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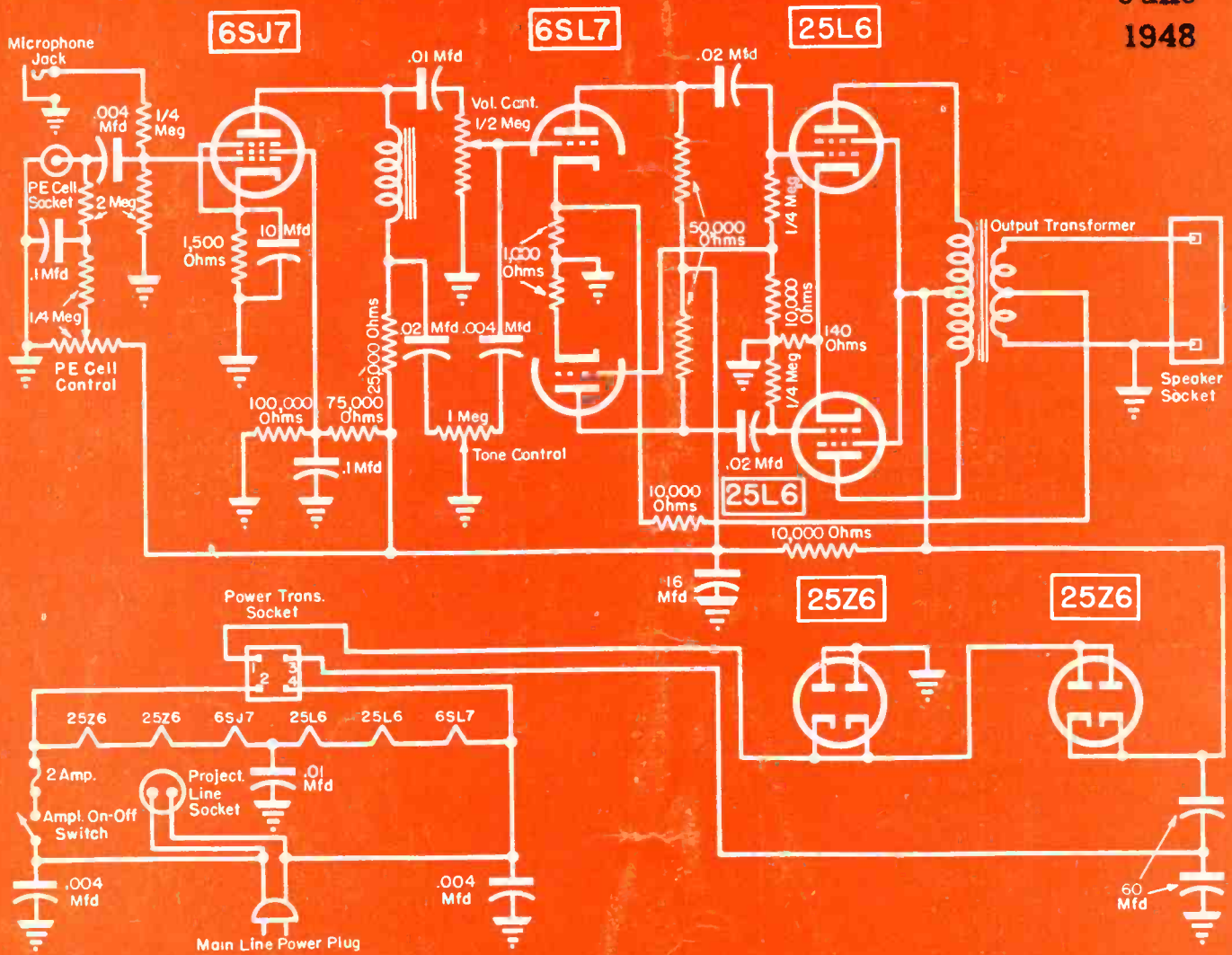
SERVICE

Sound Issue

June
1948



Four-tube amplifier employed in home-movie projector.
[See page 21]

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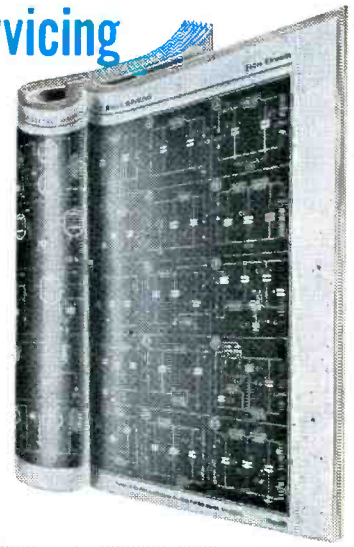

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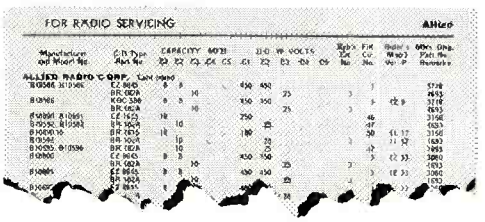

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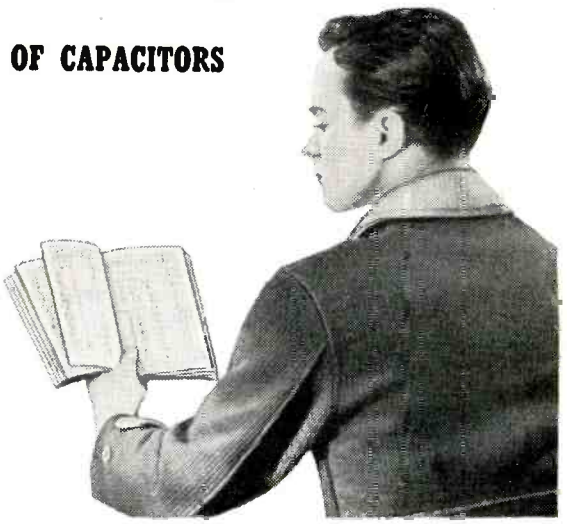

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Schenectady 5, New York

Vol. 17, No. 6

RADIO · TELEVISION · ELECTRONIC
SERVICE

June, 1948

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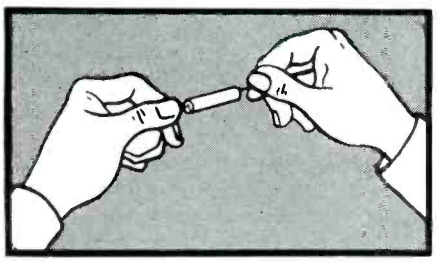

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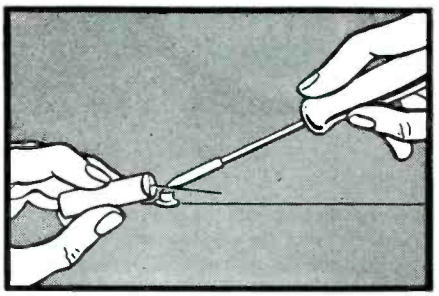

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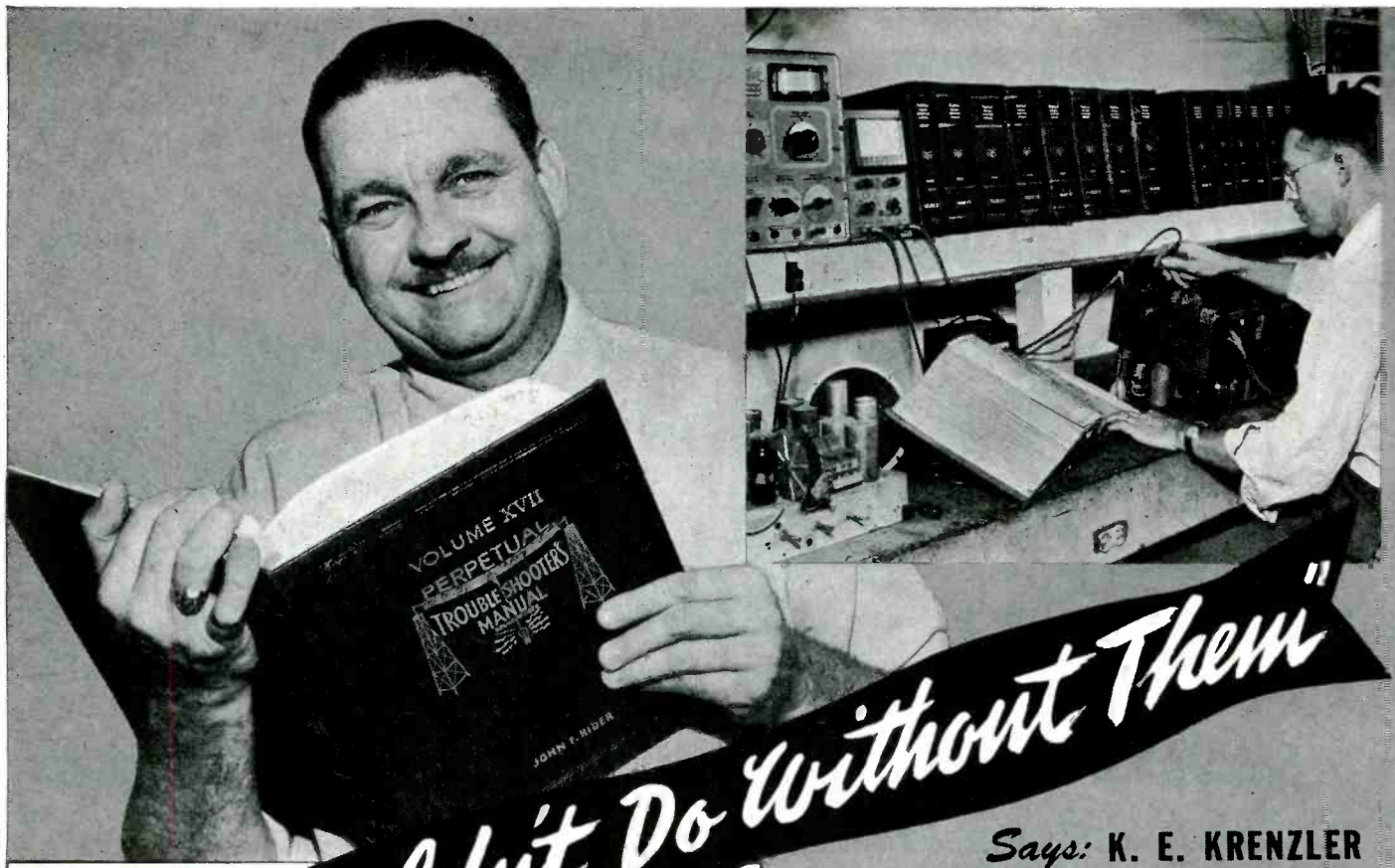

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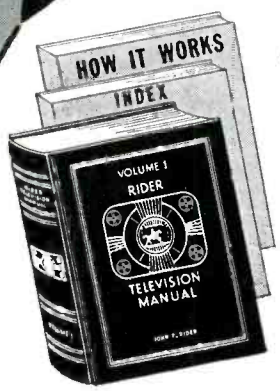

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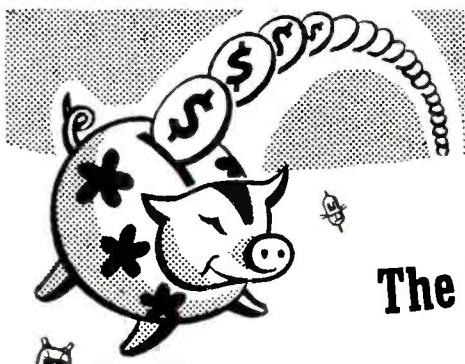
NOTE: The Mallory Radio Service Encyclopedia, 6th Edition, makes reference to only one source of Radio Receiver Schematics—Rider Manuals.



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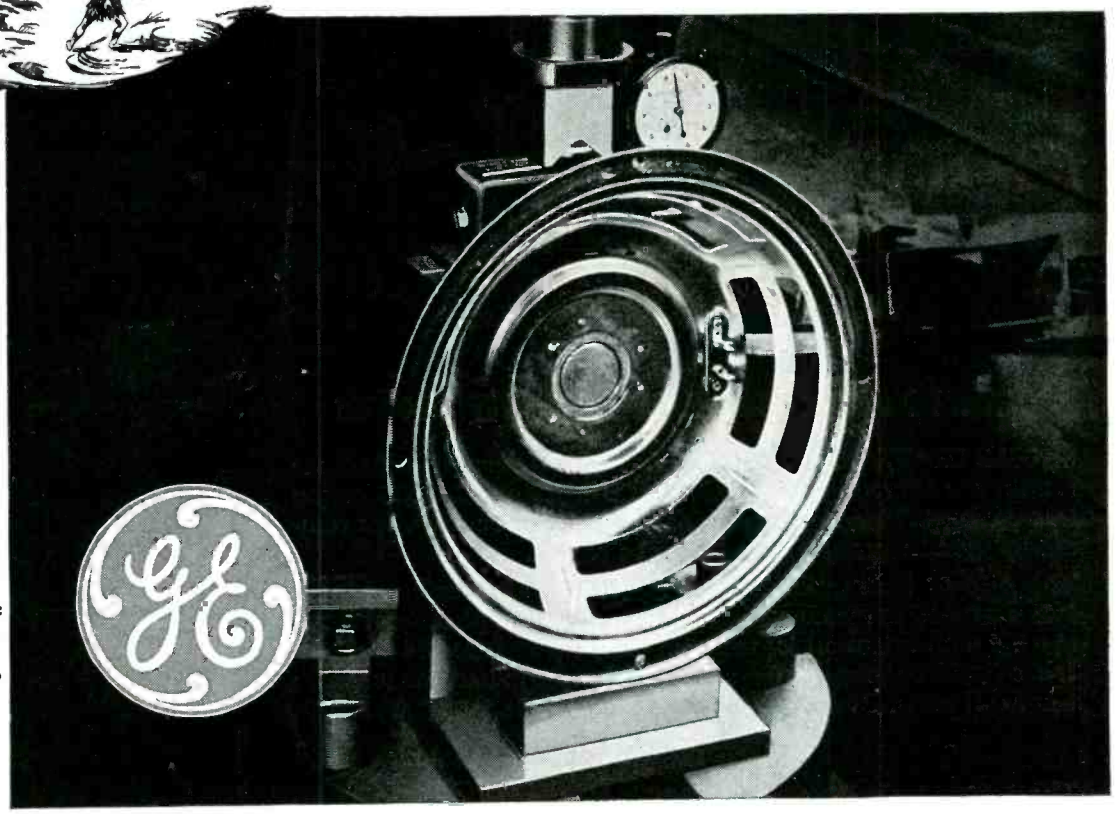

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SERVICE

Annual Sound Issue

THIS WILL BE one of the biggest years for *sound* . . . in installation, maintenance and servicing. So have predicted industry's foremost specialists. And the reason for their enthusiasm becomes quite apparent when we look over the variety of advancements produced in sound, the endless applications, and the fact that this is a crucial election year.

In the home, factory, field, office . . . everywhere . . . sound has become a vital factor. As a hobby, sound is rapidly approaching the popularity of ham radio and photography. And as an essential to the conduct of business sound ranks with the leaders. There are few modern plants which do not have or do not plan to have sound systems in their factories and offices. There are few modern rural homes which are not or will not be equipped soon with two-way systems or multiple radio speaker setups. And there are rows and rows of other fields in which sound is or will be a featured provision.

Veteran Service Men have long recognized the prospects of the field and newcomers are quickly realizing the bright future sound offers.

In tribute to this outstanding industry, we have had a special series of articles prepared, covering the year's developments, for presentation in this, the *annual sound issue* of SERVICE.

The Sound Issue Articles

IN FEW FIELDS has sound been so important an ingredient as in commercial and home movies. Photographic fans are rapidly becoming aware of the *new life* sound affords. Alert Service Men have noticed this trend and have suggested the publication of articles on this subject. Accordingly, we have had such text prepared and the first of a series appears in this issue on page 14: *The Servicing of 16-mm Sound-On-Film Projectors* by W. L. Lyons. Discussed are the amplifiers used in a typical home movie system, troubles that occur in such systems and how to cure them. Lyons details the unusual problems that crop up in 16-mm projectors and describes ways and means of detecting these defects. For instance, there is need for a method of checking the leakage resistance of capacitors. Accordingly, Lyons shows a method he uses with a vacuum-tube voltmeter. Illustrated and described, too, are a projector-amplifier test circuit, using a sound-to-light conversion method with a receiver.

On the cover appears the circuit diagram of an amplifier used in a modern type of home-movie sound projector with a description of the system; page 53.

BASS BOOSTING, an extremely important factor in sound, is analyzed very effectively by Jack Najork in his article entitled *Why Bass Boost*.

Najork explains why bass boosting is necessary, how it is achieved and how to plot frequency response curves, which will indicate the proper degree of bass boosting, with an audio oscillator. This all-important article begins on page 18.

THE INTERESTING AND IMPORTANT subject of *Hearing Aids* is the basis of another sound article by Ira Kamen. Presented for the first time are data on the various types of hearing aids available today, their design characteristics, application problems met in the field and the rather specialized techniques required for servicing today.

In this article, which appears on page 26, will be found frequency-response and frequency-control curves, typical output circuits used in hearing aids, power system requirements, etc.

AN UNUSUAL intercom system, which uses the facilities of radio receivers and a pair of amplifiers for two-way work in a small home, is described by Frederick E. Bartholy on page 10. Employing a unique time-control relay system, Bartholy has developed a two-way link which affords automatic silencing of either of two radio sets when in operation, control from either of two points by pressing of buttons and automatic shut-off shortly after conversation ceases with return of radio program to the receiver. Bartholy presents the circuit employed and describes completely the operation of the system. It's quite a story which every Service Man will heartily enjoy.

THE ELECTRIC MEGAPHONE has become quite an item in p-a work. Arthur J. Sanial (page 25) offers an exceptionally comprehensive discussion of the types available today and how they can be used. Presented is a chart showing the coverage which can be expected of electric megaphones in noisy, ordinary and very quiet areas. Offered, too, is a very lucid analysis of the *threshold of hearing*, a reference characteristic which has puzzled many Service Men. And listed are over 60 possible applications for electric megaphones.

ON THE SER-CUITS pages in this issue, beginning on page 22, program distribution systems are analyzed, with a complete description of the receiver, amplifier, magnetic wire reproducers, preamps and switching panel used. Presented, too, are circuits of a three-stage amplifier kit and a four-tube record player, together with a discussion of the circuit designs.

MANY NEW SOUND PRODUCTS are also discussed in this roundup of sound news. Albert Kahn, for instance, describes a torque drive 'phono pickup on page 32. This is a new type of pickup, which provides transformer-like step-up efficiency. Other new products in sound are described and illustrated on page 50.

Other Features in This Issue

IN ADDITION TO THE SPECIAL FEATURES on sound in this issue, there's a very complete discussion of the sweep frequency signal generator and its application to f-m servicing.

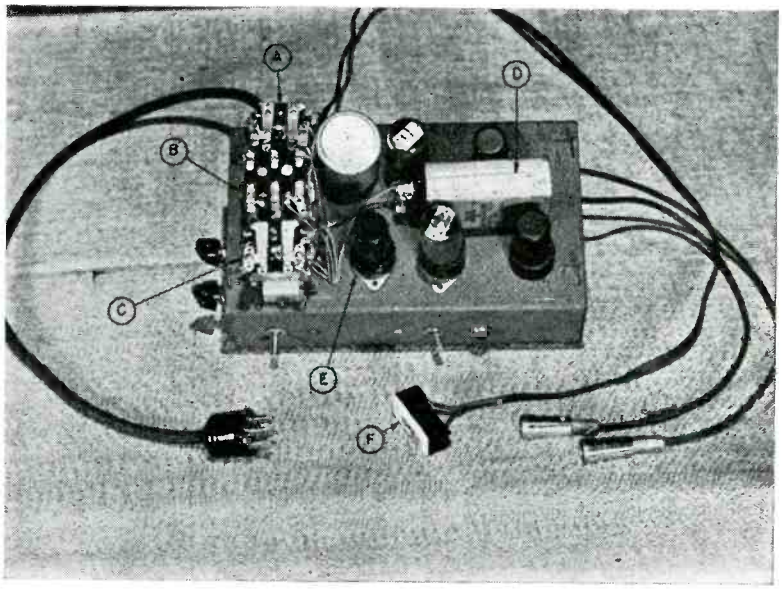
IN AN ARTICLE ON TV, Edward M. Noll discusses *TV AGC and Picture Tube Voltage and Signal Systems*. The article features an analysis of agc circuits used in tv receivers, intercarrier circuit designs, the relationship of signal and voltage to picture-tube operation, and the characteristics of high-voltage systems for electrostatic and magnetic deflection picture tubes. This timely article appears on page 36.

The TV Scoreboard

IT'S TWENTY-SIX NOW. . . . 26 tv stations on the air. And there are nearly 300,000 tv receivers in use today. According to J. J. Kahn, who is chairman of the RMA Parts Division, industry estimates there'll probably be close to 900,000 sets in use by the end of the year, nearly 2½ million in the field by 1949, over 5 million in 1950, 9 million in 1951 and 13½ million in 1952.

TV is really setting a pace!—L. W.

Intercom System Using



Left: Author with intercom system which operates through radio receivers. Right: Chassis of intercom with cover removed. At *A*, *B* and *C* are the relays. The time-delay capacitor is shown at *D* and the control tube appears at *E*. The basement-call button is at *F*.

ACTING IN A CONSULTING capacity to service organizations often results in interesting and unexpected problems. Recently one of my clients was commissioned to build and install an intercommunication system in which the requirements were unique, to say the least.

In view of the fact that the customer did not mind the expenses, as long as his specifications were met, a rare instance one must admit, no effort was spared to satisfy his wants. The story is an interesting one,

My client, whom we shall call *Joe* for the sake of simplicity as well as anonymity, services in well-to-do suburban area. His customer, whom we shall call *Mr. X*, spends a great deal of his time in his basement photographic laboratory far removed from his living quarters, where his poor wife, neglected but not forlorn, pursues two of her hobbies, namely, playing bridge with friends, or listening to a fine radio-phono combination. Occasionally they want to exchange a few words, and shouting through the basement door just did not work out, particularly when either her radio or her husband's in the basement was going full blast! Joe, who takes care of the servicing of the sets and other appliances in this household, was asked if he could furnish some kind of an intercommunication system which would have a great deal of flexibility to meet the following major requirements: (*1*) The system, when in use, should automatically silence any one of the receivers which may be playing; (*2*) require no other manipulation on the part of the wife than pushing a button once. Clearly, a conventional intercommunication system, where both parties have to throw a switch back and forth, accompanied by the military *Roger* and *Over* lingo, would not fill the bill.

Aside from these main qualifications, it was desired that the system be completely automatic, in that it need not be turned on beforehand and kept in a standby condition, but should be operable from both stations by merely pressing a button or throwing a switch, with clear indication when ready for talking, and should shut off itself in a short time after talking has stopped so as to return the interrupted programs on the receivers. The system had to be silent, or free from hum and clicks, and have high sensitivity so that neither user would have to speak into any device directly, but merely converse in the room as if both were present. Joe, after enumerating all these requirements, admitted that it was a headache, and tendered it to me for design purposes, together with two aspirin tablets.

In this case an interview with the customer was necessary and Joe made an appointment. In going over the various features, somehow we mentioned that it may be possible to use the speakers in the receivers for intercom purposes. The idea that he could use the big console and his voice would come out through the speaker appealed to Mr. X tremendously. It seems that, in the bridge parties, there is a doctor friend whom he often addresses in Bugs Bunny's vernacular, "What's up, Doc?" To be able to do this unexpectedly when the bridge game is on, and even break into the radio program, gave him a childish gleam in his eyes. Yes, that's the way he wanted it. From then on, Joe and I referred to this job as the "What's Up, Doc?" project.

After several attempts at formulating the necessary design steps, it looked gradually better and better as the work progressed. It is good to report that the system has been in operation for some time, with satisfaction from every angle, and Mr. X is showing it off to all his friends with manifold increase in the reputation of Joe's Service Shop in his community.

System Design

High sensitivity suggested the use of microphones which could easily be hidden in the rooms, particularly in the living room where the large console, as well as the bridge games, held the center of attraction. Since both sets had to be silenced when the communication system was in use, with the least amount of clicks, due to switching, it was obvious that voice

Receiver Speaker Setup

Novel Design Provides Use of Two Receivers And Automatic Silencing of Either Set When In Operation . . . Control From Either of Two Points By Pressing Button . . . Automatic Shut-Off Shortly After Conversation Has Ceased And Return of Program To Radio Set. System Uses Pair of Amplifiers Built On One Chassis And A Pair of Mikes, One of Which Is Hidden In A Table Lamp.

by **FREDERICK E. BARTHOLY**

coil disabling was the answer. This, in turn, made the use of the speakers in the respective receivers to function also in the communication channels rather simple. A slight complication was added by the fact that when the sets are not switched on, the speakers would have no field excitation for inter-com use. In the basement set, which was a table model Philco, this was easily solved by installing in place of the old speaker a p-m speaker and replacing the field coil with a choke. In the large and expensive console, the speaker had very fine response and it was felt that a change, even to an expensive p-m speaker, may not be desirable. Therefore, means had to be provided in the design to automatically switch on the console when the inter-com was used to have field excitation.

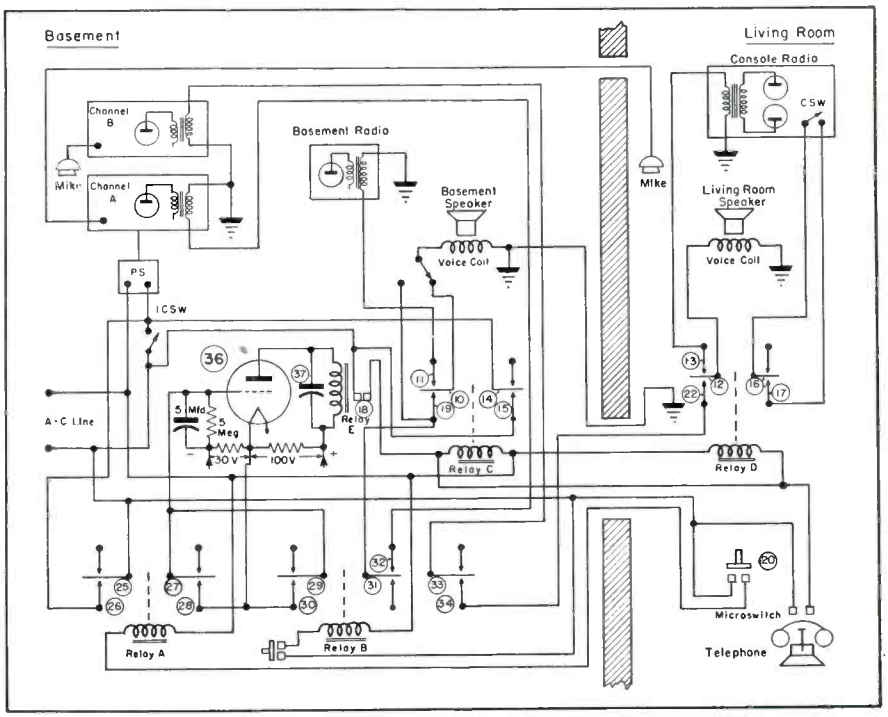
The audio channels were designed along conventional lines. Single 6V6s were chosen for the output in each channel. The two channels differed in gain requirements in that the one from the living room, where the microphone is far from the speaking person (it was hidden in a table lamp) was designed to have higher gain than the other channel from the laboratory, where the microphone is on a stand and fairly close to the person. All high-gain circuit components were carefully shielded and care was taken to give natural reproduction to voice in choosing the inter-stage coupling elements. The microphones are both of the crystal type and the attenuation in the long lead from the living room to the basement, about 75′, was compensated as much as possible in the input circuit design. The capacity of the cable measured .008 mfd.

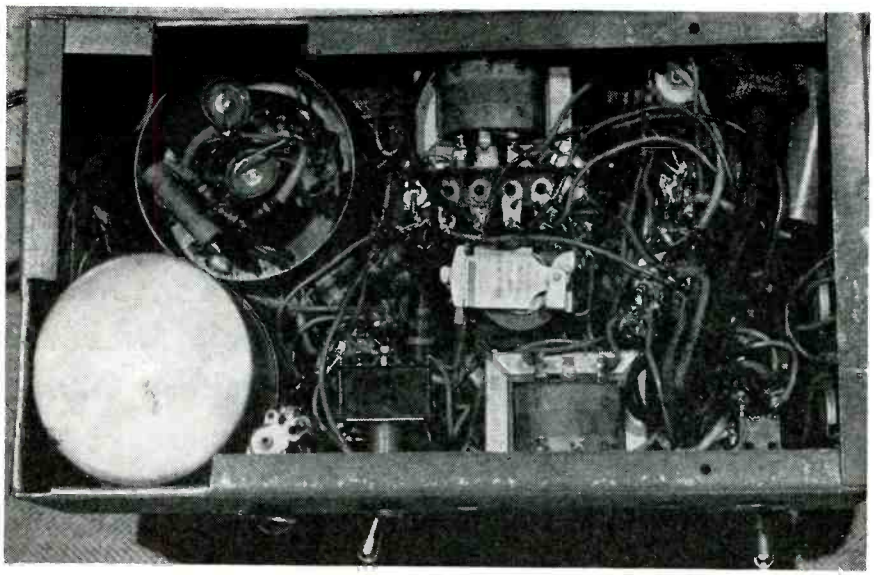
Basically, the system consists of two separate and distinct audio amplifiers built on one chassis, with outputs to speaker voice coils. Each amplifier has its individual microphone so that there is no switching in any other but the voice coil output circuit. All switching is effected by relays. A time-delay circuit of the vacuum tube type provides a certain time period for holding the amplifiers in operation and shutting off the system when this time period is expired, unless it is reestablished by any one of the parties using the system. For the particular use which this system serves, a 25-second time period was found satisfactory.

The two audio channels were built on one chassis and will be referred to as channels *A* and *B*. Of these, *A* feeds from the living room to the basement and *B* from the basement to the living room. A separate power supply (*PS*) was used to satisfy space requirements. The microphones are permanently connected to the respective channels.

Five relays perform the various switching functions. Four are 110-volt a-c operated and one is a plate circuit type. Two of the relays have similar functions in that they are used to transfer the voice coils of the speakers from the respective radio sets to the output of respective channels. One of these relays, *C*, transfers the voice

Circuit diagram of the Bartholy intercom system.





Bottom view of chassis with cover of high gain stage of one channel removed. Switch at lower left is the listening switch. Relay in center is *E* relay.

coil of the basement speaker (*BSP*) from the basement radio to channel *A*, whereas another relay, *D*, located in the living room, transfers the voice coil of the living room speaker (*LSP*) to channel *B*. This relay was installed in the cabinet of the console and placed in a sponge rubber lined housing to eliminate any mechanical noise when it is actuated.

Transfer-Relay Operation

Both transfer relays *C* and *D* are simultaneously switched on by a plate circuit relay, *E*, which is in the output circuit of a control vacuum tube (*36*), associated with a timing circuit. It should be remembered that one of the qualifications was that no manual operation need be performed in using the system from the living room, and that when the system is no longer in use, it should shut off itself. These requirements were met by the control tube (*36*) and its associated timing and relay circuit. This tube receives plate energization from a voltage divider, the terminals of which are supplied from the power supply of the inter-com system. Between cathode and the plate return the voltage divider gives about 100 volts, whereas between cathode and the grid return there is a potential of 30 volts negative with respect to the cathode. Under these conditions, the tube (*36*) is biased to cutoff and the plate circuit relay contacts (*18*) are open. The grid circuit includes a 5-megohm resistor shunted with a 5-mfd capacity.

As long as this tube is so biased, the transfer relays remain in the normal position. When the bias is removed by shorting the grid to the cathode, plate current flows instantly, closing the contacts (*18*) of the plate circuit relay, *E*, which, in turn, actuates the transfer relays *C* and *D*. Now, if the short circuit of the grid to the cathode is removed, the tube will still remain in a state of current conductivity, because the 5-mfd capacitor was charged to the potential of the voltage divider between cathode and the negative terminal of the supply, and in such order of polarity that the grid is effectively at cathode potential until the capacitor loses this charge. The discharge of the capacitor takes place through the 5-megohm grid resistor. The time taken for the capacitor to discharge through the resistor depends on the relative values and equals in seconds the product of $C \times R$, when R is in megohms and C is in microfarads. Consequently, 5 mfd $\times$ 5 megohms gives a time constant of 25 seconds. Therefore, every time the grid of the tube (*36*) is short circuited to the cathode, it will take 25 seconds after this short is removed before the control tube (*36*) is biased to cutoff.

Control Relays

The two control relays, *A* and *B*, were mounted on the chassis. Of these, *A* is energized from the living room by means of a call button (*20*), whereas *B* is energized from the basement by means of a call button (*21*) located there. Instead of ordinary push buttons for this purpose, microswitches are used because of their definite snap action. These relays have two distinct functions. One is to short circuit the grid of the tube (*36*) to the cathode and thereby set into motion the timing and relay circuits which effect the voice coil transfers. Another function is to complete the voice coil circuits as well as to bridge the inter-com switch (*ICSW*) so as to switch on the system.

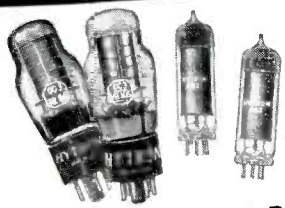
Operation of the System

Assuming that Mr. X desires to put a call through from the basement, he will turn on the inter-com system by closing the power switch (*ICSW*). When this switch is closed, channels *A* and *B* are both energized and ready for operation. There is, of course, the normal 30-second time interval required for the heating up of the tubes. The system now is in a stand-by condition. The control tube (*36*) is still biased to cutoff and plate circuit relay, *E*, is not closed. Now Mr. X pushes his call button (*21*), which actuates the control relay *B*. Certain contacts (*29* and *30*) of this relay return the grid of the control tube (*36*) to the cathode. This instantly produces plate current, closing contacts (*18*) of the plate circuit relay, *E*. This, in turn, energizes the transfer relays *C* and *D*, of which one opens the voice coil circuit of *BSP* (contacts *10* and *11*) and also closes this circuit to the output of channel *A* (contacts *10* and *19*). The control-relay *B* also opens the voice coil circuit of *BSP* from channel *A* (contacts *31* and *32*). The reason for this is that when Mr. X uses channel *B* and his voice comes out through the living-room speaker, it must not feed back through the living-room microphone and channel *A* to the basement speaker. This would create, of course, a feedback condition. The remaining contacts (*33* and *34*) of the control relay *B* complete the output of channel *B* to the speaker of the living room. The latter is switched to this channel through the transfer relay *D* (contacts *12* and *22*). The circuit from channel *B* is now completed to the living-room speaker, and also it is to be noted that certain contacts (*16* and *17*) of transfer relay, *D*, bridge the console switch so that, in case the set was not on in the living room, it is on now to give field excitation to the speaker. As long as control relay *B* is energized by keeping the button (*21*) closed, channel *B* is in operation. The inter-com switch is now also shorted by transfer relay *C* (contacts *14* and *15*) and cannot be shut off.

When the call from the basement to the living room is completed and Mr. X desires an answer, he removes his finger from the button (*21*), which will return the control relay *B* to the normal position. The voice-coil circuit from channel *B* to the living room is now opened (contacts *33* and *34*), and the voice-coil circuit of the base-

(*Continued on page* 48)

TUBES ARE KNOWN BY THE COMPANY THEY KEEP



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SPECIALISTS IN RADIO RECEIVING TUBES SINCE 1921

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Servicing 16-MM Sound-On-Film Projectors

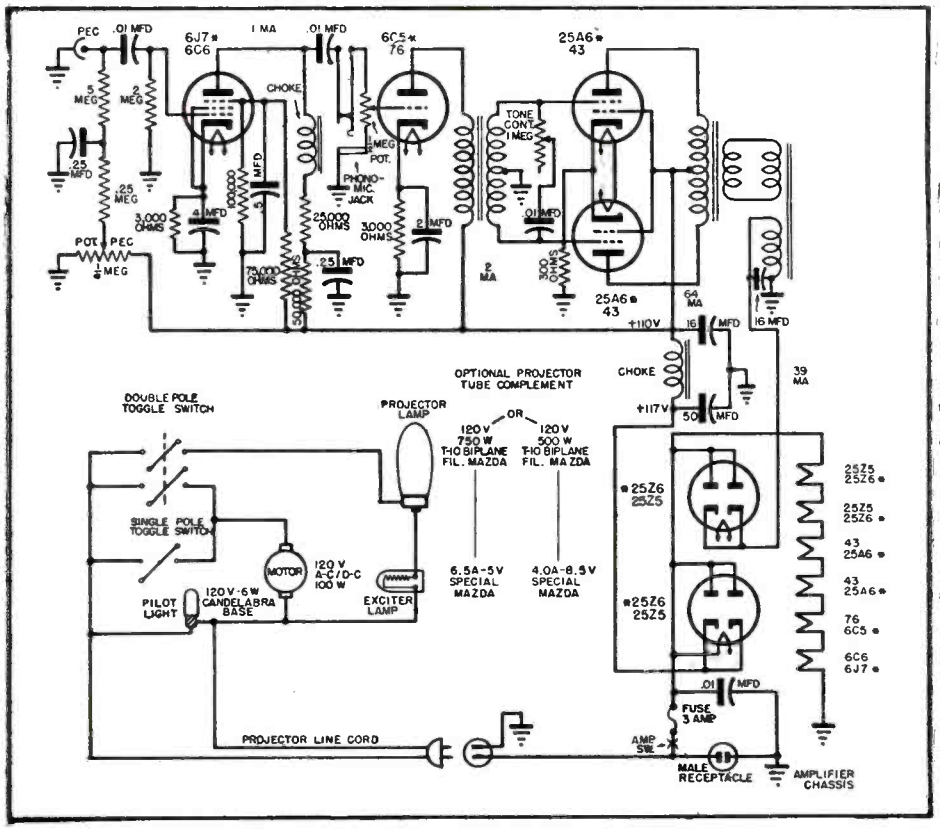


Fig. 1. Circuit of the projection and amplifier system of the Victor model 25 universal. Early models used the 6C6, 76, 43 and 2525; later models, 6J7, 6C5, 25A6 and 25Z6 tubes. Readings in ma were made at 115 v. a-c.

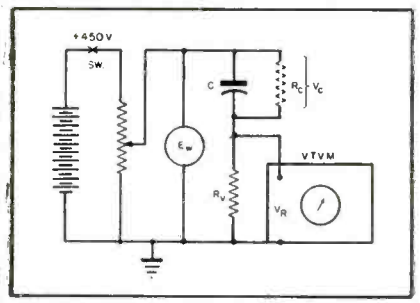
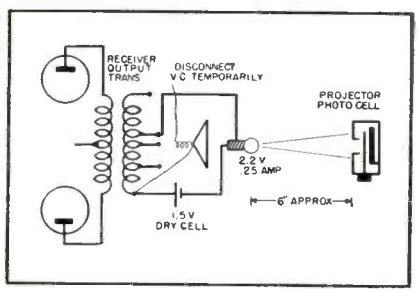


Fig. 2. Setup using a vacuum-tube voltmeter for the checking of leakage resistance of capacitors. *C* is a capacitor under test; R_c, leakage resistance of the capacitor in megohms; R_v, total resistance between the vtvm terminals in megohms before the capacitor is placed into the circuit; V_c, voltage drop across R_c; V_R, voltage drop across the vtvm and E_w, working voltage for the capacitor being tested.

Fig. 3. Projector amplifier test circuit using a sound-to-light conversion with a receiver.



THE 16 MM SOUND-on-film motion-picture projector has come into extensive use in the last five years.

These projectors feature many electronic accessories which can readily be repaired by the Service Man. There are, for instance, the speaker, amplifier and photo cell units, which are certainly familiar to every Service Man. The old models, which are still in wide use, provide quite a fertile field for service work.

Among the old timers which were quite popular was the Victor Universal 25, a luggage blimp model.

Power Amplifier

The power amplifier in this model consisted of a 6C6 first amplifier, 76 second amplifier coupled to '43 power tubes in push-pull, coupled finally to a 10″ Rola K-10 speaker with a 3000-ohm speaker field powered directly from the cathodes of 25Z5 rectifiers. Medium values of coupling capacitors, reactance load in the first amplifier and the medium power output served to accentuate the high frequencies in the overall amplification. This method serves to compensate for high frequency losses in the photocell and those inherent in the sound track on the usual commercial film, losses due to diffusion in emulsion and base, and the limitations of emulsion and optical resolving power and the characteristics of recording equipment.

The '76 grid has a potentiometer input for volume control, and a phono jack allows the insertion of phono player or a microphone, both of which should supply an average of 1½ volts to the grid to obtain good volume from the speaker. Since the amplifier chassis is always one side of an a-c or d-c line, it is essential that the line cord be inserted into an outlet for the polarity which will keep the chassis at ground potential whenever possible, and that there be no difference of potential between the amplifier chassis and the connections from a record player or other apparatus with direct metallic connections to the line. This can be ascertained by a finger test. In using a d-c line with the positive side grounded, the Service Man must remember in working near radiators, chandeliers or other similar metallic installations, that his sound equipment has a difference of potential with respect to them.

The rectifiers have no input impedance ahead of the plates of the 25Z5s and the amplifier tends to encourage surges if the switch is snapped to the *on* position while tube filaments are still red from immediately previous use. The inclusion of a Mazda 41 pilot-light and shielded receptacle on the control board of the projector, connected in series with the line to the rectifier plates will provide the necessary protection and serve as a sensitive fuse, pilot light indicator and a cut-in

Locating And Curing Troubles In Amplifiers And Photocell Systems Used In Home Movie Sound-On-Film Projectors

by W. L. LYONS

to check total B current with a milliammeter. This setup will protect filter capacitors from surges and prevent blowing of fuse wires in the rectifier tubes in the event of a $B+$ short.

In one instance, an electrolytic short which had been preceded by excessive hum made necessary the replacement of the average electrolytic filters, which were enclosed in two waxed cardboard containers with the cathode bypass capacitors. These packs were replaced by individual aluminum tubular electrolytics strap-mounted to a metal plate which was secured to the amplifier chassis by the four screws originally holding the pack capacitors. This isolation of each unit gave better electrostatic shielding, less expensive future replacement and controlled spread of damage. The capacity of the replacements were somewhat greater than the originals to secure optimum performance.

The wax impregnated paper coupling capacitors were also replaced by molded mica types after erratic and noisy amplification indicated that leakage from the $B+$ to the grid resistors, in each case, was severely altering grid bias of the tubes, particularly the first amplifier and hastening the final deteterioration of the capacitors themselves. The choice of a coupling capacitor requires that it stand up under heat, moisture, fumes, mechanical injury or handling to preserve its most important electrical characteristics, a high leakage resistance. Fig. 2 shows a setup using a vtvm which will give accurate results in checking leakage resistance for the selection of a capacitor. If in this setup, by the use of parallel resistors, R_V is made small enough (two megohms) to have a value comparable to the grid resistance across the amplifier tube, then with the correct voltage of E_W, one may either demonstrate or calculate the extent a leaky capacitor will modify the grid bias. In cases where the grid is battery biased, V_R represents quite accurately the grid voltage modification.

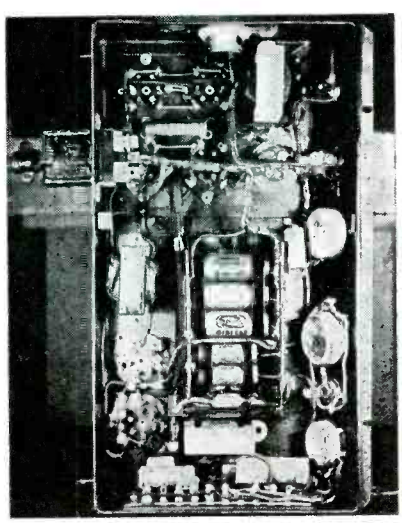
Difficulty may no doubt be experienced by anyone attempting replacement of the tubes which are mostly of the older types. The small sizes of some of the miniatures lend themselves to tube replacement with the use of adapters. If the lack of proper rectifier tubes threatens to render the amplifier inoperative, the new selenium rectifiers can be mounted on discarded rectifier tube bases with resistors of the proper value and wattage to compensate for the absence of the rectifier filaments. Two selenium rectifiers of 150 ma rating per unit will amply supply all $B+$ current needs for this amplifier and will make available a somewhat higher $B+$ voltage with greater reserve amplification in the first amplifier.

The photocell is a tube of special dimensions and is most easily obtained from the projector manufacturer or sales rep.

A quick test of the photocell can be made by holding a brightly glowing cigarette just below the housing aperture after removing the sound head and exciter lamp. With all amplifier controls set for maximum sensitivity, hiss and rushing noise will greatly increase at the approach of the cigarette. If the cigarette is vigorously vibrated below the cell aperture, the speaker will give out decided *whumps*.

Fig. 3 shows a more complete test of the photocell and entire amplifier, particularly useful if sound film is not at hand to make the more usual test. A Mazda lens type flashlight bulb 222 (TL-3) rated at 2.2 volts, 0.25 ampere, is connected in series with a 1.5-volt dry cell and the voice coil output side of a transformer in a receiver; the bulb is allowed to shine into the photocell aperture from a distance of about 6". With the receiver tuned to a *high fidelity* program and its volume control kept below the point where the bulb starts blinking, sufficient modulated light will be supplied to the photocell to obtain normal output from the projector amplifier speaker. The sound quality will be quite good considering that the bulb was not designed with this application in mind. The best match for this bulb will probably be obtained using a transformer or the transformer taps intended for a 9-ohms impedance voice coil. With a tapped output, of course, the best match can soon be determined experimentally after disconnecting the receiver voice coil.

Fig. 4. Bottom view of amplifier showing the aluminum tubulars which replaced the electrolytics.



The use of an analyzer is very helpful in checking circuit conditions. In one instance, comparison of the '43 amplifier plate currents disclosed that one plate drew 26 ma against 30 ma for the other. Interchanging tubes confirmed the fact that they differed in their emissions. The selection of two tubes with like plate current draw as well as other characteristics is always good practice for push-pull operation, lessening chances of hum and decreasing probability of feedback to preceding amplifier tubes. Operation of the amplifier above its rated 110 volts runs the tube filament rather bright but the usual service voltages encountered will not ordinarily cause filament current to exceed permissible tolerances. Overvoltage operation, however, does appear to make the first amplifier tube rather sensitive to the vestiges of higher harmonics of the a-c line or to induced voltages from other sources, which appear to enter the tube through the filament leg grounded to the chassis. Experimental bypassing of the filament with both 8-mfd paper and 20-mfd high-voltage electrolytics, which removed these hums, appears to confirm this view. Generally, responses to these stray frequencies will not be above ear-to-the-speaker level. Poor contact of the 6C6 shield to chassis will give rise to extreme hum.

Tubes should be replaced with the machine in actual operation, using pre-

(*Continued on page* 53)

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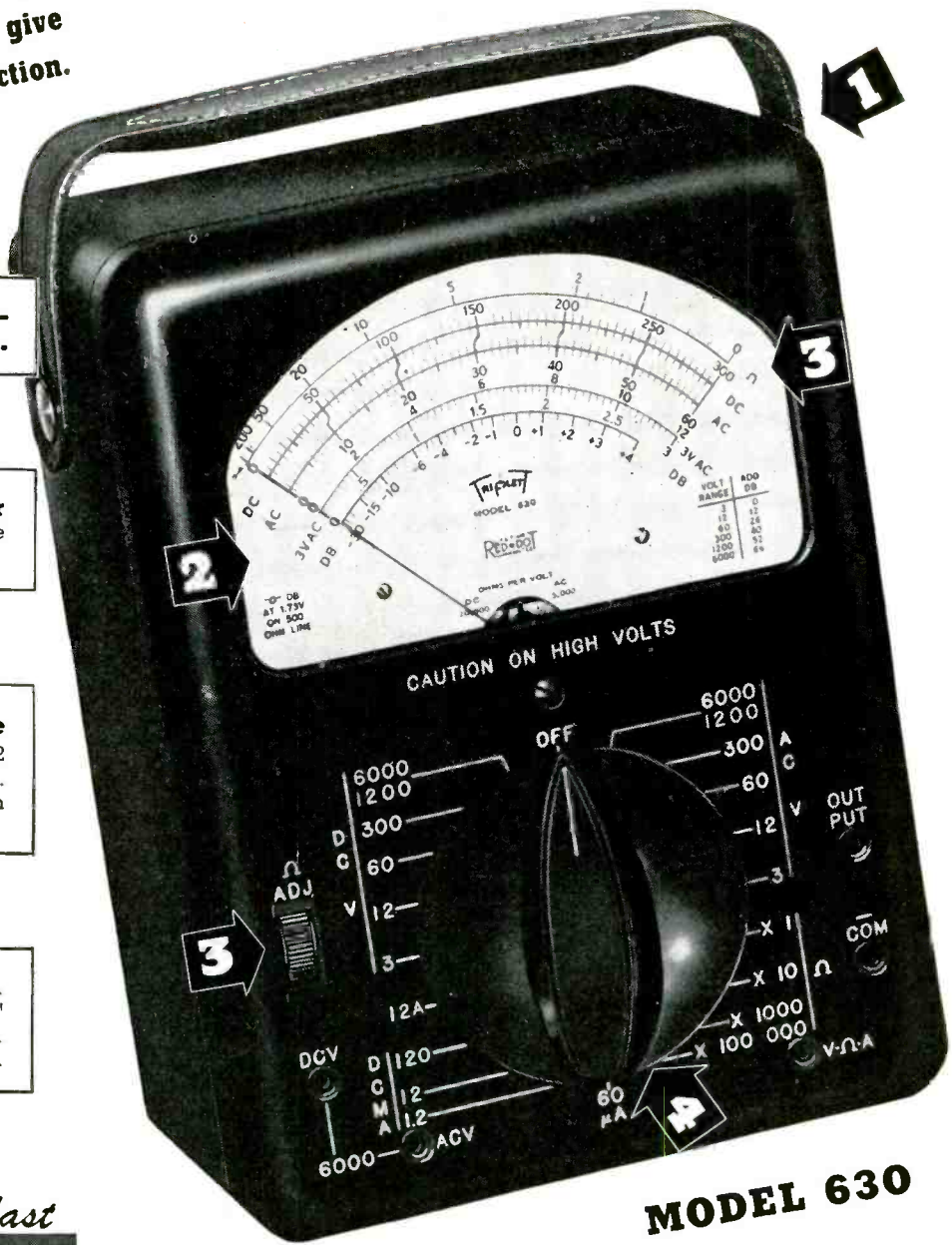

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Why Bass Boost

What the Response Curve Means . . . Why Compensation Is Used . . . Rules For Bass Boosting . . . Use of Audio Oscillator For Plotting of Frequency-Response Curves.

by JACK NAJORK

Specialty Division
General Electric

PROBABLY MORE has been written and less has been understood about bass boosting than any other single topic in the general field of audio amplification. Too often, the uninitiated Service Man, after reading glowing accounts of commercial amplifiers which are flat within 1 db over the entire audio spectrum, assumes that the ideal amplifier is one whose response curve plots a bee-line from 10 cycles to 20 kilocycles. Such an amplifier would sound just like the response curve—flat and lifeless, unless it were run at an unholy loud level of around 20 watts. The basic reason for this can be traced back to the fundamental response of the human ear, which, as shown in Fletcher's curve, is definitely non-linear. Thus, to suit the response of the ear, an amplifier requires constant compensation if different audio frequencies are to sound equally loud at various levels. Briefly, Fletcher's curve reveals that as the intensity of sound is lowered, the sensitivity of the ear decreases more rapidly at the low and high end of the audio spectrum than in the middle register. As the intensity of sound is increased, however, the ear responds more readily to these high and low frequencies until a point is reached where the ear's sensitivity is nearly uniform over most of the commonly used audio spectrum. Hence, if we run our *flat* amplifier at a high enough level, it will sound fine, but as soon as we start to reduce the level, we begin to notice a marked lack of bass, and to a lesser extent, treble. Radio manufacturers have long recognized this effect and have attempted to correct for it by various means of bass and treble compensation. One simple method of bass compensation frequently employed uses a tapped volume control and an RC network as shown in Fig. 1. This works, but it has the disadvantage of giving a constant bass boost below a certain level, whereas what we are after is continuous compensation which will correct the deficiencies of our ears for *all* levels.

This problem has been attacked in a more realistic (and more expensive) manner by designers of console-model receivers. An example of this effort appears in Fig. 2, where we have the typical response curves for the G. E. model 41[1] at different output levels. It will be noticed that as the output level is decreased, the bass compensation or bass boost increases, whereas at higher levels, bass boosting decreases. Although the curves show bass compensation for only five levels, the actual response of the amplifier varies continuously as the output level is varied and the result is a continuously compensated output which follows closely the Fletcher curve theory.

Thus far, nothing has been said about treble compensation and furthermore, the solid-line curves show no treble increase or decrease at various levels. This is because the curves

Fig. 2. Fidelity curve of an amplifier similar to that used in the G.E. Musaphonic models. Dotted lines indicate effect of speaker response.

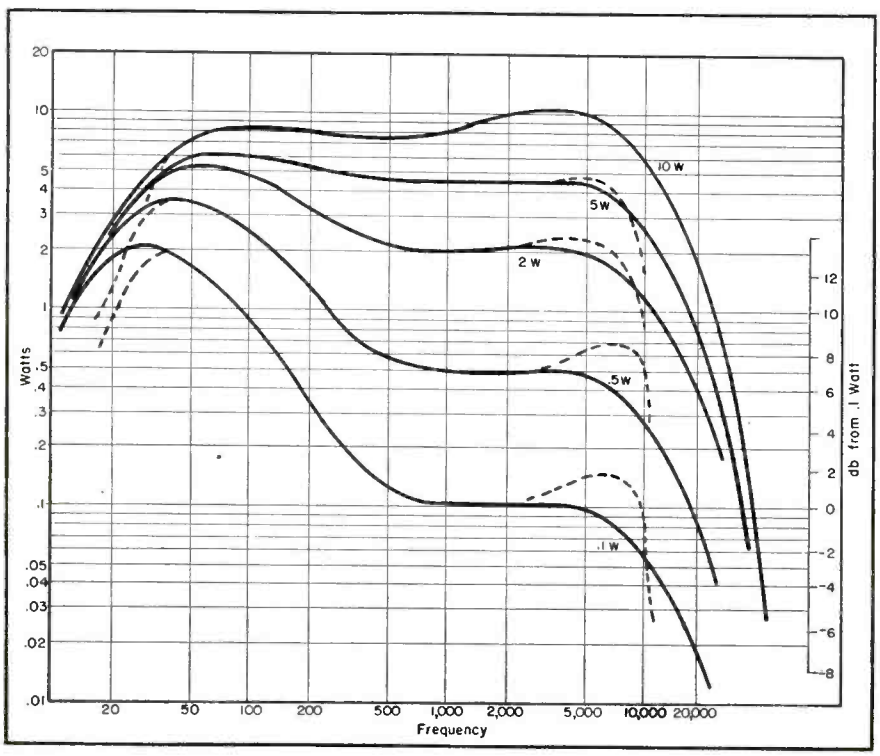
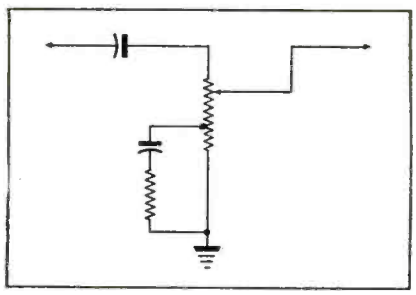


Fig. 1. Tapped volume-control arrangement commonly used to obtain a fixed bass boost at low volume control settings.



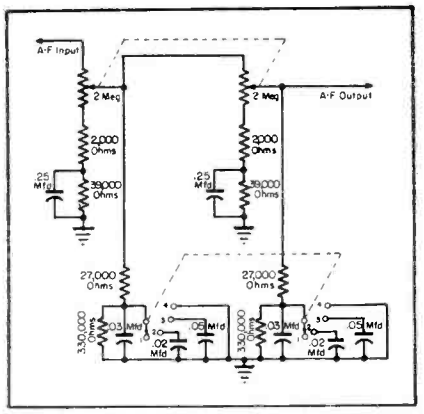


Fig. 3. A dual volume-control circuit used to obtain the desired bass-boost characteristics over a wide range of output levels. Circuit is similar to that used in the G.E. model 41.

shown are electrical responses which do not include the effect of loudspeaker voice coil resonance. Actually, with the loudspeaker connected, there is a very definite peak at the high frequency end of the spectrum which will vary in amplitude and frequency depending upon the characteristics of the loudspeaker voice coil.

Fig. 3 shows the volume control circuit developed for an experimental amplifier. This circuit is similar to that used in the G. E. console[1] series to achieve the continuously compensated response curves shown in Fig. 2. A dual volume control is used, together with a ganged switch which permits four (or more, if desired) levels of bass boost. Maximum boost is obtained when the switch is in the open position, and as more capacity is added to each leg, the boost decreases. The curves in Fig. 2 were run at maximum boost which would correspond to switch position *1*. Besides providing continuous compensation, we get an additional bonus with this circuit in that the slopes of the boost curves are fairly sharp. This is important if we are to preserve the natural reproduction characteristics of music and speech. If, for example, bass boost extends too far into the male voice spectrum around 250 to 400 cycles, your favorite announcer will begin to sound like a *woofing* dog and the voice will be far from natural.

A general rule of thumb which can be followed in bass boosting is: The higher the power of the amplifier, the lower the frequency of the bass boost, down to the capabilities of the speaker used. It is important to remember that bass boosting at frequencies much below 100 cycles requires *power*. Although an average level of one-half watt or so is usually adequate for normal listening, the amplifier must have a large reserve of power if it is to reproduce faithfully the accentuated bass notes. If, for example, the amplifier has a 10-db bass boost at 40 cycles, we would require ten times the power at 40 cycles that we need at 400 cycles, since 10 db corresponds to a power increase of ten. Thus, for half-watt listening levels, our amplifier should be capable of delivering at least 5 watts, or ten times that required at 400 cycles. The G. E. console[1] amplifiers bass peak is between 30 and 50 cycles; the amplifier uses four 6V6's in push-pull parallel driving two ten-inch speakers which have very high power sensitivity due to the use of Alnico magnets and efficient cones. If you are deal-

(*Continued on page* 41)

[1]Musaphonic.

Fig. 5. Front view of the beat-frequency audio oscillator.

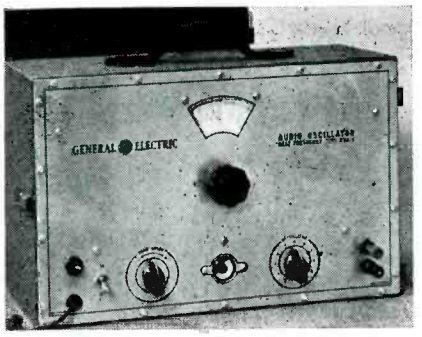
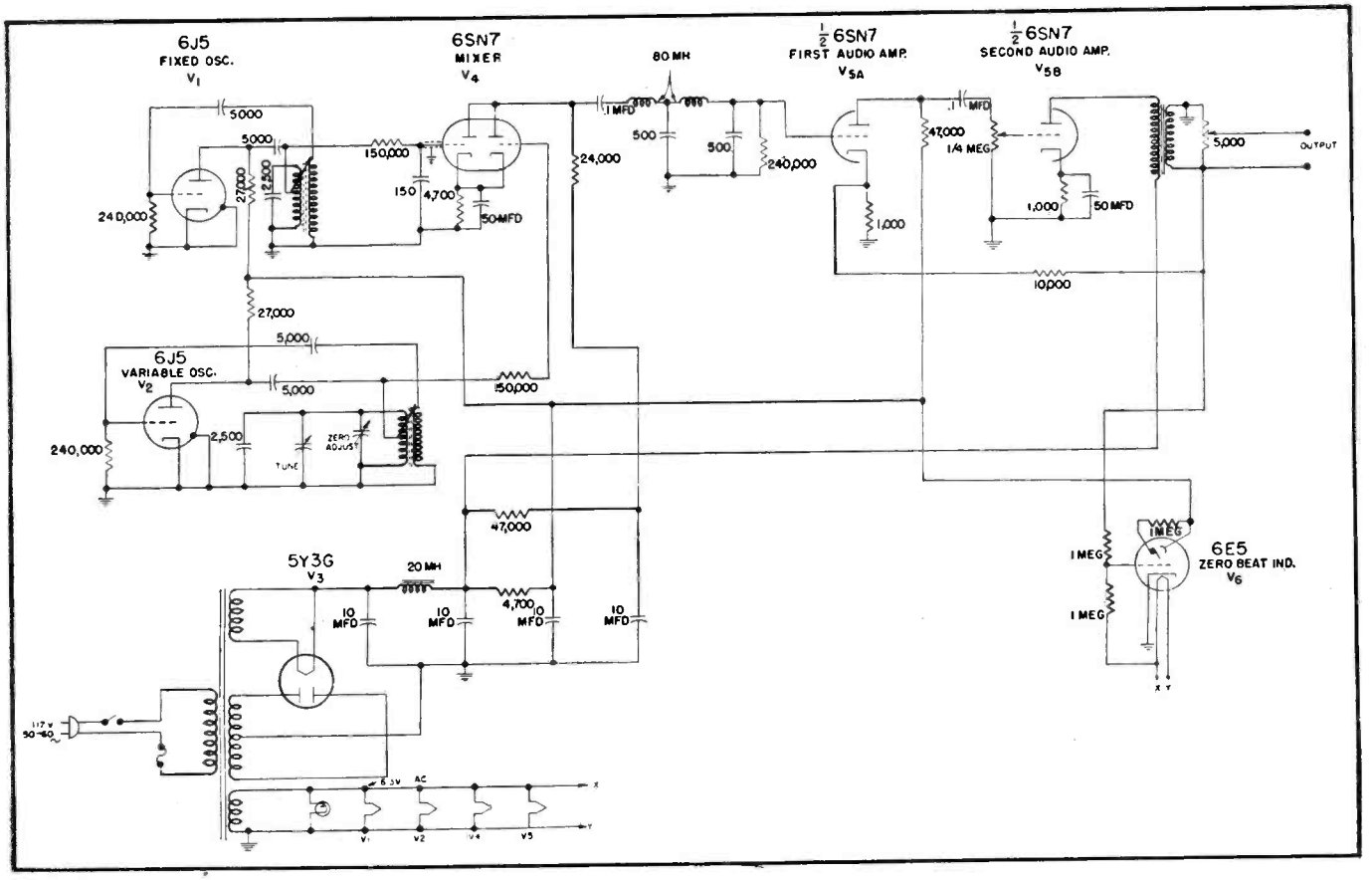


Fig. 4. Schematic of the G.E. beat-frequency audio oscillator.



Simpson testers
built for the future

Like any sound investment, the purchase of test equipment should return to the serviceman or service dealer the utmost aid in turning his work into dollar earnings and customer satisfaction. Every Simpson instrument is engineered to handle today's receivers in just that fashion — and to do the same for receivers that will come to market within the forseeable future.

We show here four such Simpson instruments — one well-known as the world's most famous set tester, the other three new to the Simpson family. These three new testers are outgrowths of Simpson engineering of similar test equipment. Each brings you new engineering refinements that are exclusively Simpson. Each in its price class brings you quality of materials and construction you will find in no other test equipment in the world.

Every dollar you invest in these Simpson instruments will pay a rich return for many long years to come.

Ask Your Jobber.

SIMPSON ELECTRIC COMPANY
5200-5218 West Kinzie Street, Chicago 44, Illinois
In Canada: Bach-Simpson Ltd., London, Ont.

Simpson
INSTRUMENTS THAT STAY ACCURATE

World's most famous set tester

MODEL 260 IN THE ROLL TOP CASE

- **Model 260 permanently fastened in Roll Top Case.**
- **Heavily molded case with Bakelite roll front.**
- **Flick of finger opens or closes it.**
- **Built-in compartment for test leads beneath instrument.**
- **Protects instrument from damage.**

At 20,000 ohms per volt, this instrument is far more sensitive than any other instrument even approaching its price and quality. Unequalled for high sensitivity in radio and television servicing.

RANGES

20,000 Ohms per Volt D.C., 1,000 Ohms per Volt A.C.
Volts, A.C. and D.C.: 2.5, 10, 50, 250, 1000, 5000
Milliamperes, D.C.: 10, 100, 500
Microamperes, D.C.: 100
Amperes, D.C.: 10
Decibels (5 ranges): −10 to +52 D.B.
Ohms: 0-2000 (12 ohms center), 0-200,000 (1200 ohms center), 0-20 megohms (120,000 ohms center)

Dealer's net prices:
Model 260 ..... $38.95
Model 260, in Roll Top Case $45.95
Both complete with test leads.

A new vacuum tube voltmeter

MODEL 266 FOR AM, FM, TELEVISION SERVICING

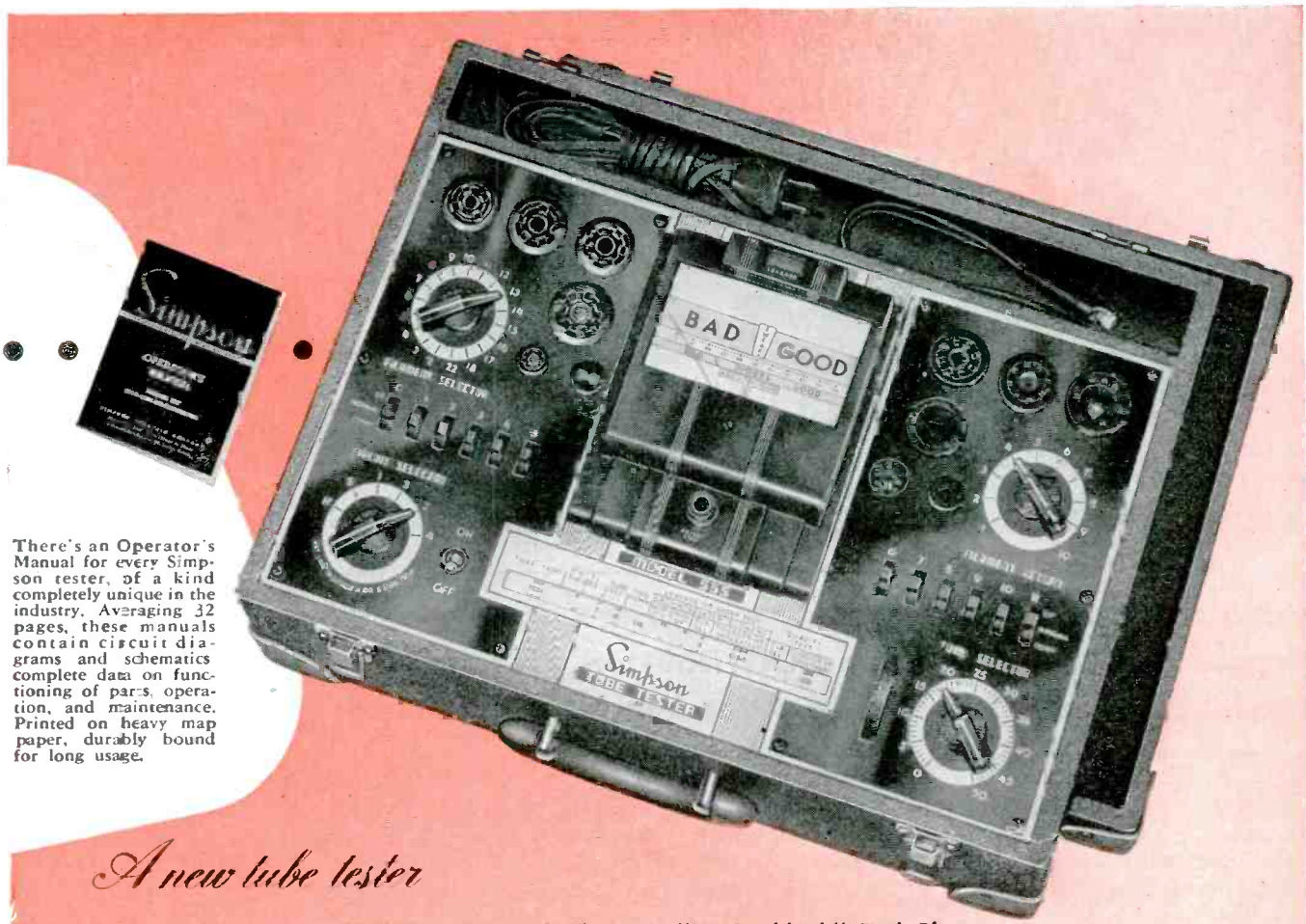
Note these distinguishing Simpson features: the 1 volt range, for full scale deflection, necessary in low R. F. voltage measurements; the zero center switch provided for discriminator circuit alignment, a feature which embraces all D.C. voltage ranges. D.C. volt input resistance ranges from 50 megohms to 200 megohms; A.C. volt input impedance at 60 cycles is 40 megohms. The low input capacitance of the probe (approximately 4 micro-microfarads) insures the accuracy essential for the high frequencies encountered in servicing FM and television receivers. Model 266 has many other equally important features. Ask your jobber, or write, for descriptive circular.

RANGES

Volts: (A.C. and D.C.) 0-1, 5, 10, 50, 100, 250, 500, 1000, 5000
Milliamperes: (D.C.) 0-1, 5, 10, 50, 100, 250, 500
Amperes: (D.C.) 0-10

Ohms:		
	0-1000	(10 ohms center)
	0-10,000	(100 ohms center)
	0-100,000	(1000 ohms center)
	0-1 megohm	(10,000 ohms center)
	0-10 megohms	(100,000 ohms center)
	0-100 megohms	(1 megohm center)
	0-1000 megohms	(10 megohms center)

Size: 8½" wide x 9½" high x 8" deep. Dealer's Net Price $94.50



There's an Operator's Manual for every Simpson tester, of a kind completely unique in the industry. Averaging 32 pages, these manuals contain circuit diagrams and schematics complete data on functioning of parts, operation, and maintenance. Printed on heavy map paper, durably bound for long usage.

A new tube tester

MODEL 555 *with Simpson "No-Backlash" Roll Chart*

This latest addition to the Simpson engineered line of quality test equipment is outstanding in its simplicity of operation and attractive appearance.

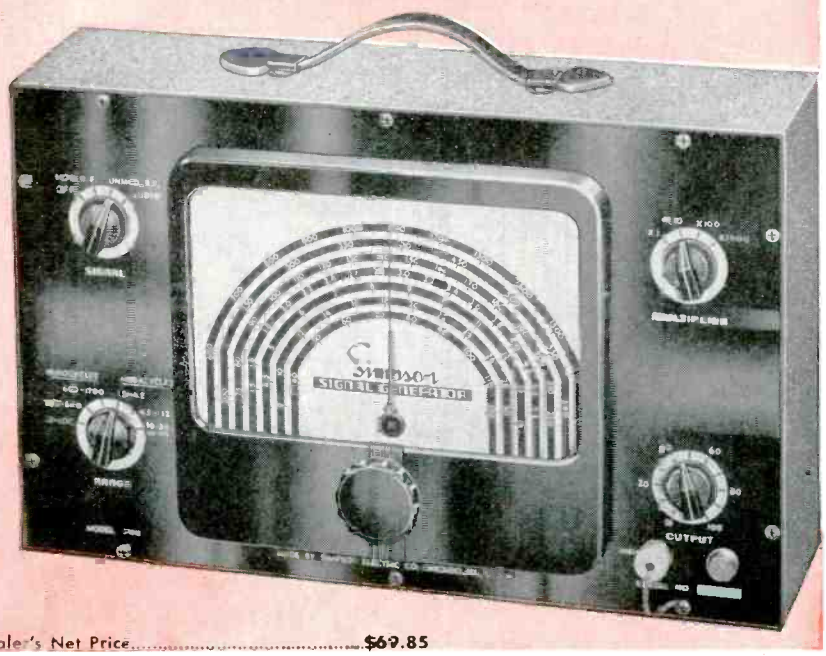
Using the basic RMA recommended circuit, it is possible to test any tube regardless of its base connections or the internal connections of its elements through the use of the new exclusive Simpson three-position lever-operated toggle switches. These switches use a molded rotor carrying silver plated contacts which are self-cleaning through their wiping action.

The Model 555 will test all receiving tubes, including the latest nine pin miniature tubes and the subminiatures as used in hearing aids, etc. Extra sockets are provided and the flexible individual element switching arrangement takes care of future tube developments. Tests can also be made on gaseous rectifiers, pilot lamps, and continuity of ballast tubes.

The panel of Model 555 is distinguished by beautiful modern styling in the shining silver and black of highly polished, enduring anodized aluminum. Ask your jobber, or write, for descriptive circular.

Size: 16¾" wide x 12½" High x 6" deep.

Dealer's Net Price..... $69.85



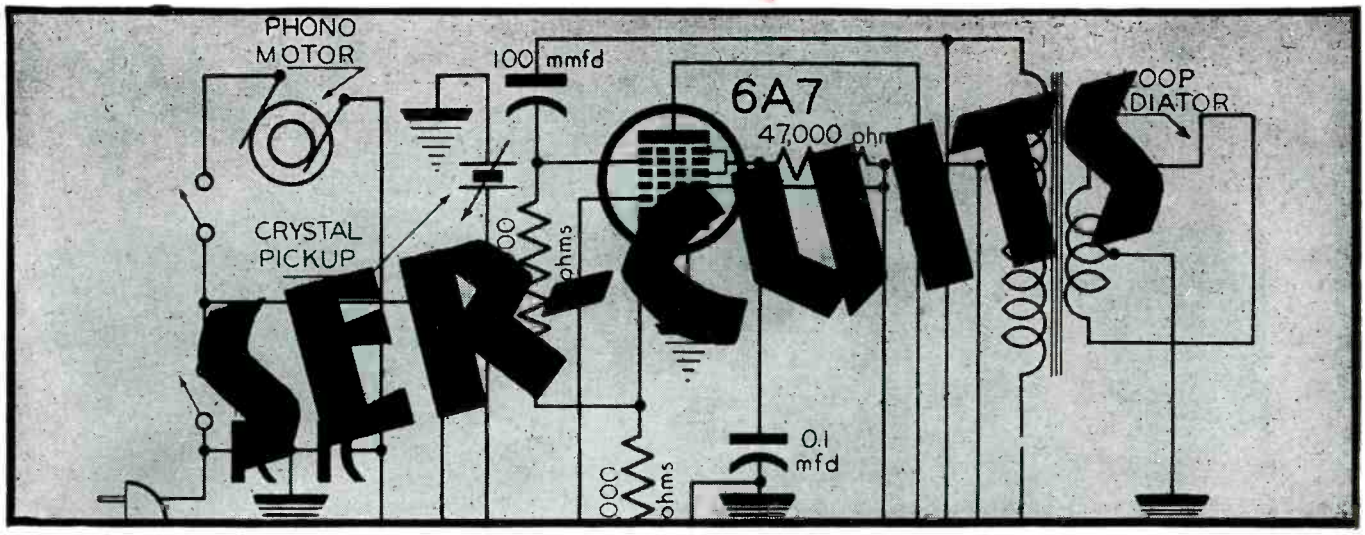
A new Signal Generator

MODEL 340

75 Kilocycles to 120 Megacycles
Fundamentals to 30 MC

The 120 megacycle range on the dial of this new Simpson instrument makes available readings for the high frequencies encountered in servicing FM receivers. A special high output jack is provided. Electron coupled circuit assures extreme stability and output uniformity throughout the band. Standard 30% modulation at 400 cycles. Effective shielding throughout. Beautiful black and silver panel of enduring anodized aluminum.

For 105—130 volts, 50-60 cycle. Size 15" x 10" x 6". Dealer's Net Price..... $69.85



Circuit Features of Receiver, Amplifiers, Preamps And Magnetic Wire Reproducers Used In Sound Distribution System . . . Highlights of G. E. Model 14 Record Player And Altec Lansing Amplifier Kit

PROGRAM DISTRIBUTION SYSTEMS, which are now being used widely in hotels, clubs, restaurants, trains and apartments, employ many interesting types of audio gear.

In one installation, for instance, recently completed by W. E., audio equipment used included two magnetic wire reproducers, each reproducer consisting of two units furnishing three hours each of continuous program; one monitoring loudspeaker; two preamplifiers, for raising the output level of the magnetic wire reproducers to that of the radio receivers (approximately *O* vu), and three 12-watt amplifiers[1] for feeding the three channels. Two multi-channel fixed tune crystal-controlled receivers[2] were also used.

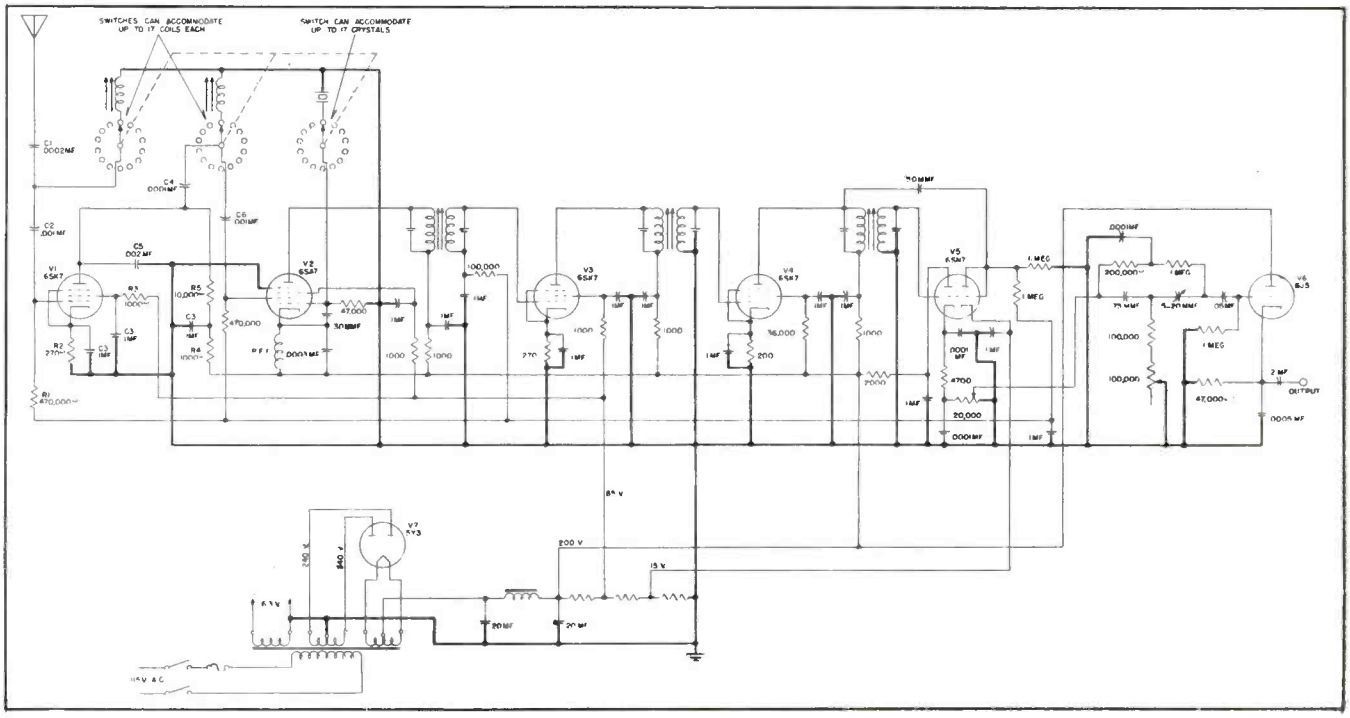
This setup, originally developed for train installation aboard the Twin Cities Zephyr, employs many audio facilities which are readily adaptable for standard multiple sound-distribution systems.

[1]W. E. 124E. [2]Smith-Meeker RR37.

Switching Panel

A switching panel provides all the facilities for switching programs to three channels, and for monitoring. At the top of the panel are a monitor selector switch and monitor loudspeaker. The monitor-selector switch

Fig. 1. Multi-channel fixed tune crystal-control superhet used in sound-distribution system.



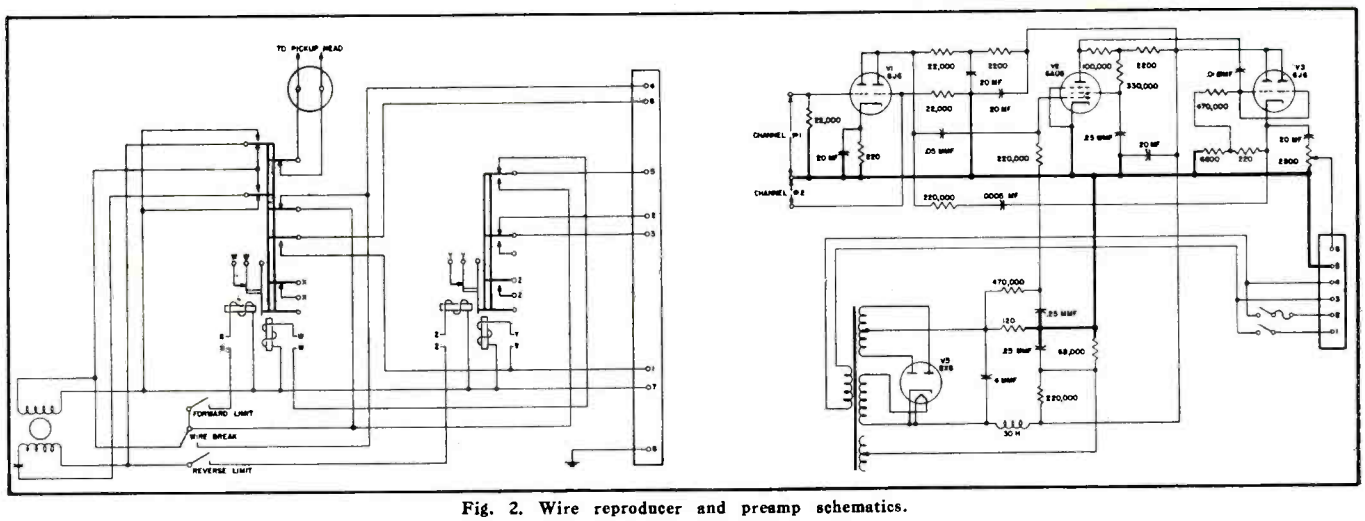


Fig. 2. Wire reproducer and preamp schematics.

connects the monitor loudspeaker to any of the three program channels, or to an *off* position. Directly below are three input-selector switches, each of which is associated with one of the three program channels. Any three of the four available programs can be dispatched by means of a train line to the various public and private locations of the train. A channel *on-off* switch is associated with each of the input-selector switches, and is mounted directly below its respective selector switch. In the *on* position, these switches connect the outputs of the amplifiers to the train line. In the *off* position they disconnect the amplifier output connections from the train line, and short circuit the train line to disable the channel. A handset, with a *push-to-talk* switch, is mounted in a hanger. When the handset switch is operated, relay contacts in each channel, in the circuits between the input-selector switches and the input of the amplifiers, connect the handset transmitter circuit to the input circuits of each of the amplifiers, and disconnect the input-selector switches from their respective channels. This operation causes the announcement to take precedence over any of the programs normally on the three channels. In addition, a non-locking, multiple circuit key switch on the panel permits announcements to be made to either end of the train independently, and short circuits the train line to the other end of the train.

Two switches, associated with magnetic wire reproducers, are mounted on the switching panel. When operated in an *up* position, these switches connect the reproducers in the *run* condition. When operated *down*, the reproducers rewind to the start of the program after completion of the reel which is being played.

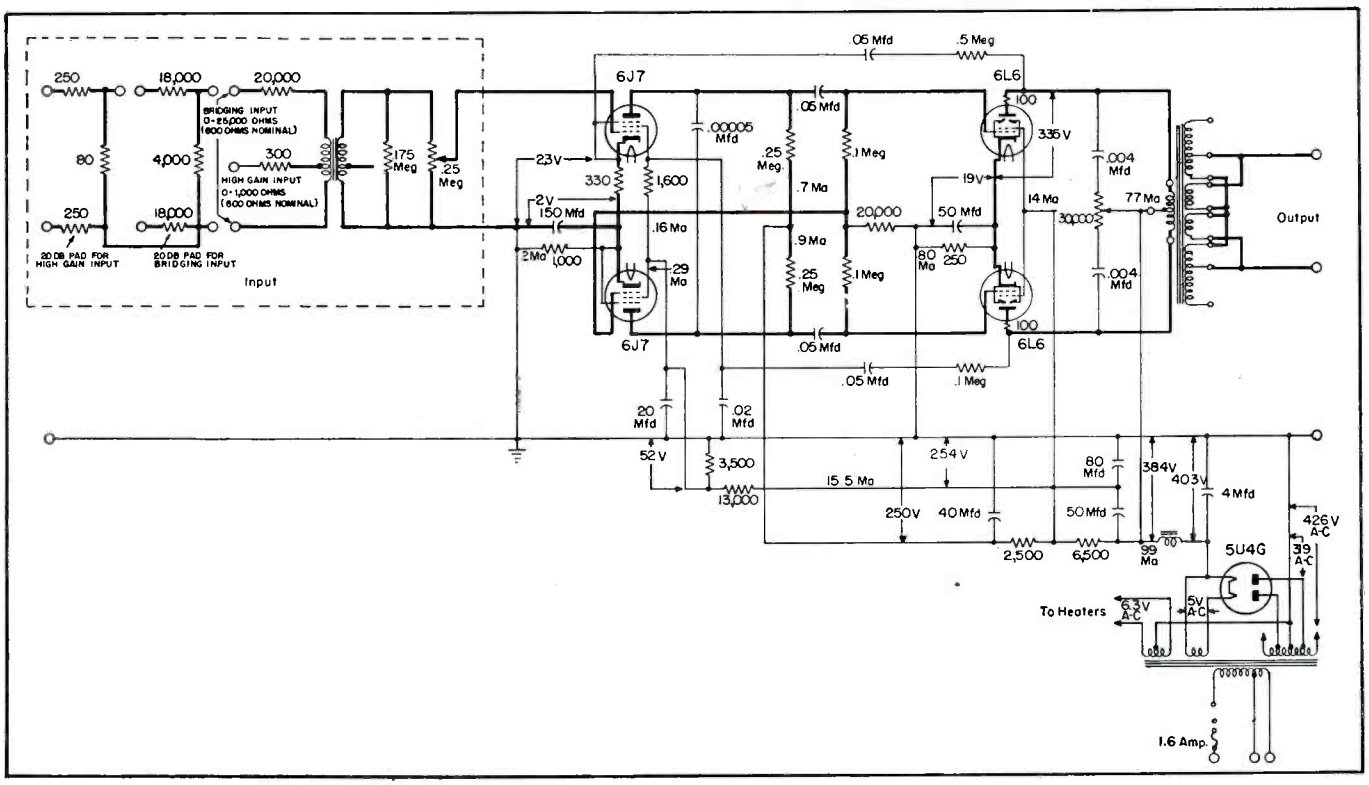
Fixed Tune Receivers

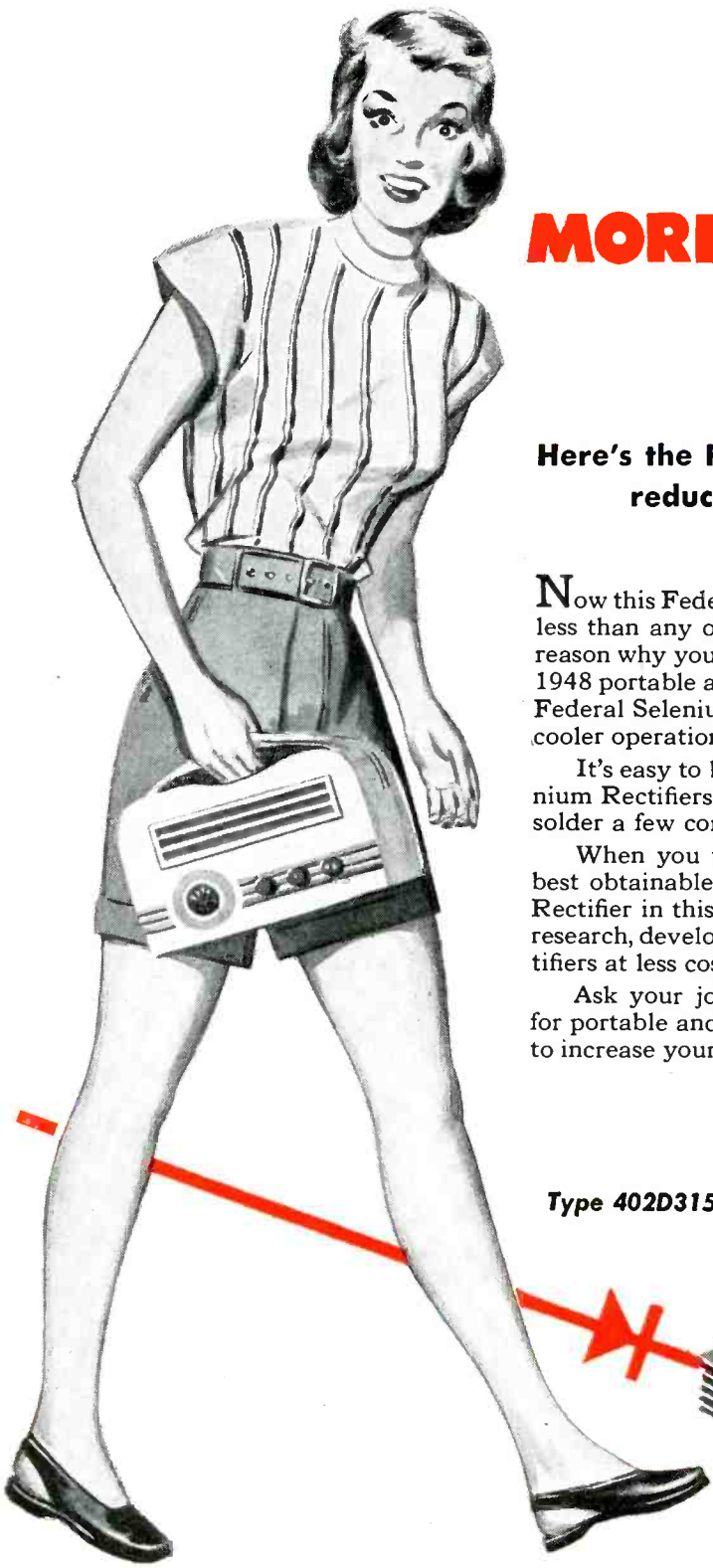
The receiver (Fig. 1) is a multichannel, crystal-controlled superhet with provisions for as many as 17 crystals and tuned circuits selectable by means of a single control, multitap rotary switch.

The input circuits of the receiver have been designed to be operated from an antenna with known electrical characteristics, since the reactance of the antenna is made a part of the tun-

(*Continued on page* 45)

Fig. 3. The 12-watt amplifier used in the sound-distribution system.





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Here's the Federal Miniature Selenium Rectifier that reduces your cost and does a better job

Now this Federal Miniature Selenium Rectifier actually costs much less than any of the rectifier tubes it replaces. That's the economic reason why you will find this modern power supply in so many of the 1948 portable and personal radios. The performance reasons are that Federal Selenium Rectifiers assure instant starting . . . longer life . . . cooler operation.

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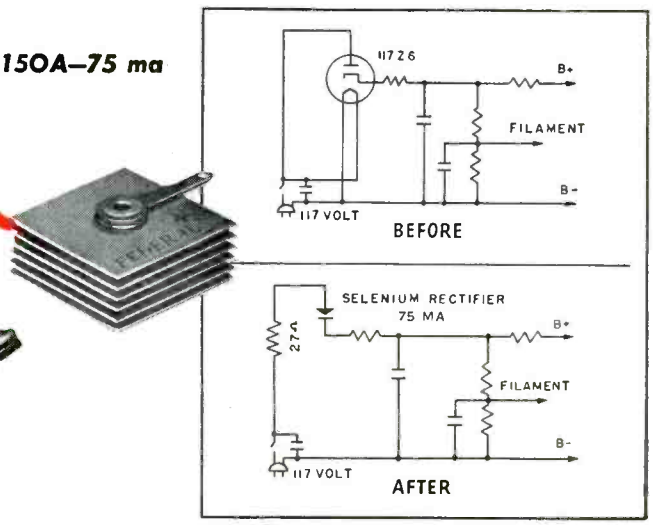
When you use Federal Selenium Rectifiers, you're sure of the best obtainable. It was Federal that first introduced the Selenium Rectifier in this country nine years ago. And Federal has led in the research, development and manufacture of ever-better Selenium Rectifiers at less cost.

Ask your jobber about Federal Miniature Selenium Rectifiers for portable and personal radio repairs. For full information on how to increase your profits by their use, write to Department F-956.

Type 402D315OA—75 ma



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Electric Megaphones in P-A

Portable Battery-Type Systems, Now Available With 20 And 30-Watt Outputs, Have Variety of Outdoor And Indoor Applications

by ARTHUR J. SANIAL
Chief Engineer
Audio Equipment Co., Inc.

THE ELECTRIC MEGAPHONE, although widely used for voice communication by the Armed Services during the War, is not as familiar to p-a engineers and technicians as the older types of sound systems. An electric megaphone is actually a portable p-a system which usually consists of two units—the electric megaphone proper which combines a microphone and loudspeaker in one horn-like structure which is used like an ordinary megaphone, and the amplifier and battery unit to which the electric megaphone is connected by a flexible cable.

The electric megaphones are particularly adaptable to a wide variety of applications, in which the standard systems cannot be used.

Generally where voice communication is required in noisy locations or over considerable distances by an easily portable system, complete in itself, the electric megaphone is the most simple, practical and efficient apparatus to use.

Electric megaphones today are available in relatively high power capacities. The original problem of acoustic feedback with microphones and speaker so close together has been overcome so that it is no longer necessary to limit the design to low power, one to two-watt systems. Now 20-watt systems are commercially available, and even 30-watt systems have been successfully demonstrated as practicable.

The high power electric megaphone systems are capable of projecting the human voice over distances of a mile or even more, under favorable conditions. In practical use this is not always the most important application, but it illustrates the carrying power of these devices, particularly for outdoor use.

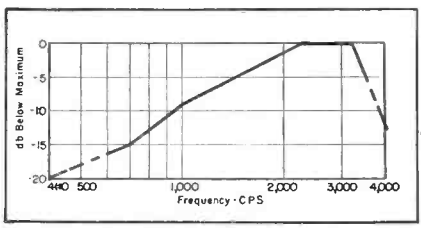


Fig. 1. Overall acoustic response, from microphone input to horn output, of typical electric megaphones.

Electric megaphone systems, with this high efficiency and margin against feedback, are intended primarily for speech reproduction. As such, the frequency response is weighted to emphasize the bands that contribute most to high speech intelligibility, and unnecessary high and low frequencies are reduced or cut out. Thus, low frequency response is often severely attenuated intentionally up to some frequency between 400 and 700 cycles. As little is gained in intelligibility by reproducing beyond 3500 to 4000 cycles, the high frequencies from here up are also greatly attenuated. A response rising with frequency is also utilized, as this aids speech intelligibility greatly in distant communication or in noisy locations generally.

The electric megaphones are considerably more directional than the conventional p-a folded horn type loudspeakers, although it is not practically possible to limit sound projection wholly within a specified *beam*. As with light, the megaphones are designed to concentrate the greater proportion of their radiated sound within a 15° to 20° angle. This aids their

(*Continued on page 29*)

Fig. 2. Coverage which can be expected of electric megaphones.

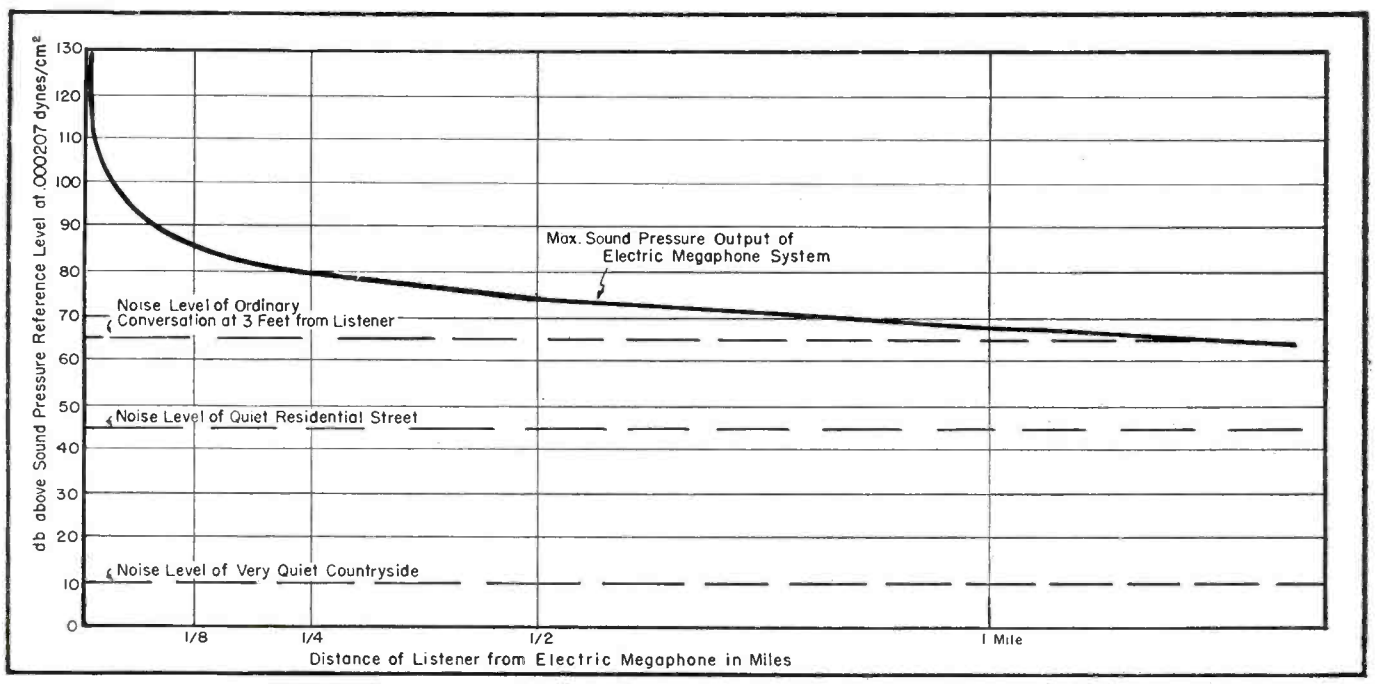


Fig. 2. Frequency response of a typical hearing aid.

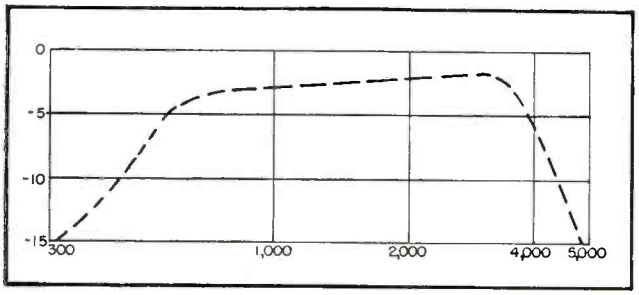
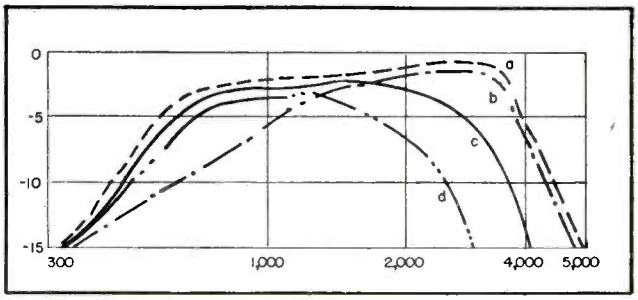


Fig. 3. Frequency control plot: *a*, normal response; *b*, tone position *1*; *c*, tone position *2*; *d*, tone position *3*.



Hearing Aids

Types Available . . . Design Features . . . Application Problems . . . Servicing Techniques

by IRA KAMEN

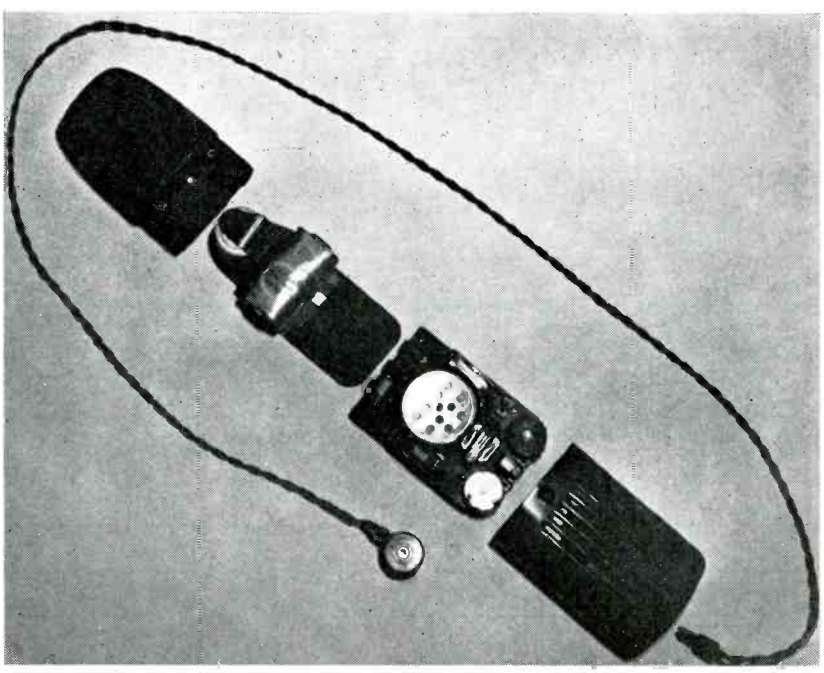
Commercial Radio Sound Corp.
New York City

AN ELECTRONIC HEARING AID is radically different than any other audio amplifying equipment in both application and function. A hearing aid must change natural sounds so that subnormal ears may hear them naturally, while all other sound equipment merely attempts to faithfully reproduce natural sounds for normal ears.

The hearing aid is regarded as a medical device and must be designed in accordance with the standards of the American Medical Association's Council on Physical Medicine. While there is no legal restriction to the sale of hearing aids which do not bear the seal of approval of the *AMA*, lack of approval definitely restricts the sale of the instrument. The National and Local Leagues for the Hard of Hearing who advise the deafened on hearing aids usually will only recommend those hearing aids which are *AMA* approved.

A design engineer with the fundamental knowledge of the manifestations of deafness, audio amplifier circuitry, sound reproduction and the problems of wearable products can usually effect a hearing aid design which will be acceptable to the *AMA*.

Fig. 5. Assembly of typical hearing aid using a magnetic air receiver. (*Courtesy Dysonic*)



Types of Hearing Loss

There are three major types of hearing loss:

(1) Middle-ear (*conductive*[1]) deafness.

(2) Nerve deafness.

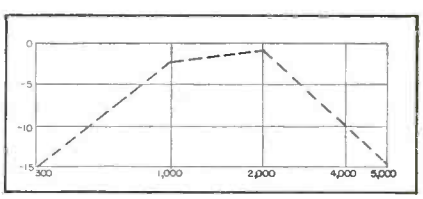
(3) Brain (*cortical*[2]) deafness.

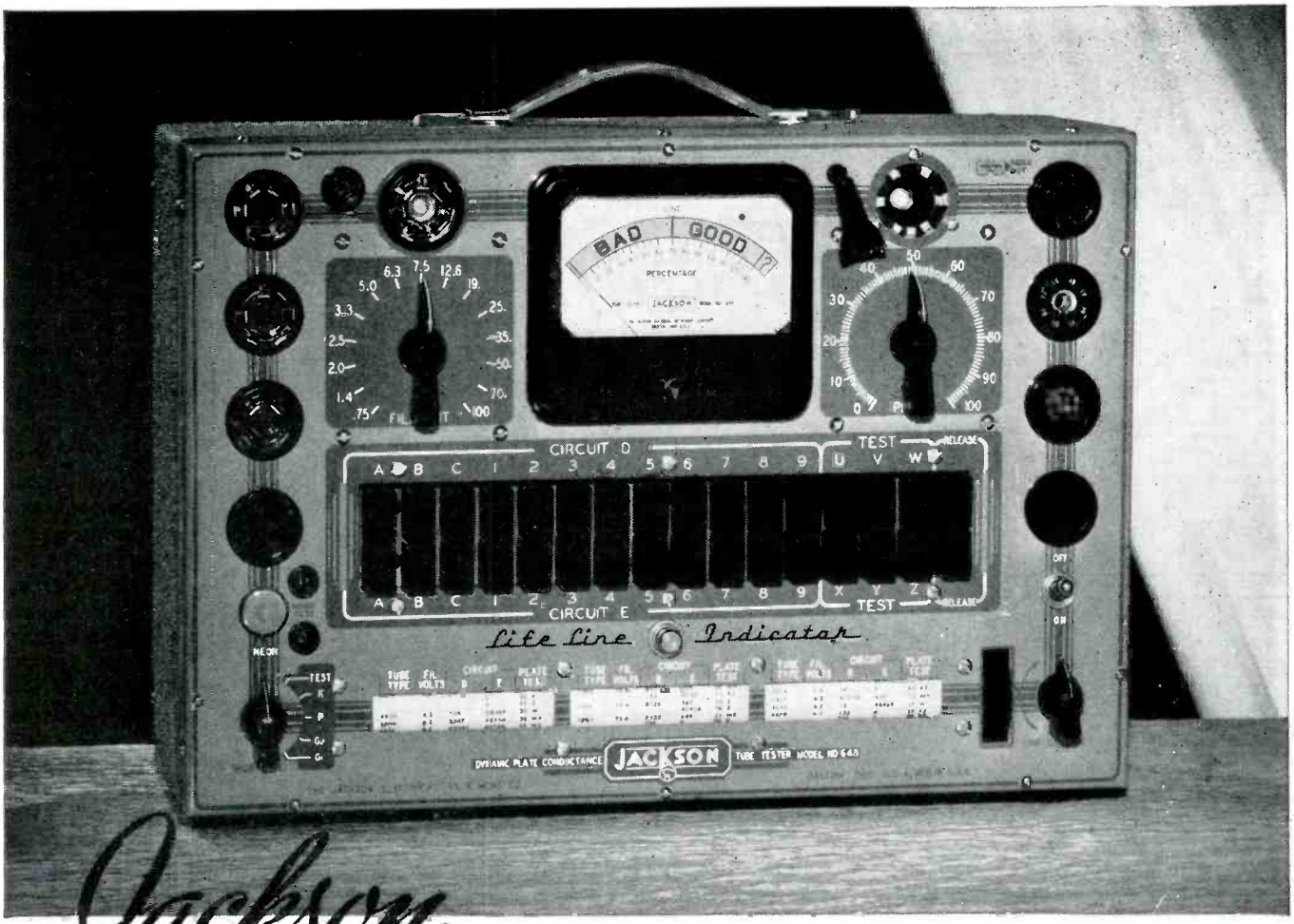
A combination of any of these three basic types of deafness are called mixed impairments. Most hard-of-hearing cases are a combination of two forms of deafness.

Middle-ear deafness is commonly found in those persons who have long suffered with ear sinus infections, colds and catarrhal conditions although a hardening of the drumskin or fixation of the ossicles (middle ear bones) causes severe hearing loss in many cases. People who clean their ears with objects that are smaller and sharper than their elbows and punc-

[1, 2]Medical terms.

Fig. 4. Response of *Noisemaster* tone adjustment.





Jackson FEATURES AN "ALL NEW" TUBE TESTER

Simplified Sequence Switching cuts time by ½. Visualize making a faster and better test on over 750 tube types without confusion.

MICROMOHS, relative conductance indicated directly on dial in addition TO the GOOD-BAD reading.

Only JACKSON offers the Life Line Indicator that is a "Crystal Ball" for the operator. It predicts future failure in apparently good tubes.

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SIMPLIFIED SEQUENCE SWITCHING

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LIFE-LINE INDICATOR

The Jackson Electrical Instrument Co.

16 S. Patterson Blvd.
Dayton 1, Ohio

JACKSON *Radio Testing Equipment*

THE JACKSON ELECTRICAL INSTRUMENT CO., DAYTON, OHIO

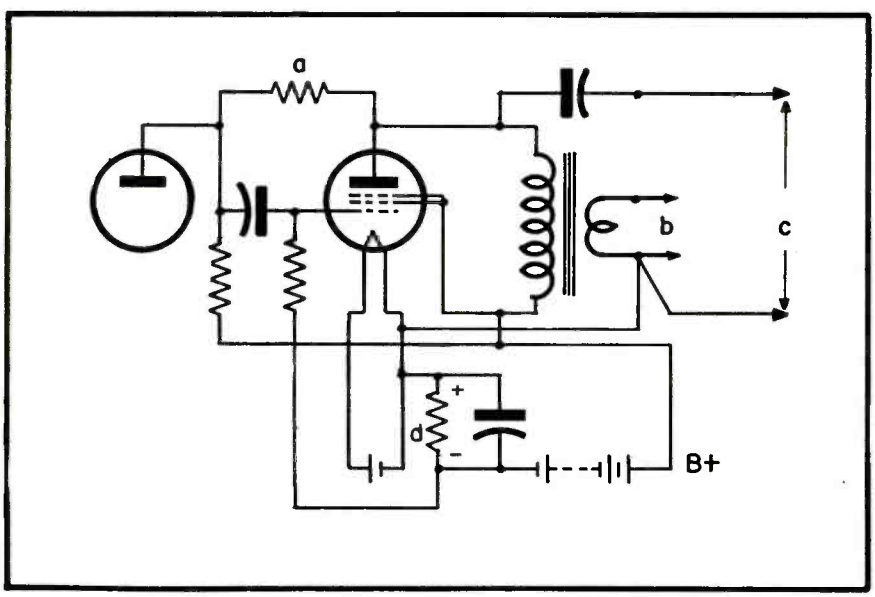
Low Pitch Words		Medium Pitch Words		High Pitch Words	
Word	*Score*	*Word*	*Score*	*Word*	*Score*
1. wore		1. gown		1. thatch	
2. mall		2. kind		2. sap	
3. hub		3. good		3. pat	
4. mole		4. nook		4. chat	
5. lair		5. coon		5. fast	
6. war		6. rain		6. path	
7. lobe		7. gain		7. chief	
8. hum		8. vine		8. cease	
9. rob		9. king		9. seep	
10. ball		10. jade		10. cheat	
11. well		11. died		11. teach	
12. bowl		12. Jake		12. peep	
13. more		13. dig		13. feet	
14. wear		14. deed		14. chip	
15. mob		15. coin		15. fifth	
16. loam		16. Jean		16. safe	
17. rare		17. gig		17. faith	
18. lull		18. dike		18. spaced	
19. bum		19. juke		19. chase	
20. home		20. kid		20. taste	
Number correct		*Number correct*		*Number correct*	
Per cent correct		*Per cent correct*		*Per cent correct*	

1. roar		1. down		1. patch	
2. wall		2. dined		2. pass	
3. rub		3. could		3. tap	
4. hole		4. cook		4. fat	
5. hair		5. noon		5. past	
6. mar		6. vain		6. chaff	
7. robe		7. cane		7. thief	
8. mum		8. nine		8. peace	
9. Bob		9. ring		9. cheap	
10. hall		10. raid		10. seat	
11. bell		11. ride		11. teeth	
12. roll		12. rake		12. peach	
13. lore		13. jig		13. peat	
14. mare		14. need		14. tip	
15. hob		15. join		15. pitch	
16. roam		16. keen		16. chafe	
17. bear		17. rig		17. face	
18. hull		18. bike		18. paste	
19. rum		19. duke		19. pace	
20. hem		20. did		20. chaste	
Number correct		*Number correct*		*Number correct*	
Per cent correct		*Per cent correct*		*Per cent correct*	

Fitting: ( ) *air* ( ) *bone* — *Accentuator:* ( ) *high* ( ) *medium* ( ) *low* — *Receiver:* ( ) 1 *dot* ( ) 3 *dot*

Position of volume control..... *Battery voltage*.....

Fig. 1. Speech-hearing test charts. At top is a standard word test for use without a hearing aid. Chart below is used after final hearing-aid fitting. (*Courtesy Acousticon*)



ture their eardrums find themselves accidently with middle ear deafness.

The hearing loss of the human ear, which has middle ear deafness, is unusually a linear loss. Middle-ear deafness can be simulated by a person with normal hearing if he *places his fingers in his ears.* It is obvious that for a hearing aid to compensate for this type of deafness it need only *shout louder,* by linear amplification, into the ear. All losses with this type of deafness are less than 50 db. When the losses are higher a mixed impairment is definitely indicated.

Nerve deafness is an impairment of the inner ear which is caused by deterioration of the nerve endings with age or as a delayed reaction to some childhood disease like scarlet fever. Radio operators, boilermakers, riveters and others whose ears undergo continual pounding of high level sounds in their daily work suffer nerve impairments, categoried as *occupational nerve deafness.*

Most nerve-deafened persons have the peculiar characteristic of hearing high level sounds in noisy areas as well as a person with normal hearing, but are completely lost in quiet areas where speech is conducted at a low level. For example, suppose we generate a tonal signal which a person with normal ears barely hears; the nerve deafened individual will have a 50 db loss at this level. As we increase the signal level 10 db the person with normal ears will hear it 10 db louder but the nerve-impaired individual at this level may have only a 25 db loss, and with another 10 db increase in tonal level may hear as well as the person with normal ears. In many cases the threshold of pain, due to high sound level, is reached at a lower sound pressure in an ear with a nerve impairment than in a normal ear. This change of hearing sensitivity with signal level is called recruitment factor and varies markedly with frequency; therefore a person with a nerve impairment has hearing loss with many dips and peaks and provides a very complex problem for the hearing-aid designer.

Brain deafness may be a result of a neglected impairment (middle-ear or nerve) in which the hard of hearing person has lost the ability to interpret sounds because he has not heard them for a prolonged period. This person can only be helped by rehabilitation with a hearing aid which compensates

Fig. 6. Output circuit used in hearing aids. At *a* is an inverse-feedback resistor (constant-voltage feedback); *b* is for input to a low-impedance magnetic or bone receiver; *c* output is for high-impedance crystal receiver; *d* is a self-bias resistor.

for his hearing loss and has a minimum of harmonic distortion. Fig. 1 shows a typical speech-hearing chart used for the re-education of the deafened who have lost the so-called *language factor.* Other conditions such as senility, cerebral strokes and other diseases which deteriorate the brain cells and are in the brain deafness category cannot be compensated by any hearing aid. Some instruments have been sold to semi-senile persons on the basis that high level signals enable better concentration and interpretation of speech.

Hearing-Aid Design

In designing a hearing aid the engineer has four components to use:

(*1*) The microphone, which may be crystal or magnetic.

(*2*) The amplifier, which may be 3-stage resistance coupled or two-stage impedance coupled.

(*3*) The receiver, which may be a magnetic air or bone conduction unit, or a crystal receiver.

(*4*) The power supply, which may be a special *flashlight type* of *A* (filaments) battery or a mercury type *Rubin* cell and a *B* (plate and screen) battery made up of a pile of flat thin cells.[3]

The engineer must take these four units and combine them into a packaged product that is pocket size and capable of being worn without loss of comfort.

In designing hearing aids which were approved by the *AMA* the following performance specifications were used as a guide:

(*1*) Frequency response (Fig. 2) relatively flat within ±3 db from 500 to 3,500 cps with cutoff at the low end at 300 cps and at 5,000 cps at high end.

[3]Eveready Mini-Max type.

(*Continued on page* 52)

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Electric Megaphones

(*Continued from page* 25)

forward efficiency and yet is not so restrictive as to require exceptional care to aim them; it is only necessary to point them as one would normally direct an ordinary megaphone.

Two types of portable amplifiers are used with the high power types of electric megaphones. One is a storage battery, powered with the usual vibrator, filters, etc., for plate supply, and the other is dry-battery powered, using the efficient and lightweight *B* batteries available today. The latter type usually are built to produce lower audio power output, in the interests of increased battery life. The storage battery type includes a built-in charger,

(*Continued on page* 30)

(Continued from page 29)

making it easy to keep the battery up to charge by plugging into a 110-volt 60-cycle outlet.

An idea of the coverage that can be expected of a high power electric megaphone is illustrated in Fig. 2. It must be appreciated this is comparative, as every sound engineer and technician knows how weather and atmospheric conditions can vary the results.

Threshold of Hearing

In this plot, we have the reference sound level of .000204 dynes/sq cm and distance of listener indicated. The reference level is important since this is the threshold of hearing. When the strength of a sound is gradually decreased, it becomes fainter and fainter to the ear. The point at which it first disappears into inaudibility for a normal human ear under the most quiet possible conditions, is the threshhold of hearing. The strength of a given sound then may be expressed in db, referred to threshold. This means that the ratio of the pressure of this given sound, to the threshold pressure, is represented by the arithmetical figure to which the decibels are equivalent. For instance, if it is stated that a certain steady sound is 100 db above threshold, we know from the logarithmic definition of db, that this corresponds to a pressure ratio (just like voltage ratio in electrical transmission circuits) of 100,000 times or 10^5. Multiplying .000204 by 10^6 gives 20.4, which is the number of dynes/cm^2 or *bars* pressure of the sound in question. It should be remembered that this is the *rms* value of an alternating pressure (corresponding to the electrical signal that is actuating the sound generator) above or in excess of the normal atmospheric pressure. Atmospheric pressure averages about 14.2 pounds per square inch, or approximately one million dynes/ sq cm. If one wishes to express the acoustic power of a sound which has threshold pressure, i.e., .000204 dynes/sq cm, this power is 10^{-16} watts/sq cm.

Electric Megaphone Applications

Some of the applications for high-power electric megaphones are:

Airfields and airports
Amusement parks
Armories
Auctioneers

Bus terminal starters
Bridge construction
Boy Scout activities
Boat yards
(Beaches (lifeguards)
Building construction
Bridge tenders
Berthing ships

Cheer leaders
Circuses
Committee boats (yacht races)
Carnivals
Camps
Company outings and picnics
Communication to barges

Dam construction

Fire fighting and rescuing
Fairs
Football and baseball games
Forest rangers
Freight yards

Gymnasiums

Hockey
High tension lineman communication

Loading and unloading ore; and coal carriers
Logging operations
Lightstrips and lighthouses

Municipal and State park police
Military and nautical schools
Marine rescue work
Motion pictures direction

Oil fields
Other athletic events and games

Police and fire boats
Political rallies
Paging
Playgrounds
Parades and pageants
Police traffic and riot control
Pipe line dredge and tender communications

Quarries and open mining operations

Revivalist meetings
Railroading
Road building
Racetracks

Steel mills and foundaries
Swimming pools
Stone and gravel yards
Shipyards
Ship canal and channel control
Ships to small craft

Truck loading
Track meets
Towboats and tugboats
Trawlers to fishing boats and net tenders
Tunnel construction

Universities and college stadiums

Waterway locks

Yacht basins
Yacht Club floats

JOHN C. HINDLE ACQUIRES GULOW CORP.

John C. Hindle has acquired all the outstanding stock of The Gulow Corporation, and has been elected its president. The corporation name has been changed to Eastern Transformer Co., Inc. They will be located at 147 West 22nd Street, New York 11, New York.

Mr. Hindle was formerly general manager and part owner of the New York Transformer Company.

Saul Koren, formerly with Ferranti Electric, Inc., as chief design engineer and previous to that with the American Transformer Co., is chief engineer of the new company.

Torque-Drive Phono Pickup

High-Compliance Unit Provides Transformer Step-Up Efficiency. Needle Force Applied By Needle, At Exact Center of Crystal, To A Harness Drive Which Is Cemented To Four Corners And Driven With Rotary Or Torque Motion, Simultaneously Pressing Two Diagonal Corners And Expanding Two Others.

by ALBERT KAHN

President, Electro-Voice, Inc.

EVER SINCE the first commercial *graphaphones* were produced, it has been desirable to produce the most good sound from the least force on the phonograph needle. The mechanical phonograph recorder and reproducer did an amazing job, considering the inherent limitations of the mechanical system. Perhaps our childhood memories of *In the Gloaming* and *Nearer My God to Thee* on the Sonora in the parlor are so distant they have softened the remembrance of non-linear and harmonic distortion which must have been in super-abundance.

The first *electric pickups* which appeared in the late '20s were perfection by comparison to the mechanical types, but these, too, were inherently stiff devices but took less record force to drive.

The entire evolution of phonograph pickups has been directed to lessening the force on the needle, yet give the desired voltage output. It is obvious that a record groove is simply a series of horizontal bumps and depressions. Ideally, the needle will slide over them, its motion perfectly conforming to their physical shape. These bumps exert force on the needle tip as they slide past and conversely the needle tip exerts equal and opposite force on the needle.

As force is mass times acceleration, and considering that acceleration reaches 5000 G's at 5000 cps, it is pretty obvious that the mass of the driving mechanism must be kept low. If the needle and drive are stiff and possess much mass, the force and counter force is high. The higher these forces, the greater is the wear, like a piece of steel on a slow grinding wheel. Thus, a stiff, high mass pickup produces excessive wear on both needle and record.

This stiffness has other faults. It produces high radiated surface scratch and *needle talk*. *Needle talk* is particularly objectionable on deeply cut records in a normal room when the speaker volume is low.

Needle compliance or softness and flexibility, has been accomplished in various degrees by a number of methods. The familiar *Bimorph*[1] crystal when driven directly by a needle does have inherent leverage action. Placing soft material between the needle drive and the crystal gives additional compliance at the expense of lowering the electrical output in proportion to the additional compliance it offers. Needles, too, have been designed with extra flexibility with improved performance, particularly on low frequencies.

[1]Brush Development Co.
[2]Electro-Voice *Torque-Drive* crystal pickup.

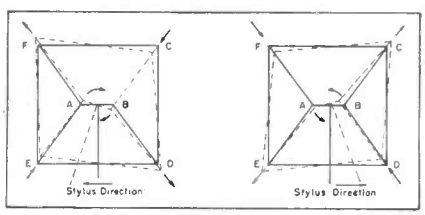
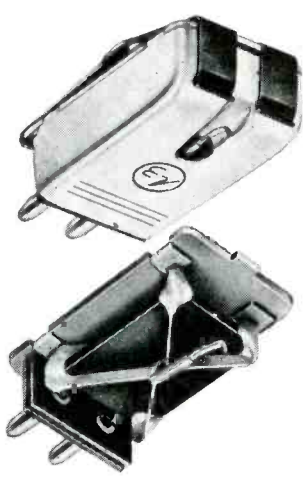


Fig. 1. Action of harness on crystal for rotational motion.

Fig. 2. External and internal views of pickup.



It might be considered that the basic problem of a crystal pickup designer is to match a desired low mechanical impedance of a needle point to a high impedance of a crystal and to reduce the driven mass. Most present methods are analogous to matching a low impedance line into a high impedance one. Flexible driving members are merely adding losses like matching capacitive circuits with a parallel capacity.

Torque-Drive Pickup

Recently a new, phono-pickup drive mechanism,[2] which effectively gives transformer step-up efficiency to a mechanical system, was developed. High compliance is attained much in the manner that a nut is turned with a wrench instead of the fingers. This method is shown in Fig. 1. The needle force is applied by the needle, at the exact center of the crystal, to a harness drive. This harness drive, cemented to the four corners, is driven with a rotary or torque motion simultaneously pressing two diagonal corners and expanding two others. As the needle moves in the opposite direction, the corners of the crystal reverse position. This crystal deformation produces a substantial voltgage across a single shear plate crystal.

The crystal itself is mounted on a duplicate harness which is oriented at 90° from the one on top. At low frequencies the two harnesses combine to double the output, decreasing to about 800 cps. This provides the pickup with additional compensation to match the constant velocity cutting of

(*Continued on page* 49)

The Sweep-Frequency Signal Generator

Basic Design Features . . . Step-by-Step Analysis of the Operation of The Generator With a 'Scope

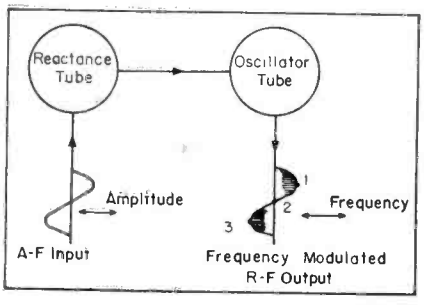
IN ITS SIMPLEST FORM, the sweep-frequency signal generator consists of a frequency-modulated oscillator tuned to the desired frequency. One of the earliest systems of frequency modulating an oscillator employed a motor-driven capacitor to swing the frequency of the oscillator back and forth across the center frequency at a rate dependent upon the speed of the motor. This system has since been superseded by an electronic method of frequency modulating the oscillator with a reactance tube. The reactance modulator consists of a tube connected to the frequency-determining circuit of the oscillator in such a way as to act as a variable inductance or capacity, thereby changing the frequency of the oscillator. A simplified diagram illustrating this system is shown in Fig. 1. The amount of change or frequency modulation depends primarily upon the amplitude of the audio signal applied to the grid of the reactance tube. Thus, by varying the audio input to the reactance tube, it is possible to control the frequency sweep or *bandwidth* of the f-m test signal. Since it is extremely difficult to design a reactance-tube modulated oscillator which will operate properly over the wide range of frequencies encountered in a-m and f-m work, it is common practice to design the frequency-modulated oscillator to work at only two or three fixed frequencies. The frequency modulated signal is then mixed or heterodyned with a variable frequency oscillator to produce the desired output frequency as shown in Fig. 2.

The Heterodyning Process

The combination of two voltages of different frequencies gives rise to beat frequencies equal to the sum and difference of the two frequencies. For example, if two frequencies, F_1 and F_2, are mixed or combined, the following new frequencies will result: $F_1 + F_2$ and $F_1 - F_2$. If either frequency is modulated, amplitude or frequency, the sum and difference frequencies will retain the modulation component. As an illustration, if a 20-mc signal with a frequency deviation of ±10 kc is mixed with an unmodulated 30-mc signal, the sum of the two frequencies will equal 50 mc with a frequency deviation of ±10 kc. This phenomena, commonly referred to as heterodyning enables a fixed-frequency oscillator of known frequency deviation to control the modulation characteristics of the sum or difference frequency resulting from the combination of a modulated and unmodulated signal. In practice, either the sum or difference frequency may be used to obtain the desired output signal. A typical circuit embodying this principle is illustrated in Fig. 2.

In a 'scope the sweep voltage is applied to the horizontal deflection plates of the c-r tube to swing the electron beam back and forth across the screen of the tube. If a sweep voltage is applied to the reactance tube which frequency modulates the oscillator somewhat the same action will take place, the difference being that we are now swinging the *frequency of the oscillator* back and forth. If the *same* sweep voltage is simultaneously applied to the horizontal plates of the 'scope and to the f-m oscillator, the two instruments will be in exact synchronization, disregarding for the moment slight phase-shift effects. This practice of using the same sweep voltage for both the f-m signal generator and the horizontal plates of the 'scope is an extremely important point to remember because it forms the basis for practically all visual alignment operations. A simplified visual alignment circuit is shown in Fig. 3.

Fig. 1. Simplified frequency-modulated oscillator. The r-f output of the oscillator is swung back and forth across its center frequency (2) in accordance with the audio waveshape applied to the reactance tube. The amount of swing or deviation of points *1* and *3* depends upon the amplitude of the a-f voltage applied to the reactance tube.



Here we have a 60-cycle sine wave applied to the horizontal plates of the 'scope and also to the reactance tube which frequency modulates the oscillator. The f-m oscillator, operating at a center frequency of 1 mc, feeds into an amplifier also tuned to 1 mc. A rectifier demodulates the r-f coming out of the amplifier and the resultant audio frequency voltage is applied to the vertical plates of the 'scope.

Let us assume that the audio input to the reactance tube is adjusted so that the frequency deviation of the oscillator is 30 kc either side of the 1-mc center frequency or a total deviation of 60 kc. Let us now follow the action which takes place if we simultaneously apply one-half cycle of audio-frequency voltage to the reactance tube and the horizontal plates of the 'scope.

At the extreme positive half of the cycle, point *A*, the reactance tube has swung the frequency of the oscillator 30 kc lower than the 1-mc center frequency. At the same instant this same positive voltage on the horizontal plates of the 'scope pulls the beam to the extreme left of the screen to point

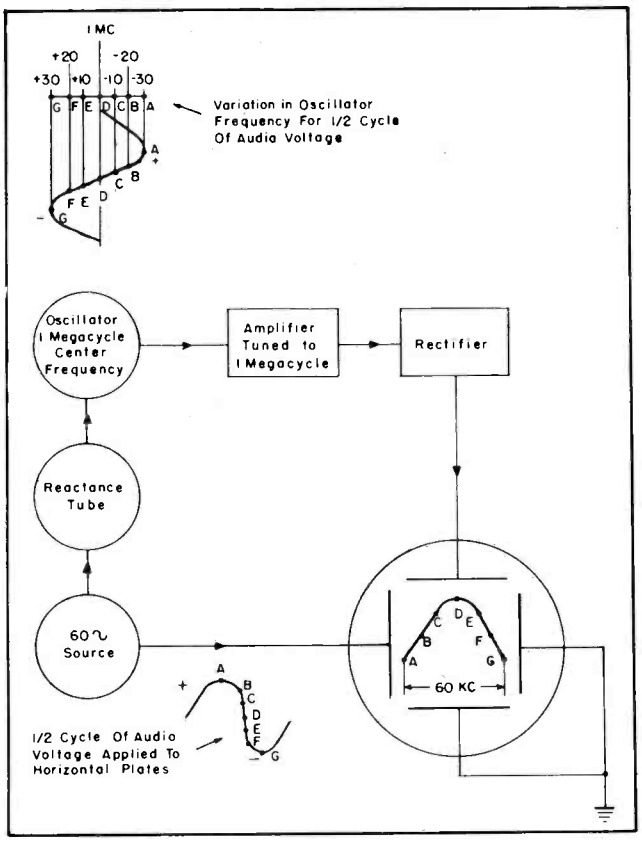
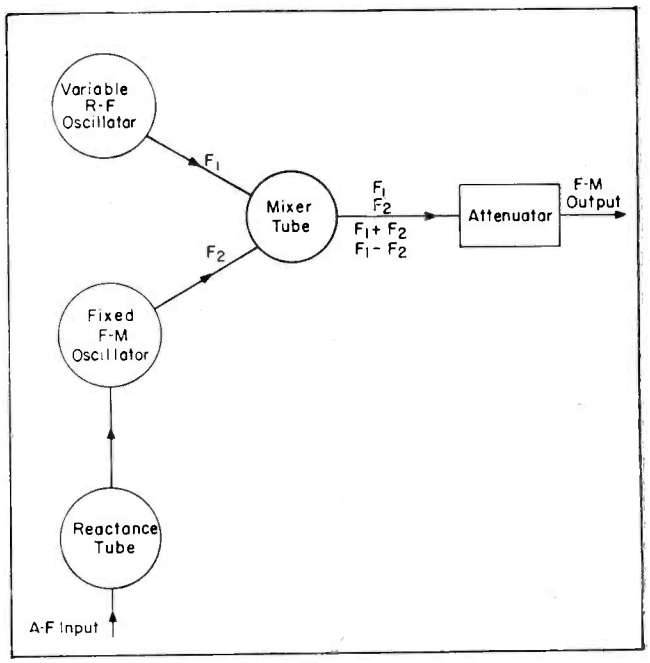


Fig. 3. Simplified visual alignment circuit.

Fig. 2. How a fixed frequency-modulated signal and a variable, unmodulated signal are combined to produce an f-m signal of the desired frequency in one type of sweep-frequency signal generator.



A. Since the oscillator is 30 kc away from the resonant frequency of the amplifier, amplification is very low and relatively little voltage is fed into the rectifier and the vertical plates of the 'scope. The vertical plates therefore have very little effect upon the position of the beam. Following the audio cycle to point *B*, we find that the reactance tube has shifted the oscillator frequency back toward the center frequency or 20 kc away from 1 mc. At the horizontal plates of the 'scope the less positive voltage draws the beam to point *B* on the screen. Since the oscillator is nearer the resonant frequency of the amplifier, amplification increases, more voltage is applied to the vertical plates and thus the beam is also drawn upward. At point *C* the oscillator is still closer to the resonant frequency of the amplifier, while at the same time the changing voltage on the horizontal plates deflects the beam further to the right. Amplification in the amplifier increases and the vertical plates exert more pull on the beam which is thus drawn further upward. At point *D*, the oscillator is exactly at the resonant frequency of the amplifier, horizontal deflection moves the beam to the center and since amplification is now at a maximum, the vertical plates pull the beam to the top of the pattern. At points *E*, *F*, and *G*, the oscillator swings away from the resonant frequency of the amplifier while at the same time the horizontal deflection resulting from less positive or now negative voltage, continues to pull the beam to the right. Amplification decreases, less voltage is applied to the vertical plates and thus the beam drops as it moves to the right.

On the other half of the cycle the same action occurs in reverse and an almost identical curve is again traced on the screen of the c-r tube. This second curve may not follow precisely the same path as the first curve because of phase shift effects. This condition can usually be corrected by the addition of a simple phase-shifting network connected to the horizontal plates. Typical constants and connections are shown in Fig. 4. The potentiometer should be adjusted so that the two curves merge into one.

C-R Screen Traces

It can be seen from the preceding explanation that the actual response curve of the amplifier is traced on the screen of the c-r tube. It is this feature which makes visual alignment so valuable for f-m work. Peak f-m receiver performance requires that the i-f response curve have a wide, flat-top and steep-sided skirts as illustrated in Fig. 5.

[Based on copyrighted material prepared by Jack Najork of the measurement engineering section, specialty division of G. E., for the booklet, Visual Alignment Techniques for F-M Servicing.]

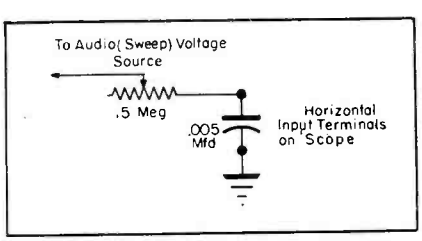


Fig. 4. Phase shifting network used to eliminate double trace.

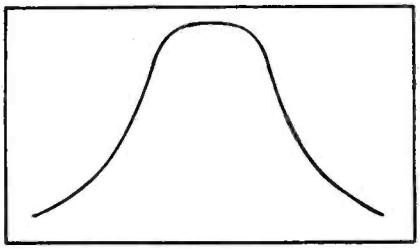


Fig. 5 (right). Typical over-all response curve of f-m i-f channel.

Precision....

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TV AGC and Picture-Tube

AGC Circuits Used in TV Receivers . . . Intercarrier Circuit Designs . . . Relationship of Signal and Voltage to Picture-Tube Operation . . . Characteristics of High-Voltage Systems for Electrostatic and Magnetic Deflection Picture Tubes

by EDWARD M. NOLL

Instructor in Television
Temple University

IN THE FEBRUARY installment[1] of this series, automatic-gain-control systems were described, and a simple agc circuit was shown.

Continuing this analysis, let us now study several commercial examples of agc applications.

RCA 641 System

Quite an elaborate agc system is used in the RCA 641 tv receiver: Fig. 1. In this circuit, the output of the fourth picture i-f amplifier is applied to the plate of the agc detector. A long time constant circuit C_{240} and R_{251} charges up to the peak amplitude of the sync tip. The voltage that appears on the cathode of the agc detector is therefore proportional to the amplitude of the signal sync tip as in the case of the previous agc system, with the exception that a positive charge appears across capacitor C_{240}.

One disadvantage of the simple agc system is that sharp noise pulses will also charge up the capacitor and operate the agc system. Thus, if strong noises are received not only do the noises charge up the agc system, but this additional charge further reduces the amplification of the i-f system and reduces the actual signal strength. Accordingly, not only is the noise present, but the signal strength of the composite television signal is also reduced during the time that the noise is operating the agc system. To prevent this defect in the RCA-agc system a noise limiter diode circuit immediately follows the agc rectifier. Sharp noise impulses will cause the two diodes to conduct which will shunt capacitor C_{240} with a low resistance and prevent the capacitor from being charged by the sharp noise impulses. In addition, the large resistor, R_{253}, and capacitor C_{242} in the grid circuit of the agc amplifier will also very effectively filter sharp-noise impulses. Consequently, the voltage on the grid of the agc amplifier will be an essentially constant voltage depending on the average charge placed on capacitor C_{240}. Of course, this average charge is dependent upon the peak level of the continuously received sync tip.

[1] February, 1948, SERVICE.

*From a forthcoming book, *Television For Radiomen*, to be published by Macmillan.

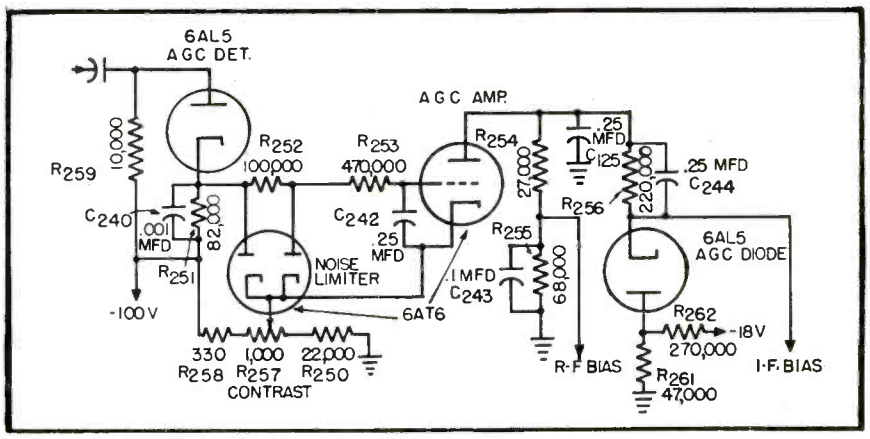

Fig. 1. The agc system used in the RCA 641 tv receiver.

AGC Cathode Bias

The cathode of the agc amplifier tube is biased-negative with respect to its plate, which is at ground or near ground potential. The grid of the agc amplifier is biased by two voltages, one of them the voltage of the negative supply and the other, the positive charge built up on capacitors C_{240}. When the positive voltage across the capacitor is sufficient to overcome the negative voltage from the negative supply (depending on setting of picture control or contrast control of receiver) the agc amplifier will conduct. When this agc amplifier conducts, a voltage drop across R_{254} and R_{255} makes the plate negative with respect to ground. Therefore the negative bias will be applied to the r-f bias line and the i-f bias line. The amplitude of this negative voltage will be proportional to the positive charge on capacitor C_{240} and the positive charge on the capacitor is dependent on the peak amplitude of the received signal. If the setting of the picture control is changed the agc amplifier grid bias will also change and therefore the negative voltage on the r-f and i-f bias lines will also vary. This is a very expedient method of changing the gain of the i-f amplifier and therefore the

Voltage and Signal Systems

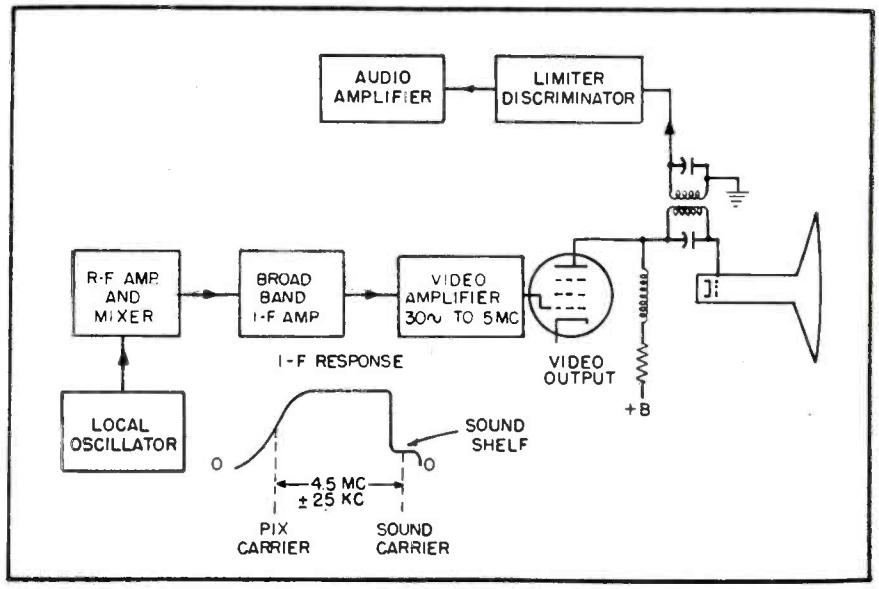

Fig. 2. Intercarrier system used in the G.E. tv receiver.

peak-to-peak amplitude or contrast of the detected signal.

In the reception of the tv signal, signal-to-noise ratio is an important consideration and if the gain of the receiver is to be changed it is better to change the i-f gain and permit the r-f stages to operate at maximum gain because of the improved signal-to-noise ratio. If the signal, however, is exceptionally strong it is possible to overload the first i-f stage in which case the r-f gain must be reduced. The agc system shown does just this: once the signal is of medium signal strength, the i-f gain is affected much more than the r-f gain and the signal-to-noise ratio is sustained. However, when an exceptionally strong signal is received the r-f gain is affected more than the i-f gain. This shift of control is done with the agc diode which, after the diode reaches a certain negative value, conducts and prevents the bias from rising on the i-f bias line, while it continues to rise at a more rapid rate on the r-f bias line. Thus, on a very strong signal the current drawn through resistors R_{255} and R_{254} is the current of the agc amplifier tubes, plus the current of the agc diode and consequently, the bias on the r-f line rises more rapidly.

Summary

In summation, the function of the agc sysem is to apply an i-f signal to the video detector which is essentially constant for substantial variation in received signal strength. This is accomplished by rectifying an agc-control voltage which is proportional to the amplitude of the i-f signal during the sync tip.

Special I-F and Video System

A special i-f and video system called an intercarrier system, has been developed by G.E. In this system, Fig. 2, the picture and the sound are carried through the picture i-f and video amplifiers up to the grid of the picture tube. Only one i-f system is necessary. The sound is taken off a tuned-circuit located between the video output and the grid of the picture tube which is tuned to 4.5 mc. The sound is then passed to a conventional limiter-discriminator and audio system.

Video-Sound Carrier

Actually the 4.5 mc, to which the parallel resonant circuit is tuned, is the original megacycle separation between the picture and the sound carrier. In other words, in transmitting such a broad band of frequencies through the i-f, the frequency-modulated sound carrier looks just like another component of modulation to the picture carrier and the video detector. To make sure that the picture carrier always dominates at the video detector, the i-f system is detuned very much at the sound carrier and the sound carrier appears on a shelf in the response curve as shown in the figure. Inasmuch as the sound carrier is frequency modulated, the megacycle separation between it and the picture carrier is not always 4.5, but varies 4.5 mc, ±25 kc. Consequently, there is a frequency-modulated 4.5 mc center frequency in the parallel-resonant circuit which is detected as the sound. The parallel-resonant circuit in series with the picture signal path prevents the sound from appearing on the grid of the picture tube. Oscillator tuning is not critical because the sound i-f frequency is dependent on the megacycle separation between picture and sound carrier and this is independent of the setting of the local oscillator. Since the picture i-f system is so very broad the setting of the local oscillator is not critical.

Picture Tube Voltage and Signal Circuits

A number of a-c signals and d-c voltages must be applied to the electrodes of the picture tube. The three a-c signals are picture and blanking to the control grid, and vertical and horizontal sawteeth to the respective deflection systems. A variable d-c bias voltage must also be applied to the control grid and the proper potentials must be applied to the elements of the electron gun. In addition, it is necessary to have a d-c component of deflection voltage or current to properly center the entire picture on the scanning raster.

The various signals, voltages, and currents necessary to properly operate

(*Continued on page* 39)

Service Shop Tools

by ALFRED A. GHIRARDI

Advisory Editor

THE MODERN SERVICE SHOP should be equipped with an adequate complement of carefully selected tools of good quality for rapid performance of all the mechanical work involved in servicing the wide variety of receivers and accessories every day. The more elaborate shops will provide themselves with practically all the items of tool equipment that have been listed and described in the previous articles of this series. Others, perhaps more gradually, will see the benefits to be gained in terms of dollars and cents of profit through working time saved, and will acquire them a few at a time.

Not only is it important that the Service Man have all these tools and learn to use them correctly and to utmost advantage, but he also should learn how to maintain and take care of them so that every tool will be in excellent working condition whenever they are needed. It is impossible to do the best work with tools that are not in good condition.

Proper Use and Care of Pliers

The Service Man uses his pliers so frequently that it is nothing but sensible economy on his part to take good care of them. A basic caution on all pliers is not to force them to do work which is heavier than they were designed to handle, as this will spring the jaws and render the pliers unserviceable. As has already been explained, pliers of different types and sizes are manufactured for different uses. It is always wise to use the right *type* and the right *size* called for by each particular use to which the pliers are to be applied. Specific precautions to observe when using the various types are:

Diagonal Sidecutting Pliers—The light weight (6″ type) diagonal side-cutting plier commonly used by Service Men is strictly a cutting, skinning, or cleaning plier for use on the lighter gauges of insulated wire—up to about 16-gauge steel or 14-gauge copper. They are not intended for heavy work. The extra-heavy type of diagonal side-cutting plier should be purchased (or the more sturdy electrician's side-cutting plier should be used) for uses that would constitute abuse of the lighter type. The chief misuse of diagonal side-cutting pliers is forcing them to cut heavier or harder wire (or other objects) than that for which they are intended.

Electrician's Sidecutting Pliers—Remember that the design of this type of plier is such that when the cutting blades of the side cutters meet, the gripping jaws are still open a few thousandths of an inch. Such design insures clean cutting of wire and insulation. It is best not to cut heavy solid wire completely apart with these pliers, as this may injure the cutters. The wire should be nicked, and then the gripping part of the jaws used to bend the wire back and forth until it breaks.

The chief precaution to observe in using this type of plier is to avoid any *rocking* or *prying* action in cutting through tough material. Do not of course hammer the handles or squeeze them in a vise—use a larger and heavier plier. All pliers are hand *tools* and are designed to withstand leverages resulting from the grip of the *human hand*. Don't expect a *side-cutter* to do the work of a *bolt-clipper!* Also, remember that this type of plier is not intended to be used as a substitute for a wrench of any description.

Long-nose and Needle-nose Pliers—These pliers are intended for holding small parts, wire, etc., while fastening or soldering to a terminal lug, reaching places not readily accessible to the hand, etc. However, they are often misused and abused by being forced to hold large objects, tighten nuts, or to bend and form the larger guages of wire and sheet metal. Such use soon *springs* the jaws so they no longer close firmly on small objects, or it actually breaks them, rendering them unserviceable. Because their jaws are very slender, needle-nose pliers are especially susceptible to damage by such abuse.

General—Pliers must be kept clean and free from dirt and rust. Use a size and jaw shape that is designed for the particular use to which you want to put the plier. Never use pliers as a wrench or a hammer. Oil the rivets in the hinges of all pliers occasionally to keep them working easy.

Television

(*Continued from page 37*)

a magnetically deflected picture tube are indicated in Fig. 3. Signal voltage is of course applied to the control grid of the picture tube to modulate the electron stream in accordance with the light variations, and to shut off this electron beam during the retrace intervals of the scanning process. Sawtooth-signal current in the horizontal and vertical deflection coils produce the changing magnetic field which causes the beam to scan across and down the screen. The electrode voltages for the cylindrical elements of the electron gun are generally taken off a bleeder divider across a high-voltage power supply. The grid is the most negative electrode of the gun and it is either at the low potential end of the bleeder system, or a separate low-voltage power supply source is used to set the grid negative with respect to the cathode. A d-c component of current also passes through the deflection coils to properly center the electron stream. In addition, the magnetic field generated by the focusing coil and the ion-trap coil must be formed with a component of d-c current generally taken off the low-voltage power supply. As can be seen, proper operation of the picture tube circuit is dependent on a number of signals and voltages which must be properly set in level and amplitude to obtain a satisfactory picture.

When electrostatic deflection is used, Fig. 4, a similar picture and blanking voltage must be applied to the control grid, and sawtooth voltages of the proper horizontal and vertical repetition rate must be applied to the deflection plates. The electrode potentials for the electron gun and the deflection plates are generally taken off a bleeder across a high-voltage power supply. One deflection plate is always at second anode potential and its companion plate can be raised above or below the second anode voltage by means of the centering control. Consequently the picture as a complete unit can be moved right or left, or up and down, to properly center the picture on the face of the tube. Generally the d-c component of grid voltage which sets the average brightness is obtained from a divider system across the low-voltage power supply, applying positive voltage to the cathode of the picture tube. So far as grid signal is concerned, it is simply a voltage variation. Inasmuch as little power is required in picture-tube circuits, components can be made at a reasonable cost and without excess weight. To generate a magnetic field of sufficient strength to deflect the beam its full sweep horizontally requires some power, and horizontal-deflection current required sometimes approaches a half of an ampere.

High Voltage Systems

A high accelerating potential is necessary to generate the high velocity scanning beam of the cathode-ray picture tube. Although the potential necessary is in the thousands of volts the actual current drawn at this high voltage is relatively small. Thus it is possible to construct a satisfactory high-voltage supply for picture-tube operation with relatively small parts, which do not add excessively to the weight and area of the receiver chassis. A number of systems are being used presently in the modern tv receiver. There are only a few current tv models which use a high-voltage transformer excited by the 110-volt primary-line voltage. Most of the re-

(*Continued on page 40*)

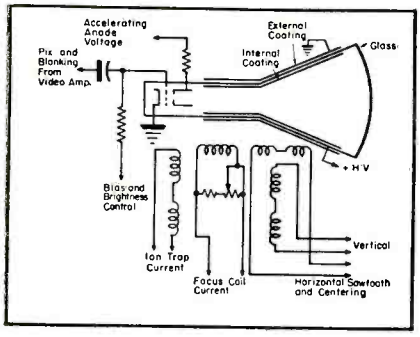

Fig. 3. Picture tube circuit for magnetic deflection and focusing.

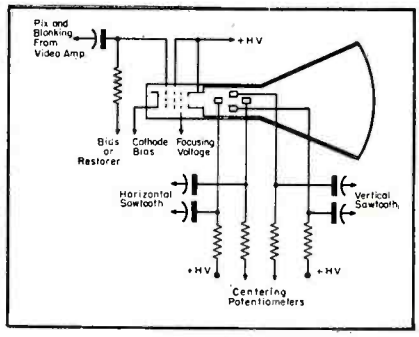

Fig. 4. A picture tube circuit for electrostatic deflection and focusing.

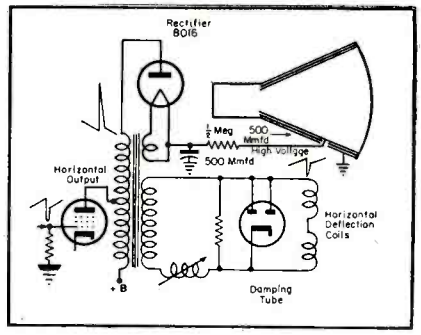

Fig. 5. A flyback high-voltage supply.

ceivers rectify the peak amplitudes of some oscillating or transient voltage as their source of high voltage d-c potential. This system has been found very practical because the very minute current drawn does not appreciably load the transient voltage source or in any way affect the operation of the circuit to which the transient is associated.

The current requirements of the average picture tube is extremely low and the very peak instantaneous current is less than one milliampere. The low current requirement means that the size of the parts can be kept small and a simple filter system, consisting generally of only a resistor and a pair of capacitors can very effectively filter the rectified voltage. If the time constant of the filter capacitors and resistor is kept sufficiently long to prevent any appreciable discharge of the capacitor, between conducting periods of the high voltage rectifier, a well-filtered high voltage source is obtained.

When electrostatic deflection picture tubes are used, a series of resistors are connected across the high-voltage source and the various electrodes of the picture tube are tapped off at appropriate points to obtain their correct potentials. The current drawn by the picture tube, and the current passing through the bleeder resistor represents the load placed on the high voltage supply. In practice the values of the resistors in the bleeder network are relatively high and bleeder current as a result is always less than one milliampere. In those receivers, where the picture tube is focused and deflected magnetically there is no bleeder system across the high-voltage supply, high-voltage supply only furnishing the second anode potential. Proper potentials for the accelerating grid and other low-voltage electrodes of the picture tube are obtained from the low-voltage supply. As a result there is an extremely light load on the high-voltage supply system because of the absence of a bleeder network, plus the fact that the only potential required is that which is applied to the second anode of the picture tube.

To prevent focusing instability and variation of correct focusing point, with changes in brightness setting, it is necessary that the high-voltage supply system have good regulation. Good regulation, of course, can be obtained by keeping a constant load on the high-voltage supply which does not vary appreciably with the changes in the picture tube beam current. This can be accomplished by using a bleeder network which draws appreciable current from the high-voltage system. Of course, the greater the current drawn the higher the ripple voltage becomes and stricter filter requirements are necessary. If magnetic deflection and focusing is used there is no interaction between focusing and the high-voltage systems.

In the transient and oscillating-voltage system, the base ripple frequency is much higher than when a high voltage transformer is used and consequently it is filtered with greater ease by relatively small value capacitors. This expedient also makes the high-voltage supply less hazardous because the small capacitors cannot accumulate as high a charge as the larger capacitors needed to filter low-frequency 60- to 120-cycle ripple.

The transient voltage supply is an economical and effective means of obtaining the 8,000 to 10,000 volts required for optimum operation of the tv picture tube. Decidedly fewer component parts are required and the expensive and hazardous high voltage transformer is unnecessary. The filtering requirements are not as strict because of the higher ripple frequency. This means of obtaining the high voltage also presents a safety feature so far as the operation of the picture tube is concerned, because if there is a failure of horizontal sweep voltages, the high-voltage second anode also fails at the same time and an extremely bright spot does not appear on the fluorescent screen.

If the high voltage system is to be operated at peak efficiency it is necessary that the load on the system be kept extremely light and consequently dielectric losses and arcing losses must be kept at a minimum. Thus high-voltage cables are used to convey the high-voltage signals to the picture tube and proper spacing must be allowed between the high voltage points and ground as well as other surrounding objects. Tube sockets and other mountings also must be made of good dielectric material to prevent stray losses. To prevent the occurrence of arc-over and sparking, it is necessary that the conducting wires, as well as the connection points, contain no sharp points or rough edges, because sparking is much more likely to occur off a sharp point or surface. Consequently rounded corona shields are used at many connection points in the high-voltage system. As the potential requirements become increasingly higher the corona and spark-discharge problems become more acute. In projection tv receivers we have this problem, since picture tube voltages here are as high as 30,000 to 90,000 volts.

A transient or fly-back voltage supply is a part of the horizontal deflection output circuit and utilizes a transient voltage generated in the horizontal deflection coils to supply the high-voltage potential for the picture tube. A typical transient-voltage supply is shown in Fig. 5.

[To Be Continued]

Bass Boost

(*Continued from page* 19)

ing with a-c/d-c sets, the bass peak can be placed between 130 to 200 cycles, not only because there isn't much power available but also because the usual five or six-inch speaker used in such sets just isn't capable of adequately reproducing frequencies much below 100 cycles.

Although the final test of any amplifier is how it sounds, response curves such as those shown in Fig. 2 go a long way toward removing the uncertainty usually associated with the performance of an amplifier. All that is needed to plot such curves quickly and accurately is a good audio signal generator and an output meter. The signal generator should have low distortion and be capable of covering the entire audio spectrum with negligible variation in output. Particularly well adapted for this type of work is a beat-frequency audio oscillator[2], such as the model shown in Fig. 4. This unit covers the entire audio spectrum in one band, and its variations in output are less than 1 db over the range of 50 cycles to 16,000 cycles. Practically any type of amplifier can be tested with this instrument because its output of 5 volts across 500 ohms (50 milliwatts) is sufficient to drive even a low-gain amplifier to full output and plotting is simplified because the audio spectrum is covered in one sweep of the dial. Thus, once the output is set to the desired level, an entire curve can be plotted merely by setting the frequency dial and noting the output meter readings.

The curves are plotted by selecting a reference frequency, usually 400 or 1000 cycles, and adjusting the input to the amplifier at this reference frequency until the desired output level is obtained. Output of the amplifier over the audio spectrum is then plotted on either side of the reference frequency to produce a curve such as shown in Fig. 2. If only the electrical characteristics of the amplifier are to be measured, the output transformer can be terminated in a resistor equal to the voice coil impedance of the speaker which is to be used with the system, and the output meter is connected across this resistive load. Voltage readings can be converted to watts by Ohm's law: $P = \frac{E^2}{R}$.

If the response of the loudspeaker is to be included in the final curves.

[2]G.E. YGA-4

(*Continued on page* 43)

ASSOCIATIONS

ARSNY, New York City

THE MONTHLY MEETING of the Asciated Radio Servicemen of N. Y. held in New York at the Manhattan Center on May 20, was an outstanding affair. The meeting, sponsored by John F. Rider, was attended by over 1500 Service Men.

An extremely interesting technical program was offered on a p-a, f-m and tv by four industry experts.

The p-a talk was presented by C. A. Tuthill, who played a major role in the United Nations sound-system installation. He covered such problems as acoustic feedback, speech equalization, microphone baffles and speaker placement.

Seymour D. Uslan, who collaborated with John Rider in the book, *F-M Transmission — Reception*, offered a comprehensive discussion of tv and f-m receiving antennas. Uslan described simple and folded dipoles, and director and reflector elements. He also described directivity patterns, broadband effects, impedance matching of transmission lines and traps for image interference. Discussing installation, Uslan analyzed orientation methods, multiple signal-path problems, indoor antennas and the connection of two or more receivers to one antenna.

John Meagher of RCA described the various types of test equipment used in television servicing. He showed a number of typical applications for the instruments and revealed how it was possible to set up a test procedure which could streamline television servicing. This information will appear in a booklet to be published soon.

Maurice Plotkin of RCA Institutes described the features included in current television receivers.

A highlight of the evening was a presentation of a plaque to John Rider by Max Liebowitz, president of ARSNY, bearing the inscription . . . "Awarded to John F. Rider, in grateful appreciation of his meritorious achievements in behalf of the radio service industry (during the years) 1921-1948."

John F. Rider (right) receiving the ARSNY plaque . . . "in grateful appreciation of his meritorious achievements in behalf of the radio service industry" . . . from Max Liebowitz, president of the Associated Radio Servicemen of New York.

In accepting the testimonial, Mr. Rider congratulated ARSNY on its progress and the acceptance it has received from the public, press and judiciary. He stated that ARSNY would serve as a model for Service Men in other localities who could similarly enjoy the benefits resulting from a well-organized local group which was equipped to further the interests of the individual Service Men and protect the industry as a whole from the damage of unfair practices and discriminatory legislation.

Theodore Wiegand, legal assistant to the minority of the N. Y. City Council, also appeared at the meeting and disclosed that the excellent work of ARSNY has convinced the councilmen that licensing will not be necessary in New York City. He pointed out that the sincere desire of the association to operate under a strict code of ethics and the excellent results achieved by such operation made licensing unnecessary. He said that a large pressbook showing the accomplishments of the servicing group in New York further emphasized the coordinated spirit of the local group and demonstrated the high quality of their activities today.

The second edition of the ARSNY News, distributed at the meeting, revealed that the association will have its own radio program over WNEW during a thirteen-week period. There will be eighteen announcements a week over the station.

The news bulletin also disclosed that ARSNY will play a major role in a N. Y. Town Meeting which will be held in September and sponsored by component, accessory and distributing groups in the industry, under a plan similar to that set up for the Town Meeting in Philadelphia recently.

Window and counter card supplied to members of the Oklahoma City Radio Service Association.

TEN YEARS AGO

From the Association News page of SERVICE, June, 1938

RSA CONTINUED TO GROW with service groups from Alton, Ill.; Staten Island, N. Y.; Holyoke, Mass.; Fremont, Ohio; Lansing, Mich. and Steubenville, Ohio, joining the ranks. . . . The first RSA board of directors meeting was held in conjunction with the RSA Convention at the Hotel Stevens in Chicago. . . . The Lansing Chapter held its first meeting. Joe Cole, district director, served as president. . . . The Rochester group announced that its membership was growing. B. L. Lewis, former national president of the NRSA, pioneered the organization of the Rochester group. . . . The Duluth Chapter attended the Minneapolis Radio Dealers Convention. . . . John Mutschler directed the activities of the Fremont, Ohio, Chapter. . . . F. Fiske of the New Bedford Chapter died. . . . The Detroit Chapter held a series of closed meetings to discuss by-laws. . . . Robert W. Clayton was named chairman of the Alton Chapter and R. L. Foster, secretary-treasurer. . . . The Boston Chapter held an election for director. Saunders and Paulsen were running neck and neck in the contest. . . . At a meeting of the Jamestown, N. Y. group, auto radio installation and servicing prices were discussed and a minimum installation charge of $3.50 for dealers was established. . . . Plans were made for an annual summer banquet to be held on the shores of Lake Chautauqua in July. . . . Service Men in Buffalo were addressed by John F. Rider, who spoke for 2½ hours on everything in servicing. Radiart engineers explained vibrators and their application to the Buffalo boys at a subsequent meeting.

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Bass Boost

(*Continued from page* 41)

the speaker should be connected and voltage readings taken across the voice coil, although this procedure is somewhat painful at ten watt levels. A series of response curves plotted at various output levels will quickly reveal the compensated response of the amplifier and will enable experimentation with various values of R and C until curves similar to those shown in Fig. 2 are obtained.

Sound Literature

TWO BULLETINS on microphones and pickups have been released by Electro-Voice Inc., Buchanan, Michigan. In one bulletin (No. 139) appears a description of an improved model *Cardyne* cardioid dynamic microphone which features an impedance selector and external shock mount. The second bulletin (No. 141) contains a description of a *Torque Drive* crystal pickup which weighs 1/5 of an ounce. Features of the crystal are said to be low-mass drive system, high lateral and high vertical compliance and a 20 time multiplication of needle force to crystal. . . . A 24-page catalog (No. 48) has been released by Mark Simpson Mfg. Co., Inc., 32-28 49 Street, Long Island City 3, N. Y. Described are portable amplifier systems, industry sound distribution equipment, school system amplifiers, musical instrument amplifiers, etc. . . . Bell Sound Systems, Inc., Columbus 7, Ohio, have released a 20-page catalog describing 5 to 50-watt p-a systems, 6 to 30-watt mobile amplifiers, intercom equipment, portable record players, console sound systems, etc. . . . A 12-page catalog covering a replacement line of speakers for automobile and home use has been published by Utah Radio Products, Division of International Detrola, Huntington, Indiana. Offered are tables providing electrical and physical data on speakers ranging from 3" to 15" of oval, e-m, p-m, and wide-range type. . . . Jensen Mfg Company, 6601 South Laramie Avenue, Chicago 38, Ill., have prepared an assortment of catalogs and booklets on their speaker line. One bulletin (Data Sheet No. 142) contains data on projector speakers. Another (Data Sheet No. 37A) describes the Jensen line of coaxial loudspeakers and special cabinets designed to accommodate the speakers. Data Sheet No. 140 covers a new line of cabinets designed by Jensen for speaker, and radio and phonograph uses. The complete line of Jensen equipment is described in the general 28-page catalog, No. 101E. . . . University Loudspeakers, Inc., 80 South Kensico Avenue, White Plains, N. Y., have prepared a series of bulletins and catalogs on their speakers and speaker systems. A carillon sound system is described in a 4-page bulletin. Design criteria for speaker systems are contained in another bulletin. Installation and operating data for high frequency speakers appear in another technical release. The University p-m tweeters are described in still another data sheet. University's complete line is shown and discussed in a general 20-page catalog. . . . Tartak Speakers, Inc., 3120 East Pico Blvd., Los Angeles 23, Calif., have prepared a 4-page catalog describing their line of p-m replacement and p-a speakers. . . . Automatic record changers are discussed in two bulletins released by the V-M Corporation, Benton Harbor, Michigan. . . . The American Microphone Company, 370 South Fair Oaks Avenue, Pasadena 2, Calif., have published a 12-page catalog (No. 43) with data on phono pickups, pickup cartridges, dynamic microphones, hand held microphones, hand held microphones, hand sets, floor stands, etc. . . . Intercom data appear in folders prepared by the Rauland Corporation, 4245 North Knox Avenue, Chicago 41, Ill. Described are master and remote stations for office and home use. Rauland has also prepared a 4-page release on a line of Lyric sound equipment which is being made in 15 and 30-watt types. . . . Amplifiers and p-a packs are described in bulletins prepared by the Stark Sound Engineering Corporation, 2131 Fairfield Avenue, Fort Wayne, Ind. . . . Automatic record changers featuring automatic mixing are described in a bulletin released by the Garrard Sales Corp., 315 Broadway, New York 7, N. Y. Release also contains data on a two-speed transcription motor and carrying cases for the equipment. . . . Crystal desk microphones and wire recorder heads are described in two technical bulletins released by the Turner Company, Cedar Rapids, Iowa. . . . A line of 4", 5" and 12" p-m speakers in standard and elliptical shapes is shown and described in an RCA technical bulletin. . . . Coaxial and separate two-way speaker systems are illustrated and discussed in a 16-page catalog (No. 109) published by the Stephens Mfg. Co., 10416 National Blvd., Los Angeles 34, Calif. . . . Dynamic, velocity and carbon microphones are described in a data sheet folder prepared by the Universal Microphone Company, Inglewood, Calif. Data presented also covers recording chassis, recording heads, constant velocity frequency records, microphone stands, etc. . . . Sound and intercom equipment are illustrated and described in a 6-page bulletin released by Stromberg-Carlson, Rochester, N. Y. . . . The Thordarson Electric Mfg. Division of Maguire Industries, Inc., 500 West Huron Street, Chicago 10, Illinois, has released booklets and catalogs describing a variety of low and high-power amplifiers for home and p-a work.

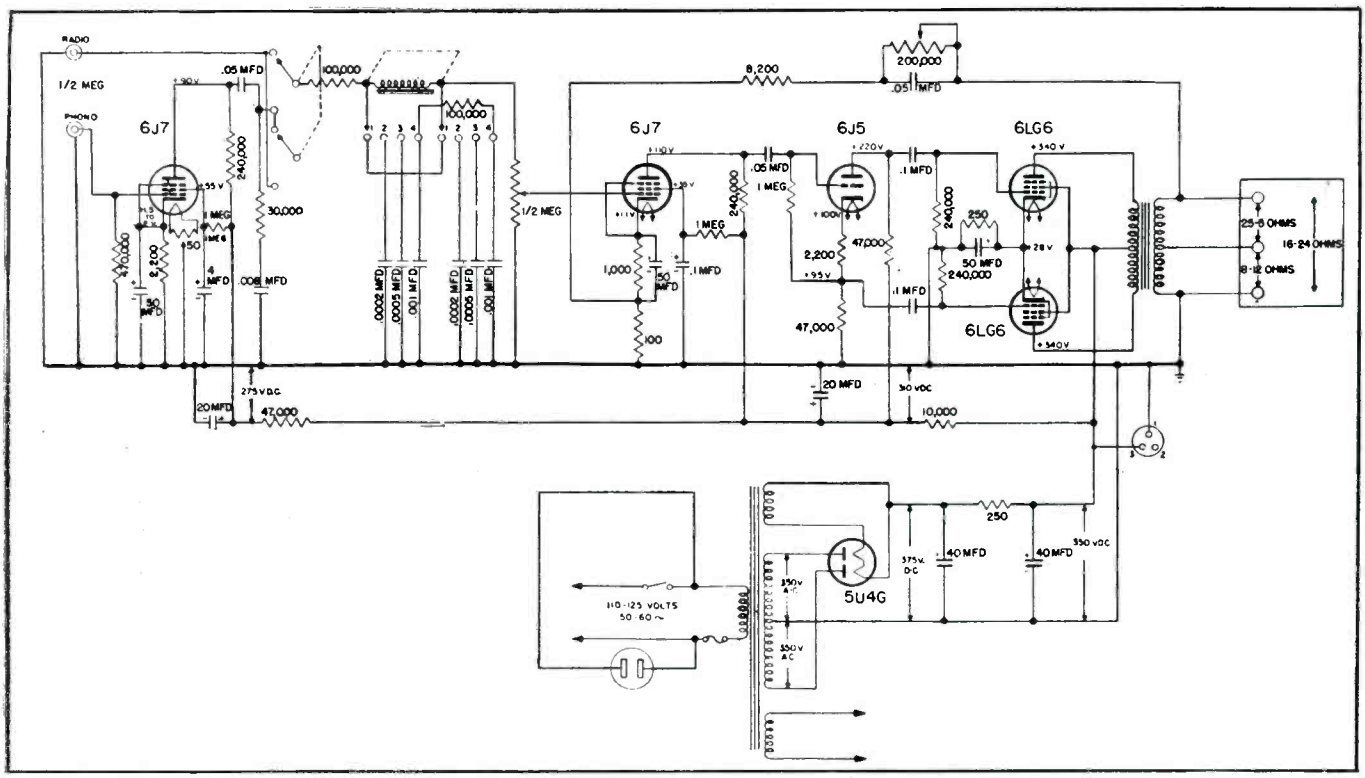


Fig. 4. Circuit of the Altec Lansing amplifier kit.

Ser-Cuits

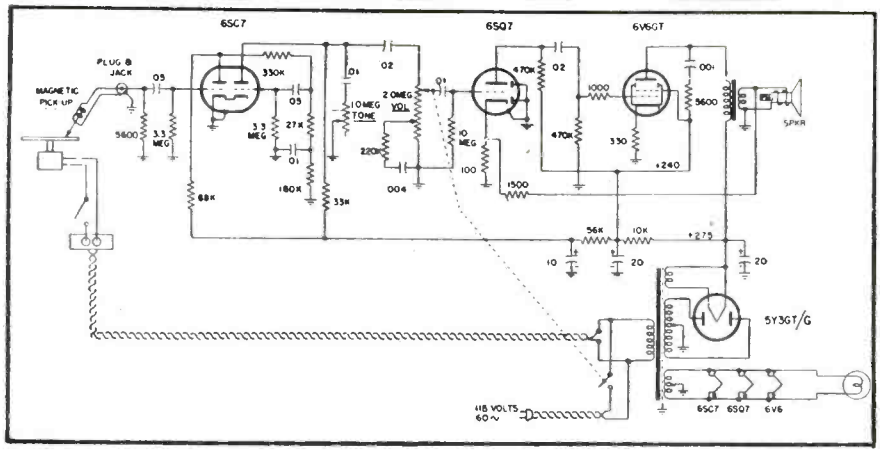
(*Continued from page* 23)

ing of the r-f amplifier. Operation with other antennas results in reduced receiver sensitivity.

The i-f of the receiver is 2,000 kc. The use of this frequency rather than the more conventional frequency of 465 kc, allows a wide band pass for the amplifier, for high fidelity reproduction.

The second detector is of the infinite

(*Continued on page* 46)



Ser-Cuits

(*Continued from page 45*)

impedance type, which is recognized as having extremely low distortion. The use of this type of detector also removes any loading of transformer that would be imposed if other types of detector were used.

A sample of i-f voltage from the plate of a 6SK7 is applied to the grid and plate of one-half of a 6SN7. This section functions as a rectifier of this voltage. The resulting d-c is filtered by means of a capacitor and resistor, where it is then used to supply bias to tubes V1, V2 and V3 for avc operation.

Audio-frequency output voltage from the infinite-impedance detector is taken from the cathode of the left half of V_5. Between this point and the grid of the cathode follower a-f output tube, V_6, is a 10,000-cycle rejection filter. This filter was placed in the circuit to reject any 10,000-cycle heterodyne whistle resulting from stations operating on adjacent channels.

The volume control is a potentiometer in the cathode of the second detector. The audio frequency output level is approximately *O* vu at the maximum adjustment.

Magnetic Wire Reproducers and Preamps

The wire unit has a spooling mechanism device for level-winding magnetically recorded plated wire from a supply reel, past a magnetic reproducing head, to a take-up reel. The supply reel holds sufficient wire for three hours recording. The wire speed is two feet per second, with less than ½% flutter or *wow*. The unit will also rewind the wire in the reverse direction, at the same speed.

A differential unit mechanically couples the supply reel to the take-up reel so that when the supply reel turns in one direction the take-up reel turns in the opposite direction. The wire is drawn off the supply reel by a capstan, and the turning supply reel drives the takeup reel by means of the differential.

The turning ratio between the two reels is automatically controlled and maintains a constant tension on the wire in either direction of rotation. This tension may be varied by means of an adjusting screw.

Loudspeaker Transformers

This sound system is designed to operate into a 24-volt program distri-

Fig. 5. Circuit of the G.E. record player, model 14.

bution circuit. In the loudspeaker distribution circuit each speaker has its own associated transformer which adjusts the impedance to a proper value for use on a 24-volt circuit. Thus, where a loudspeaker is intended to operate at ¼ watt, the ¼-watt transformer tap is used, which makes its impedance such that it will draw ¼ watt of power if 24 volts is impressed across it.

The Amplifiers

The amplifier, Fig. 3, has a gain of approximately 63 db at the high-gain input connection and approximately 50 db, bridging input connection.

Gain control is 38 db in 2-db steps.

Altec Lansing 10576

In Fig. 4 we have a 3-stage plus phase phase inverter amplifier, Altec Lansing A-323-B, which is now available in a kit form, type 10576. In the kit are five elements; output transformer, power transformer, low-pass equalizer choke, punched chassis and circuit diagram.

The amplifier features a hum-balancing potentiometer, high- and low-gain inputs, continuously variable l-f tone control, h-f equalization through the use of a stepped controlled low-pass filter which provides sharp cutoff of noise frequencies, and equalization for phono pickup (designed for variable reluctance type pickups, but can be used with standard magnetic type pickups). Crystal pickups can be used by connection to radio input.

G. E. 14 Record Player

A 4-tube 2.5-watt amplifier, designed for use with a variable-reluctance pickup, appears in Fig. 5. A 6SC7 serves as the phono input, 6SQ7 as amplifier, 6V6GT as power amplifier and a 5Y3GT as rectifier.

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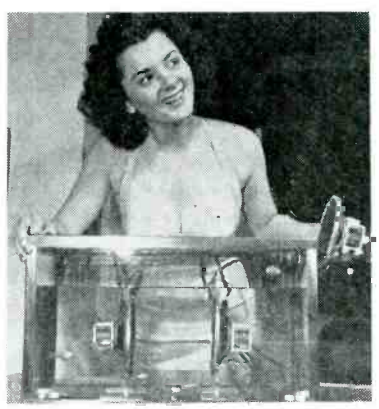
UNDERWATER SPEAKER TEST



G.E. goldfish bowl speaker-test exhibit at the recent Radio Parts Show at Chicago, which served to demonstrate that G.E. speakers, with aluminum foil base voice coils, are not affected by excessive moisture or humidity.

Intercom System

(*Continued from page* 12)

ment speaker is closed to the output of channel *A* (contacts *31* and *32*). It should be remembered that the control tube (*36*) now starts its discharge period, inasmuch as the short circuit of the grid is removed (contacts *29* and *30* are opened) and the capacitor begins to discharge through the 5-megohm grid resistor. For 25 seconds both transfer relays *C* and *D* will be held closed and this is the time period within which channel *A* from the living room is open for communication use. It is estimated that this time interval is sufficient for Mrs. X for her answer. As soon as Mr. X replies again and closes his call button (*21*), the timing circuit is reestablished for another 25-second time period. This was found, under normal conversation, to be entirely satisfactory. As soon as this time period is over and no further conversation takes place from the basement, the control tube (*36*) opens the plate circuit relay *E*, which de-energizes the transfer relays, *C* and *D*, and the system is returned to the normal position, and both voice coils are connected to their respective radio receivers.

Mr. X may leave the power switch (*ICSW*) closed, keeping the system in stand-by condition, or he may shut it off. In either case, if a call is to be put through from the living room, the call button (*20*) is pushed down, which instantly closes the control relay *A*, which again initiates current conductivity of the control tube (*36*), (contacts *27* and *28*), and places the system in operation for 25 seconds after the call button (*20*) is released. Channel *A* is completed to the basement speaker in the same manner as before. It is to be noted that the call button (*20*) need not be held closed for communication from the living room and may be released as soon as the transfer relay *D* is closed. This is observed either by the fact that the living-room speaker will become disconnected from the receiver and the program stopped, or if the receiver was not on, by the fact that it is turned on (contacts *16* and *17*) and the pilot light of the console will be lit. These are the indications for Mrs. X as to how long she should press down on call button (*20*).

If the system was not in a stand-by condition, operation from the living room can be effected in the same manner since certain contacts (*25* and *26*) of the transfer relay *A* bridge the power switch (*ICSW*) of the intercom. In this case, the call button (*20*) will have to be held a little longer until the system is warmed up and the plate circuit relay *E* is closed; that is, until either the radio program of the console stops, or, if it was not on, the pilot light shows. Thereafter, the system is in operation for 25 seconds, should there be no reply from the basement. If there is a reply within that time, and basement call button (*21*) is closed, the circuit is reset again for an additional 25 seconds, as explained before. When both parties finished talking and the time for the discharge of the grid circuit capacitor of the control tube (*36*) elapsed, the plate circuit relay *E* opens and the contacts (*14* and *15*) which held the system in operation by bridging the power switch (*ICSW*), will open and the inter-com is shut off.

An interesting phenomenon was observed here in that the system would not shut off immediately but would go on and off several times before it finally shut off. It was a slow oscillation and traced to a shock excitation of the plate circuit relay *E*, when the power supply was shut off. This was cured in bypassing the relay winding with a 50-mfd 25-volt capacitor (*37*).

An additional advantage in utility was also made in providing a separate switching circuit for the transfer relays *C* and *D*, actuated from the telephone in the living room or the extension in the basement. A micro-switch was used for this purpose, simply glued on the phone, with a flexible arm extending under the receiver. In this manner, when the phone has to be answered, the receivers are automatically silenced as soon as the telephone receiver is picked up. This is very convenient for those who play the sets fairly loud and have to race around to turn the volume down before they can use the telephone.

It will be noted that no mention has been made of the s-p-d-t switch shown in the circuit next to the voice coil of the basement speaker. This is quite a special switch, about which Mrs. X knows nothing. When the system is in a stand-by condition and this switch is thrown to the left, and you happen to be in the living room, please be careful of what you are saying, even in a whisper!

●

Phono Pickup

(*Continued from page 32*)

commercial records, and in addition serves to increase compliance.

No bearings are employed in this pickup and thus there is no attendant wear and possibility of misalignment through use. The dual torque action is similiar in action to a push-pull audio amplifier resulting in negligible harmonic generation. In addition, vertical movement of the needle produces equal force on adjacent corners of the crystal, instead of opposite ones and will, therefore, produce no voltage. This virtually eliminates reproduced rumble that is associated with vertical movement.

In action, the ratio of the needle length to the cross member of the harness gives the *wrench action* or *torque drive*.

Outwardly, the pickup looks like a conventional type. It mounts, however, on a separate mounting plate which is first installed in place of the old cartridge. The cartridge element is snapped into a prosphor bronze plate which makes it possible to more quickly remove it for examination or eventual replacement.

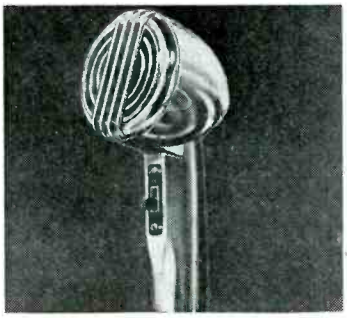
The replaceable needle is low mass whisker type held by a friction sleeve holder. This type needle takes full advantage of the low mass *torque drive*. It is merely pulled out with the fingers or tweezers and a new one inserted in its place.

NEW SOUND PRODUCTS

ASTATIC DYNAMIC MICROPHONES

A dynamic microphone, the *Velvet Voice,* has been introduced by The Astatic Corporation, Conneaut, Ohio.

Has an output level of –50 db below one volt per bar and a frequency range of from 50 to 10,000 cps. Four models cover recommended load impedances of 50, 200, 500 ohms, and 5 meg., the latter model with optional off-on switch.



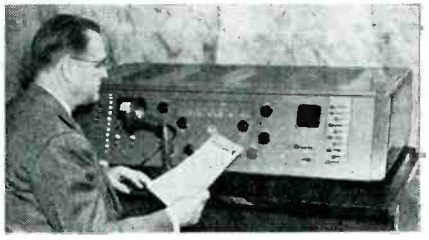
RCA SOUND SYSTEM CONSOLETTE

A control consolette for medium-size sound systems, designed to permit switching of radio or recorded programs or special announcements to loudspeakers in as many as 40 locations, is now being produced by the RCA engineering products department.

Designed with a built-in tuner for a-m, f-m and short-wave use, the consolette (type MI-12798) can supply broadcast programs to any one or all outlets of the sound system. A transcription turntable and several microphones can be used with the unit for supplying music and news to a complete sound system network.

Located on the inclined front panel of the consolette are provisions for up to four banks of switches, each switch governing one loudspeaker location. There are ten switches in each bank. Also included on the front control panel are the mixer controls, a meter for measuring output level, and the radio tuning control.

The consolette has facilities for mixing and controlling three microphone inputs, or two microphone inputs and one high-impedance, high-gain phonograph input. A program control permits variations of level of the input selected by the program switch. In addition to the three-band radio tuner, the unit includes a receiver power supply and a 30-watt amplifier.



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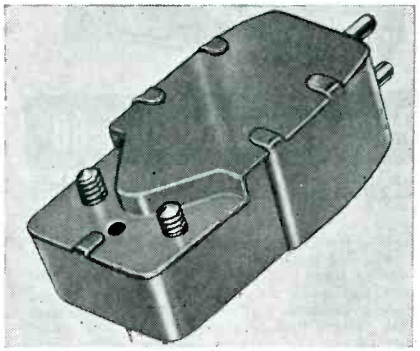
WEBSTER ELECTRIC MAGNETIC CARTDRIDGE

A magnetic cartridge, the *Featheride Magnetic,* has been announced by Webster Electric Company, Racine, Wisconsin.

Supplied with a retractable osmium-tipped needle. Cartridge exerts a tracking pressure of one ounce, giving .1 volt output (uncompensated) at 1,000 cps. Weighs 25 grams.



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WRIGHT SPEAKER DEMONSTRATING BOARD

A speaker demonstration board accommodating two 5", 6", 8", 10" and 12" speakers, complete with a receiver and ten push buttons which control each speaker separately or in multiple, has been announced by Wright, Inc., 2233 University Ave., St. Paul 4, Minn.

Also includes a switching arrangement for matching different voice-coil impedances.

STROMBERG-CARLSON AMPLIFIERS

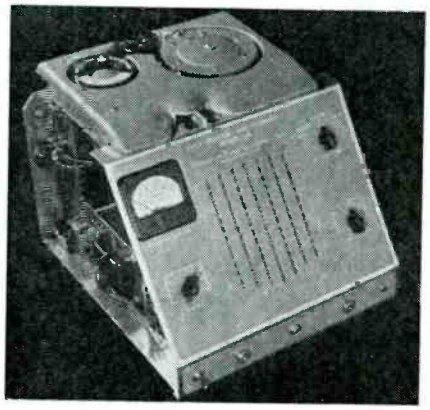
A mobile amplifier with record player operable from either a six-volt storage battery or 105-125-volt 60-cps a-c has been introduced by the Stromberg-Carlson Co., Rochester, N. Y.

The amplifier, model AM-43, will deliver 25 watts at less than five per cent distortion.

Uses two 6SC7s, a 6SJ7, 6N7. 6L6G, and 1006.

EAGLE-WEBSTER WIRE RECORDING KIT

A wire-recording unit kit, with a Webster-Chicago 79 recording mechanism, has been prepared by Eagle Electronics, Inc., Irvington, N. Y.



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JENSEN PROJECTORS

Four *Hypex* projectors have been announced by Jensen Manufacturing Company, Chicago, Ill.

Projectors, ranging from 9" to 24" in size, include model VH-24, a 24" unit; model VH-20, a 20" projector; model VH-15, a horn of 15" diameter; and model VH-91, 9" *baby Hypex*. The two larger projectors are designed for speech and music; the smaller sizes for speech only. Hypex design is covered by patent No. 2,338,262.

* * *

G.E. PHONO PREAMP

A phono preamplifier, UPX003, is now available from the Component Parts Section of G. E.

Preamp, equipped with a rectifier and transformer, may be used in any radio phono, since its source of power is any wall outlet. Designed for use with the G. E. variable reluctance pickup.

Hearing Aids

(*Continued from page 29*)

(*2*) Frequency control (Fig. 3) with at least three positions for adjusting the low and high-frequency slopes of the response curve alternately, and a tone position (Fig. 4) which attenuates the low and high-frequency slopes of the curve, simultaneously. This tone position is called a *noisemaster adjustment* because it cuts out all rumbling noises in the low-frequency spectrum of sound and the hissing, crackling and clothes noises in the high-frequency spectrum. Only the important middle frequencies vital to speech intelligibility are unaffected by the noisemaster adjustment.

(*3*) Peak output limiter to control the maximum acoustic output of the hearing aid. The adjustment of this limiter, which may be an audio or d-c power adjustment, precludes the possibility of sounds striking the threshold of pain in a nerve deafened ear with recruitment factor.

(*4*) Gain from 35 to 85 db depending on the size of the *B* battery employed with the hearing aid; *B* batteries of from 15- to 45-volt power are used with various hearing aids.

(*5*) Gain control continuously variable, providing a 50 db logarithmic adjustment.

(*6*) Power consumption of the *A* battery no more than 70 ma at 1.5 volts, the *B* battery being required to carry a load of more than 1.5 ma at 45 volts. A positive acting switch is essential too, to enable the user to turn off the *A* battery. It must be designed to avoid accidental starting by contact with clothing.

All hearing-aid tubes are of the filament type, since the heating and current drain must be kept as low as possible. The average *A*-battery life is approximately 50 to 85 hours during the time it drops from 1.5 to 1 volt. The average *B*-battery drain of a hearing aid provides a life expectancy of 250 to 400 hours during the period in which each of the series cells drop from 1.5 to 1 volt per cell.

The present trend in hearing-aid design is to incorporate the battery power supply with the amplifier as a single unit. Such a unit (Fig. 5) cannot include a battery with more than 30-volt capacity, or the weight of the unit will be excessive as a wearable instrument; therefore when a 45-volt battery is required, it must be external from the amplifier.

(*7*) Quality; total harmonic distortion at a level which does not interfere with the intelligibility of speech, as tested with many using a test chart of the type shown in Fig. 1.

(*8*) Flexibility; output (Fig. 6) of amplifier being adaptable for connection to air or bone receivers and to crystal receivers. Inverse feedback used when the receivers have a fluctuating impedance characteristic with frequency or a sharp resonant peak which

[3]Eveready Mini-Max type.

would load the primary side of the transformer.

Important Design Features

In developing a hearing aid, three factors must be considered:

(*1*) Feedback must not exist, and all tubes and circuits mounted on a chassis less than five square inches.

(*2*) All possibilities of moisture on the tubes, chassis and other components must be eliminated.

(*3*) Microphone and chassis must be floated so that clothes and cord (between receiver and amplifier) noise is at a minimum level.

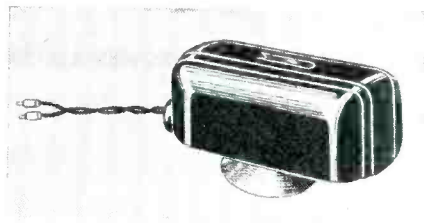
The newest hearing aid models now being marketed have a number of features not included in any prewar instruments:

(*1*) Printed circuits on ceramic chassis.

(*2*) Inductive pickup coils (Fig. 7) for use during telephone conversations. This pickup coil in the hearing aid makes it unnecessary for the user to hold the receiver portion of the telephone against the microphone as was previously necessary; therefore much of the interference and contact noise is eliminated when the sounds are coupled into the hearing aid magnetically.

(*3*) Magnetic microphones which are not affected by humidity and high temperatures.

Fig. 7. Inductive coil pickup attachment for hearing aid used with telephone. (*Courtesy Acousticon*)



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16-MM Servicing

(*Continued from page* 15)

ferably a constant-output sound loop. An output meter will then indicate the tube giving highest amplification in each position and the machine vibration attending operation will show up any harmful resonant mechanical microphonism in the tubes.

Victor 55 Amplifier (Cover)

A 3-tube amplifier used in one of the newer types of projectors, the Victor 55, appears on the cover of this issue.

This projector is a lightweight type, particularly designed for home, classroom and conference applications.

WHEN YOU CHANGE YOUR ADDRESS

Be sure to notify the Subscription Department of SERVICE at 52 Vanderbilt Avenue, New York 17, N. Y., giving the old as well as the new address, and do this at least four weeks in advance. The Post Office Department does not forward magazines unless you pay additional postage, and we cannot duplicate copies mailed to the old address. We ask your cooperation.

NEWS

SYLVANIA SERVICE MAN PROMOTION CAMPAIGN

A national campaign to boost radio repair sales for authorized Service Men, including a continuing series of advertisements in national weeklies, has been launched by the radio tube division of Sylvania Electric Products, Inc.

The national campaign will be supplemented at the local level with merchandising material supplied in a kit including direct-mail pieces, window displays, decalcomanias, window posters and mats for local newspaper advertising by Service Shops.

The national magazine campaign is designed to attract the set owner through cartoon type illustration, text featuring the Service Man, his services, and the Sylvania authorized dealer emblem. The emblem is offered in two four-color decalcomanias in 8" and 12" sizes for application to shop doors and windows and the Service Man's truck.

* * *

BRACH CATALOG

A 16-page catalog, 48-A, has been issued by L. S. Brach Manufacturing Corporation, Newark, N. J.

Catalog discusses lightning arresters, gas relays, terminal strip, potheads, and other electric equipment.

* * *

ALPHA WIRE CATALOG

A 12-page catalog, No. 48, describing wire and wire products for a variety of a-m, f-m and tv applications, has been published by Alpha Wire Corp., 50 Howard Street, New York 13, N. Y.

SANFORD H. LEVEY BECOMES ALLIED RADIO S-M

Sanford H. Levey has been appointed sales manager of Allied Radio Corporation, Chicago.

Walter F. Marsh, formerly sales manager, leaves Allied to join the Leroy W. Beier Company.

* * *

RIDER TV "HOW-IT-WORKS" BOOK

The Rider *Television-How It Works* 200-page book, which accompanies the new Rider Television Service Manual Volume 1, will be available as a separate book, and sell for $2.70.

The book is divided into twelve chapters. The opening chapter deals with an over-all picture of the transmission and reception of tv signals; then frequency standards and receiving antennas are discussed, followed by explanations of each section of the television receiver. The latter portion of the book covers trouble-shooting and alignment.

PHILCO SERVICE EXPANDS MEMBERSHIP

The service division of Philco has been expanding its membership since the war and now has about 30,000 service representatives in the United States trained in the maintenance and repair of all makes of receivers and allied Philco products.

In addition, there are 2,962 certified members of Philco Service in Canada, and 2,309 trained representatives in other countries.

* * *

JACK MENDELSON NOW AIR KING FIELD SALES DIRECTOR

Jack D. Mendelson has been named field sales director for Air King Products Co., Inc., Brooklyn, N. Y.

Mendelson was formerly with Emerson radio.

* * *

TRANSVISION TV BOOKLET

A 20-page booklet detailing the operation of a tv receiver and transmitter has been issued by Transvision, Inc., New Rochelle, N. Y.

Among the topics discussed are tv camera tubes, picture tubes, interlaced scanning, ground and sky waves, antennas, tv kits and their design and assembly.

Booklet is priced at 35 cents.

JFD TV ANTENNA FORUM

The first in a nationwide series of forums on tv antenna installations and servicing sponsored by the JFD Manufacturing Co., Brooklyn, New York, was held recently in Newark, N. J., in cooperation with the R. A. D. A. of Northern New Jersey. The forum was attended by 350 parts distributors and Service Men, in addition to local JFD television and f-m antenna distributors.

Guest speakers included George Duwall, of the Duwall Radio Service, who founded Television Technicians in 1939. He discussed the growth of problems in tv installations.

Martin Bettan, chief engineer of the Colonial Television Company, was also a guest speaker, and discussed theatre television projection.

Albert J. Friedman, JFD chief antenna development engineer, analyzed practical and theoretical television installation practices. Impedance matching and phasing of complex arrays, and the use of various antennas with regard to specific locations were the other main topics covered by Mr. Friedman.

George Duvall (left) and Albert Friedman answering questions during the open-discussion period at the JFD forum.

JOTS AND FLASHES

TV HAS SKYROCKETED the importance of antennas. At the recent Parts Show in Chicago, tv antennas shared the limelight in the various exhibits, models being shown for all types of locations for outdoor and indoor use. The indoor antennas were quite interesting, some being of the simple dipole type for molding or under-the-carpet installation, and others for attic use. One attic antenna was extremely unusual in its design, consisting of a pair of biconical tinfoiled flares for assembly by the Service Man. . . . Sound was also a featured item at the Show with an assortment of amplifiers, speakers and pickups on view. Magnetic pickups were featured by several manufacturers. Comprehensive analyses of these developments and other factors in sound appear in this, the annual *Sound* issue of SERVICE. . . . E. H. Vogel has returned to G. E. as a member of the staff of Dr. W. R. G. Baker at Syracuse. . . . D. E. Weston is now assistant sales manager for the standard line of G. E. receivers. . . . Admiral Corporation, New York Distributing Division, Inc., are now located at 621 W. 54 Street, New York City. E. R. Glauber is sales manager. . . . G. Robert Wannen, manager of Sylvania Electric's eastern radio tube sales division, died recently. . . . R. M. Karet Associates have been appointed national sales appointed national sales representatives for the Astra-Sonic portable wire recorder-radio-phono units made by the Pentron Corp., 611 W. Division St., Chicago. . . . A complete roster of The Representatives of Radio Parts Manufacturers, Inc., has been prepared and will be furnished to manufacturers free. Requests should be addressed to L. C. McCarthy, secretary of The Representatives, 9 S. Clinton St., Chicago 6, Ill. . . . The Crown Capacitor Corp., recently formed, is now located at 316 Stuart St., Boston, Mass. J. H. McCulloch, formerly with the Canadian Marconi Company is chief engineer. Joseph D. Blumenthal is general manager. . . . Members of the Los Angeles chapter of The Representatives visited the Naval Air Missile Test Center at Point Mugu recently. A complete series of tests of radio controlled planes were viewed by the Reps. . . . Henry S. W. Burwell, Atlanta, Georgia, has been named president of The Representatives. William E. McFadden, Columbus, Ohio, has been chosen vice president, and L. C. McCarthy, Chicago, Ill. secretary-treasurer. . . . A six-page folder on rosin-filled solder has been published by Alpha Metals, Inc., 363 Hudson Avenue, Brooklyn 1, N. Y. . . . J. C. Farley is now general manager of the radio division of Sylvania Electric. . . . Paul Meissner has been named production manager of the Marion Electrical Instrument Company, Manchester, N. H. . . . Folded dipole antennas manufactured by the Technical Appliance Corporation, Sherburne, N. Y., are licensed under RCA patents. . . . Sid Goldin has become an account executive with Sander Rodkin Advertising Agency, Chicago. . . . Irving W. Rose, 344 North Michigan Avenue, Chicago, is now the midwestern rep. for the Illinois Condenser Co., Chicago. . . . Wright, Inc., 2233 University Ave., St. Paul, Minn., has produced an adjustable mounting bracket which permits installation of Wright speakers in practically any table model receiver.

ADVERTISERS IN THIS ISSUE

SERVICE INDEX—JUNE, 1948

EQUALLY MATCHED

Split the reed assembly of a Mallory vibrator down the middle and the two halves will match each other so accurately that no scale made will register a significant difference.

This precise distribution of weight is a major factor in assuring accurate output, reliable operation and long life.

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The Mallory Replacement Vibrator Guide is free. The Vibrator Data Book is $1.00—from your distributor or by mail.

Such careful manufacturing makes Mallory vibrators free of bounce and chatter and dependable in starting. More of them are used in original equipment than all other makes combined. That's convincing proof they are the best replacement vibrators for you to stock.

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Mallory "2448" Vibrator Deal

This deal gives you a handsome storage and display cabinet for your stock of vibrators, together with a selection of vibrators and buffer capacitors that will answer 75% of your requirements.

You pay only the service man's net price of $24.48 for the six vibrators and twelve buffer capacitors. There is no charge for the attractive, convenient cabinet. Your Mallory distributor has them in stock for immediate delivery.

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APPROVED PRECISION PRODUCTS

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

New "Double-Pitch" displays work hand-in-hand with Counter Merchandiser to help you sell more RCA Radio Batteries.

Another RCA First...

a Counter Merchandiser for Portable Radio Batteries

• RCA leads again . . . this time with a *radio* battery counter merchandiser that puts those fast-moving RCA portable types right out on the selling line! And it takes up only 8 x 14 inches of your valuable counter space!

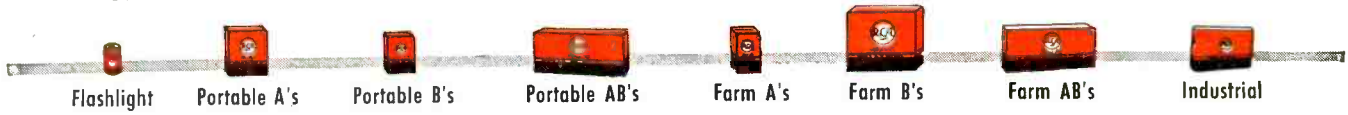
Each counter merchandiser holds 18 VS-016 "B"s and 24 sealed-in-steel VS-036 "A"s . . . or a combination of other RCA portable types. And there's storage space for spares in the back.

This powerful little salesman is of *all-steel* construction, dressed up in the famous red-white-and-black RCA carton colors familiar to millions of users of RCA products.

Don't miss the *extra* business this point-of-sale natural will bring. Ask your RCA Battery Distributor for Form No. 2F406 . . . and the story on the most comprehensive *sales promotion plan* in the radio battery industry today!

Another RCA first in counter merchandising . . . the Carry Kit Package of eight sealed-in-steel "A" batteries that stimulates large unit-of-sale purchases. Get *your* share of the big portable "A" business by ordering an ample supply today.

SELL RCA BATTERIES—*THE COMPLETE LINE FOR THE RADIO AND ELECTRONIC TRADE*



TUBE DEPARTMENT

RADIO CORPORATION of AMERICA

HARRISON, N. J.