modulation should be "On" whilc searching for the r.f. signal from the oscillator) which will locate 1200 kc. on the rcceiver dial. The oscillator can now be retuned to 1200 kc. and set to zero-beat with a station at this point without disturbing the receiver and thus two points can be accurately located with one station identification. Two points can be located this way for all the other channels between 550 and 850 kc., but for the higher frequencies, it will be necessary to listen for stations directly, as the harmonics will be less useful unless another oscillator is available

Typical calibration curves for test unit.



in addition to the one being calibrated. After several key stations have been accurately located, it will be easier to estimate the approximate location of unknown frequencies.

Locate the i.f. frequencies by using station frequencies of 910 kc. to locate 455 kc., 930 kc. for 465 kc., etc. After locating key stations about 100 kc. apart, it is convenient to tabulate the results on graph paper for future reference and to assist in locating intermediate points. However, the more actual frequencies located, the greater the accuracy of calibration. These suggestions should enable most anyone to accurately calibrate the instrument from broadcast station carriers and the accuracy of calibration will be close enough for any practical use to which this type of signal generator is usually put, and much closer than the calibrated dials on most commercially built service test oscillators.

In actual use, this test oscillator is about half the size and half the weight of the conventional all-wave unit and this makes it convenient to carry out on jobs in the customer's home and it can be used for everything except alignment of the oscillator section on short-wave bands where the use of harmonics might lead to errors. Nice harmonics up to 30 megacycles are available for checking, however. —30—

FREE RADIO COURSES

FROM the Samuel Gompers Vocational and Technical High School at 455 Southern Boulevard, New York 55, New York comes word of a series of free evening courses to be given in elementary and advanced radio work and elementary and advanced industrial electronics.

According to Elmer C. O'Donnell, teacher-in-charge, applicants for these courses must be employed in the radio or electrical field. Registration will be held at the school on September 13 and 14, from 7 to 8:45 p.m.

The classes are being held under the sponsorship of the Board of Education of the City of New York. —30—

RADIO-TV EXHIBIT

THE second annual radio, television, and electronics exhibit, sponsored by the Philadelphia Radio Service Men's Association, will be held at Philadelphia's Broadwood Hotel from September 25th through the 27th.

The purpose of the show is to acquaint service technicians, dealers, and others in the servicing industry with the newest developments in electronics. Several important educational seminars and lectures have been planned during the daily sessions which will begin at 7 p.m. on September 25 and run from 10 a.m. to 10 p.m. on September 26 and 27.

Activities of the first evening will be devoted to an introductory program with addresses by key industry figures and civic officials plus the opening of the many trade displays which will be set up in the hotel's main ballroom.

An invitation to attend the show is extended to all organizations and service technicians. Tickets of admission will be available from parts and radio distributors. —30—

Within the Industry

(*Continued from page 26*)

of U. S. groups on standards that come before the ISO for international consideration. More than 100 national technical societies and associations and some 1700 industrial firms are ASA members.

* * *

C. ARTHUR ROBSON has joined the engineering staff of *The Turner Company* of Cedar Rapids, Iowa.

A graduate of the University of North Dakota with a degree in electrical engineering, Mr. Robson was formerly associated with the *Crosley Broadcasting Corporation* where he spent 8 years in the WLW engineering department.

He has had considerable experience as a design engineer on television transmitters and designed and built one of the first fixed frequency boosters for rebroadcasting television programs originating in distant locations.

* * *

SAMUEL FREEDMAN, formerly new developments engineer for *DeMornay Budd Inc.,* has organized his own firm, *Technical Products & Services Company,* at Santee, California. The new firm will manufacture a comprehensive line of radio, electronic, and nucleonic products and services for schools, laboratories, and manufacturers.

* * *

GEORGE R. SOMMERS is the new general sales manager of the Radio Tube and Television Picture Tube Divisions of *Sylvania Electric Products Inc.*

He succeeds C. W. Shaw who was made assistant to the vice-president in charge of sales.

Mr. Sommers joined the company in 1940, becoming manager of the Capitol Division in Washington, D. C., three years later. Later he became the Pacific Coast sales director for the company and a year ago was moved to the headquarters office in New York to assist in the direction of radio and television tube sales.

* * *

THE TOWN MEETINGS COMMITTEE of the Radio-Television Manufacturers Association (formerly RMA) has designed an extensive series of meetings for television dealers to be held during September and October.

According to Harry A. Ehle, chairman of the Town Meetings Committee of R-TMA, dealers will be shown slide films designed to help them reexamine their sales, merchandise, business management, and service practices.

In addition to a group of manufac-

turers who are underwriting the venture nationally, distributors, television networks, TV stations, electrical associations, and public utilities are cooperating with R-TMA in bringing these meetings to the television dealers of the United States.

* * *

CAPITOL COMMODITIES CO., INC. of Chicago has been appointed national distributor for *Crescent Industries'* line of speakers, wire recorders, record changers, etc.

The firm recently moved to new and larger quarters at 1229 W. Washington Blvd., Chicago 7, in order to provide the necessary facilities for handling the distribution of this newly-acquired line. The company formerly had quarters at 737 W. Van Buren Street in Chicago. —30—

TV Receiver

(*Continued from page 35*)

tinuously variable tuning control (like the *Du Mont* and *Stromberg-Carlson* sets), rotate this control until the picture disappears, then back-track until the station reappears.

2. Rotate the vertical hold control and note whether there exists any leeway before the picture starts slipping up or down. Some leeway should exist. Return the control to its previous position and see whether the picture has any difficulty locking-in again.

3. Rotate the horizontal hold control and note whether there is a range of about 90° through which the hold control can be turned before the picture falls out of synchronism. Observe whether or not the picture can be locked-in again easily when the control is returned to its previous setting.

4. With the vertical and horizontal hold controls in their normal position, switch the power to the set off and then on and note whether the picture locks back in immediately.

5. Finally, for the severest test of all, have the salesman plug a vacuum cleaner in to the same electrical outlet as the set and observe whether the picture remains locked-in while the cleaner is in operation. (Other electrical apparatus suitable for this test would be any brush-type of a.c. motor, *i.e.,* electric shaver, fan, etc.)

If the set passes all these tests, it is reasonable to assume that its synchronization system is stable.

We have now checked the most important features of a television set and these should receive the major consideration of the set buyer or set owner. However, there are, in addition, several secondary features that should also be inspected. Thus, the width and height of the picture should completely fill the visible screen, both when a picture is being received and when no station is present and only the white scanning lines are visible. Rotation of the contrast control should occur gradually and smoothly. Tuning from one station to another should be achievable with a minimum of effort. There should be plenty of leeway in all controls; a slight adjustment should not have any marked effect either on the sound or the picture.

In some sets a low-pitched buzz will be heard from the loudspeaker when a station is tuned in. In some sets the buzz will not appear until the contrast control is quite far advanced; in other sets the buzz will be present even when the contrast control is only partially advanced. In the latter sets this represents a definite deficiency in design or construction and is certain to interfere seriously with your enjoyment of the set. On the other hand, if the buzz appears only when the contrast control is near the extreme clockwise end of its rotation, the buzz need not prevent you from considering the set for purchase provided that by the time the contrast control reaches the point where the buzz makes its appearance, the picture is too dark (overloaded) to be useful for viewing.

The foregoing series of tests, if carried out with reasonable care, will tell you much concerning the capabilities of a television set. It is true that these tests will not tell you how well a set will stand up in prolonged operation—nothing can do that except actually using the set in your home. Even the manufacturers themselves must run life tests on sets to see how they stand up. However, if a set is chosen according to the tests specified above, you can be sure of enjoying the set while it is in operation and, should anything go bad, competent repair will return the set to its previous condition. It is difficult to ask more than that of any electronic device.

—30—

Fig. 8. Two illustrations of images which have slipped out of horizontal synchronization.

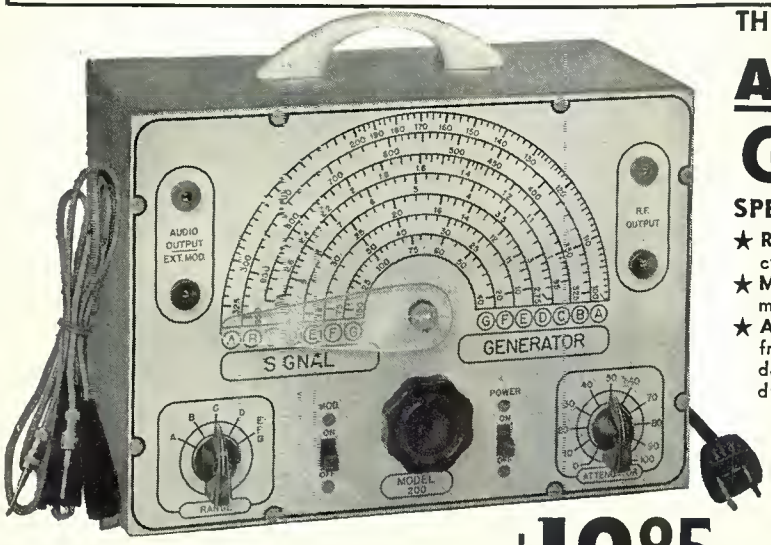
GUARANTEE?
Every unit sold by us is covered by a one year guarantee.

MONEY BACK?
Every unit we advertise is offered on a strict "money-back-if-not-satisfied-basis." No if's—no but's—no maybe's. If you are not completely satisfied after a 10 day trial—return for complete refund. No explanation—you are the sole judge. Plain enough?

THE UNITS OFFERED ON THIS PAGE ARE COMPLETE INSTRUMENTS, NOT KITS! EVERY MODEL IS FACTORY-WIRED, CALIBRATED AND READY TO OPERATE.

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 670

SUPER-METER

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

SPECIFICATIONS:

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

ADDED FEATURE:

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

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

$28.40 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-9, 9B PARK PLACE, NEW YORK 7, N. Y. RN-9

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.)

Technical BOOKS

"ESSENTIALS OF ELECTRICITY FOR RADIO AND TELEVISION" by Morris Slurzberg & Wm. Osterheld. Published by *McGraw-Hill Book Company Inc.,* New York. 516 pages. Price $5.00. Second Edition.

This is a new and enlarged edition of the author's "Electrical Essentials of Radio" published some six years ago.

The advent of commercial telecasting and the expansion of FM broadcasting has extended the field of electricity with which the service technician and student must be familiar.

This text is suitable for the student with a limited mathematical background inasmuch as the only prerequisite is a working knowledge of simple arithmetic. The more involved mathematical operations required by the subject are discussed completely in the text and illustrated by a sufficient number of problems and examples to make the subject matter clear. All of the text material has been written according to the electron theory which eliminates the redundant explanations of earlier texts.

As required of elementary texts, this book is copiously illustrated with photographs and circuit diagrams. Thirteen appendices provide all types of reference data so that the student need not rely on additional books for his working formulas, symbol designations, wire tables, color codings, etc.

Problems covering the text material are included at the end of each chapter with the correct answers supplied in one of the appendices. From the standpoint of clarity and completeness this text provides an excellent one-volume electrical "library" for the student.

* * *

"THE RADIO MANUAL" by George T. Sterling & Robert B. Monroe. Published by *D. Van Nostrand Co., Inc.,* New York. 879 pages. Price $12.00. Fourth Edition.

Twelve years have elapsed since the Third Edition of this well-known text was presented to the public and during those years many significant changes have taken place in the different branches of the electronic communications field.

In bringing the text up-to-date most of the material included in the previous editions has been revised and much data has been added. Chapters covering FM systems, radio wave propagation, antennas, radio equipment for the emergency services, FM broadcast transmitters, and lifeboat radio equipment are new with this edition as is a comprehensive chapter on television contributed by Dr. Thomas T. Goldsmith, Jr. of *Du Mont.*

While most persons now in the radio field are familiar with this book, there may be a few newcomers that are not aware of its existence. This text is

designed both as a reference and study manual for those entering the electronics and telecommunications field.

The text material is lavishly illustrated with photographs and schematic diagrams covering various types of commercially-available equipment. Like the previous editions, this book should find wide acceptance as a source book and reference text.

* * *

"TELEVISION AND F-M RECEIVER SERVICING" by Milton S. Kiver. Published by *D. Van Nostrand Company, Inc.*, New York. 244 pages. Price $3.25. Second Edition.

This is a revised and enlarged edition of a handbook which appeared about two years ago. Designed and written for the television technician, the material included is practical rather than theoretical.

The book is divided into two main sections, the first dealing with television receiver servicing, while the second part covers FM sets. The author has devoted considerable space to a discussion of television antennas and their installation, on the premise that many of the troubles encountered in television can be traced to the antenna system.

A brief chapter is devoted to the test instruments required for servicing and then the author takes up the various portions of the television receiver and discusses the operation of the circuit, its adjustment, and servicing. One particularly valuable chapter covers a coordinated procedure for servicing television sets, with special emphasis being placed on the utilization of visual and aural indications.

The lavish use of photographs and diagrams enhances the value of the text and provides the service technician with a graphic method for checking his servicing results. While the practical value of this book can only be measured in terms of day-in, day-out servicing, it is the belief of this reviewer that the busy technician will find this handbook of great assistance in expediting his servicing work. —30—

AFCA NEWS

This Association is a patriotic non-profit organization, with chapters in most of the larger cities, dedicated to developing and maintaining efficient personnel, commissioned, enlisted, civilian, for the supply (including design and development), installation, maintenance, and operation of communications and electronic equipment for Army, Navy, and Air Force and their supporting civilian activities. It publishes a magazine "SIGNALS" at its national headquarters in Washington. Every American interested in any way in communications is eligible and invited to join. Dues are $5.00 per year. Application should be submitted to the secretary at 1624 Eye St., N. W., Washington 6, D. C., who will furnish details upon request.

AFCA NEWS

Naval Academy Award

The annual AFCA award, which is made to the graduating midshipman who stands highest in the electronics course, was won by Robert Rawson Monroe of Knoxville, Tennessee. The prize consisted of an *RCA* portable radio receiver which was donated by Col. W. W. Watts, vice-president of *RCA Victor Division* and vice-president of AFCA. Francis H. Engel, president of AFCA's Washington Chapter and manager of the local *RCA Victor* office, made the presentation at the awards ceremonies at Annapolis on May 31st.

Military Academy Award

The award at West Point, made to the graduating cadet having the highest rating in electricity, went to Richard Brownson Keller of Mundelein, Illinois. The prize, similar to the one made at Annapolis, was also donated by Colonel Watts of *RCA*. The presentation was made by Theodore S. Gary, vice-president of *Theodore H. Gary & Co.* of Chicago, and president-elect of AFCA, at the military and academic awards ceremony at West Point on June 4th.

R.O.T.C. Awards

The AFCA medal, which is awarded annually to outstanding ROTC (Army, Navy, or Air Force) students in the communications course, was presented to the following cadets:

David L. McCausey, A&M College of Texas; John K. Stewart, Jr., Carnegie Institute of Technology; Howard R. Hart, Jr., Cornell University; William H. Muse, Georgia Institute of Technology; Donald L. Reinertson, Iowa State College; Frank L. Westerman, Jr., Kansas State College; Edwin A. Corrie, Massachusetts Institute of Technology; Robert G. Cunningham, Michigan State College; William A. Bocchino, New York University; Frederick O. Smetana, North Carolina State College; Homer E. Henschen, Ohio State University; James D. Spangler, Oklahoma A&M College; Roland E. Curtis, Oregon State College; Arthur C. Hupp, Purdue University; Richard A. Hartunian, Rensselaer Polytechnic Institute; Warren G. Bender, Rutgers University; Byrt C. Scammel, Southern Methodist University; Stuart W. McElhenny, State College of Washington; William L. Adair, Texas Technological College; Donald Chirafisi, University of Alabama; Albert G. Ponte, University of California; Bruce W. Everitt, University of Illinois; Carlyle Michelson, University of Kentucky; Warren E. Hammond, University of Maine; William F. Squires, University of Syracuse; Robert A. Meek, University of Tennessee; Gerald B. Bunker, University of Texas; Robert B. Beaumont, University of Wisconsin; Carl E. Nelson, University of Wyoming; Baird M. Martin, Virginia Polytechnic Institute.

AFCA CHAPTER NEWS

Augusta—Camp Gordon

The importance of communications to the dissemination of accurate news promptly to the people of the United States was stressed at the June 28th dinner-meeting of the Augusta-Camp Gordon Chapter. The guest speakers were John R. Henry, *INS* southeastern regional manager and Ken Opstein, sports editor, *INS*, Chicago.

Boston

Members and guests of the recently reactivated Boston Chapter met at the Charlestown Navy Yard on June 22nd to hear Captain A. R. Taylor, USN, supervising inspector of naval material, discuss some of the phases of industrial mobilization planning.

Paul Hannah, general counsel of the *Raytheon Company* and vice-president of the chapter, presided in the absence of Rear Admiral T. F. Halloran, chapter president.

Eta Jima

The newly formed Eta Jima Post of the Armed Forces Communications Association held its first informal meeting recently when ten members journeyed to Hiroshima via "J" boat and toured the numerous "A" Bomb damaged sites there.

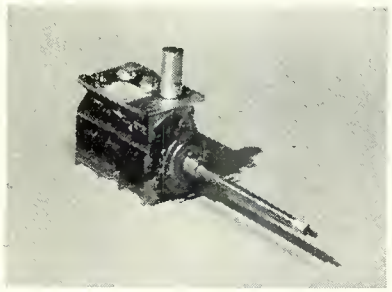
Lt. Colonel Charles W. Gibbs, Di-

OUTSTANDING VALUES NOW AVAILABLE

G I—13-CHANNEL TELEVISION TUNER

For replacement or construction work. Capacity type tuner with fine tuning control. Using 3—6J6 tubes. Input for 300-ohm line. One of the finest front ends every built.

Each.....$6 95 less tubes
Lots af 3..... 6.50 each



VOLUME CONTROL STEAL

250,000 } with switch—2½" milled shaft
500,000 } 39c each
1 meg. } Lots of 10.....$3.72
2 meg. } Asst. of 25..... 8.75

MOST POPULAR VIBRATORS

Covering 95% of all uses at great savings.
Standard 4-prong.....$1.19 ea.
10 for $10.50
Delco 4-prong.....$1.29 ea.
10 for $11.90
Buick Vibrator.....$2.59 ea.
10 for $22.50

RADIO PARTS COMPANY SPECIAL OF THE MONTH

Top Cowl Mount Auto Antenna

3-section staff—60" Bakelite insulator with chrome trim. Single-hole mount. Complete with Shielded lead and universal plug.

This monthly only.....$1.59 ea.
Case of 25..... 1.52 ea.

PM Replacement Speakers

4" Alnico V PM..... 95c
5" Alnico V PM..... 95c
6" Square Alnico V PM.....$1.49 ea.
6" Round Alnico V PM..... 1.49 ea.
8" Round Alnico V PM..... 2.25 ea.
10" Square Alnico V PM..... 3.95 ea.

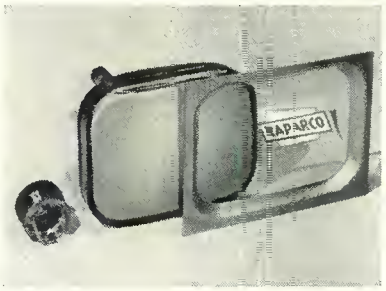
Servicemen's Replacement Kit

Includes 2—4" PM
2—5" PM
1—6" PM
.....$4.90

SEND FOR OUR LATEST CATALOG SHEETS

NOW! LARGE 14" or 16" PICTURE FROM YOUR 10" or 12" TELEVISION SET

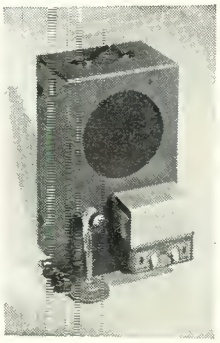
Servicemen: Convert customers' sets for extra profits! 90% of all conversions can be made by use of the RAPARCO conversion kit.



Includes 14BP4 CR tube, 70° deflection yokes and attractive lucite mask

Complete, only.....$32.95

10-WATT AMPLIFIER SYSTEM



An amazing value! Including: • 10 watt high quality amplifier. Tubes: 6L6, 5Y3, 6SL7. Mike and phono input. Attractive maroon and grey, all-steel cabinet. • Hi-Gain crystal mike with table stand. • Attractive heavy-duty carrying case. • Heavy magnet Alnico V. speaker, with matching transformer.
This amplifier system is just the thing for all medium and small gatherings. It gives excellent performance on music and speech.
Only $29.95 Complete
Amplifier alone $15.95

HIGHEST QUALITY TELEVISION COMPONENTS— at lowest prices yet!

Standard manufacture—All New—All guaranteed.

All these parts are used constantly in repair or conversian work:

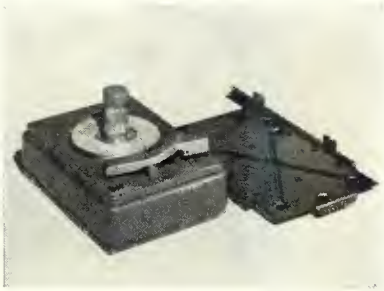
70° Deflection Yoke.....$3.99
60° Deflection Yoke..... 2.25

Flyback Transfarmer far 12½" Set...$2.75
Flyback Transfarmer for 16" Set..... 3.50

500 mmf. 20,000V Candensers...$1.29 ea.
5 for.....$5.49
Single Magnet Beam Bender.....79c ea.

14" Attractive Lucite Square Mask...$3.95
16" Attractive Lucite Square Mask... 4.50

CRESCENT CHANGERS for the RCA 45-R.P.M. System



A complete changer ready far installation or attachment. Beautiful in appearance, built to last under constant service.

Each changer comes complete with Crescent "Rollway" mounting for custom installations.
Price complete.....$8.59

Metal Base for RCA 45 R.P.M. changer—Mahagany Hammerloid Finish....$1.00

CRESCENT SPEAKER SALES

All originally, individually boxed speakers —Fully Guaranteed.

Check the prices on these frequently used, dynamic speakers—

8"—2500-ohm Field Coil....$2.59
10"—1500-ohm Field Coil.... 2.95

12"—1500-ohm Field Coil.... 3.50
12"—2500-ohm Field Cail.... 3.50

Oval Type Dynamic Speakers

4"x6" { 4-ohm Field Coil; 450-ohm Field Coil; 1000-ohm Field Coil; 1500-ohm Field Coil; 2750-ahm Field Cail } ..$1.39 each

5"x7" { 4-ohm Field Cail; 450-ohm Field Coil; 1000-ohm Field Coil; 1500-ohm Field Cail } ..$1.59 each

6"x9" { 4-ohm Field Coil; 450-ohm Field Coil; 1000-ohm Field Coil; 1500-ohm Field Coil } ..$1.89 each

Quantities Limited—While They Last!

HEAVY DUTY PM SPEAKERS

Excellent for all sound work.
12" 6.8 oz. Alnico V..... $4.95
12" 32 oz. Alnico 3.....$4.95

Radio Parts Company, 614 RANDOLPH ST., CHICAGO 6, ILL.

rector of the Signal Corps School Division of the Eta Jima School Command and inaugurator of the local membership drive for the new AFCA Post, planned the trip to Hiroshima and made arrangements for the tour.

This was the first informal meeting of the new Post which is now being organized after signing 15 new members during the local membership drive. A formal meeting for the election of officers is planned as soon as the Post receives word on its Charter application.

Future plans of the Post call for a meeting with representatives of the *Hiroshima Telephone Company* to discuss the effects of the "A" Bomb on communication installations and a tour of the *Hiroshima Central Telephone Office.*

Although present membership of the new Post is only 19, Pfc. Jack McCune, campaign manager for the local membership drive, said that he anticipates a total membership of approximately 40 members.

Pittsburgh

The Pittsburgh Chapter held its largest banquet at the Hotel William Penn on June 13th. Colonel George P. Dixon, AFCA national executive secretary, spoke, stressing "Communications are absolutely essential and extremely important to the Armed Forces because they constitute the nerve centers of military activities throughout the world in times of peace and war." He emphasized the importance of close cooperation between the Armed Forces and the communications industry in order to be prepared for any emergency.

New officers were installed for the ensuing year as follows: President—Fred E. Moran, superintendent, *Western Union Telegraph Co.;* 1st Vice-President—S. C. Stoehr, Jr., *Bell Telephone Co. of Pa.;* 2nd Vice-President—R. E. Stark, *Stupakoff Ceramic & Manufacturing Co.;* Treasurer—Charles A. McKenney, Jr., *Peoples First National Bank & Trust Co.;* Secretary—Andrew N. Galone, *Bell Telephone Co. of Pa.*

Sacramento

The May 25th meeting of the Sacramento Chapter was held at the Sacramento Signal Depot Post restaurant. Col. Harry L. Vitzthum, commanding officer of the Signal Depot, welcomed the members and guests and congratulated the chapter on its achievements during the year. Mr. W. E. Thomas presented Chapter President Milt Mauer, of the *Pacific Tel & Tel Co.,* with the scroll awarded to the Sacramento Chapter at the annual national convention for second place in the "Chapter of the Year" contest.

The subject of the evening, commercial photography, was presented by Mr. Robert O. McCurry of the *McCurry Photo Company* and was accompanied by demonstrations of the

Polaroid camera and stereo-pictures.

The results of the recent annual election were announced and the following officers were installed: President—M. G. Mauer, who was reelected for a second term; Vice-Presidents—C. A. Bairos, James R. Miller, Robert D. Livingston, Paul E. Shaad; Executive Secretary—C. A. House, also reelected for a second term; Board of Directors: H. M. Skidmore, Waldemar Doyal, Paul Carrington, Art Tanner, L. J. Brundige and W. F. Falck.

Seattle

An Army film, entitled "Invisible Ramparts," depicting the history of the Alaska Communication System, was featured on the program of the June 14th meeting of the Seattle Chapter in the Chamber of Commerce Building. The film commemorates the 50th anniversary of the establishment of the ACS by the Signal Corps on May 26, 1900, and gives a comprehensive picture of the operation of the communication system throughout Alaska.

Mr. Hershal Wandling, Jr., of the *Radio Products Sales Co.,* discussed the latest developments of the *Webster* recording equipment and demonstrated the wire and tape models.

Washington

The planning of communications, without which no civil defense organization can function, is among the hardest programs to formulate of any in the civil defense field, Paul J. Larsen, director of the Office of Civilian Mobilization of the National Security Resources Board, declared in a talk July 6th before the Washington Chapter of the AFCA. Communications could well be the "weak link" in the civil defense system without adequate planning and the full cooperation of all entities in the communications field, Mr. Larsen said.

Basic communications planning, Mr. Larsen pointed out, is complicated by the fact that no one would know before hand what communications facilities would be knocked out in event of enemy attack. Turning to the possibility of constructing added communications networks to serve as alternate or standbys, Mr. Larsen commented that draining the national economy weakens the nation's defense potential. He said that new networks cost money and take time, and that it is felt that communications planning must be carried out on the basis of existing facilities now in service. The nation's amateurs can play an important role in civil defense communications, he declared.

The AFCA, Mr. Larsen commented, can also be very helpful in the civil defense field. He explained that the federal government can be responsible only for air raid alert warnings and the communications to tie together state agencies and the regional offices of the civil defense organization. Each community must solve its intrastate communications problems,

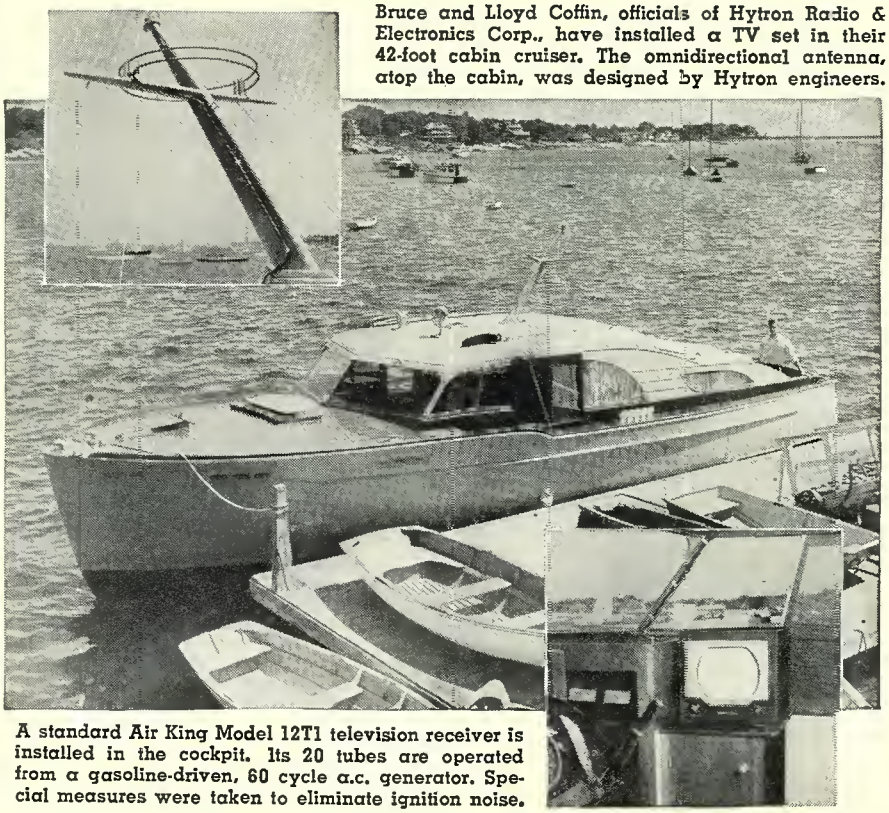
he declared, and the AFCA can aid by giving to state and municipal agencies guidance and recommendations in implementing or tying togther existing communications systems.

Throughout his address, Mr. Larsen emphasized that, as originally planned by an organization under the direction of the late Russell J. Hopley, president of the *Northwestern Bell Telephone Co.*, the federal government can give only guide-posts and over-all assistance to state and local agencies. The latter, he emphasized, in our system of government, must take responsibility for actual on-the-ground rescue and police operations. Declaring that training of a civil defense organization will be about a one-year job, Mr. Larsen said that after that time the structure should be capable of handling operations in any future disasters which may occur —not only enemy attack, but also natural disasters and explosions. He said his office is also planning a broad program of public education and public relations to inform the public on the probable effects of enemy attack and the part to be taken by civilians if an attack occurs.

At the meeting, attended by about 150 AFCA members and guests, Francis H. Engel, Washington manager of the *RCA Victor Division,* was re-elected president of the chapter for another year. Vice-Presidents named were: J. R. B. Crigler, vice-president and general manager of the *Chesapeake & Potomac Telephone Co.;* Maj. Gen. K. B. Lawton, Deputy Chief Signal Officer; Rear Adm. John R. Redman, Director of Naval Communications; and Brig. Gen. Wallace G. Smith, commanding general of the Air & Airways Communications Service. Col. E. C. Cover of the *Chesapeake & Potomac Telephone Co.,* who has served as secretary-treasurer of the chapter for the past several years, was reelected to that post. Lt. Col. J. A. Pernice of the Office of the Chief Signal Officer was named general counsel.

Directors named for the coming year were: Col. J. W. Baldwin, Assistant Deputy Chief Signal Officer; Capt. William Beltz, Asst. Director for Electronics of the Navy Bureau of Ships; Col. Percy Black, vice-president of *Gary Services;* Col. Eugene V. Elder, Asst. Chief of the Procurement & Distribution Div. of the Office of the Chief Signal Officer; E. J. Girard, Washington representative of *Federal Telephone & Radio Corp.;* F. P. Guthrie, assistant vice-president of *RCA Communications;* G. C. Harris, *Western Union* superintendent in Washington; Capt. C. F. Horne, Asst. Director of the Office of Federal Airways.

Also, Capt. D. E. McKay, Chief of Communications of the U. S. Coast Guard; A. L. Milk, Washington manager of *Sylvania Electric Products Inc.;* S. A. Moss, general plant manager of the *Chesapeake & Potomac Telephone Co.;* Comdr. Guy M. Neely, Chief Engineer of the Office of the Director of Naval Communications; Maj. R. H. Ralls, USAF, officer-in-charge of the amateur network; C. H. Teskey, Division Attorney of the *American Telephone & Telegraph Co.* Long Lines Dept.; D. C. Trafton, of the USAF Directorate of Communications; and Commodore E. M. Webster, FCC Commissioner. —30—



Bruce and Lloyd Coffin, officials of Hytron Radio & Electronics Corp., have installed a TV set in their 42-foot cabin cruiser. The omnidirectional antenna, atop the cabin, was designed by Hytron engineers.

A standard Air King Model 12T1 television receiver is installed in the cockpit. Its 20 tubes are operated from a gasoline-driven, 60 cycle a.c. generator. Special measures were taken to eliminate ignition noise.

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**

CONDENSERS

	Each
2 mfd. 4000 VDC. OIL FILLED	$2.95
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

COMMAND (SCR 274 N) EQUIPMENT

	Used	New
BC-453	$12.95	
BC-454	5.95	
BC-455	7.95	9.95
BC-456		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 5et. **$34.50**

BC 906—Frequency Meter

Range 150-225 MC with modification possible for lower frequencies of TV, etc. Contains 0-500 DC microammeter and uses Battery pack of 1.5 V and 45 VDC.

Like New—Less Batteries **$12.95**

FLAP PITCH MOTOR

24 VDC. will operate on AC—11,000 R.P.M. Complete with gear box and limit switches ..... ea. **$2.95**

SOLENOID 110V 60cyc. coil complete with trip arms that really snap into place and hold. New **49c**

HEADSETS—MIKES

H5-23 Hi Imp. Headsets	New	$2.95
H5-33 Lo Imp. Headsets	New	2.95
HS-30 Hi Imp. Headsets	New	1.50
	Used	.79
T-17D Carbon Mike	New	2.75
	Used	1.50
T-24 Hi Imp. Carbon Mike	New	1.19
T-30 Throat Mike	New	.98
T-45 (or Navy) Lip Mike	New	.98

TUBES

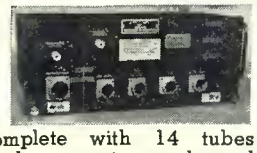
Drastically Reduced from 10 to 50%
Nationally Advertised Brands

Type	Net Price	Type	Net Price	Type	Net Price
1A4P	$0.24	6SF6GT	$0.34	37	$0.24
1A6	.19	6S7G	.39	38	.24
1B6/26S	.24	6S8GT	.59	39/44	.24
1B26	2.29	6SF7	.39	49	.39
1B29	.39	6SJ7	.69	50	.39
1B32-632A	2.29	6T7G	.39	56	.24
1C6	.19	6U7G	.29	67	.24
1C7G	.19	6Z7G	.39	76	.24
1D5GP	.24	6ZY5G	.29	77	.24
1D7G	.19	7C4/1203A	.24	211/Vt4L	.29
1F4	.24	7E6/1201	.39	316A	.34
1F6G	.24	10YVT26A	.19	371B	.34
1H4G	.24	12A6	.34	700A	7.95
1J6G	.24	12A6GT	.34	703A	1.49
1J6GT	.24	12A7	.34	706A	.79
1V	.24	12A8GT	.19	714AY	5.95
2A6	.39	12F6GT	.29	724B	4.95
2A7	.24	12H6	.29	801A	.39
2C26A	.19	12J5GT	.24	829	6.95
2V3G	.49	12J7GT	.24	832	4.95
2X2/879	.39	12Q7GT	.24	837	1.49
3FP7	.98	12SF6	.24	841	.29
4AP10	.98	12SF5GT	.24	864	.29
6BP4	2.96	12SF7	.24	872A	.98
6CP1	2.95	12SR7	.24	954	.19
6D21	19.95	12SR7GT	.29	966	.34
6FP7	.95	12SN7GT	.89	967	.34
6J23	6.95	12Z3	.29	1625	.29
6T4	.49	15R	.19	1626	.24
6AB7	.59	19	.59	2050	.89
6AJ5	.89	2J22	1.95	2061	.49
6B8	.69	28D7	.34	9002	.34
6C4	.39	30SPEC		9003	.39
6D8G	.69	(Vt67)	.69	9006	.29
6F6GT	.39	30	.24	GL4A21	.29
6F6G	.59	304TL	1.29	Amperite 10T1	.29
6H6	.39	32L7GT	.39	Jan CRP72	.98
6J7GT	.39	33	.24	REL36	.69
6L6G	.39	34	.24	VR105	.89
6L7G	.39	36/61	.24	VR150	.49
6R7	.34	36	.24		

WRITE FOR QUANTITY PRICES

ARROW has the VALUES!

RT7/APN1 TRANSCEIVER 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**

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.		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	3.95	4.95
RM 29 Remote Telephone Control	7.95	9.95
BC 602 Control Box		.98
RL 42 Antenna Gearbox Motor and Reel	4.95	7.50
TS 10—Sound powered phones	$6.50	
APS 13—Transceiver		$17.50

BC 1066 A—150 to 225 MC Portable Receiver adaptable to many amateur uses. In Canvas Carrying Bag. New $6.95

Tuning Units for **BC 375**—Presently most numbers are available in excellent condition with case at ..... $2.95 ea.

BC 306—Antenna Tuning Unit for **BC 375**. Excellent condition ..... $1.50 ea.

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 2⁹⁄₁₆", Shaft ¼"x¾" ..... New $1.49

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)**
MD-22-URA/T1 Radar Modulator
AN APRI Receiver and Tuning Units
ASB7 Complete Radar Installation
TS-251 Test Set **BC 221** Freq. Meter

MONTHLY SPECIALS

BC 456 Modulator of 274 N Command Equipment. Used condition as they come... **98c** ea. 2 for... **$1.69**

NOTE: The overwhelming majority of these units is in A-1 excellent condition, with tubes.

A Repeat Item by Popular Demand

A limited supply of Navy "LM" Frequency meters will go to the first comers at $12.95 ea. These units must go on an "as is" basis at this Low Price. They are less tubes, crystal and calibration book. Some are minus knobs and dial but have very clean—new locking insides.

SEND FOR FREE 8-PAGE ILLUSTRATED BULLETIN
listing many exceptional values

ARROW SALES, Inc.

Dept. N
1712-14 S. Michigan Ave., Chicago 16, Ill.
PHONE: HArrison 7-9374

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.

RADIO TUBES

813 ..... **$6.95 ea.**
807 ..... **1.79 ea.**

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 **$14.95**

Crystals—Set of 80 ..... **14.95**

BC 603

Receiver—Good. Used **$24.95**

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 less tubes, vib. & con $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

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

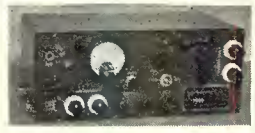
SURPRISE PACKAGE

20 lbs. Ass't radio parts. A $25.00 value for only **$1.95**

IS-185 Weston Voltmeter Model 433—0 to 150 VAC 25 to 2400 cycles. New **$24.95**

BC 188 MODULATOR

without tubes but with numerous parts, including an 0-200 MA Simpson meter making it an exceptional buy at **$2.95**



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"x9"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. **$129.50**

Brand new, ready to go .....
Extra 18" stub type antennae are available ... $2.95

AS-138/ARN—10 inch streamline loop as used with direction finding receivers. Fixed position, it is ideal for planes, boats, automobiles. New **$2.95**

All shipments FOB warehouse. 20% Deposit required on all orders. Minimum order accepted—$5.00. Illinois residents, please add regular sales tax to your remittance.

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.

CHESTER L. KEENE, Captain, USAFR, AF6YWQ-W6YWQ, 4317 Madison Avenue, Fresno, California, has been named as operator of the Air Force MARS Station of the Month by Major Rawleigh H. Ralls, Chief MARS, Air Force, for his operation of the key outlet for MARS traffic to the Far East as well as his MARS and amateur activities at home.

While running MARS nets and hamming generally takes up a great deal of his time "Chet" still manages to give an assist to the MARS gang at Castle Air Force Base, Merced, California, where he holds an M-Day assignment.

Chet is a charter member of MARS and AF6YWQ was one of the first stations under the Fourth Air Force to get on the air. He is alternate NCS on the 40- and 80-meter MARS nets and assembles traffic from these and Central California Net No. 1 on 2 meters to relay to MARS stations throughout the Far East area on 20994 and 27994. He also keeps regular skeds with MARS stations in Newfoundland, Labrador, and Alaska on the same frequencies and clears a considerable amount of traffic concerning reservist activities with AIR in the Pentagon.

Hamming just comes naturally to Captain Keene. He started his excursion into the ether in 1915 (it was ether then) with a rock-crusher, a spark transmitter, that is, and coherer somewhere below 10,000 meters with an unmetered input to the primary of the h.v. transformer using the call 1CK. Later when amateur licensing became formal he was assigned W1LXU.

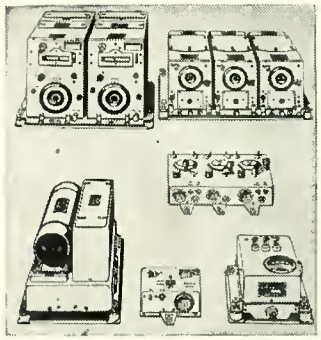
During World War I Chet served as junior radio op on *HMS Sicilian* out of Montreal, Canada and developed a liking for salt water. After the war he served four years as unit

Capt. Chester L. Keene, a charter MARS member AF6YWQ-W6YWQ, handles heavy traffic skeds for Fourth Air Force area. A BC 610, with the assistance of a beam on the higher MARS frequencies, helps him keep skeds with Far East, Alaska, Newfoundland, and Labrador.

DON'T CHASE ALL OVER

WE HAVE THE BEST AND BIGGEST VALUES!!

SCR-274 COMMAND SET . . . THE GREATEST RADIO VALUE IN HISTORY



A mountain of valuable equipment that includes not 1 but 3 of the hottest superhet Communications Receivers, the famous BC-453, BC-454 and BC-455, each with tuned R.F. stage, 3 gang condenser, crystal, and 6 working tubes not counting rectifiers. Included are 2 Tuning Control Boxes; 1 Antenna Coupling Box with R.F. meter to measure power into antenna; 4—28V dynamotors (alteration of set to 110V operation is quick and simple); 2—40 watt transmitters including crystals; and pre-amplifier and modulator so transmitters can be used for voice or code. 29 tubes supplied in all. Guaranteed electrical condition. A super value at $59.95.

NEW G-E. TRANSMITTER

Brand new General Electric BC-375 or BC-191 transmitters, export packed, complete set of spare tubes as well as 10 and 20 meter conversion instructions..$100.00 BC-312, BC-348 or BC-224 receivers sold with the above transmitters (unit for unit). 1000-mile range....$125.00

RT-1711 Brand New 12 Tube, 110 Volt Receiver-Indicator-Oscilloscope complete with all tubes and power supply. Has telescoping hood over scope tube, which is equipped with a detachable calibrated screen. Has centering and amplitude controls and two video inputs. A natural for television $39.95

RT1655
Only $14.95

11 tube crystal controlled superheterodyne receiver that covers the FM band. The ultra modern circuit uses the latest types of tubes including 7 miniature 6AJ5's. Beautiful chassis and aluminum cabinet. Tubes and diagram included.

1000 CYCLE AUDIO FILTER
With TOROID Coils

Navy PD52010-1 low pass audio filters as mentioned in the "Peaked Audio" article in June CQ, and designated by the above number, are the exact electrical and physical equivalent of commercial audio filter units selling for $35.00 wholesale. They are infinitely better than the surplus "Radio Range Filters" being sold for reducing QRM, and at 2 KC off resonance for example, a 2 section filter using PD52010-1 is capable of twice the selectivity available through the use of the QR-er (the BC453 section of the 274N which has provided the amateur's previous highest standard of interference elimination). EXTRA SPECIAL — NAVY PO52010-1 with diagram—$2.00.

MIDGET 1 WATT TRANSMITTER supplied complete with polystyrene coil forms for 3 ham bands. Size overall 3"x1"x2½" high. Includes practically all necessary parts. Your Cost.....$1.50

WE WILL PAY CASH
for RADIO TUBES

for SCR284, BC654, PE103, BC348, BC312, BC222, BC324, and BC342 receivers. SCR522 and BC610 transmitters. We are especially interested in any factory, dealer or other outlet submitting a list of surplus electronic equipment for us to bid on.

ASSORTMENTS

Wire Wound Resistors, 12 Asst., including adjustable	$1.00
Knobs, Assorted, 30 for	1.00
Sockets, 9, 8, 7, 6, 5 prong, 25 for	2.50
Coil Forms, Large & Small Asst., 20 for	1.00
Rotary Switches, Asst., 6 for	1.75
Resistors, Asst., 100 for	1.95
Insulators, Asst., 20 for	1.00
Bathtub Oil Condensers Asst., 6 for	1.00
Solder Lugs, Asst. Types, 300 for	1.00
Asst. Oscillator Coils, 7 for	1.00
Asst. Toggle & Slide Switches, $3.00 value, 5 for	1.00

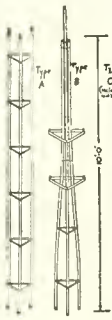
RMA Color-Coded Corbon Resistors

Superior Reslstor Asst....100 for $2.95

Manufacturers! Call on us for any size resistor by the thousand to ease your production bottlenecks. $4.00 per C or $30.00 per M for carbon resistors. We will also buy or swap for your surpluses.

THE BUFRAD SECTIONAL TOWER

This latest addition to the famous line of BUFRAD antenna products makes up to a hundred foot tower from any desired number of ten foot sections of extremely strong welded construction. The sections are shipped assembled and painted, so that erection is a matter of minutes rather than hours. Assembly is a one man job, and is accomplished by climbing up the completed portion of the tower with the next 25 lb. section to be installed. Hand and footholds are provided to make the work safe and easy. Cap at top of tower provides bearing surface for rotating, and prevents water from entering tubes. Useful for police, or amateur transmitters, and in addition the tower will provide satisfactory TV reception where otherwise it would be impossible. Ideal for supporting permanent or temporary power lines, wind generators, stadium public address speakers or spotlights for gas stations or parking lots "B" and "C" sections together cost a total of $15.75 and total 20 feet. "A" sections, which make up the entire tower except for the top, are each 10 feet long and cost but $12.75 apiece. Those who wish a mast base will be able to obtain one (not shown above), for only $6.75. The base is especially useful when erecting the tower on a sloping roof.



AUDIO AMPLIFIER

Brand new, dual triode amplifier having 2 of the valuable and scarce ouncer type audio transformers that sell for $12.80 apiece. Neat aluminum case, fully enclosed (largest dimension 6 in.). Perfect for intercom systems, phono amplifiers, mike amplifiers, or signal tracer amplifier for testing radio sets. A sensational bargain at only, each..... $3.40

Phonograph Scratch Eliminator

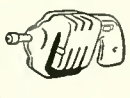
Consists of 2 condensers and powdered iron core choke connected in a filter network. Same as used in most jukeboxes to improve low note response and eliminate scratch. Connects instantly between pick-up and amplifier. A super bargain at..... $2.00

TELE-VISION & RADIO CHASSIS CRADLE

Pays for itself in a week—Saves and eliminates broken tubes, coils, dials, etc. Cadmium plated steel, finger-tip control. A necessity for Television Service.

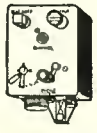
Your Cost $4.69

"DRILLMASTER" ELECTRIC DRILL



Pistol Grip electric drill, ideal for hobbyists. Complete with sander, buffers, grinding wheels, etc. $9.95

REMOTE CONTROL UNIT



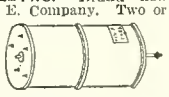
Aluminum case 4x3x2 containing 2 potentiometers, triple pole switch, 4 knobs, phone jack, gear mechanism and revolution counter..... 99c

With 8 prong JAN connector to fit box..... $1.39

$12.95 Takes All Three BIG BARGAINS

Order "Bargain D"

1. SENSATIONAL, FASCINATING, MYSTERIOUS SELSYNS. Brand new Selsyns made by G. E. Company. Two or more connected together work perfectly on 110V AC. Any rotation of the shaft of one Selsyn and all others connected to it will rotate exactly as many degrees in the same direction, following unerringly as if the units were connected together by shafting instead of wire. This is true whether you twist the shaft of the master unit a fraction of a revolution or many revolutions. Useful for indicating direction of weather vanes, rotating directional antennas, or controlling innumerable operations from a distance. Complete with diagram and instructions. Per Matched pair.....$4.95



2. ALUMINUM GEAR BOX 18x8x7 that contains two powerful electric motors and two matched gear trains, 62 gears in all varying in size from ⅜ to 4 inches in diameter. This unit is readily converted to rotate a beam antenna or any other similar use $5.00

3. HOME WORKSHOP AT BARGAIN PRICE. Accurate and precise 2 speed guaranteed hobby lathe, the essential machine for the home workshop. Sturdy enough for light production work or factory standby service. Supplied with 56" of belting for connecting to any available electric motor or power take-off. Also included in this unbelievable offer are such accessories as a ½" drill chuck with specially hardened tool steel jaws, a 4" electric furnace high speed grinding wheel, a cotton buffing wheel and a large supply of buffing compound, and a 4" steel wire scratch brush. Your cost $6.00. Sole export agent. Distributor inquiries invited.

CO-AXIAL CONNECTORS

Army No. PL 259 or Amphenol 83-15P
Army No. SO 239 or 83-1R
Army No. M 359 or 83-1AP
49c each—in lots of 10 assorted, 39c each
Practically all other AN & PL connectors in stock at lowest prices in manufacturer's quantities.

SINGLE-GANG CERAMIC-INSULATED VARIABLE CONDENSERS

Ideal for high-frequency applications in receivers and low power transmitter stages. All types.

10 mmf	$.35—10 for	$2.90—100 for	$23.00
15 mmf	.35—10 for	2.90—100 for	23.00
25 mmf	.35—10 for	2.90—100 for	23.00
35 mmf	.40—10 for	3.40—100 for	28.00
50 mmf	.45—10 for	3.70—100 for	30.00
79 mmf	.50—10 for	4.40—100 for	38.00
100 mmf	.55—10 for	4.50—100 for	39.00
140 mmf	.80—10 for	7.40—100 for	64.00
160 mmf	1.00—10 for	8.50—100 for	70.00
140-140 mmf	1.60—10 for	12.50—100 for	100.00

FAMOUS MAKE TUBULAR CONDENSERS

.0005	600 V.	18 for $1.00
.0005	1000 V.	15 for 1.00
.001	600 V.	14 for 1.00
.03	400 V.	13 for 1.00
.05	400 V.	12 for 1.00
40–20–20	150 V. electrol	2 for 1.00

SUPER SPECIAL

FAIRCHILD bombsight **POWER UNITS.** Brand new, contains 9 tubes with a value of $15.00; 8 electric motors or generators, 6 of the permanent magnet field type; relays; and 20 valuable precision resistors plus a multitude of the ordinary kind, in addition to many condensers and potentiometers. All for only.....$14.95

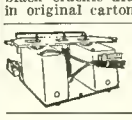
SCR 522 Transmitter-Receiver, approved by Government for taxicab use and other operation by unlicensed personnel. Special $75.00

New PE-98 dynamotors to run the above 29.50

PE-94 dynamotors to run same, only 10.00

CYBERNETICS!

RT1463 12 Stage Electronic Brain containing 3—7F7, 1—7Y4, 3—7N7, 4 potentiometers, numerous resistors, filter and bypass condensers, filter chokes, power and audio transformers, and six sensitive plate relays. A military development that provided amazing stepless control proportional to correction required, in the original application. This phenomenal unit, with its 3 multistage push-pull amplifiers and six 5,000 ohm relays in bridge circuits, will accurately control any 3 operations, related or unrelated, in minutely adjustable uniquely quantitative variations in either forward or reverse directions. 9" x 7" x 8" black crackle aluminum case. Brand new in original carton.....$9.95



3-Gang Broadcast Band Permeability tuner. Was $3.50. Now $1.50.

SAFETY SWITCHES

Spend a dollar to save your life! G.E. Interlock Safety Switches eliminate fatal shocks. $1.00 each.

HURRY

2 gang midget superhet tuning condensers with ¼" shaft and trimmers. Reg. $1.25 each, now 5 for $2.00.

BUFFALO RADIO SUPPLY, 219-221 Genesee St., Dept. RT-9, BUFFALO 3, N.Y.

commander in the USNR. Prior to World War II he was radio engineer with the *Submarine Signal Company* of Boston, Massachusetts.

During World War II he served as communications officer at Randolph Field, Texas and also as senior communications instructor at San Antonio Aviation Cadet Center. Later Captain Keene was assistant to "A-6" at Orlando Air Force Base, Florida. It was at Orlando after V-J day that he put W4KTH on the air. Hams all over the world recall the station as "The Voice of the Tiger" after the symbol of the Flying Tiger of the Fourteenth Air Force.

Chet's home station just about covers the ham spectrum. The transmitter, a BC 610, uses a BC 696 as v.f.o. to cover 80 through 10 meters and an SCR 522 handles his 2-meter traffic. His h.f. receiver is a *Hammarlund* HQ 129X with an *RME* DB 22A ahead of it.

The antenna problem is solved with doublets on 40 and 80 meters and a ground plane antenna does nicely on two. A home grown beam is Chet's delight since it performs admirably on 10, 15, and 20 by using a system of relays to throw in or cut out the required amounts of inductance for proper loading on the various frequencies. He has utilized a prop-pitch motor to rotate the array and the old standby compass indicator to orient it properly.

Power failures mean nothing to Chet since he has a PE 75 for emergency operation. He maintains close liaison with the local police and Red Cross director so that in the event a communications emergency should come to Fresno AF6YWQ may provide contact with other communities.

Captain Kermit R. Parker, MARS Director for the Fourth Air Force, Hamilton Air Force Base, uses Keene's operation of AF6YWQ as a criterion for other member MARTIANS to endeavor to equal.

—30—

SALVAGING RESISTORS

By JAMES L. SOMMERVILLE

IT is no longer neeessary to throw away burned out or broken adjustable wirewound resistors like those commonly found in bleeders in power supplies, voltage dividing networks, etc. Just put a drop of silver or copper conducting paint on the spot where the break occurs, after cleaning the spot with a little carbon tet, and then let dry. The resistor will be as good as new and the paint will not interfere with the adjustable tap.

The conducting paint used is the type currently available for making printed circuits. The paint is rather expensive but a ¼ ounce bottle provides enough paint to restore many dollars' worth of resistors to service. The paint will also be found very useful in other applications around the service shop.

When using this method, remember that the nominal value of the resistor is reduced in proportion to the number of turns shorted out, but with care this can be kept to a minimum. —30—

International Short-Wave

(*Continued from page 52*)

4. Radio Canada, 419. 5. BBC's General Overseas Service, 401. 6. PCJ, Hilversum, Holland, 388. 7. "Voice of America," 380. 8. Radio Sweden, 247. 9. Armed Forces Radio Service (USA), 231. 10. S.R.I., Buenos Aires, Argentina, 221. 11. HCJB, Quito, Ecuador, 202. 12. Radio Brazzaville, Fr. Equatorial Africa, 201. 13. AIR, Delhi, India, 200. 14. Radio Ankara, Turkey, 176. 15. WRUL, Boston, Mass., USA, 157. 16. Monte Carlo, 154. 17. Radio Norway, 151. 18. Radio New Zealand, 147. 19. Radio Andorra, 143. 20. Rome, 139. 21. Radio Indonesia, 111. 22. Radio Luxembourg, 104. 23. Radio Clube de Mozambique, 102. 24. Forces Broadcasting Service, Middle East, Malta, 98. 25. Radio de Espana, Madrid, 94. 26. TGWA, Guatemala, 78.

Mr. Bear comments further: "Many other stations received votes in small proportions. Our congratulations go to OTC which only having been on the air with its *International Goodwill Programs* for a comparatively short time has become the *most popular* station. It will be noted that most of the major broadcasting organizations also are well to the fore in listeners' popularity polling. Our thanks for publicity to the many s.w. stations and to the press throughout the world."

The *ISW DEPARTMENT* joins Mr. Bear and ISWC in congratulating OTC, *The Goodwill Station,* Leopoldville, Belgian Congo, and its fine personnel on this achievement!

* * *

Club Notes

Canada—R. O. Lyttle, *Canadian DX Club,* 140 Lake St., North Bay, Ontario, Canada, writes: "Our once small organization is now gradually increasing, thanks to the efforts of many members. Come January 1, 1951, the club will be handed over to the members themselves by means of an election." A questionnaire has been sent out with the most recent club bulletin (now issued every two months), asking members what they would like to have in the bulletin and in what activities the members are most interested.

USA—At the recent annual outing of *The United 49-ers Radio Society,* these officers were chosen for the year—Edward I. Broome, president; James Zaloudek, vice-president; Mrs. Julia Boice, secretary; Dan Ainsworth, treasurer; Charles McCormick, chaplain; Anson Boice, editor, and Richard W. Pullen, Jr., assistant editor. Inquiries are welcomed by the president or secretary; publishes a monthly bulletin.

The *Universal Radio DX Club* recently became affiliated with the *International Short Wave League,* London. The ISWL was started after World War II to bring together those

in every country with a common interest in s.w. radio, and now has more than 3000 members—including hams as well as SWL's.

* * *

This Month's Schedules

Albania—Scutari, 8.220, is scheduled 1400-1430. (*NATTUGGLAN*, Sweden)

Algeria—Radio Algiers, 9.57, noted to 2000 when signs off with "La Marseillaise"; better from 1800. (Bellington, N. Y.)

Angola—CR6RL, 9.47, Luanada, is audible in England now after *Radio Ankara* leaves 9.465 (around 1500 weekdays). (Pearce)

Argentina—The *International broadcasting Service* (S.R.I.), Buenos Aires, is now sending out a full program booklet in *English* monthly. Lists schedule as LRS, 11.880, 0900-1300 Portuguese, 1300-1400 Italian, 1400-1500 Spanish, 1500-1600 *English*, 1600-1800 French, and 1800-2200 Portuguese; LRU, 15.290, 1230-1330 Swedish, 1330-1430 German, 1430-1545 *English*, and 2100-0100 Spanish; LRY, 9.455, 1540-1650 Spanish, 2110-0100 *English*, and 1710-1750 Italian; newscasts in *English* are listed over LRY daily 2115, 2200, 2300, 0000, 0057 (Sunday has "Weekly News Review" at that time, other days "Daily News Summary"). Asks for reports and "opinions" from listeners—"Favorable or otherwise, your opinion is valuable, and we shall bear it in mind when preparing our future programs." In the preface to the attractive pamphlet it is stated—"Desirous of affording our English-speaking friends the maximum informative material comprising the outstanding features of Argentine life in its different aspects, and an idea of how the millions of inhabitants throughout the vast extent of the Republic live, labor, and amuse themselves, the International Broadcasting Service of Buenos Aires, Argentina, presents this new program pamphlet in English. We wish it to reflect, in the same manner as the daily transmissions of S.R.I., the activities of our country in all their manifestations. For this reason photographs and other illustrations will provide a visual appreciation which we are not yet able to supplement by television. This program-pamphlet will cover the multiple activities of the cities, with their labor, night life, music, lectures, theatres, cinemas, art exhibitions, sports, etc., as we are firmly convinced that your fraternal sentiments towards us will increase on a par with your knowledge of our way of life."

Austria—Direct via airmail from Clifford E. Meyers, Chief Engineer, *Blue Danube Network*, Salzburg, I have received word that the frequency of the station has been changed from 9.533 to 9.617; operating power remains 350 watts, and a regulations Signal Corps BC 610 is the transmitter. No schedules were received but I have written for them. Has been

heard, however, by Pearce, England, on the *new* channel at 0115 with news; afternoons (EST) it is buried around 1400-1500 by Delhi, Pearce explains. Bellington, N. Y., has heard this one opening around 2359 with "Star-Spangled Banner," and with a short newscast around 0028-0030.

Belgian Congo—Leopoldville, 9.767, has its Wednesday DX session at 1440 (for Europe) as well as at 2110 (for North America). Has asked listeners to suggest a "better" frequency as a substitute for the present one; evidently, wants to avoid QRM from adjacent outlets, but wants to remain close to its present (listed) 9.767. *Radio Congo Belge* is still on 9.400, heard from 0000 sign-on. (Bellington, N. Y.)

Belgium—The construction of *new* transmitters to relay the programs of OTC, Leopoldville, Belgian Congo, is to begin soon; this OTC relay will transmit on many frequencies. (ISWC, London)

Brazil—Radio Sweden says ZYN7, 15.165, Fortaleza, now broadcasts in *English* on Mon., Tue., Wed., 1400-1500. The Rio dc Janeiro police station on 9.29 has been heard by Bellington, N. Y., at 1815 with fair to good signal, but with heavy CWQRM.

Radio Nacional, PRL7, 9.72, Rio de Janeiro, has good signal evenings to 2235 sign-off; *no English noted;* some CWQRM. (Neeley, Oregon)

British New Guinea—Recently, VLT7, 9.52, Pt. Moresby, has been "coming in like a local" around 0200. (Bellington, N. Y.) Widely reported.

Bulgaria—Radio Sofia, 7.671, now has *English* 1545 and 1645. (Radio Sweden; Pearce, England)

Burma—Rangoon, 6.035, fair to good 0900. (Russell, Calif.)

Ceylon—Radio Ceylon, 15.12, good in Oregon to 1205 sign-off. (Callarman) Noted recently testing on old "wartime" channel 17.820 at 1212-1230; asked for reports. (Bluman, Israel)

China—Fried, Mich., who records many announcements from s.w. stations on tape, says "Radio Peking," 15.064V, invariably starts its 0830 news with "This is Radio Peking; here is today's news." Hannaford, South Africa, hears a Communist-Chinese outlet announcing "Radio Peking" on 15.170 with news 0830; may be Chungking with relay *from* Peking?

A *new* Communist-Chinese outlet noted on approximately 7.400 at 0930 in parallel with 6.095 has good signal in Calif. (Balbi)

Colombia—HJKD, 6.000, noted signing off 0003 with good level; *no English heard;* slogan is "La Voz del Nuevo Mundo en Bogota." (Neeley, Ore.)

Crete—Bluman, Israel, flashes to me that Khania, Island of Crete, Greece, is heard daily 0530-0700 on 10.050.

Cyprus—Limassol's *Sharq-al-Adna,* 9.650, noted 2255. (Bellington, N. Y.)

Czechoslovakia—Prague now seems to use 9.55 and 11.84 for news 1715-1730 to Europe; best on 11.84. (Bellington, N. Y.) Prague noted in *Eng-*

lish on 9.550 at 1415-1445; announces other *English* periods for Europe as 1530-1545, 9.550; 1715-1730 on 9.550 and 11.840; and for the Far East 0615-0630 on 11.840. (Pearce, England)

Denmark—Copenhagen's DX session is every second Monday 2225 over OZF, 9.52, and *repeated* Tuesday around 0545 over OZH, 15.165. (Radio Sweden, others) It is reported that this program is compiled by O. Lund Johansen, publisher of *World Radio Handbook.*

Egypt—SUX, 7.865, noted recently 1635 tune-in; fair signal after 1700 with Arabic chanting; bad QRM; must sign off now around 1745-1800. (Bellington, N. Y.)

Ethiopia—Nattugglan, Sweden, says *Radio Addis Ababa,* ETAA, is currently operating on 15.032, 7 kw., 1000-1200.

Finland—Treibel, Washington State, says the announcer speaks excellent *English* when giving news 2200 over OIX4, 15.190. Callarman, Oregon, says the 1145-1245 transmission on 15.190 comes in well, with greetings to arrivals in Finland via airplane.

Current complete schedule sent to Oskay, N. J., is—2200-2320 for USA in Finnish (actually has *English* news 2200-2210), 9.550, 15.190, 17.800; 2320-2400 for USA in Swedish (Mon. in Finnish), 9.550, 15.190, 17.800; 2330-0110 and 0350-0710, non-directional, 6.120; 0700-0715 for Europe in Finnish (Thur. in Swedish), 9.550, 15.190, 17.800; 0715-0725 for Europe in *English,* news and review of Finnish press (*weekdays only*), 9.550, 15.190, 17.800; 0800-0810 for Europe in French, review of Finnish press (*weekdays only*), 15.190, 17.800; 1000-1600 in Finnish, 6.120; 1145-1245 for USA in Finnish, 15.190, 17.800; 1600-1700 for USA in Finnish, 15.190, 17.800. Listed OIX2, Pori, 9.550; OIX4, Pori, 15.190; OIX5, Pori, 17.800, and OIX7, Helsinki, 6.120. QRA given as The Finnish Broadcasting Company, Ltd., Helsinki K, Box 180, Helsinki, Finland. Bellington, N. Y., says "last" transmission now seems to run 1600-1730.

Formosa—See "Taiwan."

French Cameroons—Radio Douala is on the air daily 1330-1630 now on 9.150, and output is 600 watts, according to a letter from the station. (Radio Sweden)

French West Africa—Radio Dakar, 11.896, verified second report in four weeks, while first report sent more than a year ago went "unanswered"; QSL card gave schedule of 0800-0830, 1300-1800 on 11.895; 1400-1530 on 15.340 (measured 11.896 and 15.341.2, respectively). (Oskay, N. J.) *ISWC,* London, says these outlets have *news in English* again daily 1400, read by a woman announcer, who says "You are listening to the news from Dakar; this ends the transmission to Europe"; has dance music, then news in French around 1530. The news at 1400 has been heard by Alcock, Ky., just shortly before this was compiled.

Germany—Leipzig, 9.728, opens weekdays 2300, Saturday 2400.

Bayerischer Rundfunk is now heard on 7.820 in parallel with *Radio Munich,* 6.160. (Radio Sweden)

The American High Commission ("RIAS" Berlin) plans to build a 20 kw. s.w. station. (Lau, Germany, via *ISWC,* London)

Baden-Baden, 6.321, good signal, news in German 0100, 1600. (Pearce, England)

Greece—Athens noted still opening 0000 in Greek on 9.607; bad QRN. (Fargo, Ga.)

The Armed Forces Radio Broadcasting Station, Larissa, is now on the air 2330-0130, 0500-0800, 1100-1600, on 6.754, with 500 watts; nice verification card received via airmail. (Radio Sweden)

Haiti—4VEH, measured 9.8856, announces location as "near" Cap-Haitien, says is owned by a Gospel Missionary Service; noted mornings around 0700-0800 closedown, and evenings; QRA is given as P.O. Box 1, Cap-Haitien, Haiti. (Oskay, N. J.) Noted by Ferguson, N. C., to 2110 sign-off; still asks for reports; uses French, Spanish, *English.*

Honduras—HRA verified with airmail letter in seven weeks; gave frequencies of 1100 kc., 5.925, and 9.035; stated is operating on exactly 5.925 (measured 5.920); said using *RCA* transmitter of 1.5 kw. with two 833A tubes in final stage, modulation with 833A tubes also; QRA is Station HRA, Radio Mil Cien, La Voz de Lampira, Tegucigalpa, Republic of Honduras. (Oskay, N. J.)

Hungary—Budapest, 11.910 and 9.832.7 (measured by Oskay, N. J.), noted 1600 and 1815 with news; on Sat. 1610 and 1830 with "Mail Bag" program; 11.910 best. (Conley, Pa.) Sent a nice card. (Fried, Mich.) *Nattugglan,* Sweden, reports *Radio Budapest* on 15.370 at 0645-0700 sign-off; not confirmed. Swedish sources say the 11.910 channel is from a *new* 100-kw. transmitter.

India—Treibel, Washington State, reports Delhi on 17.800 at 1130 with news in native dialect but with *English* announcement at break.

Iran—Radio Sweden reports Teheran, 15.100, 6.155, heard now 1430-1600; news in French 1430, news in *English* 1500, and in Russian 1530; recorded music with announcements in *English* at intervals. Says *Radio Teheran* requests an International Reply Coupon with reception reports. Oskay, N. J., recently noted the 15.100 outlet leaving the air 1528. *Radio Sweden* also reports that Teheran is heard on 6.845 at 1430-1645, with news in Russian followed by music; probably is a relay by Khorramabad, Luristan, on extended schedule.

Israel—At the time this was compiled, Tel Aviv was using 9.500, poor signal, but by now may have moved back to 9.000. Is "supposed" to use 11.935 and other channels soon according to *Radio Sweden.*

Italy—Rome requests all correspondence be addressed Radiodiffusionisni Per L'Estro, Via Veneto N. 56,

Rome, Italy. (Callarman, Oregon) Appears to have news 1900 and 2110 for North America now on announced 11.81, 11.91, 15.12. (Boice, Conn.) However, is moving around so much that may be heard elsewhere by now.

Jamaica—Stark, Texas, some weeks ago noted ZQI, 4.950, Kingston, *before* 0600 and *after* 0615 relaying a sports event; probably a special broadcast.

Japan—The call-sign "WLKS" is no longer used by the army broadcasting station in Kure, according to the British Commonwealth Occupation Forces which operates the station; however, verification cards bearing the letters "WLKS" are still dispatched; operates on 6.105 at 1530-0930 with 1 kw. (Radio Sweden)

JHK, 7.257, Yamata, heard around 0800 with fair to good signal; has QRM from *Radio Malaya*, 7.250; listed with 5 kw.; announces simply "NHK." (Neeley, Ore.) JKK2, 9.60, noted 0300 with news, weather report. (Sanderson, Australia) JJY, 8.000, standard frequency and time check outlet, heard mornings; gives time (in c.w.) each 5 minutes. (Neeley, Oregon)

Kenya Colony—Nairobi, 4.85, puts in a nice signal in South Africa around 1000-1100. (Hannaford)

Korea—At the time this was written, *Radio Seoul*, HLKA, 7.935, was in the hands of the North Korean Communist forces, and was being heard with weak signal on the West Coast. (Neeley, Ore.) By this time it may have changed hands again. Former schedule was 2100-0000, 0300-1030, 1500-1830.

The North Korean radio at Pyongyang, 7.784 and approximately 4.400, at last report was scheduled 2155-2330, 0255-0900, 1550-1800.

Liberia—I have just learned from Vernon De Jones, Liberian Afro-American Research Chamber of Commerce, New York City, that the Liberian Broadcasting Company, Monrovia, capital of the Republic of Liberia, has a s.w. transmitter of 500 watts (sometimes 1 kw.) operating on 6.025. Opens daily at 7 a.m. Liberian time (0300 EST) with announcement —"This is the Liberian Broadcasting Company." Dr. John B. West, owner and president of the Liberian Broadcasting Company, is an American Negro and formerly a physician of Harlem Hospital Clinic, New York City. He has informed Mr. De Jones that five additional s.w. transmitters will open soon with calls of ELB2, ELB3, ELB4, ELB5, and ELB6, to operate on different s.w. channels. ELBC, the m.w. station, now uses 900 kc. with 10 kw. Dr. West also operates a radio school in Monrovia. The school already is building combination radio sets, using American-made parts, and *Columbia* and *RCA* 45 r.p.m. and 33⅓ r.p.m. record-players are used.

Malaya—BFEBS, 6.175, Singapore, noted recently with improved signal; heard 0630 relaying BBC. (Oskay, N. J.) The 7.200 channel of *Radio Malaya's* Blue Network, Singapore, comes in well in Oregon although at

times has CWQRM; noted around 0800. (Callarman)

Malta—FBS, Middle East, recently moved to 7.220 from 7.270, heard opening 2300; announced 7.220, 4.965, and a m.w. channel. (Bellington, N. Y.)

Mauritius—V3USE, 15.040 (varies to 15.060 at times), Forest Side, heard 1000-1200; French 1000-1100, then *English* 1100-1200 (news 1145-1200); announcement in French is "Ici le Poste de Maurice," and in *English*

(*Continued on page* 161)

CONTRACT PRICES CUT

FOR the second time this year the RCA Service Company has announced a reduction in its factory-service television contract prices. The new price cut is said to be the result of the introduction of a streamlined and improved RCA Victor television receiver chassis which is expected to reduce installation and normal servicing costs.

Characterized by 30 per-cent fewer parts and 20 per-cent fewer connections, the new chassis will permit service technicians to install the receiver and perform all normal servicing without removing the chassis from its cabinet. In this manner, approximately 50 per-cent of the standard installation procedures have been simplified by the increased accessibility of parts within the chassis. In addition, the antenna tuning adjustment has been mounted on top of the r.f. unit to enable the technician to match the receiver to the antenna without removing the chassis from the cabinet.

For a direct comparison with the rates previously in effect, readers may check the contract prices given in the March 1950 issue on page 122.

—30—

Newly revised factory service contract price list recently released by RCA Victor. This schedule applies to both commercial and residential installations. The adjustments made for various "zones" applies to distances from the transmitter. Thus, Zone A is normally a 22 to 25 mile radius around a TV station, established by 500 microvolt range of the station. Zone B is normally about 10 miles beyond Zone A, while Zone C is normally 10 miles beyond Zone B.

PLAN I		PLAN II	
• Complete installation. • Instruction of customer. • Parts and tube protection, including picture tube, for one full year. • Unlimited service for 90 days. • After 90 days: Service-as-needed by RCA Factory Technicians at preferred flat rate of $5.75 per call in the home; $3.95 if set is brought to branch.		• Complete installation. • Instruction of customer. • Parts and tube protection, including picture tube, for one full year. • Unlimited service for a full year.	
TELEVISION ONLY	With Built-in Antenna	*With Standard Outdoor Antenna	With Built-in Antenna	*With Standard Outdoor Antenna
All 10" and 12½"	$19.95	$39.95	$39.95	$59.95
All 16"	29.95	49.95	49.95	69.95
All 19"	39.95	59.95	59.95	79.95
Projection	39.95	59.95	75.00	95.00
Extra for Radio and Phonograph	$10.00	$10.00	$15.00	$15.00
Extra for Portable Indoor Antenna	$ 3.50	–	Furnished at no additional cost when needed	–

Above prices apply for Zone A; for Zone B add $7.50; for Zone C add $15.00
*Built-in antenna prices apply when existing antenna is used.

Oscilloscope Preamp

(*Continued from page 53*)

The signal appearing across the cathode resistor R_3 is fed through coupling condensers C_3 and C_4 and appears across the low impedance gain control R_4. Two condensers are necessary to insure proper coupling at low as well as at high frequencies.

A high bias is developed on the input stage due to the large value of R_3, and this is partially cancelled by applying a positive voltage to the grid of the input amplifier through R_1.

Since a low resistance gain control (R_4) is used, the disadvantage of unequal voltage division at higher frequencies is minimized.

Coupling condenser C_5 is used to prevent any d.c. voltage appearing across R_4 due to leakage in C_4 from being applied to the grid of the second amplifier.

Finally, the amplified signal appearing across plate load resistor R_6 is applied through condenser C_7 to the input of the scope. Since most scopes have a blocking condenser in the input circuit, C_7 may be omitted if desired, and a lead run directly from the plate of the amplifier to the output terminal. In this case, there will be a "B" voltage on the output terminal and a certain amount of care should be exercised when using the unit in order to avoid shock.

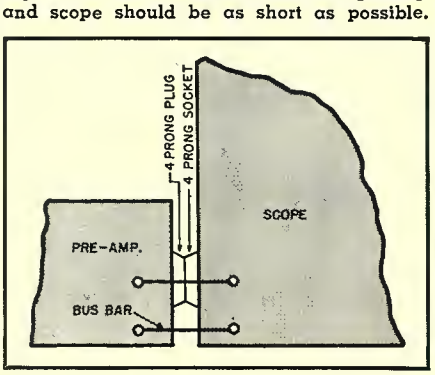
The value of R_6 is determined by the gain and frequency response desired. With a value of 2700 ohms, 1 watt, a gain of 10 is obtained, and the amplifier is essentially flat to 1 mc. With a value of 4700 ohms, a gain of 20 is obtained, but the response falls off around 300 kc. Finally, with a value of 1000 ohms, the response is flat to several megacycles, but the gain is less than five. The gain figures referred to are over-all gain of the preamp, and take into account the loss of signal in the cathode follower input.

Construction Hints

In wiring the unit, keep distributed capacities to a minimum by using short signal leads and by mounting coupling condensers away from the chassis, cabinet, or other parts.

The output terminals should be located so as to "line-up" with the input

Fig. 4. The connections between the preamp and scope should be as short as possible.



terminals of the scope, as shown in Fig. 4. This permits short connections to be made to the scope.

Power can be obtained from a separate supply if desired. However, since the current drain is small, the author preferred to use the power supply of the oscilloscope. To do so, simply mount a four prong socket on the side of the scope, and bring filament, ground, and "B plus" connections to it. A four-prong plug is mounted in the side of the preamplifier, and so located that when the unit is plugged into the scope, the input scope and output preamp terminals automatically line up. This arrangement is clearly shown in the photograph of Fig. 1.

In use, the preamplifier is simply plugged into the side of the scope, and the output preamp and input scope terminals connected together. The gain control of the scope is turned to its maximum position, and gain controlled with the preamp control.

High level signals (exceeding about 30 to 40 volts peak-to-peak) cannot be observed due to overloading the input amplifier. With such signals, the preamp's extra gain is not necessary, and the regular scope input terminals may be used.

Although this preamplifier is designed primarily for use as an oscilloscope accessory, it may be used with any instrument where additional gain, combined with good frequency response and high input impedance, is desired. It should not be used, however, with instruments or scopes already having high gain, since to do so may introduce an undesirably high hum level. —30—

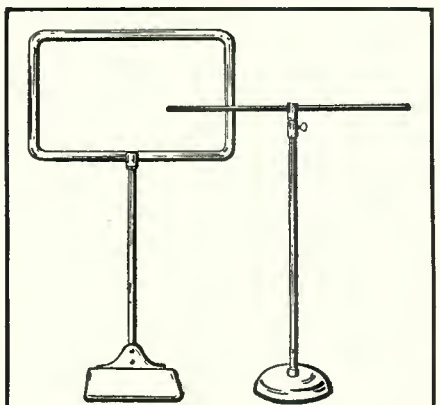
ALIGNMENT GADGET

By MILTON M. SCHUMAN

A HANDY television servicing and alignment gadget can be made from discarded display forms of the type shown in the illustration.

Rescued from the trashcan, they can be adjusted in height and used to hold a mirror. The unit may then be set in front of the television receiver so that the pattern on the screen is easily visible to the technician making adjustments on the back-of-the-chassis controls. —30—

Method for using discarded display forms to hold mirror for aligning a TV receiver.



Mac's Service Shop

(*Continued from page 67*)

When people have plenty to spend—especially if they are not used to having it—they seem to grow less concerned about getting their money's worth than they are when they have to count their pennies. As a result, the repairman finds that, for a while, he can actually make more by turning out sloppy work in a hurry than he can by taking the time to do a good job. While he loses some critical customers by operating in this fashion, there always seems to be plenty more to take their places—Say," Mac broke off suddenly, "did you notice that this pointer is off about an eighth of an inch from where it should be?"

"Yeah, after I had the set all buttoned up in the cabinet I noticed the pointer was off a little, but I did not think it was enough to warrant removing the chassis to change it."

"An eighth of an inch means about ten kilocycles in the most-used part of the band," Mac pointed out. "Better pull the set and set the pointer over. And while you are at it, get the *corners* of that dial glass clean. My wife always says that a window with dirty corners looks worse than a window that has not been washed at all."

"And oh yes," Mac went on; "I just happened to think of another thing. Remember that call you made yesterday to service Bud Clement's TV receiver? He called in this morning to say that the set was working all right but that the picture lacked about a quarter of an inch of reaching the mask, top and bottom. He said he called this to your attention as you were leaving but that you told him it would probably be all right when the line voltage went up. It wasn't, though; so I stopped by at noon and took care of it."

"Boy, there's a griper for you!" Barney exclaimed. "His sole original complaint was a dead set. I found a bad rectifier tube and replaced it, and the set took right off. He never said a thing about the vertical size of the picture being off until I had one foot out the door. I was already late for supper, and I had a date with Marge at seven, and I really did think the picture might go back up under the mask when the 'cooking supper' load was taken off the line."

"Just as the mechanics thought your windshield wipers might be all right after the oil worked in," Mac said softly.

Barney's eyebrows went up in puzzlement; then his eyes opened wide in a look of quick comprehension; and finally his face turned brick-red.

"I had that coming," he muttered at last. "Here I was panning the mechanics for doing sloppy work while I was doing exactly the same thing. You surely have a smooth way of slipping the needle into a guy, but I get the point: Don't always be looking for

something to gripe about, because the other fellow doesn't like griping any better than you do."

"Nope, Little Chum, that is not the point I was trying to make at all," Mac denied. "You remind me of the fellow who, when ordered to stop drinking Martinis, decided that what the doctor really meant was that he should give up the olives. What I was trying to make you realize was that a fault that looks as big as a barn door in someone else shrinks to microscopic proportions when seen in yourself. The identical situation, looked at from two different points of view, seems like two entirely separate things. That is why the customer's 'legitimate complaint' becomes an 'unreasonable squawk' when viewed through the jaundiced eyes of the service technician."

"And you think that rather than stop squawking I ought to concentrate on seeing to it that my—or our—customers do not get a chance to squawk."

"That's it in a nutshell," Mac applauded.

"Yes, but you said yourself that doing sloppy work pays off better."

"I said it does *for a while* and during boom times. In the long run—and not too long at that—shoddy workmanship is recognized for what it is, and then the business goes to someone else. A sad part of it, too, is that once a fellow has been accustomed to turning out inferior work it is almost impossible for him to turn out any other kind. If you try to do your best at all times, your 'best' gets better and better; but, by the same token, if good-enough-to-get-by is your goal, your 'good enough' grows worse and worse."

"Okay; you can lay the whip down now," Barney said. "I have learned my lesson. I solemnly promise on my 'Lone Ranger' badge that, although I know it will mean harder work, I will do my best on every service job."

"If you do," Mac said, "you will discover a funny thing: Your work will actually be easier instead of harder. For one thing, it is always easier to do a good job than to explain why you didn't. In the second place, a man gets a kind of 'lift' out of a job well done. Ever notice how that contented, chesty feeling you have after finally licking a stubborn intermittent differs from the tired and worried way you feel when you give a half-fixed set back to a customer with the hope that it will be all right but feeling down in your bones that it will be back in a week or so?"

"I sure have," Barney said. "When I know I have done a good job on a set, I can dismiss it from my mind; but when I do a cobbling job, the darned thing haunts me for days."

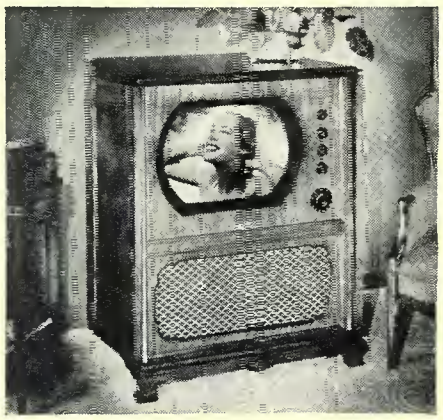
"It should!" Mac said with a grin. "And the next time you find yourself resenting a customer's complaint, remember how you felt about the garage service. As my dad used to say, 'It makes a lot of difference whose ox is gored.'" —30—

NEW TV PRODUCTS on the Market

"THE EMPIRE"

One of *Stromberg-Carlson Company's* newest television receivers is "The Empire," Model 119 CM.

Housed in a traditionally-styled mahogany veneer cabinet, the new set provides a 208 square inch viewing



area on the 19" picture tube. Also featured is 6:1 gear reduction tuning for micro-accurate channel selection. The set also incorporates the company's long-life tuner.

The receiver has keyed a.g.c., a safety plastic mask-over screen, a precision engineered audio system, with 12" PM speaker, and a built-in antenna. "The Empire" carries Underwriters' Laboratories approval.

FIELD STRENGTH METER

One of the newest television servicing instruments to come from the *Approved Electronic Instrument Corp.'s* laboratory at 142 Liberty Street, New York, is the Model A-460 field strength meter.

This new unit is designed to provide an accurate survey of television reception conditions without the expense of making a complete receiver installation.

Among the features of this instru-

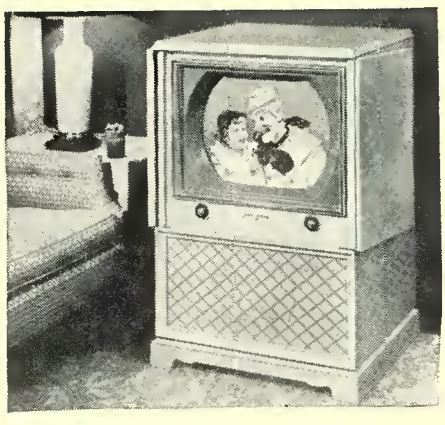
ment are; the measurement of the actual television picture signal strength, the precise orientation of antennas, an accurate check of the efficiency of various antenna combinations, the checking of receiver radiation from the local oscillator, the tracking down of interfering signals, and the measuring of the efficiency of television boosters.

The Model A-460 is housed in a heavy gauge steel cabinet finished in battleship grey and measuring 8" x 10" x 12". The instrument uses 6 tubes and a 1N34. A 16-page illustrated catalogue covering this unit is available on request.

19" DELUXE CONSOLE

Sylvania Electric Products Inc. unveiled 21 new television receivers in its 1951 line at the convention of the National Association of Music Merchants held recently in Chicago.

The top of the line is the 19" deluxe console with doors, the No. 5140B. This full-length console has a 202 square inch screen and exclusive "picture-framing" which provides wide angle viewing for the entire family.



A high fidelity FM circuit and speaker provide clear tone. Other features of the new unit are the two front controls for simplified operation, a light-up tuning knob, full 12 channel reception, and a built-in tunable antenna.

The modern cabinet measures 39 7/16" x 27½" x 24 11/16" and is available in either blonde or mahogany finishes.

NEW TV TUBES

Reeves Soundcraft Corp. of 35-54 36th Street, Long Island City 6, New York is currently in production on three types of rectangular television picture tubes.

The company's Springdale, Conn. plant is concentrating production on the 16KP4, 16TP4, and 16RP4 types of rectangular cathode-ray units. The new tubes feature extra rugged and precision electron guns to be used

with an external ion-trap magnet for the prevention of ion-spot blemishes. Another feature is the neutral density filter faceplate for increased picture contrast and detail under high ambient light conditions.

G.E. CONSOLE

One of the television receivers which attracted special attention at the *General Electric Company* display at the National Association of Music

Merchants convention in Chicago was the Model 19C-105, a 19″ console.

This new console features a 19″ round black tube with aluminized screen and is available in either mahogany finish or as the Model 19C-105 in blonde finish. This unit was only one of twelve new models introduced to the trade at the show.

REMOTE CONTROL UNIT

Tel-Par Corporation of 7313 Santa Monica Boulevard, Los Angeles 46, California has recently introduced a new remote tuning unit for television applications.

The new unit is housed in a small, compact wood cabinet designed to match most interior furnishings. The control will operate at distances of 100 feet from the television set. A 30 foot cable is supplied with the unit as standard equipment. The preamplifier chassis is designed to fit all makes and models of present-day TV sets.

COMBINATION CONSOLE

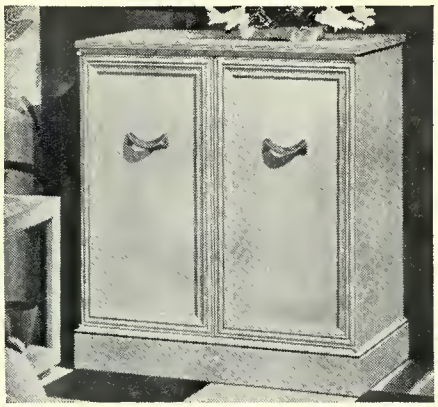
The Magnavox Company of Fort Wayne, Indiana, has added a new radio-phonograph-television combination to its line.

Known as "The Contemporary," the new receiver provides a complete home entertainment unit in a single cabinet. The cabinet is finished in blonde oak and its front panels are accented by streamlined door pulls. The same chassis is also available in a mahogany finished cabinet.

The television receiver utilizes the company's exclusive "big-picture" system with a 16″ rectangular picture tube. Its synchromatic tuning chassis with 23 tubes, including two rectifiers and picture tube, allows silent switching from channel to channel. The set also features a complete automatic

synchronizing circuit, an automatic signal leveler and contrast control, instant tuning, and a built-in three-way antenna for TV, AM, and FM reception.

The unit also includes a 9 tube AM-

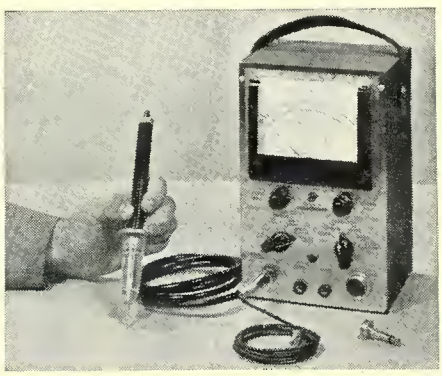


FM receiver and a three-speed automatic record changer which will handle all of the currently-available records. A 12" electrodynamic speaker on an inclined baffle with a high frequency diffuser handles the audio for all three media.

HIGH-VOLTAGE PROBE

Insuline Corporation of America, 3602 35th Avenue, Long Island City 1, New York, has introduced the "100X Kilovolter," a new heavy-duty probe that multiplies the existing ranges of any standard 10 or 11 megohm vacuum tube voltmeter by a factor of 100.

Measuring 8½" long and fitted with a clear lucite nose piece and red barrier insulator, this probe is designed especially for testing high voltage circuits in television receivers. It is furnished with a five foot coaxial cord and a separate grounding lead. The cord terminates in a standard single-contact microphone connection. A



special adapter plug is available to permit this same connector to be used with v.t.v.m.'s having phone jacks instead of microphone fittings.

ZENITH COMBINATION

The top of *Zenith Radio Corporation's* new line of television receivers is the Model H3477R FM-AM-phono-television combination console.

This unit provides 238 square inches of picture area on a 19" tube, and features a two-in-one "Selecto-Screen" and duplex picture control which

gives a choice of either the company's "Giant Circle" picture or the rectangular-type picture.

A new sensitized "super-range" chassis provides for reception in weak signal areas. The set also features automatic, single-knob tuning, built-in provision for the proposed u.h.f. on present standards, gated a.g.c., gated beam sound tube to screen out sound interference, and a gated beam picture stabilizer tube to eliminate horizontal tear and vertical roll.

The radio section provides full AM and FM coverage and the record changer will handle all sizes and speeds of records.

The entire combination is housed in a Chippendale mahogany breakfront cabinet with solid brass lattice work on dark Dover finish. The door paneling is of swirl mahogany. The cabinet measures 41"x43½"x27".

ELECTRIC EYE ROTATOR

Crown Controls Company, Inc. of New Bremen, Ohio has introduced a new electric eye rotator for television antenna applications.

The new rotator flashes the position

of the antenna at the control box. The rotator is a heavy-duty unit with the main gears and shaft fabricated of steel. The weight of the antenna and mast rests on radial end thrust bearings. No additional bearing accessories are required.

A booklet covering this new unit is available from the company on request.

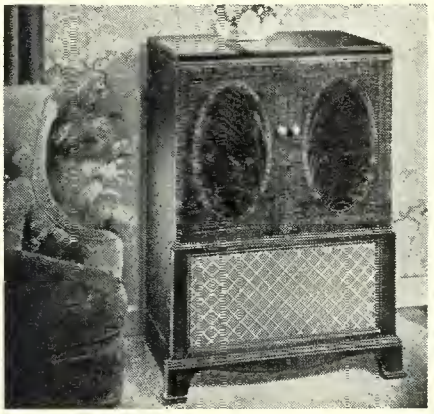
"THE FAIRFIELD"

Among the new television receivers introduced by *Radio Corporation of America* in its late-1950 line, "The Fairfield" has been singled out for leadership and special promotion.

This unit is a 16 inch console with doors, housed in a cabinet of either

walnut, mahogany, or limed oak finish. Known as the Model 6T72, this set measures 36¾" x 28" x 23¼".

"The Fairfield" incorporates several of the company's newly-developed



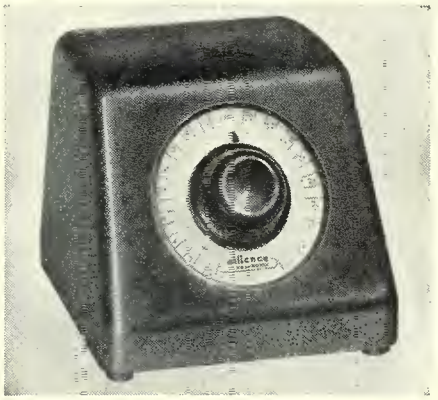
electronic circuits for improved reception in all areas. Because of the built-in antenna, no outside antenna is required in some locations. Another feature of this receiver is a special seal between the tube face and the safety glass which prevents the accumulation of dust in this area.

AUTOMATIC ROTATOR

Alliance Manufacturing Company of Alliance, Ohio, has announced the new Model HIR "Tenna-Rotor."

The new unit it fully automatic, the viewer simply sets the pointer to any desired point on the dial and the antenna then rotates automatically to that point and stops.

According to the manufacturer, this rotator requires no special installation for antenna direction orientation since the antenna is oriented from the



control case. The model incorporates the company's special 4-conductor cable with "Zip" feature which cuts installation time and trouble.

The indicator dial may be marked for new channels at any time as new TV stations go into operation in the area. A light along the dial shows the antenna position while rotating and indicates the final antenna direction at all times.

DU MONT CONSOLE

The *Allen B. Du Mont Laboratories, Inc.* has announced the availability of a new console, the "Burlingame."

The new 17" rectangular tube provides a direct view picture of 150

square inches. The set features full-range TV and FM on all channels, automatic phono-jack attachment,

electronic tuning eye, and other *Du Mont* engineering electronic refinements.

The cabinet, which is of modern design in either mahogany or blonde finish, measures 39⅜" x 26¾" x 21⅞". There are 26 tubes including 3 rectifiers and the picture tube.

"RAY-TESTER"

Weston Manufacturing Co. of 424 North Avenue, Weston, Massachusetts, has introduced a new unit for checking emission, the "Ray-Tester."

The unit will test a picture tube in the cabinet without disturbing the deflection coil, focus coil, or ion trap adjustment. The unit measures 7" x 7¾" x 12" and is entirely self-contained and powered.

Complete details on the new "Ray-Tester" are available from Dept. PRH 27 of the company.

TELEVISION MASK

Mastercraft Plastics Co., Inc. of 95-01 150th Street, Jamaica 4, New York, is currently in production on a low-cost television mask.

The new mask which is made from Royalite, a new tough synthetic composition, is stainproof, mildew proof, lightweight, alkali resistant, and scar and abrasion resistant, according to the manufacturer.

The plastic is grained to simulate leather. Other masks fabricated from lucite and plexiglas are also available on a custom basis.

For complete details on these masks as well as other plastic television components, write to the company direct at the above address.

TV CALIBRATOR

The Tube Department of *Radio Corporation of America,* Camden, New Jersey, has recently introduced a new television calibrator, the WR-39B.

The new unit provides the facilities of six instruments normally required in television alignment. The instrument includes a crystal-calibrated TV marker generator with dual markers for TV frequencies, a bar-pattern generator for linearity adjustments, a miniature rebroadcast transmitter for checking all 12 channels, a heterodyne

frequency meter including amplifier and speaker, a signal generator operating on fundamentals in all TV bands, and a dual crystal standard with three crystals supplied.

This portable unit is housed in a metal cabinet with anodized front panel with acid-etched lettering, a non-breakable clear plastic dial bezel, knobs with readily adjustable pointers, and comes equipped with a convenient carrying handle.

METAL CABINET TV

Air King Products Company, Inc. of 170 53rd Street, Brooklyn 32, New York, has introduced a new model television receiver with a 16" rectangular tube housed in a metal mahogany grain cabinet.

Priced for the lower-income mar-

ket, the new table model receiver is as small as the conventional 10" table model of a year ago. The Model 16M1 uses the *Hytron* 16" tube. According to the company, the 16M1 contains an advanced design chassis that operates in fringe areas.

PILOT COMBINATION

One of the newest television receivers to come off of the production lines at the *Pilot Radio Corporation* plant at 37-06 Thirty-Sixth Street, Long Island City 1, New York is the Model TV-128.

This combination television, FM radio, and three-speed record changer

set houses a 12½" tube in a mahogany veneer cabinet. A new television circuit is used in this model to provide reception in the difficult fringe areas as well as in urban locations. —30—

International Short-Wave

(*Continued from page* 149)

says "This is the Mauritius Broadcasting Service"; the call "V3USE" does *not* seem to be mentioned. (Sutton, Ohio) Noted with French news 2230. (Bellington, N. Y.) Still relays BBC news in *English* 2200.

Mozambique—CR7BJ, Lourenco Marques, has moved to 9.600, noted 1100-1255. (Radio Sweden) A later report from Bluman, Israel, indicates a further move to 9.585, then to 9.787 (heard opening 1100 in Portuguese), where has bad QRM from Monte Carlo and a Soviet outlet. Bellington, N. Y., has noted this one opening in Portuguese at 0000 on approximately 9.790.

McCowen, Ga., received QSL from Lourenco Marques after 3 months; regular mail; lists frequency of 11.764, call CR7BH, 7.5 kw., for its current 25-m. outlet.

New Zealand—Thomas, N. Z., sends along this current schedule of *Radio New Zealand*—"Calling Australia and the Islands," daily 2200-0500, and rebroadcast of Home Service Programs of the New Zealand Broadcasting Service daily 1300-0155, 0500-0620, over ZL3, 11.78, ZL4, 15.28 (at times ZL2, 9.54, may be in use). A new program brochure states the studios are at 38 The Terrace, Wellington, the capital city. They can be linked with all the m.w. broadcasting stations in the country so that programs originating in any part of New Zealand may be available to overseas listeners. The two transmitters are at Titahi Bay, some 17 miles from Wellington. Power is 7.5 kw. The transmitters employ high-level modulation, using two 889R type tubes as Class B modulators, and two 889R tubes as the final modulated r.f. stage. They cover a frequency range of 6-22 mc. and a change in frequency can be made in less than two minutes; as the program service is primarily intended for Australia and the Pacific, at present all antennas are designed for a total beam width of 68 degrees; the majority of the antennas consists of two-tier, two-bay half wavelength horizontal radiating elements with reflectors.

Regarding verifications and suggestions, the brochure states—"Radio New Zealand will be pleased to receive letters from listeners offering suggestions for its programs. Enquiries about New Zealand will be gladly answered in the session 'Mail Box' (*listed Friday 0415*). All correct reception reports are verified by a QSL card. Address letters to The Director, Radio New Zealand, P.O. Box 3045, Wellington, New Zealand." It was explained that "broadcasting in New Zealand is a State function."

Northern Rhodesia—Lusaka's 9.710 transmitter has *not* been on the air since June 30, 1949, according to a letter from the station; output is listed 400 watts on 3.939, 2.5 kw. on

7.200; on the air daily 1000-1330. (Radio Sweden)

Norway—Halvorsen, Oslo, sends this complete current schedule for *Radio Norway—Special Transmissions for Norwegians Abroad*—2000-2100 (Sun. 2000-2115), LKV, 15.170, LLK, 11.850, LLH, 9.645, LKF, 1578 kc., to North American Waters, North Atlantic; 0600-0700 (Sun. 0600-0715), LLP, 21.670, LLN, 17.825, LKV, 15.170, LLK, 11.850, to Far East; 0800-0900 (Sun. 0800-0915), LLP, 21.670, LLN, 17.825, LKV, 15.170, LLK, 11.850, to Indian Ocean; 1400-1500 (Sun. 1400-1515), LLP, 21.670, LKV, 15.170, LLK, 11.850, LLN, 17.825, to Africa Waters, South Atlantic; 1800-1900 (Sun. 1800-1915), LKV, 15.170, LKQ, 11.735, LLH, 9.645, LKF, 1578 kc., to South America. *Home Service*—0115-0230 (Sun. 0255-0550), LLP, 21.670, LLN, 17.825, LLK, 11.850, LKV, 15.170, to African Waters, South Atlantic; 1300-1400 (Sun. 1000-1400), LLP, 21.670, LKV, 15.170, LLK, 11.850, LLN, 17.825, to African Waters, South Atlantic (Sat. 1200-1400); 1500-1700 (Sun. 1515-1700), LLP, 21.670, LKV, 15.170, LLK, 11.850, LLN, 17.825, to African Waters, South Atlantic. *Home Service from Tromsoe*—0115-0730 weekdays (0255-0945 Sun., 0115-0320 Sat.), LKJ, 9.540; 0520-0740 weekdays, off Sun., 0520-0735 Sat., LKJ, 9.540; and 1045-1700 weekdays (1015-1715 Sun., 0930-1700 Sat.), LLS, 7.210; all these to North Atlantic and North Sea. The last 15 minutes of the daily one-hour broadcasts for Norwegians Abroad usually consists of Norwegian music or music by Norwegian artists, introduced in *both English* and Norwegian. *Norway This Week,* a feature in *English,* is radiated Sundays 0700-0715, 0900-0915, 1500-1515, 1900-1915, 2100-2115.

Philippines—Since it has increased its power from 300 watts to 3 kw., DZH7, 9.730, Manila, The Far East Broadcasting Corporation, is eager to receive reception reports. (Radio Sweden) Noted 0400 with news. (Sanderson, Australia)

Poland—Warsaw, 6.215, has news 1430. (ISWC, London)

Portugal—Lisbon was heard some weeks ago testing on 11.03 at 1945 tune-in, powerful signal and was *in dual* with 9.745; left air 2030. (Bellington, N. Y.) Some time ago, Lisbon was noted on 15.100 at 0600-0800, but more recently has been using 15.147, just audible under heavy QRM from Djakarta's YDC, 15.15, USI. (Bluman, Israel) *ISWC,* London, reports CS2MM, 11.840, Lisbon, at 1400-1500 with music, news and talks in Portuguese; *no English.*

Portuguese India—Radio Goa, 9.610, has been heard 1100-1230 sign-off in Europe lately. (Nattugglan, Sweden)

Sao Tome—Nattugglan, Sweden, says Sao Tome, 9.615, now radiates 1500-1615. Pearce, England, hears Sao Tome on approximately 4.805 around 1445; at 1500 a clock chimes 10 p.m., and this normally is followed by news in Portuguese preceded and followed by a band recording; closing announcements—by both man and wom-

an—at 1600 are followed by "A Portuguesa"; same closing procedure noticed when the 17.6775 channel closes on Sundays 0800.

Saudi-Arabia—QRA for reports to *Djeddah Radio* is John E. Morrow, Chief Engineer, Saudi-Arabia Broadcasting System, Djeddah, Saudi-Arabia. (*Nattugglan,* Sweden) Bluman, Israel, lists current schedule as 0000-0030 (Fri. 0200-0300) on 11.950, 11.850, 11.750, 9.650, 3.960; 1200-1400V on 11.950, 11.750, 9.650, 5.985, 3.960. Pcarce, England, hears the approximately 5.976 outlet regularly from 1230, says sign-off varies 1336-1346; is noted parallel from about 1300 on approximately 3.950.

Sierra Leone—Radio Australia reports a station heard on 8.135 relaying the BBC from 1100, believed to be Freetown, West Africa.

South Africa—Here are SABC schedules as convcrted for me by Worris, N. Y.—"A" program is *English;* "B" program is *Afrikaans;* "C" program is *"Springbok Radio,"* in *English-Afrikaans,* and is commercial. By frcquencies, 9.870, Johannesburg (A)—0315-0710, 0900-1130 (Sat. and Sun. 0315-1130); 9.610, Cape Town (B)—0315-0710,0900-1130 (Sun. 0315-1130); 9.523, Johannesburg (B)—0315-0710, 0900-1150 (Sat. and Sun. 0315-1150); 7.295, Johannesburg (C)—0200-1000 (Sun. 0100-1015); 5.880, Cape Town (B)—2345-0130 (Sun. 0055-0130), 1145-1605 (Sat. 1145-1645), carries "A" program Wed. 1320-1605; 4.895, Johannesburg (B)—2345-0130 (Sun. 0455-0130), 1200-1605 (Sat. 1200-1645); 4.878, Pietermaritzburg (B)—2345-0130 (Sun. 0055-0130), 0315-0710, 0900-1605 (Sun. 0315-1605, Sat. 0315-1645), carries "A" program Mon. 1215-1500; 4.800, Johannesburg (A)—2345-0130 (Sun. 0055-0130), 1140-1605 (Sat. 1140-1645); 4.373, Johannesburg (A)—2345-0130 (Sun. 0055-0130), 0315-0710, 0900-1605 (Sat. 0315-1645, Sun. 0315-1605); 3.356, Johannesburg (C)—2345-0145 (*not Sun.-Mon.*), 1015-1603 (Sat. 1015-1703, Sun. 1030-1603).

Southern Rhodesia—Salisbury is broadcasting currently on 4.890 at 1055-1500 on weekdays, 1255-1500 Sun.; on 7.290, 0430-0615 weekdays, 0330-0715 Sun.; output 15 kw. (Radio Sweden) Noted on approximately 4.885, good signal in Britain, 1400-1500 when closes "until 11 o'clock tomorrow." (Pearce)

Switzerland—The *United Nations Radio,* Geneva, informs Dary, Kansas, it is scheduled on 6.672 daily *except* Saturday and Sunday at 1330—broadcasts include a 15-minute program in *English,* then one in French—reporting the activities of the European Office of the UN.

Syria—At the time this was compiled, Bluman, Israel, flashed that Damascus had its 6.000 and 12.000 outlets "off the air temporarily"; using only 9.550. However, Pearce, England, gives the 31-m. outlet as approximately 9.520, heard 1600 when gives "local" time as 2300 and when says 30 minutes of dance music will follow; has news 1630.

Tahiti—Radio Tahiti, 12.080, Papeete, seems to have settled down to *new* schedule 2300-2345. (Bellington, N. Y.) The 6.982 channel still parallels but is barely audible in Calif. (Russell) Program usually consists of news in French 2300; music 2315, and news in Tahitienne 2330. (Neeley, Ore.)

Taiwan—Sanderson, Australia, recently noted BCAF, the Chinese Air Force Station, Taipeh, on 8.996; comes on air now 0700 instead of former 0500. Station heard on that channel in Texas by Stark at 0800 may be BCAF.

QSL from Taipeh lists current schedule on 15.235 as 2200-2400 daily to USA, and 7.151, 0400-1000 weekdays and 0500-1000 Sunday to USA; listed call of BED29 for 7.151, and BED4 for 11.725, but did *not* give call for the 15.235 outlet. (Hamilton, N. J., Slutter, Pa.)

USA—A station announcing "This is Overseas Radio Station WSY, Sayville (?), New York," has been heard testing on (announced) 7.940 around 2045-2100. (Peddle, Newfoundland) Heard by Bellington, N. Y., at 2300.

USI—YDC, 15.15, and YDE, 11.77, Djakarta, noted with native news at dictation speed from 0315. (Balbi, Calif.) YDB3, 7.270, Djakarta, noted 0533 with music; station heard on (measured) 7.298.6 at 0545, very weak, is believed YDI3, Soerabaja. (Oskay, N. J.) Djakarta's 6.045 outlet noted with Hawaiian music 0800-0830; announcements by woman (in Indonesian). (Callarman, Ore.)

USSR—When giving news on 15.170 at 0000, *Radio Moscow* stated was operating in the 19-, 25-, and 31-m. bands, and also gave a m.w. channel; probably European Service. (Fried, Mich.)

Moscow now has these *three* daily transmission in *English* to North America—0800-0815 (news), 17.84, 15.18, 11.96, 11.82; 1820-1930, and 2000-2300, 15.23, 15.18, 15.11, 11.96, 11.71, 9.69. (Hamilton, N. J.) However, I note that usually the 15.23, 15.11, and 11.82 channels are "announced" as *off* between 2100-2130, while the 15.18, 11.96, 11.71, and 9.69 frequencies continue at that time. (Fasnacht, Ohio) "Mail Bag" program is listed Saturday 2200. (Dary, Kansas)

Soviet, 11.724, noted in *English* when tuned 1650; switched to Spanish 1700. (Ferguson, N. C.) Moscow, 11.63, noted with news 1030-1100. (Hannaford, South Africa)

* * *

Last-Minute Tips

Radio Sweden reports VP03, Bridgetown, Barbados, listed 10.605, has been heard on approximately 11.780 at 1818-1845. Bellington, N. Y., heard Barbados on approximately 15.05 recently at 1245, calling Jamaica.

During "freak" weather one weekend some time ago, Sutton, Ohio, picked up ZNB, 8.230, Mafeking, Bechuanaland, with recordings 1345-1400, when man announced "This is Mafeking," then gave SABC news 1400-1415; then recordings to 1429,

when signed off (1430) with "God Save the King."

At the time this was compiled, Menado, Celebes, USI, was using approximately 9.840, heard mornings (EST). (Stark, Texas) *Radio Iraq* is broadcasting in Arabic 2300-0100 from Basra on 11.935. (Radio Sweden) Bluman, Israel, flashes via airmail that the "unidentified Persian" reported some time ago on 4.050 has moved to 3.950; heard 1030 to sign-off which varies 1330-1400; presumed location is somewhere in Iran.

Radio Sweden has received word that *Radio Goa,* Portuguese, India, is radiating on 9.610 and 17.780 *after* 0615.

CR4AA, near 5.910, Praia, Cape Verde Islands, is fine level in England from 1530; news in Portuguese ("Radio Jornal") at 1530 and 1625, both sessions introduced and ended with U.S. march medley. (Pearce, England)

Rome was recently noted 0315-0345 in *English* over 17.800, 17.770, 15.310, 15.120, 11.910, 11.810. (Bluman, Israel)

The clandestine *Yugoslav Emmigrant Radio* (*"Underground"*) is now heard on 7.880, 0130-0145, 0630-0645. (Radio Sweden)

Radio Makassar, Celebes, USI, sends schedule—YDQ2, 9.550, in Indonesian, weekdays 1700-1900, 2330-0215, 0400-1000, Saturday 1800-0215, 0400-1000; YDQ3, 11.084, Dutch, weekdays 0500-1000, 1700-1800, Sunday 0500-1000; YDQ, 5.030, weekdays 2330-0215 (Dutch), 0400-1000 (Indonesian), 1700-1800 (Indonesian), 1800-1900 (Dutch), and Sunday 0400-1000 (Indonesian), and 1800-0215 (Dutch). (Pearce, England)

A *new* Prague frequency is 9.670 (OLR3B) used "evenings" (Prague time) in parallel with 9.550. (Bluman, Israel)

Although still announcing 9.000, Tel Aviv, Israel, is noted by Pearce, England, on 9.500 with news 1415 in parallel with the 6.830 outlet; announces next *English* for 1600 on 9.000 but this is heard on 9.500 instead; announces *English* for 0600 on 6.830.

Cushen, N. Z., reports as *new* Indonesians, Madium, 4.160, Java, heard at good strength *after* 1030, and YDG, 3.332, Sarakarta, signing off 1030. (Radio Australia)

The World Listener, compiled in Copenhagen, Denmark, by O. Lund Johansen, publisher of *World Radio Handbook,* should be available in the United States in September; inquiries should be made to Ben E. Wilbur, 32 Whittlesey, Ave., East Orange, New Jersey. *The World Listener* (in *English*) is designed to promote interest in world listening and to help the beginner in his hobby, with articles on how to tune to s.w. stations, how to identify them, proper antenna for DX-ing, how to write a report, abbreviations and codes, frequency lists, and an analysis of the best frequencies for the entire world, according to day, night, and seasons. Mr. Johansen has asked listeners throughout the world to tell of

their experiences in the volume. The 1950 Edition of *World Radio Handbook (English)* should be available from Mr. Wilbur in November or December.

* * *

Press Time Flashes

At press time, I noted Tel Aviv on approximately 9.610 opening around 0500 on Sunday (may open earlier weekdays?) in native program; oboe tuning signal just before start of regular broadcast. Prague, 15.23, had news 1900, and on 11.84 and 15.32 (best) 2230. Rome, 11.910, signed on 1900 in Italian, but had *English* news at that time on 11.81, 15.12; at 2110 had news on 11.81, 11.91. *Radio Pakistan* was no longer heard on 15.335 at 2100 with news but this was being carried on 15.27 (bad QRM from "Voice of America," same channel).

From Serrano, Rio de Janeiro, via airmail, come these tips—*Radio Splendid,* Buenos Aires, noted on a *new* 19-m. channel of approximately 15.22 (varies 15.21-15.25); call is given LRS2 and outlet parallels m.w. LR4 on 990 kc. (a 50-kw. clear-channel outlet) and s.w. LRS1, listed 9.315; heard afternoons and evenings (EST). Construction permit for *Radio Educadora do Ceara* (tropical band and BCB) has been deleted; *Radio Brasil,* Box 625, Campinas, Sao Paulo, Brazil, informs Serrano that its tropical band station is ZYY3, 2.46, 1 kw., fed to a 100-ft. guyed antenna; schedule is 0600-2200; good signal in Rio de Janeiro from 1500 to closedown. *Radio Record,* Sao Paulo, noted testing on 6.055 with strong signal from around 1100 to closedown (varies 2100-2300). *Radio El Espectador,* Montevideo, Uruguay, heard on 3.245 or 3.250 in the tropical band now; poor level around 1900-2100. The government of Venezuela is building a station at a cost of one million "bolivars"; will operate on both m.w. and s.w.

Radio Clube de Angola noted in South Africa on 5.096 daily from 0130 in parallel with CR6RN, approximately 9.469. (*Radio,* South Africa)

Taipeh, 7.151, Taiwan, noted 0700 with *English* identification. JKM, 4.93, Tokyo, noted 0725. (Russell, Calif.)

HVJ, Vatican City, is now using 5.929, 6.190, 9.646, 11.740, 15.095, 17.445, 17.840, and 21.740; has *English* daily 1000 and 1315 on 9.646, 11.740, 15.095; news summary in *English* Tuesday 1030 to India, Ceylon, South Africa. (*Radio Sweden;* Patrick, England)

Radio Ceylon, Colombo, relays the BBC at 0325-0900 on 17.73 to Hong Kong, China, Japan; 0910-1205 on 15.12 to India, Pakistan, and 0325-1205 to Indo-China, Burma, Malaya. (Thomas, N. Z.)

JKH, 7.257, Tokyo, excellent closing 0830; JKJ, 7.285, good closing 0810; both announce "NHK." "Unidentified" outlet still noted on approximately 7.253 *every day;* appears scheduled 0900 to 1100 (may fade out then); first hour seems to be in *English;* programs consist chiefly of music interspersed with short announce-

ments and occasional news bulletins (usually about 2 minutes in length); is *not* Singapore. Tibet? (Neeley, Oregon)

Radio Luxembourg, 6.090, noted in England to 1930 closedown. (Patrick)

PJC2, 5.010, Willemstad, Curacao, noted on Mondays 2000 with *English* identification followed by *English* program," "Holland Today." (Cox, Delaware)

A letter-verification from 4VEH, Cap-Haitien, Haiti, states operates on 9.840, 700 watts in antenna; *English* listed Wednesday 0615-0700 and Sunday 2100-2200; station is owned and operated by The East and West Indies Bible Mission. Good signal in Maine. (Pottle)

* * *

Acknowledgement

Thanks for the splendid reports. Keep them coming! . . . . KRB.

THIRD PARTY MESSAGES

IN accordance with an official notice received from the Department of State, the Federal Communications Commission has announced that a bilateral agreement between the United States and Ecuador directly affecting licensed amateurs of the two countries has been concluded by an exchange of notes.

The terms of this agreement provide that amateur radio stations of Ecuador and of the United States may exchange internationally messages or other communications from or to third parties provided:

1. No compensation may be directly or indirectly paid on such messages or communications.

2. Such messages or communications shall be of a character that would not normally be sent by any other existing means of telecommunication. To the extent that in the event of disaster, other means of telecommunication are not readily available for expeditious handling of communications relating directly to safety of life or property, such means shall not be considered to be an existing means, and such communications may be handled by amateur stations of the respective countries.

3. This arrangement shall apply to all the continental and insular territory of Ecuador and to the United States and its territories and possessions, including Alaska, the Hawaiian Islands, Puerto Rico, and the Virgin Islands, and to the Panama Canal Zone. It shall also be applicable to the case of amateur stations licensed by the United States authorities to United States citizens in other areas of the world.

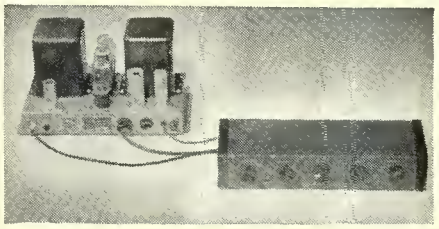
4. This arrangement shall be subject to termination by either government on sixty days notice to the other government, by further arrangement between the two governments dealing with the same subject, or by the enactment of legislations in either country inconsistent therewith.

As a matter of related interest, amateur stations licensed by the Federal Communications Commission heretofore have been able, under and in accordance with the terms of previously effected arrangements, to exchange internationally messages or other communications from or to third parties with amateur stations of Canada, Chile and Peru. —30—

What's New in Radio

(*Continued from page* 119)

controls giving 18 db. boost or cut. The treble control equalizes for high frequency recording characteristics.



Provision is made so that a noise suppressor can be connected into the system to be effective on all channels.

A data sheet on the new amplifier system is available on request.

OSCILLO-TRACER

Robert A. Waters, Inc. of 4 Gordon Street, Waltham 54, Massachusetts, is currently marketing the new "Oscillo-Tracer," an optical super-positioning device that permits tracing of cathode-ray patterns of a repetitive nature directly on graph paper.

According to the manufacturer, the use of the unit for viewing oscillograms increases accuracy by eliminating the parallax caused by curved-face cathode-ray tubes and flat calibrated scales. The "projected" pattern is exactly the size of the original trace.

Complete details and a copy of a bulletin describing the instrument are available from Dept. RN of the company.

NEW MICROPHONE

The Astatic Corporation of Conneaut, Ohio, has developed and is marketing its newly developed "Synabar," Model DR-10 microphone.

A unique feature of the new unit, which is a undirectional cardioid crystal type, is the special design which provides a 15 decibel front-to-back ratio. The frequency response of the microphone (50 to 10,000 cycles per second) is enhanced by the inclusion of a response selector switch which permits choice of ideal pick-up

characteristics for either crisp voice or general voice and music.

The new "Synabar" has an output level of –54 db. Its crystal element has a special metal seal protection against moisture or dryness. The microphone is finished in satin chrome and comes equipped with 20 feet of single conductor shielded cable and a detachable concentric cable connector.

"HI-Q" COILS

United Transformer Company of 150 Varick Street, New York 13, New York, has announced that it will now manufacture, to customers' specification, a line of "Hi-Q" coils for subaudio frequencies.

These coils have stable characteristics for frequencies from .1 to 10 cycles. A typical unit provides an inductance of 300,000 henrys with a "Q" of 10 at .15 cycles, and a "Q" of 30 at .5 cycles. This particular coil is designed for a 1 volt a.c., .1 ma. d.c. circuit.

Manufacturers with specialized coil design problems are invited to consult with the company regarding these new units. —30—

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ERRATA

An error appears in the diagram of Fig. 2 in the article "Simplified Ham TV Station" (Part 2, June, 1950) by J. R. Popkin-Clurman. There should be a 500 $\mu\mu$fd., 10,000 volt condenser connected between pin 7 on V_1 and pin 7 on V_2. Please make this correction on the diagram in question.

* * *

We have had several inquiries regarding the 68,000 ohm plate dropping resistors, R_{19}, R_{27}, R_{33}, and R_{39}, used in the video amplifier shown in Fig. 5, page 55 of Part 2 of the article "Simplified Ham TV Station" appearing in the June issue. Several readers have complained of the low plate voltages resulting from the use of such high value resistors. Actually, the video amplifier functions satisfactorily with the resistors specified. This high value was chosen for three reasons. The first one is the necessity of preventing motorboating at very low frequencies, the second of providing very low frequency compensation. The third reason is to prevent high plate voltage swings of the video amplifier from driving the following grid to very positive levels under transient conditions, paralyzing that stage. If desired, however, the voltage can be raised by starting with 68,000 ohms in the first stage, using 47,000 ohms in the second stage, 51,000 ohms in the third stage, and 47,000 ohms in the fourth stage. Of course, 10,000 ohms may be used in all stages but with some deterioration in the low frequency response.

It will be found that such high gain as is present in this video amplifier makes it imperative that each stage be decoupled properly, otherwise considerable annoyance will result from the poor apparent stability. The plate voltage swing of the first three video amplifiers is never greater than 1 volt so that the low plate voltage present on the video amplifier tubes does not present any distortion problems.

* * *

The parts list accompanying the diagram of Fig. 2, appearing on page 54 of the July 1950 issue, in the article "The 'Sumodget' Transmitter" is incorrect in one respect. The condenser C_{36} should be a .01 μfd., 2500 volt mica unit instead of a 500 volt mica.

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C1B/3C31	3.75	5CP1	2.45	7C7	.60	VT67/30	.58	700C	17.95	874	.90
1B4P	1.05	5D21	22.50	7E5/1201	.60	70L7	1.05	700D	17.95	876	.40
1B21A/GL471A	2.55	5FP7	1.75	7E6	.55	CEQ72	1.45	701A	3.00	878	1.75
1B22	3.40	5GP1	2.95	7F7	.60	CRP72	.95	702A	2.60	879/2X2	.45
1B23	7.50	5H-4 BALLAST	.45	7H7	.60	CYN72	1.65	703A/368AS	3.60	902	3.75
1B27	7.75	5HP4	4.75	7L7	.65	RKR72	.90	704A	1.05	931A	3.95
1B32/532A	1.85	5J23	13.00	7Y4	.50	RKR73	1.23	705A/8021	1.00	954	.30
1B42	6.75	5J29	13.45	9-3 BALLAST	.45	76	.40	706AY	17.50	955	.45
1B48	9.90	5U4G	.75	10	.50	77	.45	707A	12.95	957	.35
EL-1C	4.85	5W4	.76	10 ACORN	.55	78	.45	707B	14.45	958A	.35
1C5GT	.65	6-4 BALLAST	.35	10/VT25A	.53	VR78	.65	708A	3.45	967/FG17	3.75
1C6	.75	6-7 BALLAST	.35	10E/146	1.00	80	.45	709A	4.75	991/NE16	.24
1C7G	.85	6A3	.80	10T1 BALLAST	.50	FG81A	3.95	710A/8011	1.25	1005	.30
1D8GT	.90	6A6	.65	10Y/VT25	.45	83V	.90	713A	1.45	1007	4.50
1E7GT	.95	6AB7/1853	.95	12A6	.25	89	.42	714AY	3.55	CK1089	3.90
1G6	.65	6AC7/1852	.90	12A6GT	.25	89Y	.40	715B	6.55	CK1090	2.65
1L4	.50	6AF6G	1.10	12AH7GT	1.10	VR90	.95	717A	.60	1148	.35
1LC6	.75	6AG5	1.20	12BD6	.65	VT90 BRITISH	2.55	721A	2.60	1201	.45
1LN5	.80	6AH6	1.00	12C8	.40	VR92	.40	722A/287A	9.50	1203	.45
1P24	1.75	6AK5	1.20	12F5GT	.55	FG95/DG1295	9.95	723AB	14.95	1203A	.65
1Q5GT	.85	6AK6	.80	12H6	.35	VT98/REL5	14.95	724A	3.85	1236	1.75
1R4	.55	6AL5	.85	12J5GT	.35	100R	1.05	724B	.85	1294/1R4	.55
1S5	.60	6AQ6	.65	12J7GT	.59	101/837	1.65	725A	.85	DG1295	9.95
1T4	.65	6AU6	.65	12K8	.59	102F	3.55	726A	[illegible]	1299/3D6	.45
2A7	.70	6AV6	.65	12SA7GT	.62	FG105	9.75	726B	13.50	1299A	.60
2B7	.70	6B4G	.90	12SF7	.50	VU111S	.45	730A	9.95	1613	.55
2B22/GL559	1.75	6B7	.75	12SG7	.55	114B	.80	801	.40	1616	.75
2C22/7193	.35	6B8	.65	12SH7	.40	121A	2.55	801A	.65	1619	.35
2C26	.30	6B8G	.75	12SJ7	.60	122A	2.65	803	3.40	1624	1.25
2C26A	.40	6BA6	.65	12SK7	.55	VT127 BRITISH	.35	804	6.90	1625	.35
2C34	.40	6C4	.40	12SL7GT	.55	VT127A	2.95	805	5.75	1626	.35
2C40	5.25	5C5	.55	12SN7GT	.59	VR150	.48	808	1.65	1629	.35
2C44	1.25	5C6	.65	12SR7	.50	VT158	14.95	809	2.65	1630	2.75
2E22	1.10	6C8G	.70	12X825 2A.TUNG	1.45	FG172	19.25	811	2.35	1638	.65
2J21	10.45	6C21	19.10	13-4 BALLAST	.35	205B	1.35	812	2.95	1641/RK60	.65
2J21A	10.45	6D6	.50	14B6	.75	211/VT4C	.40	813	8.95	1642	.55
2J22	9.65	6F5	.65	14Q7	.55	215A/VT5	.28	814	2.60	1852/6AC7	.90
2J26	8.45	6F6	.60	15E	1.40	221A	1.75	815	2.35	1853/6AB7	.95
2J27	12.95	5F6G	.60	15R	.70	227A	2.90	826	.75	1960	.85
2J31	9.95	5F8G	.85	16X879 2A.TUNG	1.35	231D	1.20	830B	3.95	1961/532A	1.85
2J32	12.85	6G6G	.85	FG17/967	3.25	RX233A	1.95	832	6.50	1984	1.75
2J33	18.95	6H6	.45	19	.85	257A	3.00	832A	7.95	2051	.75
2J34	17.50	6H16 BALLAST	.45	20-4 BALLAST	.45	268A	2.95	834	5.75	UX6653	1.20
2J37	13.85	6J5	.45	REL-21	2.10	274B	2.65	835/38111A	1.00	7193	.35
2J38	9.95	6J5GT	.45	21-2 BALLAST	.45	282B	5.25	836	1.45	8011	2.55
2J48	19.95	6J6	.85	23D4 BALLAST	45	287A/722A	9.50	837	2.25	8012	2.75
2J61	24.50	5J7	.65	RK24	1.55	304TH	3.70	838	3.10	8013	1.25
2K25/723A/B	14.95	6J8G	.95	24A	.40	304TL	1.95	841	.40	8020	2.10
2X2	.45	6K6GT	.55	VT25A/10	.45	307A/RK75	3.60	842	2.75	8025	6.75
2Y3G	1.20	6K7	.65	25Z5	.65	316A	.45	843	.40	9001	.45
3-16 BALLAST	.45	6K7G	.65	25Z6GT	.52	327A	2.50	851	39.00	9002	.40
3A4	.35	6L6	1.10	26	.55	350B	1.85	852	6.10	9003	.45
3A4/47	.45	6L7	.75	27	.55	354C	14.95	860	7.55	9004	.55
3B7/1291	.40	6N7	.85	28D7	.40	356B	4.95	864	.40	9006	.30
3B22	2.35	6N7GT	.85	30/VT67	.58	368AS/703A	3.75	865	1.85	38111A/835	1.00
3B24	1.75	6Q7	.55	30	.40	371A	.80				
3BP1	3.45	6R7	.75	33	.70	371B	.80				
EL-3C	3.95	6R7G	.75	34	.33	388A	2.95				
3C21	4.85	6R7GT	.55	RK34/2C34	.35	393A	3.60				
3C24/24G	.45	6S7G	.85	35/51	.55	394A	3.60				
3C31/C1B	3.75	6SA7GT	.55	35W4	.45	395A	4.85				
3CP1/S1	1.95	6SC7GT	.65	35Y4	.50	MX408U BALLAST	.30				
3D6/1299	.30	6SF5GT	.65	36	.55	417A	14.25				
3D21A	.95	6SG7	.65	37	.35	434A	2.85				
3DP1	3.75	6SH7	.40	38	.35	446A	1.15				
3FP7	1.85	6SH7GT	.40	39/44	.30	446B	1.75				
3FP7A	2.25	6SK7GT	.50	43	.50	GL451	1.90				
3GP1	4.95	6SL7GT	.60	45SPEC.7V.FIL.	.28	GL471A	2.75				
3H-1-7 BALLAST	.45	6SQ7	.55	46	.65	SS501	3.00				
3HP7	3.45	6SR7GT	.55	EF50	.45	527	12.85				
3Q5	.65	5U7G	.55	50B5	.65	WL530	2.75				
3Q5GT	.65	6V6GT	.75	50L6GT	.54	WL531	1.75				
3S4	.60	6X5GT	.73	VT52/45SPEC.	.28	WL532	1.65				
GA4	2.00	7-7-11 BALLAST	.35	56	.70	532A/1B32	1.85				
REL-5	14.95	7A4/XXL	.55	57	.45	GL559	2.10				
VT5/215A	.40	7A7	.56	58	.50	KU610	6.90				

PHOTO. TUBES.	
917/CE11V-C.	$2.10
918/CE1C.	1.45
920/CE21D.	2.40
922/CE22C.	1.20
923/CE23C.	1.10
927/CE25.	1.25
930/CE30C.	1.20
SPECIAL TUBES.	
4B24/CE224.	3.25
4B25/CE221.	7.85
4B26/CE226.	1.90
4B27/CE201A.	2.45
4B28/CE225.	2.40
4B35/CE212B.	7.65

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PICTURE TUBE DATA CHART

MAGNETIC DEFLECTION AND FOCUS TELEVISION TYPE CATHODE-RAY TUBES

DUMONT

DUMONT

Type[1]	Bulb	Dimensions (Inches) Overall Length	Diameter	Min. Useful Diameter	Deflection Angle (degrees)	Position of Face Curvature (Inches)	Envelope	Contact	Ion Trap Magnet	Max. Design Center Values: Anode Volts	Grid No. 2 Volts	Comparative Operation Conditions**: Focus* Current (ma.)	Anode Volts	Eg, Grid No. 1 Cut Off Volts	Grid No. 2 Volts
10BP4 10BP4A[5]	12D	17⅛	10½	9	50	42	Glass[7]	Cavity	Double	12,000	410	132	12,000	33-77	300
10CP4	12D	16½	10½	9	50	42	Glass[7]	Ball	None	12,000	410	—	12,000	33-77	
10DP4[5,6]	12C	17⅛	10½	9	50	42	Glass	Cavity	None	12,000		—	12,000		
10EP4	12D	17⅛	10½	9	50	42	Glass	Ball	Double						
10FP4[6]	12D	17⅛	10½	9	50	42	Glass[7]	Cavity							
10MP4 10MP4A[5]	12G	17	10½	9⅛	52	42	Glass[7]								
12JP4	12D	17½	12	11	56	20									
12KP4 12KP4A[5]	12D	17½	12¼	11¼											
12LP4 12LP4A[5]	12D	18¾	12¼	11											
12QP4 12QP4A[5]	12D	17½	12¼	11											
12RP4	12D	17⅝	12	11											
12TP4	12D	18¾	12¼	11											
12UP4 12UP4A[5]	12D	18⅛	12¼	11¾											
12VP4 12VP4A[5]	12G	18	12¼	11											
14BP4[5,6]	12D	16½	9¾x12½	12¾ diag.	70										
14CP4[5,6]	12D	16¾	9¾x12¾	12¾ diag.	70										
14DP4[5,6]	12D	16¾	9¾x12¾	12¾ diag.	70										
14FP4[5,6]	12D	16½	9¾x12½	12¾ diag.											
15AP4	12D	20½	15½	14											
15CP4	12D	21½	15½	14											
15DP4	12D	20½	15½	14											
16AP4 16AP4A[5]	12D	22¾	15⅛	14⅝	53										
16CP4	12D	21½	15⅛	15											
16DP4 16DP4A[5]	12D	20¾	15⅛	15											
16EP4 16EP4A[5]	12D	19⅞	15⅛	14⅝											
16FP4	12D	20½	16⅛	15	62										
16GP4[5,6]	12D	17⅝	15⅛	14⅝	70										
16HP4 16HP4A[5]	12D	21¾	15⅛	14⅝	60										
16JP4 16JP4A[5]	12D	20¾	16⅛	15	60										
16KP4[5,6]	12D	18¾	11½x14¾	14⅜ diag.	70										
16LP4 16LP4A[5]	12D	22¾	15⅛	14½											
16MP4 16MP4A[5]	12D	21¾	16⅛	14⅝											
16OP4[5,6]	12D	19⅝	11½x14¾	15 diag.	70 diag.										
16PP4[5,6]	12D	18¾	11½x14¾	14½ diag.	70 diag.	27									
16SP4 16SP4A[5]	12D	17⅜	15⅜	14½	70										
16TP4[5,6]	12D	18½	11½x14¾	14½ diag.	70 diag.	27									
16UP4[5,6]	12D	18⅜	11½x14¾	15 diag.	70 diag.	27									
16VP4[6]	12D	17⅜	15⅜	14½	70										
16WP4[6]	12D	17⅜	15⅜	14½	70										
16XP4[5,6]	12D	18⅜	11½x14¾	15 diag.	70 diag.	27									
16YP4[6]	12D	17⅜	15⅜	14½	70	56⅝	Glass[7]								
17AP4[5,6]	12D	18½	12¾x15⅜	16 diag.	70 diag.	27									
19AP4 19AP4A[5]	12D	21½	18⅜	17½	66	28									
19DP4 19DP4A[5]	12D	21½	18⅜	17½	66	60	Glass[7]								
19EP4[5,6]	12D	21⅜	17x13⅝	17⅝ diag.	70 diag.	27	Glass[7]								
19FP4[6]	12D	22	18⅜	17½	66	60	Glass	Cavity							
19GP4[6]	12D	21¾	18⅜	17½	66	60	Glass	Cavity						33-77	300
20BP4	12D	28	20	18¾	54	30	Glass	Metal Cap						33-77	300
22AP4 22AP4A[5]	12D	22⅛	21⅝	20¼	70	27	Metal	—			410	108*	12,000	33-77	300

Notes:

1. All the types listed have heater values of 6.3 volts, 0.6 amps.
2. These types employ electrostatic focus.
3. "A" type indicates use of grey filter faceplate.
4. Type employs metal-backed screen.
5. Rectangular type.
6. Types other than "A" types employing grey filter face plate.

* Types employ RMA Focus Coil #109, all others RMA focus coil #106.

† Types have external conductive coating.

7. All types employ a white flourescence material of medium persistence.

**These values are for comparison only and do not imply typical operating conditions.

Data based on latest information from RMA Data Bureau.

• Du Mont Teletrons

USING THE DATA CHART

Several important factors must be considered by the technician when using this tube data chart as an index to tube interchangeability.

Bulb Outline *(exclud… …verall length)*

Tube … bulb outlines present no problem of … to chassis layout, unless the differ… that the two types in question would … gn.

… focus … range … ed.

… the … uble to a … it …

Conductive Coating

If a tube without external coating is replaced for a tube with external coating, a 500 to 1500 *mf.* capacitor connected between the high-voltage output lead and ground will insure proper set operation.

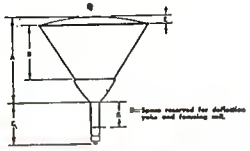
Bulb Contact

In general there are three types of connectors to the anode of television tubes, the cavity and ball connectors in all glass types, and the clip connector for types with a metal cone envelope. When making tube changes, the appropriate connector must be used.

Deflection Angle

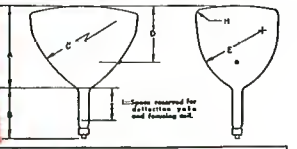
In practice, the same deflection yoke usually may be employed with all tube types having deflection angles of less than 66°. Types with deflection angles of 66° or over will require a wide-angle deflection yoke.

…OUTLINES



METAL GLASS — ROUND TYPES

	A	B	C	D	E
	…⅜	7½	8	4¼ min.	¾
	14⅝	11	7¾	4 min.	⅜
	12¾	9¾	6½	3¾ max.	⅛
	10½	7¾	6½	4 min.	½
	14⅝	9⅛	7½	4¼ min.	1⅛
	15⅝	11⅜	7¼	4¼ min.	1⅛

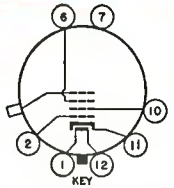


…LASS — RECTANGULAR TYPES

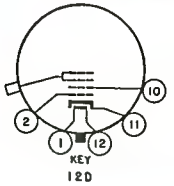
	C	D	E	F	G	H	I
	17⅛	6⅝	8⅛	∞	2¾	¼	3⅛
	17⅛	6⅛	8⅛	∞	2¾	¼	4⅝ min.
	17⅛	6⅝	8⅛	∞	2¾	¼	5⅛ min.
	17⅛	6⅛	8⅛	∞	2¾	¼	4⅝ min.
	7½	18	6¾	9	3¾	¼	4¾
	…⅜	18	7⅛	9	3½	¼	
	…½	18	7⅛	9	3¾	¼	
	11¾	6⅛	18	7⅛	9	3¾	¼	4⅝ min.
16LP4	11¾	6⅛	18	7⅛	9	3¾	¼	4⅝ min.
16ZP4	11¾	7½	18	7⅛	9	3¾	¼	
17AP4	11¾	6⅛	—60	7⅛**	13⅝	27°	2⅝	¼	
19EP4	13⅜	7½	19½	10	11¼	∞	2⅝	¼	3⅛

* Side adjacent to F has curvature radius of 21 inches.
** Anode contact is located on broad side.

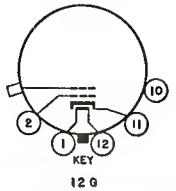
…given in inches.



12C

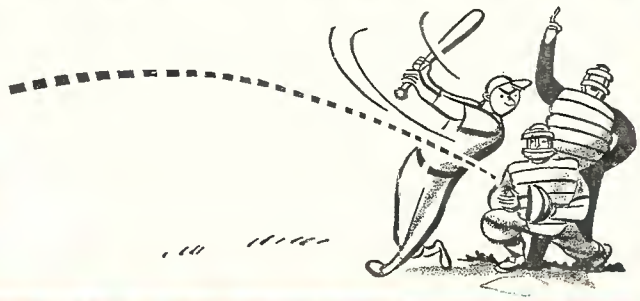


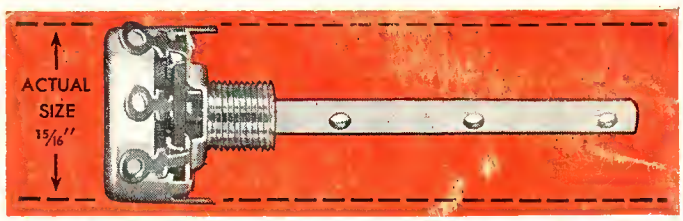
12D



12G

A Controlled Curve For Better Performance!





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The Mallory Midgetrol is the answer to your control problems. A 15/16" diameter control with electrical characteristics superior to 1⅛" controls, it lets you standardize on *one* control for all of your replacements!

WIDER APPLICATION The small size allows you to service portables, auto radios and small AC-DC receivers requiring 15/16" controls.

LESS INVENTORY Electrical characteristics allow you to use the Mallory Midgetrol to replace large as well as small controls. No special shafts required. You carry fewer controls in stock.

SIMPLER INSTALLATION The new and unique flat shaft design of the Mallory Midgetrol saves installation time with all types of knobs.

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