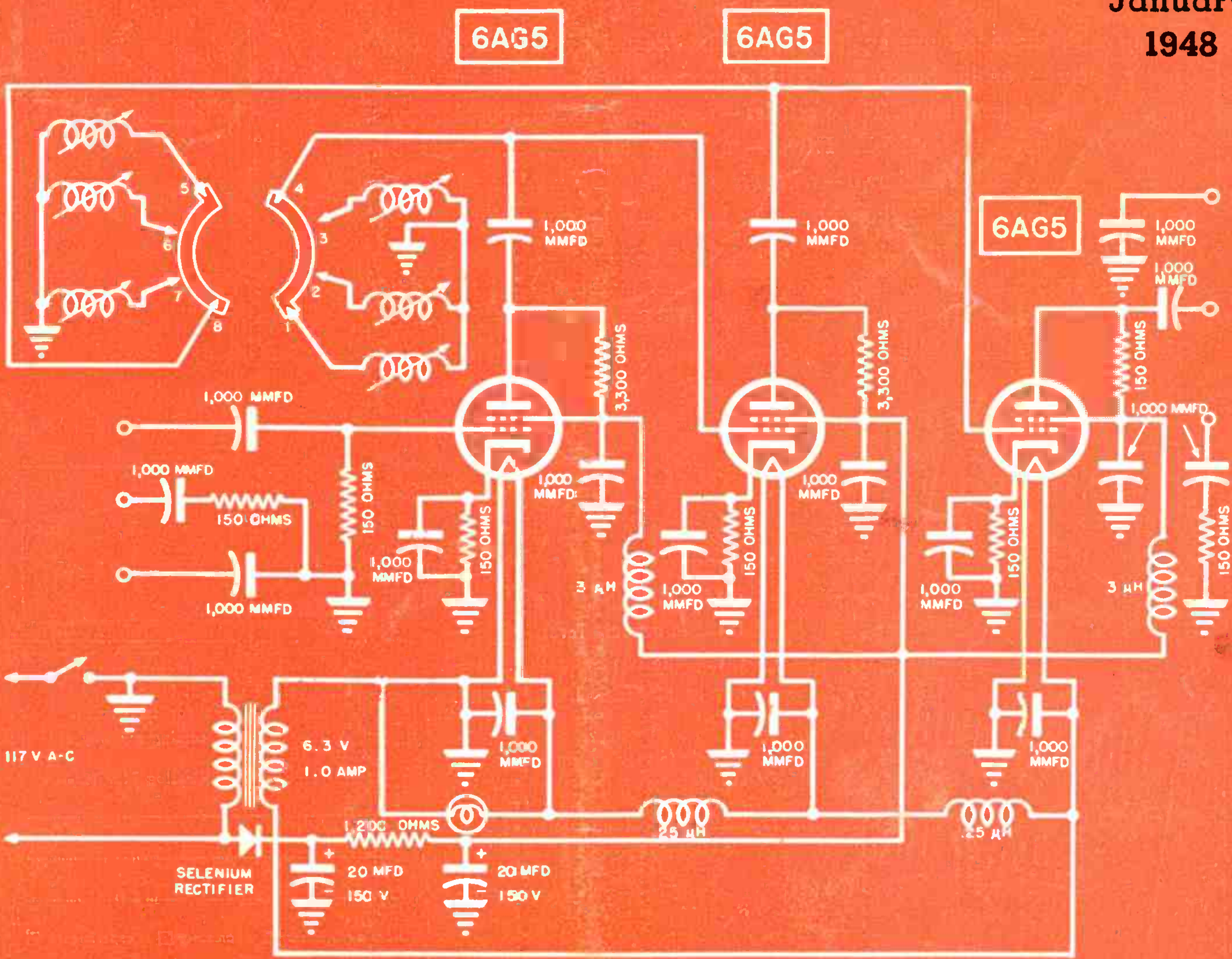
RADIO · TELEVISION · ELECTRONIC

SERVICE

January
1948



Three-tube high-gain television-signal booster, with provision for 75-ohm or 300-ohm inputs and outputs.

[See page 2]

THE TECHNICAL JOURNAL OF THE RADIO TRADE

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AT THE PHILADELPHIA TOWN MEETING OF TECHNICIANS

THE FIRST OF THE SERVICING BUSINESS-TECHNICAL clinics, held in Philadelphia in January, which may serve as the basis of nationwide meetings, proved to be quite a show. In a two-day crowded program, some twenty specialists thoroughly covered a variety of business and technical problems.

The Program

The president of the Charter Bank of Philadelphia, Ralph Pitman, analyzed the vital subject of bank credit, telling how to build it, use it and treat it. Then Charles Toewe, a certified public accountant with Main and Co., told the boys about money and how to keep it. The fairness of bills to the technician and customer was the subject of a talk by Philip G. Zink, Jr., a certified public accountant with Wolf & Co. The vice chairman of the electrical group, National Credit Men's Association, Charles Abell, revealed some very vital information in a talk on "How and When to Collect and Pay Your Bills."

Advertising was also treated quite effectively in two talks. Harry P. Bridge, of Harry P. Bridge Co., disclosed ways and means of using advertising, and David Arons, publicity director of Gimbel Brothers, covered the all-important subject of public relations versus purse relations.

Television and f-m were featured topics in the technical talks. John A. Meagher of RCA Service Co., covered the subject in two talks: one on tv service in the home with elementary test equipment and another on alignment procedures for tv and f-m. Robin D. Compton, chief engineer of WCAU-TV, gave the boys some practical pointers on how to install a television set in the home with hints on the kind of instruction to give the customer. Television servicing in the shop was the subject of another talk by Ray Robinson of Philco. Mr. Robinson also covered the subject of antenna installation and adjustment in another presentation.

Two engineers from Philco, James Russel and John Pell, analyzed f-m, r-f and i-f systems and r-f conversion systems.

A series of four papers on testing, prepared by John F. Rider and Howard W. Sams, were presented by members of the Temple University Technical Institute staff; Matthew Mandl, lecturer in electronics, presented a paper on signal tracing; Edward M. Noll, who is currently writing a series of articles on television for SERVICE, and who is a lecturer in television, electronics and technical writing at Temple, offered a discussion on cathode-ray oscilloscopes; Fred Kierstead, lecturer in electronics and television, covered signal sources, r-f and audio; and Arthur L. Hatton, lecturer in radio and electronics, presented the paper on voltage, capacity and resistance measuring devices.

The keynote address of the meeting was made by Max F. Balcom, RMA president. He pointed out that the meeting was an encouraging sign that those in servicing are vitally interested in doing something about a problem, a very important problem of setting up standards of operation which will instill confidence in the entire profession.

"I don't need to tell you men," he said," that the day when a handy man about the house could fix a radio with a screw driver and a pair of pliers has passed. Proper servicing requires more skill, greater familiarity with various types of test equipment and more technical know-how than ever."

"The technician is an extremely important representative of industry and dealer," he continued. "Going into the home to repair equipment, he comes in more direct contact with the consumer than anyone else. By his actions he is able to build up or undermine public confidence in the industry and its products. I think, perhaps, all of us have been guilty of underestimating the importance of the technician in industry public relations, and our present efforts should be only the first step in rectifying this mistake."

The town meeting, which was sponsored by the Radio Parts Industry Coordinating Committee, Electronic Parts & Equipment Manufacturers, NEDA, RMA and Sales Managers Club, Eastern Division, was also suported by ten distributors in Philadelphia and the Mid-Lantic chapter of the Representatives. Cooperating with these groups were the Philadelphia Radio Servicemen's Association and the Federation of Radio Servicemen's Associations of Pennsylvania.

The importance of the radio technician was also stressed by W. L. Parkinson, of General Electric, who is chairman of the RMA Service Committee. He pointed out that RMA will work very closely with the technician to promote their usefulness to the industry and the consumer. A definite plan is being formed now and will be announced within the next few weeks.

The clinic meetings were proceded by an interesting one-day session of the Federation of Radio Servicemen's Associations of Pennsylvania during which delegates of Pennsylvania servicing associations and associations in ten other states were present. Some 22 organizations were represented, covering the activities of over 3,000 men.

The group prepared a resolution for presentation to the RMA as a guide in setting up a coordinating public relations program for the Servicing industry. A new code of ethics was also prepared, which said in part:

"I will at all times, without any exceptions, perform my work to the very best of my knowledge and ability. In addition, I will make a sincere effort to improve my knowledge of the technical and business requirements of my profession, thereby enabling me to render still better radio-electronic service.

"I will, whenever practicable and desirable, prefer to use original factory replacement parts. In other cases, I will use replacement parts known to be of equal or better quality, thus insuring satisfactory performance.

"I will engage only in fair and ethical practices recommended and approved by the radio-electronic technicians' profession as being conducive to public confidence."

The industry, technician and consumer can't help but benefit from clinic sessions of this type. We hope there will be more meetings in other cities and very soon!

Highlights of the technical and business papers presented at the sessions will appear in February. Watch for them.—L. W.

In This Issue

F-M Antenna

The transmission line is a major factor in v-h-f antenna systems. Its characteristics determine the manner and effectiveness in which a signal is conducted or guided from the antenna to the receiver.

There are four common types used for the transfer of r-f energy, namely: two-wire, four-wire and coaxial lines, and wave guides. The two-wire and coaxial lines are most often employed in home receiver installations.

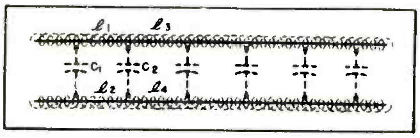
Transmission Line Impedance

If the length of a transmission line is short compared to the wavelength of the r-f voltage it carries, then the opposition presented to this r-f voltage is chiefly at the load connected across the receiving terminals. If the line is long compared to a wavelength, the line itself may present even more opposition to the r-f voltage than the actual load. This is because a long line (compared to a wavelength) exhibits not only resistance but also reactance to the flow of a-c.

This reactance is in the form of series inductance and shunt capacitance uniformly distributed over the length of the line, as shown in Fig. 1. This can be understood if we think of each conductor in a parallel line as being a simple air-core inductor unwound. We know that every current-carrying conductor has both an electromagnetic and electrostatic field about it. It follows that every conductor carrying an alternating-current must be an inductor and therefore, must present an inductive reactance to the flow of this a-c.

The distributed capacitance can be accounted for by considering the two conductors of a transmission line as two plates of a capacitor upon which an r-f voltage is impressed. From a study of Fig. 1 we note therefore that the distributed inductance opposes the r-f voltage transfer over the line and the distributed capacitance acts as a shunt across the line, thus short-circuiting part of the signal or power from the load connected at the receiving end of the line. Both of these effects represent a loss between the sending and receiving end of the line and must be carefully taken into account when working with the transmission of r-f energy at 100 mc.

Fig. 1. Distributed constants of a transmission Line.



Characteristic Impedance

One of the most important properties of an r-f transmission line is commonly referred to as its characteristic impedance[1], Z_0. The characteristic impedance of a line is important because the load value at which minimum line losses occur is determined by the ratio of Z_0 to the load impedance. The characteristic impedance, Z_0, may be defined as the impedance a line of infinite length would present to an electrical impulse induced in the line.

We can obtain a picture of how this characteristic impedance is determined by studying Fig. 2. Here we have a purely resistive network made up of the resistances indicated. If only the first section, r_1 r_2, is connected across 100 volts, the current flowing will be 0.01 ampere and the resistance will be

$$R = \frac{E}{I} = \frac{100}{.91} = 110 \text{ ohms}$$

If three sections are connected across 100 volts the current will be 2.06 amperes and

$$R = \frac{100}{2.06} \text{ or } 48.4 \text{ ohms}$$

Similarly it can be shown that the resistance of 6 sections is 38.6 ohms. At this point it will be noted that the resistance has decreased less than 10 ohms even though the number of sections in the circuit have been doubled. This leads to the assumption that if a sufficient number of sections were added a point would be reached where an increase in the number of sections would not decrease the total resistance of the circuit by any noticeable amount. It can be shown mathematically that the total resistance of such a circuit composed of an infinite number of sections is 37 ohms.

Although the mathematics for calculating the characteristic impedance of an r-f line is much more involved than this resistance network example, it should be evident that the same reasoning applies to both cases. In other words, an infinitely long line must present a certain impedance to an applied r-f voltage.

[1]Impedance is the resultant of the d-c resistive, inductive and capacitive components within an a-c circuit.

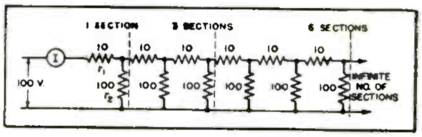
Resonant and Non-Resonant Lines

Every transmission line regardless of physical construction may be classed as either resonant (tuned) or non-resonant (untuned). If it is terminated in its characteristic impedance it is non-resonant or untuned. Non-resonant lines are usually employed for receiving antennas. Although a perfect match is difficult to obtain in practice, a close approximation is possible. It is important to remember that *the line must be terminated in a pure resistance;* a reactive component in the terminating load will cause reflections of voltage and current even though the load impedance in ohms equals the characteristic impedance. The reactive component in a load can be tuned out in order to obtain a pure resistive effect.

Standing Waves

If the load is not resistive and matched to the line impedance it reflects signal back into the line. The

Fig. 2. Parallel-series resistance network of an infinite number of sections.



Transmission Lines

Complete Analysis of Two-Wire And Coaxial Lines, With Data On Types of Lines, Line Impedance, Characteristic Impedance, Resonant And Non-Resonant Lines, Standing Waves, Quarter-Wave and Half-Wave Lines.

by LES GRAFFIS

Staff Engineer
Service Division
Bendix Radio

combination of the outgoing and reflected signals produce what are commonly referred to as standing waves on the line. An r-f voltmeter may be used for measuring the voltage waves and an r-f ammeter inserted in series with one conductor for measuring the current wave providing the line is carrying sufficient power to actuate a meter. An f-m antenna does not receive sufficient power when used for receiving purposes; therefore, it is necessary to couple an r-f voltage into the line from an r-f oscillator to measure the standing waves. It is important to remember that even though the maximum and minimum points of the waves are stationary (as long as the load does not vary) that the actual voltage and current are alternating at the r-f frequency. There is no d-c component of either voltage or current.

The presence of standing waves on a transmission line indicate a mismatch between the line and the load. If the load does not match the line the length of the line becomes critical. The ratio of mismatch is approximately equal to the standing-wave ratio, providing there is little or no reactive component in the load impedance.

$$\text{The standing-wave ratio} = \frac{E_{max}}{E_{min}}$$

where E_{max} is the voltage at the peake of a wave and E_{min} is the voltage minimum. A standing-wave ratio less than 2 to 1 is to be desired for a satisfactory non-resonant line. For example, if an r-f voltmeter indicated a voltage peak of 12 volts and a voltage minimum of 4 volts

$$\text{the standing wave-ratio would} = \frac{12}{4}$$

or 3 to 1. This indicates that the load impedance is either 3 times greater or ⅓ the characteristic impedance of the line.

Previously it was stated that the signal was reflected back along the line unless the load impedance equalled the line impedance and was purely resistive. Also, that the impedance presented to the r-f generator by the line, plus the load, equals the load impedance *only* when the two are matched. This suggests that a line terminated in other than its characteristic impedance might be used either as an impedance matching transformer, or as reactive (inductive or capacitive) elements in an r-f circuit.

If a line is terminated in a short circuit, there is no load resistance in which to dissipate the energy, therefore, it is reflected back toward the r-f generator. The standing waves of voltage and current along the line are 90° out of phase, which also indicates that no power is being dissipated. It will be noted that a voltage minimum and a current maximum occur at the shorted end. This is logical since high current and low voltage are to be expected at a short circuit.

If the line is terminated in an open circuit, the voltage and current loops are reversed and a voltage maximum and current minimum appears at the open circuit end. Again these are the conditions to be expected at an open circuit and indicate that no power is radiated.

The foregoing discussion dealt with a line of specific length. It was emphasized that location of the voltage and current maximums were determined solely by the value of load impedance at the receiving end of the line. If a line is shortened by one-quarter wavelength the impedance seen by the generator will be reversed from a high to low impedance, or vice versa, as the case may be, regardless of whether the line is terminated in a short or open circuit. A quarter-wave section of line, therefore, presents either a high impedance when shorted or a low impedance when open circuited.

It is apparent that the characteristics of a quarter-wave section of line, are similar to a resonant circuit. For

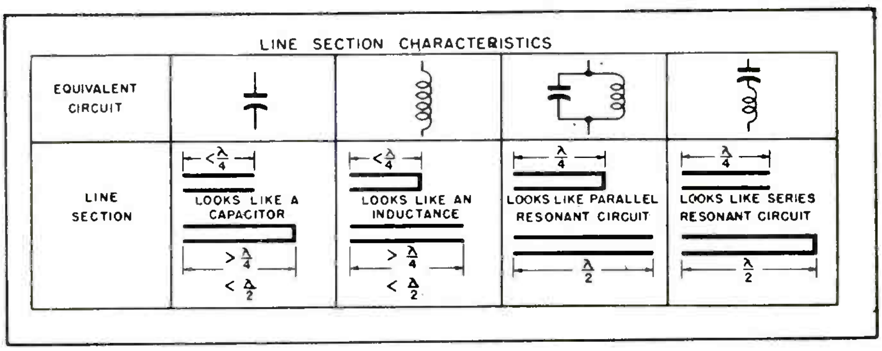


Fig. 3. Characteristics of line sections.

How The 'Scope Works

by **ALVIN A. BAER**

Meybaer Radio
New York City

Simplified Mechanical Analogy Used To Explain How The 'Scope Interprets A-C Waveforms, And Projects Their Picture On The Tube Screen

WITH THE ADVENT OF TV and v-h-f home and commercial receiver servicing, the 'scope has become a necessity in every Service Shop. It is the shop's handiest tool for such specific jobs as alignment, instrument calibration, audio circuit analysis, auto radio vibrator tests, hum measurements, checking test oscillators, filter circuit analysis, etc.

The heart of the 'scope is the c-r tube, which consists essentially of a cathode, control grid, two anodes and two pairs of deflection plates.

C-R Tube Operation

Electrons emitted by the cathode, flow through the control grid toward the two anodes. These anodes are operated at very high potentials and differ from ordinary tube plates in that, instead of attracting the electrons emitted by the cathode, they serve to accelerate the electron flow. In other words, they *push 'em along*. The electron stream then passes between the two sets of deflection plates, which are so balanced as to move in pairs. One pair moves vertically, the other pair horizontally, as shown in Fig. 1*c*, the movement being a function of the voltages applied to these plates.

Since the electron stream is sandwiched between them, and moving forward, it will be forced either right or left, or up or down, in much the same manner that the direction of a stream of water is controlled by the movement of the nozzle.

The face of the c-r tube, coated on the inside with a fluorescent material, fluoresces, or emits light, wherever the electron stream hits it. Thus, the tube is actually an instrument consisting of several elements which serve to control a spot of light appearing on its face.

If a spot of light is moved rapidly enough, the persistency of vision of the eye would cause that spot to appear as a continuous line. This phenomenon is used in the c-r 'scope in tracing patterns on its screen. The patterns are actually a dot moving so rapidly that the eye sees it as a continuous function, or line.

With the application of voltage to the deflection plates, of varying polarity and magnitude, it is conceivable that the spot could be made to move in a circle, a triangle, or almost any

Fig. 1. Three schematic views of a typical cathode-ray tube. In *a* appears the elements of the tube, consisting of a cathode, control grid, and accelerating anodes. These elements serve to create and form the electron stream. The two sets of deflection plates then direct the stream at the fluorescent screen. In *b*, and *c* appear the deflection plates in greater detail.

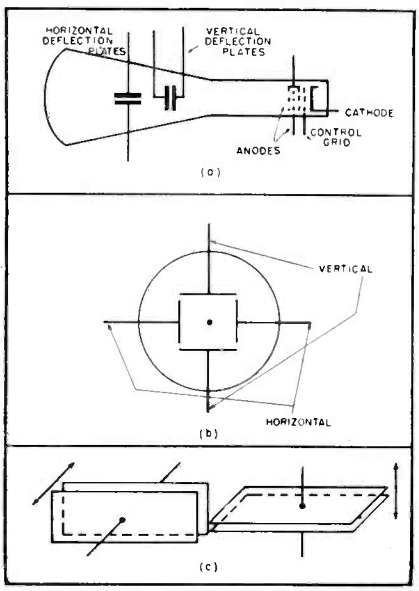


Figure 2. A mechanical analogy to the action of the c-r deflection plates. In *a* we see how a pencil whose movement is restricted by a slot, will draw a straight line within the confines of the slot. If the slot is placed sideways, as in *b*, the line traced will be horizontal. Movement of the slot in conjunction with the pencil movement, as in *c*, will trace a diagonal line. The figures traced by more complex movements of both slot and pencil are shown in *d* and *e*.

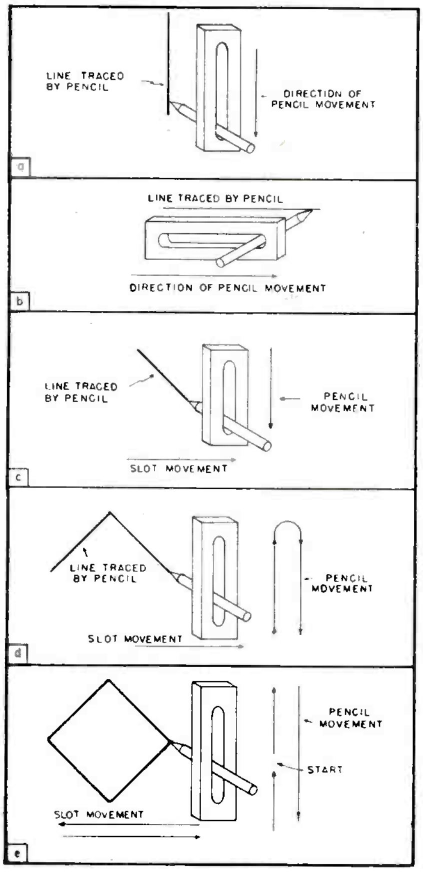
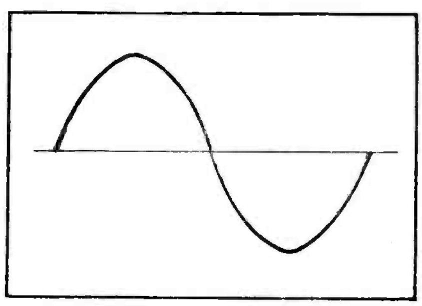


Fig. 3. Sine-wave representation of an a-c voltage.



pattern. This mental concept is very important, since it will help in understanding and interpreting what appears on the screen.

Deflection Plate Voltages

The next point is best illustrated by a mechanical analogy. Let us consider a pencil, so placed in a slot, that its movement is restricted to an up and down movement. So long as the slot remained stationary, the pencil could only draw a straight line; Fig. *2a*. If the slot were placed on its side, as in *2b*, a horizontal line would be traced.

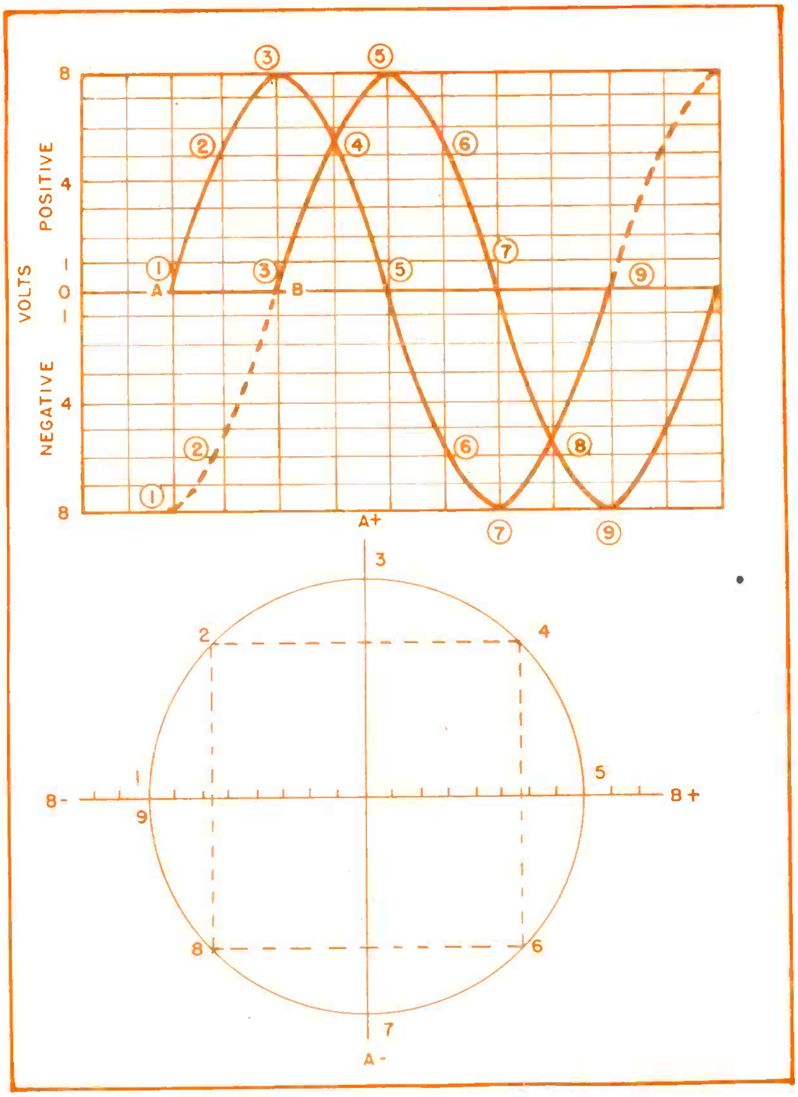
Now, if, while the pencil were completing one movement from top to bottom, the slot itself were moved in a horizontal direction, a diagonal line would result; *2c*. The slope of the line would then be a function of the ratio of the two movements. That is, if both movements were equal in length, the resulting figure would be a slope of 45°.

If the pencil were to move once up and once down, while the slot completed one movement from left to right, an inverted V would result; *2d*. Fig. *2e* shows a perfect square drawn by the pencil. Here, the pencil starts at the halfway mark, and completes one movement up and down, while the slot moves from left to right and back again in the same length of time.

The tieup between this mechanical analogy and the voltages applied to the deflection plates of the c-r tube can now be traced. Fig. *2a* would represent a voltage applied to the vertical plates, varying uniformly from zero to maximum, *2b* represents the same voltage applied to the horizontal plates, and *2c* would result if the voltage were applied to both sets of plates simultaneously. The analogy can be traced similarly for Figs. *2d* and *2e*.

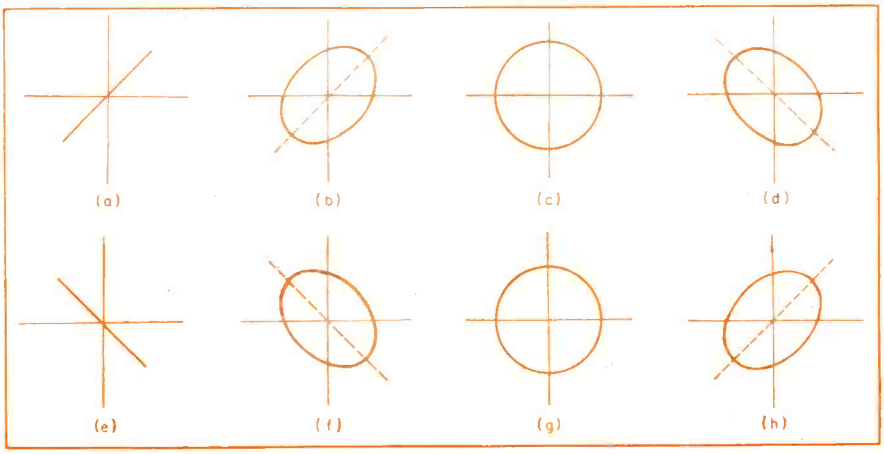
Service Men are familiar with the sine wave representation of an a-c voltage; Fig. 3. If such a voltage were applied to the vertical plates of a c-r tube, a straight vertical line would result. If the same voltage were applied to the horizontal plates, a straight, horizontal line would result. If this voltage were applied simultaneously to both sets of plates, a diagonal line would result. Analyzing the reason for the wave shape, we find that in the case of the straight vertical line, the moving dot is retracing its path in a vertical pattern. The same reasoning applies to the horizontal line. For the diagonal line,

(*Continued on page* 46)



Figs. 4 (above) and 5 (below). The tracing of a Lissajou figure is here shown in detail. Two similar voltages have been applied to both the horizontal and vertical plates. However, one voltage is starting 90°, or ¼ of a cycle later than the other. In Fig. 5, *A* — and + represent the vertical voltages, and *B* — and + the horizontal voltages. The position of the dot will then be a function of these two voltages. The resultant picture in this case is a perfect circle.

Fig. 6. The pictures shown are used to illustrate the effect of phase relationship between two voltages on Lissajou figures. All eight pictures are the result of two identical voltages, both in frequency and amplitude, being applied to the vertical and horizontal deflection plates. However, each picture shows a different phase relationship. Starting at a, which represents zero phase shift, each successive picture depicts a phase shift of 45°, up to and including 270°.



Replacing The OUTPUT TRANSFORMER

Handy Data On Selection Of Proper Output Transformer, Such As Universal Outputs

by FREDERICK E. BARTHOLY

An output transformer is the link between a power tube or tubes in a receiver or amplifier and the speaker. The need for this transformer arises from the difference that exists between the required load impedance for a certain tube or tubes to give maximum output with the least possible distortion and the impedance that the voice coil of the speaker possesses. If the voice coil impedance would be the same as the one required for the load of the tube, no transformer would be necessary. Power tubes and tubes in general are comparatively high-impedance devices, whereas a voice coil, due to space limitations and other physical factors, is a low-impedance device. Unfortunately, hasn't been possible to make a tube which will work efficiently into a six-ohm load, nor can we wind a voice coil under existing physical limitations which would have an impedance of several thousand ohms. Obviously, an impedance-matching device must be provided which will transform the low impedance of the voice coil to the value which equals the recommended load, or vice versa. A transformer is such an impedance-matching device by virtue of the fact that the effective impedance between terminals of one winding depends on the load attached between the terminals of another winding. This relation is governed by the squares of the turns ratio[1], and may be expressed as

$$\left(\frac{N_1}{N_2}\right)^2 \times r = R \qquad (1)$$

where N_1 is the number of turns of one winding and N_2 the number of turns of another winding, r the load placed across the winding having N_2 turns, in ohms, and R the resultant effective load impedance. In loudspeaker matching, r stands for the voice-coil impedance and R for the recommended load impedance of the particular tube.

Unfortunately many Service Men pay little attention to this simple relationship. Often I have heard in a request for a replacement: "Let's have a transformer with a primary winding of such-and-such ohms." The general belief seems to be that the primary impedance is some fixed value that the manufacturer builds into the transformer. This is not the case. Of course, the primary, or any winding, has a certain inductance which, in a good transformer, is relatively high and, therefore, the impedance is high. However, this open circuit or *choke* inductance of the transformer is not the impedance about which we are concerned when matching. The choke inductance has to do with the quality of the transformer and with the losses over a certain frequency range.

It should be remembered that a good transformer, disregarding its small losses, *does not impose a load on the circuit to which it is connected* unless one of the windings terminates in some sort of a load, such as a resistor, capacitor or coil; for example, the voice coil of a speaker. A transformer merely *reflects unto the primary a load connected to the secondary.* This *reflected* impedance is determined by the turns ratio between primary and secondary and not by the number of turns of the primary. For example, a transformer with 1000 turns in the primary and 3000 turns in the secondary has a turns ratio of 3 : 1. Another transformer may have only 500 turns in the primary and 1500 turns in the secondary, but the turns ratio is still the same as before. It is this ratio in which we are interested when considering replacement. This ratio seldom appears on transformers or output transformers; therefore, it must be determined.

We cannot very well take the transformer apart and count the number of turns. On the other hand, the voltage of one winding depends on the voltage supplied to another winding and the turns ratio. As a matter of fact, for all practical purposes the voltage ratio equals the turns ratio. Consequently, if we apply a known voltage to one winding, let us say the primary winding, and measure the voltage on the secondary, we can determine the ratio between the two voltages by simple arithmetic and obtain also the turns ratio at the same time. It may not be amiss to state here that in a transformer the primary winding is the one to which power is applied and the secondary where power is taken off. In a step-up transformer, the primary has fewer turns than the secondary, whereas in a step-down transformer, such as an output transformer, the situation is reversed.

To effect this measurement and make the calculations simple, the voltage supplied to the primary should be an even number, preferably 10, or 100. The 60-cycle supply is satisfactory, or if there is an audio oscillator, the 400 cycle standard may be used. The only instrument necessary is a good alternating-current voltmeter or a vacuum-tube voltmeter. Using the a-c line, the voltage should be dropped down to 100. This can be done with a potentiometer as shown in Fig. 1.

The potentiometer is adjusted to 100 volts, using the meter for this purpose across the primary winding. After that, the voltage across the secondary is measured. The ratio may be read directly. For example, if the secondary volts is 10, the ratio is $\frac{100}{10}$ or 10 : 1, etc.

It was stated before that the primary impedance is determined by the squares of the turns ratio multiplied by the secondary load resistance. For the turns ratio, we have taken the

[1]By turns ratio is meant the difference in the number of turns of one winding with respect to another.

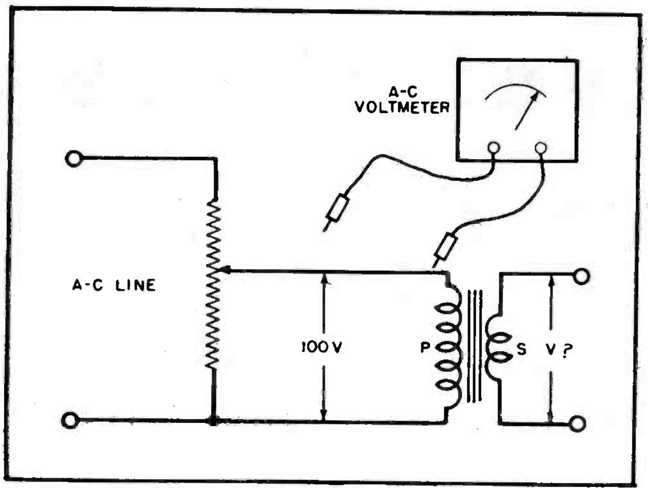


Fig. 1. Dropping voltage to 100 with a potentiometer and measuring circuit to determine winding ratios with an a-c voltmeter.

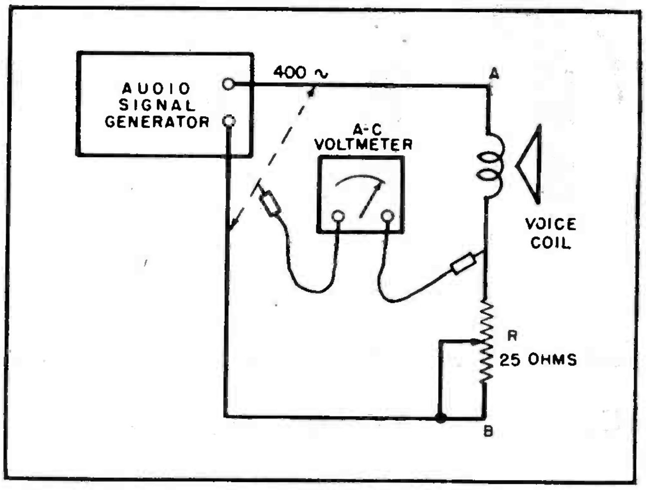


Fig. 2. Circuit used to measure v-c impedance with an a-f generator set at 400 cps and an a-c voltmeter.

voltage ratio and can write the relation in equation *(1)* for voltage ratio by simply substituting *E* for *N*

$$\left(\frac{E_1}{E_2}\right)^2 \times r = R \qquad (2)$$

In this manner, we may proceed easily to determine what output transformer is needed, or in most cases, what tap of the output transformer should be used in a certain speaker and output combination.

Let us illustrate this with a practical example. Suppose we have an output transformer on hand and we want to know what tube it will match with a speaker that has an 8-ohm voice coil. The voltage ratio is measured; let us say this is $\frac{100}{5} = 20$.

Now we must square this number, that is, multiply 20 by 20, which equals 400, and then multiply this by the voice coil impedance . . .

$$400 \times 8 = 3200 \text{ ohms}$$

From the tube characteristics, we find the particular tube for which 3200 ohms is the recommended load. The accuracy here need not be critical and a few hundred ohms plus or minus may be disregarded. If the speaker on hand has a 15-ohm voice coil instead of 8,

$$400 \times 15 = 6000,$$

the matching will be for a tube where the recommended load is in the neighborhood of 6000 ohms; for example, push-pull 6F6 tubes, class AB_2 triode connected.

This method is particularly useful for matching universal output transformers used for replacement. In this case, we can calculate in advance the voltage that the taps used should have and then find the taps that have as nearly as possible this voltage. As an example, let us assume we have a receiver which uses two 6V6s and a speaker with a 6-ohm voice coil. The recommended load for a pair of 6V6s at 285 plate voltage is 8000 ohms. Using the basic formula, we put down the known values. It should be remembered that 100 volts is our standard for the primary.

$$\left(\frac{100}{E_2 \text{ (secondary volts)}}\right)^2 \times \text{voice coil impedance} = \text{load impedance.}$$

Substituting the known values,

$$\left(\frac{100}{\text{secondary volts}}\right)^2 \times 6 = 8000,$$

$$E_2 \text{ (secondary volts)} = \sqrt{\frac{60{,}000}{8{,}000}} = 2.75$$

This means that placing the universal output transformer with the primary across 100 volts a-c, a pair of voice-coil taps between which the voltage reads the closest to 2.75 volts is the correct pair for the voice-coil connection to match the speaker to a pair of 6V6 push-pull tubes; in other words, to obtain 8000 ohms primary impedance. The above formula may be put down in the following form for convenience of calculation:

$$E_2 \text{ (secondary volts)} = \sqrt{\frac{100 \times 100 \times \text{voice-coil impedance}}{\text{load resistance}}}$$

$$\therefore E_2 \text{ (secondary volts)} = \sqrt{\frac{10{,}000 \times r}{R}}$$

In push-pull circuits, the plate load is specified as between the two plates of the tubes. Consequently, the entire primary winding without the center tap should only be considered for the above measuring operations. In single output-tube circuits, additional flexibility is obtained with universal transformers in that either one-half of the primary or the entire winding may be used. It is important here to remember that the reflected impedance between the center tap of the primary and one of the plate terminals is one-fourth of that between the entire winding. As an example, if the reflected impedance across the primary is 8000 ohms, across one-half of the primary, the reflected impedance will be 2000 ohms and not 4000 ohms.

At times it is necessary to determine the voice coil impedance which is always rated at 400 cycles. This frequency is chosen as a standard because it is the frequency at which the voice coil has generally the lowest impedance. The effective impedance of a voice coil varies and at the base resonant frequency, it is about six times that at 400 cycles. To measure the impedance, it is necessary to have an audio signal generator set at 400 cycles and an a-c voltmeter. The circuit shown in Fig. 2 has proved very effective for this measurement.

The output voltage at the signal generator is adjusted to any desired readable value for the meter and *R* is adjusted until the voltmeter has the same indication at *A* as at *B*. The voltage drop across R is then equal to the drop across the voice coil. Hence, the impedance equals the resistance *R*. The latter, after being disconnected, is measured with an ohmmeter.

TV Receiver Video Amplifiers*

General Functions of Video Amplifiers . . . Operation of D-C Restorers in Grid-Rectifier Systems . . . Picture-Tube Signal Circuits

by **EDWARD M. NOLL**

Instructor in Television
Temple University

THE VIDEO AMPLIFIER (one to three stages) increases the amplitude of the detected signal to a level sufficient to swing the picture-tube control grid over its full range. Two other functions of the video amplifier are to apply a properly polarized signal to the picture tube control grid and to establish the average brightness of the picture. The former of these functions, of course, is accomplished by consideration of the number of video stages, and properly choosing the diode detector polarity to produce a negatively polarized signal on the picture tube grid. The latter function, establishing average brightness, is performed by a d-c restorer.

A typical video amplifier has the following features:

(*1*) Polarity of diode is such that a properly polarized signal appears across the diode load resistor and appears negative on the control grid of picture tube.

(*2*) Low value diode-load resistor is used, reducing amplitude of detected signal but preserving high-frequency response up to the highest modulation component.

(*3*) Diode-peaking coil, which assists in maintaining the highs and aids in filtering out the i-f frequency.

(*4*) High value coupling capacitor to prevent degeneration of the lows.

(*5*) Contrast adjustment which controls amplitude of signal developed across output of video amplifier and, consequently, amplitude of signal as it appears on picture tube control grid.

(*6*) Adequate screen filtering to prevent oscillations or degeneration in video amplifier.

(*7*) Inductance peaking to prevent loss of highs.

(*8*) Low value plate resistor to prevent loss of highs.

(*9*) Resistor-capacitor combination with a long time constant for d-c restorer action.

(*10*) Cathode grounded for d-c restorer action or separate d-c restorer tube.

(*11*) D-C coupling often used between video output and picture tube grid, to prevent loss of d-c level established by d-c restorer action.

(*12*) Brightness control to set d-c bias on picture tube for proper illumination of the fluorescent screen.

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

D-C Restoration

Contrast and brightness are often discussed in a physical sense.

In analyzing a tv system, it becomes necessary to evaluate the electronic re-

Fig. 2. Loss of average brightness and blanking levels through a coupling capacitor. Upper plot shows the signal distribution after coupling through capacitor.

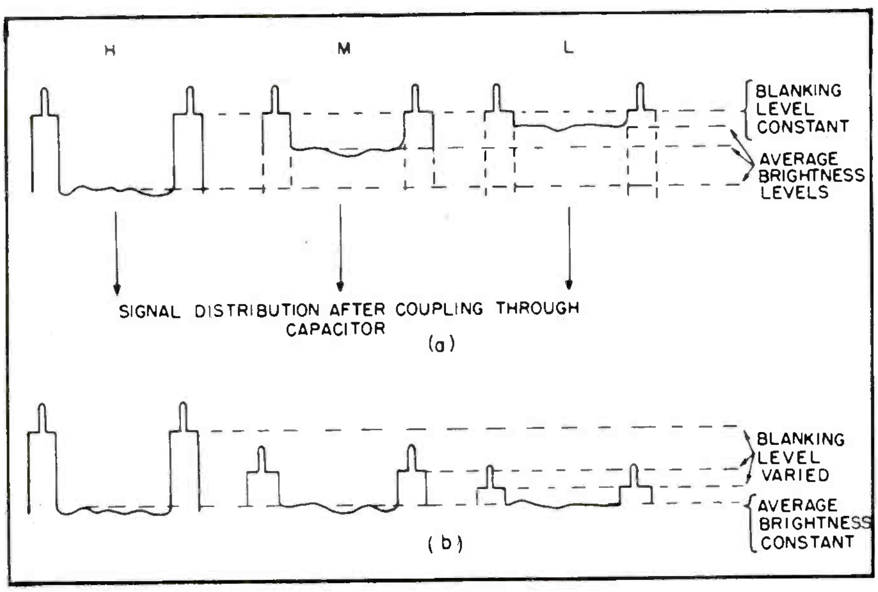
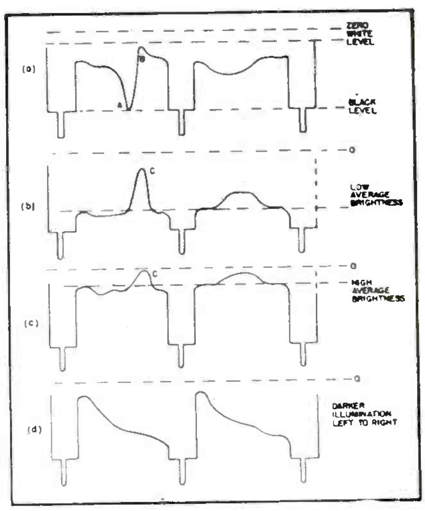


Fig. 1. Distribution of picture information along a few lines.



Quiet as a Moonbeam Falling on Velvet

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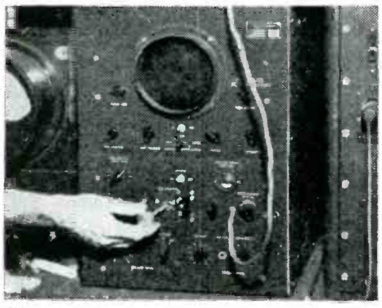

Meter used in the noise level test. Readings were taken on volume controls of all leading manufacturers. Mallory controls gave no audible sound, registered 22% below all others in inaudible sound vibrations.

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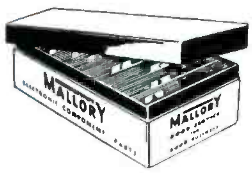

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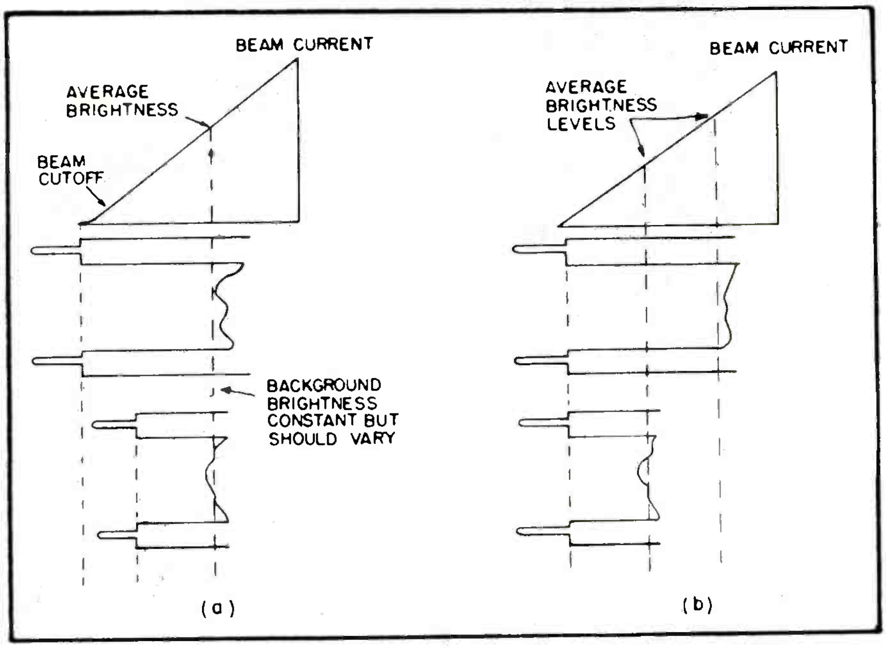


Fig. 3. Signal distribution on grid of picture tube with and without proper restoration. Plot at left shows how the blanking level varies with the signal content. Blanking does not always coincide with the blackout level at all times. The plot at right shows the proper restoration. Here the blanking level is constant and the average bias varies with average brightness of the scene.

lationship of contrast and brightness and discuss it with respect to the construction of the composite signal. Each of the plots of Fig. 1 represents the signal distribution among a few lines of a televised scene, with the signals inverted as they would actually appear on the control grid of the picture tube.

In *a* we have a scene with a high contrast range (illumination from very dark to very bright) with point *A* representing an extremely dark point on the line (almost at black level) and point *B* an extremely brilliant point. Furthermore, it represents a very abrupt and sharp change from dark to bright at this point.

In *b* appears part of a scene in which almost the entire line is at a high negative voltage level (near the blanking level) which maintains a high negative voltage on the grid, producing a correspondingly dark scene. Although the average brightness is low, there can be instantaneous bright spots along the line such as point *C*, which represents a very brilliant spot.

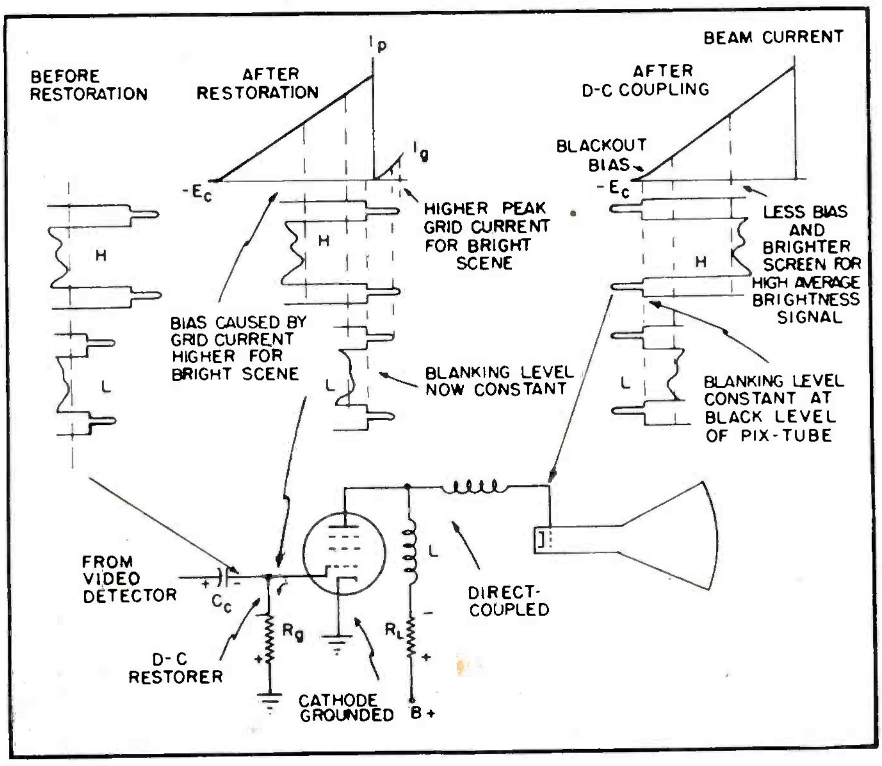


Fig. 4. Grid rectifier type of d-c restorer and waveforms.

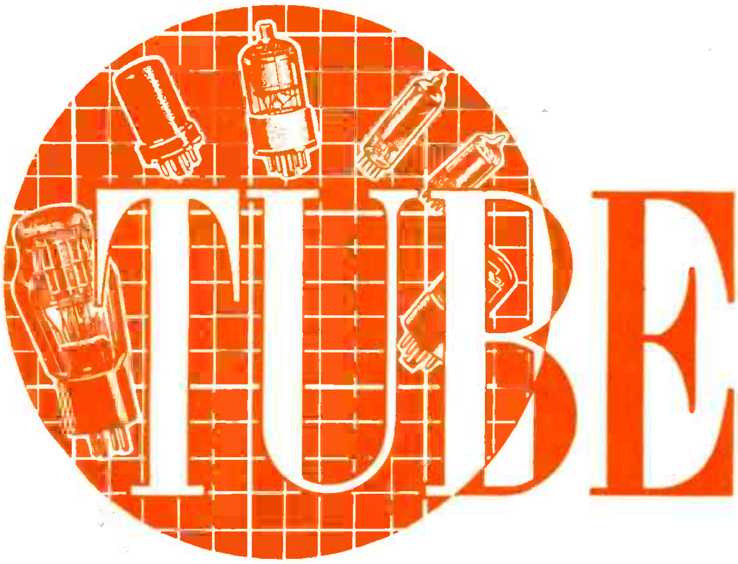
The relative light distribution along the lines represented in *c* is almost the same as the relative light distribution along the line of *b*. However, the average brightness is higher, for the entire signal is at a lower negative voltage level and the average illumination of the screen is correspondingly greater.

The plot in *d* illustrates a gradual decline in screen illumination as the beam moves from left to right across the screen, scanning one line.

As stated, each plot represents light distribution along one line. If the same average brightness, as shown on any one plot is maintained throughout the total number of active lines for one frame, the average brightness of that frame is set. When the average brightness of the scene televised changes, the background level or brightness of the reproduced picture follows (difference between *b* and *c*). Likewise, if the average brightness of the scene changes from top to bottom, background brightness follows. The average picture signal level (axis of symmetry of the video signal) then represents the average illumination or background brightness of the scene. As shown this d-c level rides up and down as scene brightness changes (*compare* *b* and *c*). It is a function of the video amplifier and more specifically the d-c restorer to cause the average bias on the picture tube grid to vary with this shift in level, thereby changing the average illumination of the picture tube in accordance with average brightness of the scene. Special circuits are required to maintain the d-c levels of this single polarity signal because each time it is capacitor-coupled the signal arranges itself as an average about a zero axis (or bias axis of succeeding stage) without regard to the average brightness level of the scene.

The d-c restorer associated with tv receivers reestablishes the d-c blanking level of the composite signal as a constant, after it has been lost through capacitive coupling in the video amplifier. Actually, it is a d-c reinserter reestablishing the d-c brightness component of the composite signal in accordance with its initial separation from the blanking level. If it were possible to develop a large enough signal

(*Continued on page* 36)



TUBE News

by L. E. STEWART

SUBMINIATURE TUBES used in hearing aids have many unusual operating characteristics. Two general types are available, output pentodes and voltage-amplifier pentodes. The output pentodes operate at a filament voltage of 1.25 at current drains varying from 30 to 50 ma, while the voltage-amplifier pentodes operate at a filament voltage of .625 volt at current drains from 20 to 50 ma.

Maximum plate and screen voltages are 45, with most hearing aids operating at lower potentials. The total *B* current drain for power types varies from .75 to 1.65 ma, depending on the output power, which is rated from 6 to 25 milliwatts.

Voltage-amplifier tubes have voltage gains of from 30 to 35, and are operated at zero bias, thereby simplifying circuit design. Power types use as high as 4.5 volts bias. The control grid resistors are usually about 3 megohms, while plate-load resistors vary anywhere from 1 megohm to 30,000 ohms, depending on the tube type.

Two additional types are available in subminiature form; the double space charge tetrode, and voltage amplifier triode. The tetrode is used as a voltage amplifier, with a voltage gain of 32.5, at a total current drain of .26 ma. Filament voltage is .625 drawing 50 ma. The triode has an amplification factor of 16, draws .15

Figs. 2 (below) and 3 (right). Receiving tube classification charts.
(Courtesy RCA)

Cathode Volts			1.4	2.0	2.5-5	6.3	12.6-117
Converters and Mixers							
Converters		pentagrid	1A7GT 1LA6 1R5	{1C6, 1C7G} {1A6, 1D7G}	2A7	{6A7, 6A8, 6A8G, 6A8GT, 6D8G} {6BE6, 6SA7, 6SA7GT} 6SB7Y 7B8 7Q7	12A8GT {12BE6, 12SA7, 12SA7GT}
		triode-hexode				(6K8, 6K8G)	12K8
		triode-heptode				6J8G 7J7	
		octode				7A8	
Mixers		pentagrid				(6L7, 6L7G)	
Voltage Amplifiers (with and without Diode Detectors), Triode Detectors, and Oscillators		single unit	1G4GT 76*	{1H4G, 30}	27 56	6C4, (6C5, 6C5GT) (6P5GT, 76) (6J5, 6J5GT) 6L5G, 7A4, 37	12J5GT
		with r-f pentode				6F7	
Triodes	medium-mu	with power pentode				6AD7G	
		with pentode and diode	1D8GT 3A8GT				
		with two diodes		{1B5/25S, 1H6G}	55	{6R7, 6R7GT, 6BF6, 6SR7, 6ST7} 7E6 85	12SR7
		twin unit				6C8G (6F8G, 6SN7GT) 6J6 12AU7	12AH7GT 12AU7 12SN7GT
	high-mu	single unit				{6S5, 6S5GT, 6SF5, 6SF5GT} 6K5GT 7B4	{12F5GT, 12SF5}
		with diode	1H5-GT 1LH4				
		with two diodes			2A6	{6SQ7, 6SQ7GT, 6B6G, 75} {6AT6, 6AQ6, 6Q7, 6Q7G, 6SZ7, 6Q7GT} 6T7G, 7B6, 7C6	(12AT6 12S7GT) (12SQ7, 12SQ7GT)
		with three diodes				6S8GT	
		twin unit				6SC7 6SL7GT 7F7 12AX7	12SC7 12AX7 12SL7GT

Hearing-Aid Subminiatures . . . Classification Data On Converters and Mixers . . . Triode Detectors and Oscillators . . . Tetrode and Pentode Detectors and Oscillators . . . Triode, Beam Tube and Pentode Amplifiers

ma, and operates at a filament voltage of .625 volt, at a current rating of 30 ma. Both tubes operate at zero bias.

Power outputs of Raytheon subminiature pentodes are: 6 mw (CK 502AX), 9.5 mw (CK503AX), 25 mw (CK506AX), and 11 mw (CK-507AX).

Two voltage amplifier pentodes are available from Raytheon, the CK505-AX, with a voltage gain of 35, .2 ma *B* current drain and 30 ma *A* current drain; and the CK512AX with a gain of 30, .135 ma *B* current, and 20 ma *A* current drain.

Tube Clasification

A CHART which classifies converters and mixers; voltage amplifiers with and without diode detectors, triode detectors, oscillators; voltage amplifiers with and without diode detectors, tetrode and pentode detectors and oscillators; power amplifiers with and without rectifiers, diode detectors and voltage amplifiers, appears in Figs. 2 and 3.*

*Prepared by the tube department of RCA.

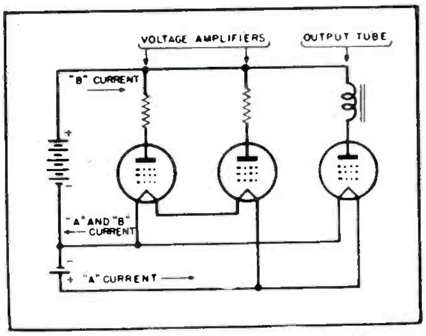
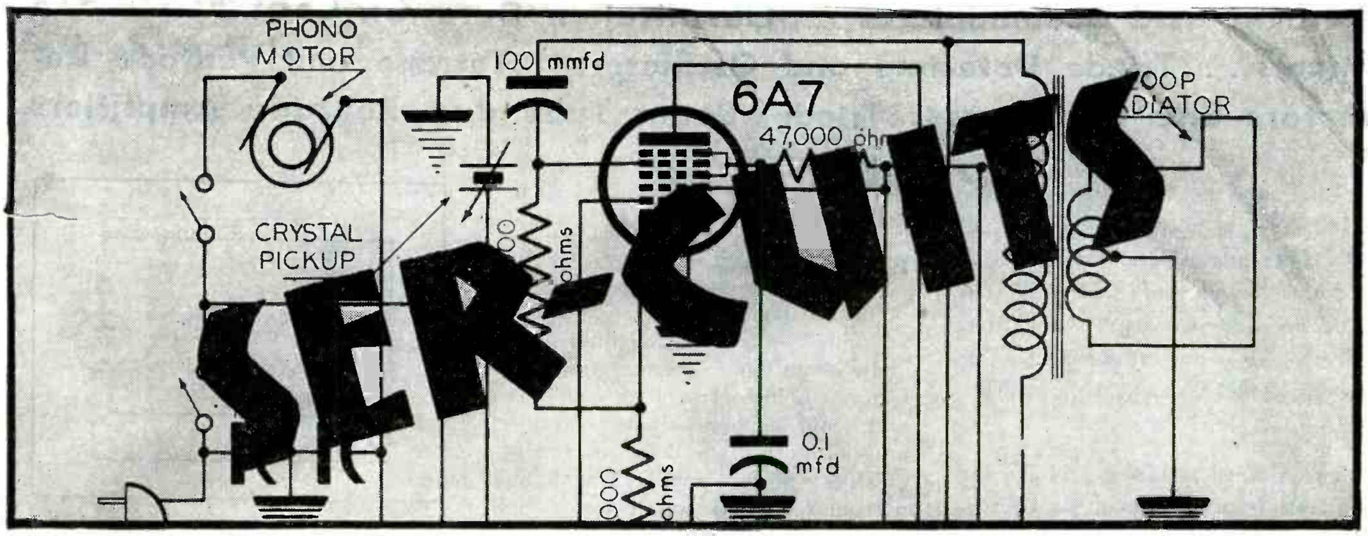


Fig. 1. A typical 3-tube hearing-aid circuit using two voltage amplifiers and an output tube. The *a* supply of 1½ volts feeds two tubes with their .625-volt filaments in series. The filament of the output tube is rated at 1.25 volts. *(Courtesy National Carbon Co.)*

Cathode Volts			1.4	2.0	2.5-5	6.3	12.6-117
Voltage Amplifiers, with and without Diode Detectors, Tetrode and Pentode Detectors, Oscillators							
Tetrodes	remote cutoff				35		
Tetrodes	sharp cutoff			32	24-A	36	
Pentodes	remote cutoff	single unit	1T4 1P5GT	34 1D5GP, 1A4P	58	6K7, 6K7G, 6K7GT, 78 6D6, 5U7G, 5S7, 6S7G (6BA6, 6SG7) 6BJ6 7A7, 7B7 7H7 6AB7/1853 6SK7, 6SK7GT 39/44	(12BA6, 12SG7) 12SK7, 12SK7GT 12K7GT 12A7/12B7
Pentodes	remote cutoff	with triode				6F7	
Pentodes	remote cutoff	with diode				6SF7	12SF7
Pentodes	remote cutoff	with two diodes			2B7	6B7, 6B8, 6B8G 7E7	12C8
Pentodes	sharp cut-off	single unit	1LN5 1L4, 1U4 1N5-GT	1E5GP, 1B4P 15	57	6J7, 6J7G, 6J7GT, 6C6, 6W7G, 77 6SJ7, 6SJ7GT 6AU6, 6SH7 6AC7/1852 7G7/1232 6AG5 7C7	(12AU6, 12SH7) 12AW6 12SJ7, 12SJ7GT
Pentodes	sharp cut-off	with diode	(1S5, 1U5)				
Pentodes	sharp cut-off	with two diodes		1F6, 1F7G			
Power Amplifiers, with and without Rectifiers, Diode Detectors and Voltage Amplifiers							
Triodes	low-mu	single unit		31 49	2A3 45 46 71A	6B4G 10** 6A3 50**	
Triodes	high-mu	single unit				6AC5GT	
Triodes	high-mu	twin unit	1G6GT	1J6G, 19	53	6A6, 6N7, 6N7GT 6Z7G 79	
Triodes	direct-coupled arrangement					6B5	
Beam Tubes	single unit		1Q5GT, 3Q5GT*** 1T5-GT			6BG6G 6L6, 6L6G 6AQ5, 6V6, 6V6GT 6Y6G 7A5 7C5	14A5 35A5 25L6, 25L6GT (35B5, 35L6GT) 50A5 (50B5, 50L6GT)
Beam Tubes	with rectifier						32S7GT 70L7GT 117L7/M7GT, 117P7GT 117N7GT
Pentodes	single unit		1A5GT 1C5GT 1LA4, 1LB4 (1S4, 3S4***) (3Q4***, 3V4***)	1F4, 1F5G 1G5G 1J5G 33	2A5 47 59	6A4/LA (6AK6, 6G6G) 6AG7 (6F6, 6F6G 42) (6K6GT, 41) 7B5 38 89	25A6, 43
Pentodes	with medium-mu triode					6AD7G	
Pentodes	with diode and triode		1D8GT				
Pentodes	with rectifier						12A7
Pentodes	twin unit			1E7G			

*Cathode volts, 1.5.
**Cathode volts, 7.5.
***Filament arranged for either 1.4 or 2.8-volt operation.



A-M/F-M Receiver Featuring Grounded-Grid Amplifier, Series-Resonant Circuits, and Ratio Type of Detector

MANY ADVANCED CIRCUIT designs are being incorporated in current models, particularly the a-m/f-m receivers. The circuit shown in Fig. 1 is an interesting example. In this model, the Admiral 7C73, we have, for instance, a grounded-grid r-f amplifier.

Grounded-Grid R-F Amplifier

In any amplifier circuit, the input signal is introduced between grid and cathode. It is conventional to apply the signal between grid and ground. The cathode is then grounded at signal frequencies. If the grid is grounded, the signal can just as well be applied between cathode and ground. This is the circuit arrangement used in a grounded-grid r-f amplifier.

Since the cathode circuit of a tube has a low characteristic impedance, the grounded-grid amplifier has a low-input impedance and provides a satisfactory match for a folded dipole antenna. This eliminates the need for complicated antenna coupling devices.

Due to the low impedance and inverted nature of the input circuit of the grounded-grid amplifier, feedback which might result in oscillation, is unlikely. It is therefore possible to use a triode which greatly reduces cir-

(Continued on page 34)

RESISTORS

R1	100 Ohms, ½ W
R2	330 Ohms, ½ W
R3	470,000 Ohms, ½ W.
R4	39,000 Ohms, 1 W.
R5	4,700 Ohms, 1 W.
R6	33,000 Ohms, ½ W
R7	47,000 Ohms, ½ W
R8	18,000 Ohms, 2 W.
R9	120,000 Ohms, ½ W.
R10	18,000 Ohms, 1 W.
R11	22,000 Ohms, 1 W.
R12	120,000 Ohms, ½ W.
R13	100,000 Ohms, ½ W.
R14	470,000 Ohms, ½ W
R15	220,000 Ohms, ½ W.
R16	82,000 Ohms, ½ W
R17	8,200 Ohms, 2 W.
R18	2,200 Ohms, 1 W.
R19	390 Ohms, ±5%, ½ W.
R20	27,000 Ohms, ½ W.
R21	6,800 Ohms, ±5%, ½ W.
R22	6,800 Ohms, ±5%, ½ W.
R23	1 Megohm Volume Control & on-off switch SW6. Tapped at 300,000 and 600,000 ohms.
R24	4.7 Megohms, ½ W
R25	47,000 Ohms, ½ W.
R26	2 Megohms Tone control & D.P.S.T. switch SW7.
R27	10,000 Ohms, ½ W
R28	470,000 Ohms, ½ W
R29	100,000 Ohms, ½ W.
R30	470,000 Ohms, ½ W.
R31	2.2 Megohms, ½ W
R32	390 Ohms, 1 W.
R33	390 Ohms, 2 W.
R34	100 Ohms, 1 W.

CONDENSERS

C1	1000 mmfd., Mica
C2	.01 mfd., 400 V.
C3	35 mmfd., Special
C4	27 mmfd., Special
C5	500 mmfd., Mica
C6	3-40 mmfd., Trimmer
C7	3-12 mmfd., Trimmer
C8	200 mmfd., Mica
C9	35 mmfd., Special
C10	40 mmfd., Special
C11	12-170 mmfd., Trimmer
C12	300 mfd., Silver Mica
C13	25 mmfd., Special
C14	3-12 mmfd., Trimmer
C15	50 mmfd., Special
C16	3-12 mmfd., Trimmer
C17	200 mmfd., Special
C18	.005 mfd., 600 V.
C19	100 mmfd., Special
C20	5000 mmfd., Ceramic
C21	3-40 mmfd., Trimmer
C22	27 mmfd., Special
C23	180 mmfd., Special
C24	2000 mmfd., Mica
C25	.01 mfd., 400 V.
C26	.01 mfd., 400 V.
C27	.01 mfd., 400 V
C28	.10 mfd., 400 V
C29	.2 mfd., 400 V
C30	.05 mfd., 400 V.
C31	200 mmfd., Mica
C32	.05 mfd., 200 V
C33	.05 mfd., 200 V
C34	100 mmfd., Special
C35	100 mmfd., Special
C36	4 mfd., 150 V., Elect.
C37	.002 mfd., 600 V
C38	.005 mfd., 800 V.
C39	1000 mmfd., Mica
C40	500 mmfd., Mica
C41	.005 mfd., 600 V.
C42	.005 mfd., 600 V
C43	.05 mfd., 200 V.
C44	.05 mfd., 400 V.
C45	.01 mfd., 400 V.
C46	.005 mfd., 600 V.
C47	.005 mfd., 600 V.
C48	.01 mfd., 400 V.
C49	.002 mfd., 600 V.
C50a	20 mfd., 250 V.
C50b	30 mfd., 350 V.
C51	.01 mfd., 400 V.
C52a	30 mfd., 350 V.
C52b	30 mfd., 350 V.

COILS, TRANSFORMERS, ETC.

CH1	Choke, F.M. Antenna
CH2	Choke, Grounded Grid Cathode
CH3	Choke, Grounded Grid Plate
CH4	Choke, R.F. Plate
CH5	Choke, A.M. Oscillator Cathode
CH6	Choke, F.M. Oscillator Cathode
CH7	Choke, R.F. Filament. Consists of approximately 8 turns of #20 solid hookup wire wound around condenser C51
CH8	Choke, Filter
L1	Antenna, F.M. Folded Dipole
L2	Antenna, A.M. (13")
L3	Coil, A.M. Antenna
L4	Coil, F.M.-R.F.
L5	Coil, F.M. Converter
L6	Coil, A.M. Converter
L7	Coil, F.M. Oscillator
L8	Coil, A.M. Oscillator
SW1	Switch, Antenna (Second from front)
SW2	Switch, R.F. (Fourth from front)
SW3	Switch, Oscillator (Third from front)
SW4	Switch, I.F. (Farthest from front)
SW5	Switch, Audio (Closest to front)
SW6	Switch (ON-OFF)
SW7	Switch (Tone Control)
T1	Transformer, 1st I.F. (F.M.)
T2	Transformer, 2nd I.F. (F.M.)
T3	Transformer, Ratio Detector
T4	Transformer, 1st I.F. (A.M.)
T5	Transformer, 2nd I.F. (A.M.)
T6	Transformer, Power
T7	Transformer, Output

Fig. 2. Parts list for the Admiral 7C73.

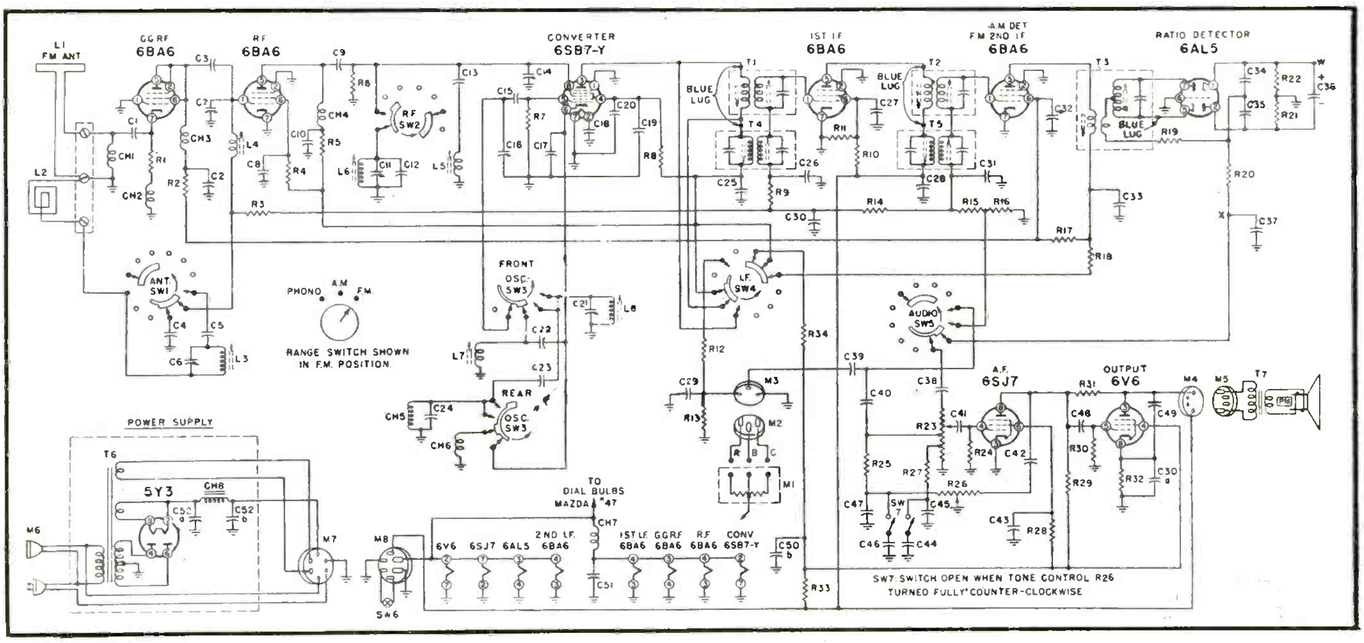
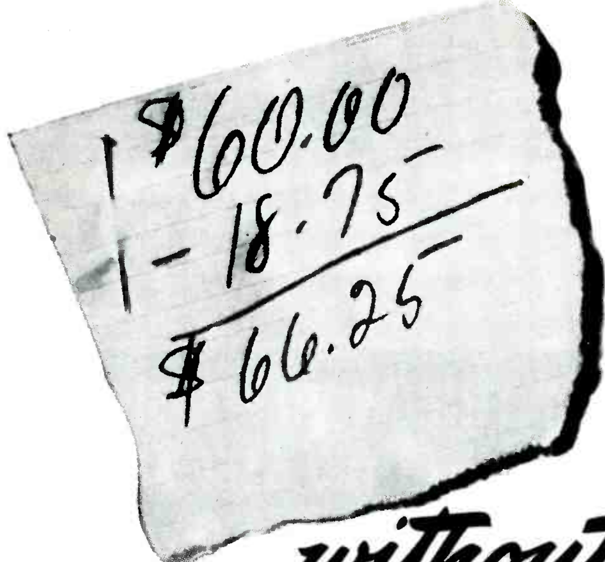


Fig. 1. Circuit of a-m/f-m Admiral 7C73 receiver.



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The future of your business is closely dependent upon the future economy of your country. To a major extent, that future depends upon management of the public debt. Distribution of the debt as widely as possible among the people of the nation will result in the greatest good for all.

How that works is clearly and briefly described in the free brochure shown at the right. Request your copy—*today*—from your State Director of the U. S. Treasury Department's Savings Bonds Division.

ACTION BY TOP MANAGEMENT NEEDED

The benefits of regular Bond-buying are as important today as ever—but war-time emotional appeals are gone. Sponsorship of the Payroll Savings Plan by a responsible executive in your company is necessary to keep its benefits *advertised to your employees.*

Banks don't sell Savings Bonds on the "installment plan"—which is the way most workers prefer to buy them. *Such workers want and need the Payroll Savings Plan.*

Those are the reasons why it's important to make sure that the Plan is adequately maintained in your company.

The State Director will gladly give you any assistance you wish.

"The National Debt and You," *a 12-page pocket-size brochure, expresses the views of W. Randolph Burgess, Vice Chairman of the Board of the National City Bank of New York—and of Clarence Francis, Chairman of the Board, General Foods Corporation. Be sure to get your copy from the Treasury Department's State Director, Savings Bonds Division.*

The Treasury Department acknowledges with appreciation the publication of this message by

SERVICE

This is an official U.S. Treasury advertisement prepared under the auspices of the Treasury Department and the Advertising Council

Your Success In Sound

How To Make Sound-System Sales That Will Bring You More Business

by ROBERT NEWCOMB

Newcomb Audio Products Company

ARE THE SOUND INSTALLATIONS you've made something you'd like to forget? Or are you happy about them, proud of them?

Pride in your work and a continued effort to give better and better service will bring, not only a sense of accomplishment in your own mind, but also increased financial rewards.

Look at it this way:

More than likely, you are either of two classes of people—either the "hot shot" type, who can sell anything, regardless of its value to the purchaser, pick up a couple of fast bucks and forget it (in which case, it may work out and it may not); or you are the efficient, technically aware type of man who knows what the prospective buyer really needs, and is ready to go to some trouble to make him see it. If you're the first type, you may be able to make a quick killing all right—and later find it necessary to leave town. If you're the second type, you may get off to a slow start, you may not get rich overnight; but in the long run you'll have a solid, expanding business and plenty of friends.

What I'm talking about here is not only the business of doing the simple, obvious things for which the customer asks. I'm talking about that extra service, additional effort and careful thought that are involved in satisfying your customer's needs more *fully*, even in matters of which he himself may not be aware. You may be amazed—if you try it—to find out how that extra consideration and follow-up service pays off in terms of customer confidence and respect. And confidence and respect mean more and bigger business.

The average sound installation is far from a credit either to the installation engineer or to the purchaser. In far too many cases, the Service Man doesn't bother to look deeply enough into the application to find out exactly what the customer needs and exactly why. Not knowing this, he is unable to give the customer any valid reason for spending sufficient money.

In any field, if you know something about it, you won't buy—for yourself—an inferior product. You'll pass up these items in favor of those that will really do your job. You won't hire a boy to do a man's job and you won't buy a two-burner hot plate to cook a Christmas dinner.

Your customer is the same. He, too, in practically every case, will pay a fair price to get the best sound system for his needs.

But he may not know what his needs are. And you come in at this point to show him, after—and *only* after— you have questioned him thoroughly on his problems, as seriously as a doctor would question a patient. Then you explain how the system you propose will not only solve all his problems as presented to you but also will help in other ways he had not thought of. Make your sound system sufficiently desirable and price will seldom be an obstacle. Do not take it for granted that your customer knows every advantage a sound system can bring to him. He probably knows about only the obvious advantages.

If your customer is making a purchase on behalf of some group or institution, your job may not be nearly as difficult as you think. Because a group, a large corporation or institution, will condemn the buyer far more for buying a poor piece of equipment than for paying more to get a good one. He may merely need to be reminded of this point when discussing the merits of your suggestion. It can well happen that a single failure in a sound installation may cost the management more than the cost of the entire system. There are endless variations in the requirements of all installations. How many times have you cursed the negligence of the management of some railroad station or air terminal for the fact that they cared so little about you as a customer as to install a sound system that was virtually impossible to understand.

But was it the management's fault? The man who sold the system would probably say it was. Yet the management would have been glad to pay more money for a sound system that could give them better performance, that would sustain or promote better public relations, *if they had only been properly sold and had had full confidence in the sales source.*

I've gone into all this to make the point that you must be armed with adequate knowledge and information in order to explain clearly to your prospect why he needs what you think he needs. To make him believe, you must first spend a sufficient amount of time investigating and discussing with him his problems, so that he will realize your suggestions are no snap judgment decisions, but are based on facts. His confidence in you is almost in direct proportion to the thoroughness of your analysis of his needs.

It may seem easier at first to sell cheaper systems and not worry about the future. But each such sale puts one more obstacle in the way of your growth, reduces your pride in your work, makes it more difficult for you to improve your knowledge of the field and of men and women in general, which you need in any business. A little effort and straight thinking will produce bigger sales, better installations, greater profits and more satisfied customers: and the farther you go with it, the easier it will become.

ASSOCIATIONS

TEN YEARS AGO

From the Association News page of SERVICE, January, 1938

A LICENSING ORDINANCE, proposed in Spokane, was not passed due to the efforts of Art Welch and Frank Dunnigan of the RSMA of Spokane. . . . Les Burden, a RSMA member, left the Inland Radio Company to join the Spokane Radio Co. as a city rep. . . . A written and practical examination procedure was adopted by members of the Seattle Radio Service Society. Commenting on this exam program, president, N. B. Anderson said "The examinations are a step forward in the right direction. Later on we plan to make examinations a bit harder and raise the standards somewhat higher. An applicant is not expected to pass an engineer's examination, nor will we include any catch questions, but anyone who takes these practical and technical tests will show whether he can properly repair a receiver". To assist members who might want to polish up on schooling, an auxiliary tutoring group was also set up. . . . Technical lectures and sessions were planned by the Chicago Chapter of RSA. . . . An examination procedure was set up by the ART of British Columbia. Applicants who could prove five years active experience were permitted to join ART without examination. . . . The RSA received full recognition from the Radio Manufacturers Association and the Sales Managers Clubs of New York and Chicago. . . . W. George Dillon of Dillon's Radio Shop, Sharpsburg, Pa. and Mildred Quinn were married according to a notice in the association bulletin, the *Amplifier*.

ARSNY, New York City

A NEW SERVICING ORGANIZATION, the Associated Radio Service Men of New York, Inc., was organized recently in New York City. Formed as a result of a proposed bill for licensing of Service Men in New York City, the association has set up an excellent enrollment-exam-code program. The examinations, involving some 50 questions and covering the entire field of servicing, have been prepared by a board of experts who also supervise the exams.

To curb unfair practices by some Service Men, the association has set up a committee to investigate claims of overcharging, deficient service and other general grievances that may be charged against Service Men. In order that the complaints can be accurately studied, complainants are asked to report fully the claims of the Service Men and what they believe has not been fulfilled. Information included on the complaint includes names of the complainant and the Service Man against whom the complaint is made, date of service, make and model of the receiver serviced, nature of the difficulty, what the Service Man said was done to the receiver and the charges made for the repair. If the complaint is justified and the Service Man refuses to make adjustment of the complaint, ARSNY will recommend that legal action be taken against the offender in a small claims court, ARSNY offering technical testimony in favor of the complainant.

This program has been publicized by way of special transcriptions over NBC and other New York City stations.

The plan, similar to that adopted by PRSMA, has already proved very effective and won the appreciation of both Service Men and the public.

Members of ARSNY, of which there are 300 at the present writing, are pledged under a code of ethics to: (1) Make repairs according to their best knowledge and ability and keep informed of advancements and new equipment in the industry; (2) conduct business in an honest and straightforward way; (3) use factory replacement parts wherever possible; (4) charge a just and fair price; (5) handle customers property with all reasonable care; (6) guarantee all repairs for 90 days and (7) indulge in no unfair competitive practices. ARSNY members also require that an itemized bill for all ser-

(*Continued on page 27*)

Officers of Associated Radio Service Men of New York, Inc., and PRSMA at a recent meeting of the new association in New York City. From left to right: Harry Anis, ARSNY corresponding secretary; Max Leibowitz, ARSNY president; Dave Krantz, PRSMA president; Richard D. Davaney (standing behind Dave Krantz), vice president of PRSMA; Norman Jacobson, ARSNY vice president; Mr. Barrett of the Better Business Bureau of New York; Mr. Weigandt of the City Council of New York City; Jack Edel, ARSNY recording secretary and treasurer, and Gerard Neurenberg (at script stand) attorney for ARSNY.

(Continued from page 26)

vices and parts used be given to all customers. All members of the ARSNY will receive an emblem for shop display, which will state that the member has been examined by a board of examiners and certified as competent in repair of home receivers and auto radios.

Max Leibowitz is president of the association. Harry Anis is corresponding secretary. Norman Jacobson, vice president, and Jack Edel is recording secretary and treasurer.

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PRSMA, Philadelphia, Pa.

MEMBERS OF KYW, Robert E. White, general manager and Arthur C. Schofield, station advertising manager, received honorary memberships in the Philadelphia Radio Service Men's Association recently.

In bestowing the memberships, Dave Krantz, PRSMA president thanked the KYW executives in behalf of the members for the station's fine cooperation in serving as a liaison in special programs and through special announcements during 1947. KYW publicized the work of PRSMA and urged listeners to look for the PRSMA decal when hiring a Service Man for receiver repair.

PRSMA, which has been active in Philadelphia for the past 15 years, has set up a broadcast and publicity committee to work with KYW. KYW provides a separate 'phone service for Service Men through which customers can place orders for repair work. When a customer calls, KYW secretary, Miss Joey Thomas checks a map of greater Philadelphia, which is dotted with locations of PRSMA shops and refers the customer to the nearest Service Shop.

Officers of PRSMA include Dave Krantz, president; Richard D. Devaney, vice president; Stanley W. Myers, treasurer and F. B. Guthrie, recording secretary.

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RSA, Trenton, N. J.

A NOTE FROM Secretary J. T. Dzicbek reveals that the new name of the Delaware Valley Service Men's Association is Radio Service Men's Association of Trenton, N. J.

A reorganization of the association is now being held and new officers will be announced very soon.

Servicing Helps

Mixer Inputs With Twin Triodes, Pentodes And Cascaded Circuits For Up to Eight Inputs . . .

by CHARLES P. ELLIOTT

MIXER SYSTEMS are essentially circuits which provide multiple input sources for an audio amplifier. In general, each device feeding the amplifier requires an individual input circuit both for its control and to isolate it from other input sources.

Fig. 1 shows an input system in its simplest form. Here, two high impedance inputs have been connected so that either one may be used to drive the audio amplifier, whose first stage is shown.

The circuit shown in Fig. 1 is used for illustration, rather than as an example of design, since, in a high gain amplifier, a very loud thump would result every time the switch were made from one input to the other. The proper design of an multiple input system would therefore require some method for a smooth transition from one channel to another.

A simple method of accomplishing this is shown in Fig. 2. Here, a twin triode has been used. Resistors have been inserted in series with the plate circuits to isolate the two systems, and also increase the individual plate loading so as to reduce the distortion factor for output voltage.

Fig. 3 shows a similar system employing pentodes instead of triodes. Because pentode-plate circuits are usually very high impedance, the use of isolating resistors is unnecessary. In addition, the stage gain for the pentode is very much higher than for the triode.

The proper design of a multiple-input system is governed by two important constants of the input devices; the impedance and voltage output. For example, a magnetic pickup may be either a high or low-voltage device, and is usually a low-impedance device. Crystal pickups are invariably high impedance, high-voltage sources. Most microphones are low voltage devices, with the exception of the carbon mike. Thus, it may be seen that the design of an appropriate input stage must be determined by these factors.

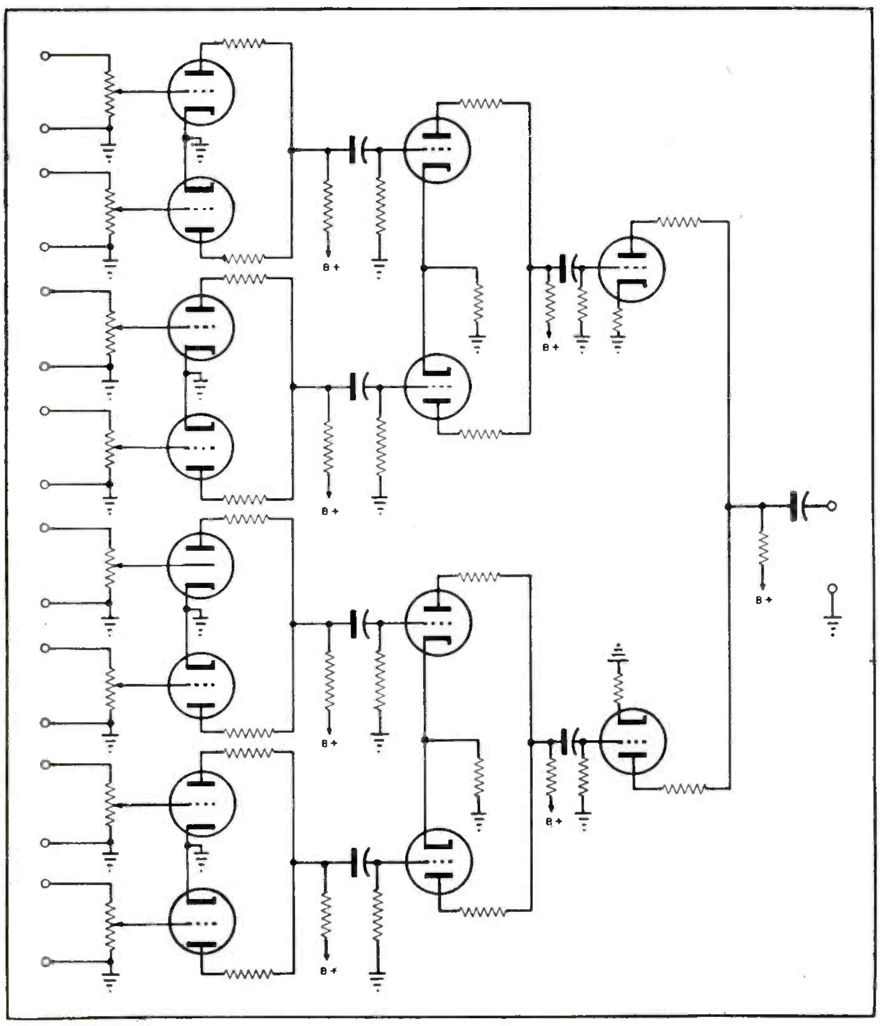
High impedance devices may be fed directly into the grid of a tube. Low-impedance devices require the use of an input transformer; Fig. 4. Transformers in addition to converting low-impedance sources to high impedance, may also amplify the input voltage, depending on the turns ratio.

Fig. 5 shows a method of connecting two phono inputs to one tube. The use of the isolating resistors prevents interaction between controls. Thus, one pickup can be set at zero input without materially decreasing the voltage input of the second pickup.

A large number of input systems requires the cascading of the various circuits, before feeding the entire group into an amplifier. A mixer input system exemplifying such a circuit is shown in Fig. 6. Here, eight input circuits have been cascaded to feed a common amplifier using twin triodes. Since each stage will contribute its own gain, it is necessary that low-gain triodes be used. Additional reduction of the stage gain may be controlled by increasing the size of the isolating resistors in the plate circuit, and by not bypassing the cathode resistors. The use of feedback will have the salutary

(*Continued on page* 33)

Fig. 6. A mixer input for eight inputs cascaded to feed a common amplifier with twin triodes.



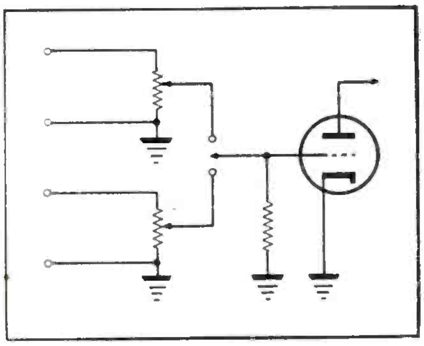


Fig. 1. An input system in its simplest form.

Fig. 2. Input system with twin triodes in which are series resistors in the plate circuits to isolate the two systems and also increase individual plate loading to reduce the distortion factor for output voltage.

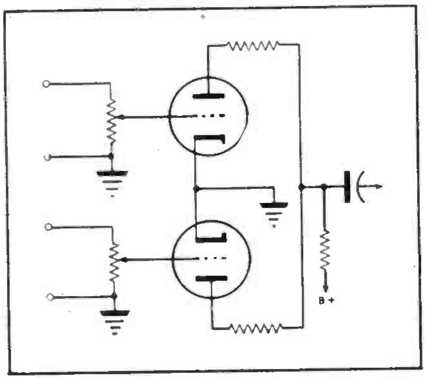


Fig. 3. An input system with pentode high-impedance circuits where isolating resistors are unnecessary.

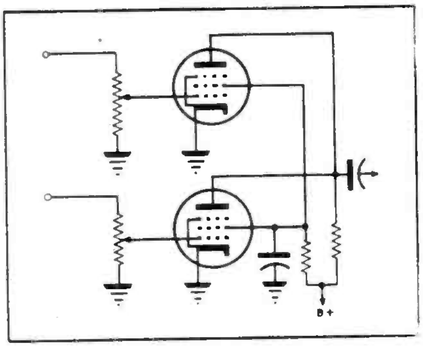


Fig. 4. Low-impedance input with an input transformer.

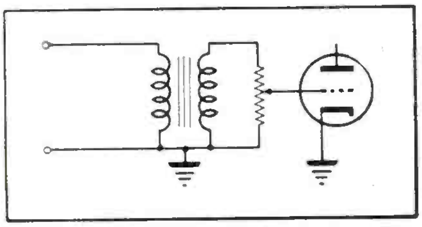
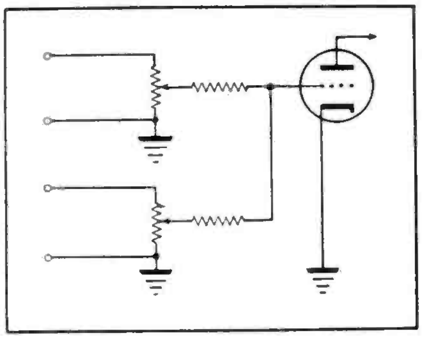


Fig. 5. Connection of two phono inputs to one tube.



F-M Lines

(*Continued from page* 11)

example, a parallel tuned circuit presents a high impedance at *one* frequency; a shorted quarter-wave line also presents a high impedance at one frequency. Likewise, a series tuned circuit presents a low impedance path for r-f at its resonant frequency, and an open quarter-wave is practically a short circuit to r-f induced at its input end. The characteristics of open and shorted sections of line are shown in Fig. 3. These characteristics repeat when multiples of an electrical half-wave are added and are inverted as *odd numbers* of electrical *quarter-wave* sections are added.

If the input frequency applied to either a parallel or series resonant circuit increases, the circuit becomes inductive. If the frequency is decreased below the resonant frequency, the same circuit becomes capacitive. Quarter-wave transmission lines behave in exactly the same manner. Fig. 3 shows this relationship for both quarter- and half-wave lines.

From the foregoing discussion it is evident that transmission lines may be used as: (1) Impedance matching transformers, (2) voltage or current transformers, (3) parallel or series resonant circuits, and (4) phase inversion transformers. (A quarter-wave line shifts the phase 90°.)

Propagation Constant

Because r-f energy travels more slowly on a wire than in free space, the wavelength is shorter on the wire than in space. This is because the

$$\text{wavelength is equal to } \frac{\text{velocity}}{\text{frequency}}.$$

The velocity of an r-f wave in free space is equal to the velocity of light.

or 300,000,000 meters per second. Therefore,

$$\text{a wavelength in meters} = \frac{300{,}000{,}000}{f}$$

when f is in cycles per second. The electrical length, previously mentioned, then differs slightly from the length in terms of the free space wavelength. The capacitance effects between the wires themselves and between each wire and ground decrease the velocity of propagation on the line. The insulating material between the wires have a dielectric constant greater than air, which increases the effective capacitance, which also affects the wave velocity. The factor by which the velocity in a line is reduced from the velocity in free space is called the *propagation constant*. It is always less than one.

The propagation constant for some common lines are:

Parallel line (open, bare)	0.975
Parallel tubing	0.95
Parallel line (polethylene insulated, 300 ohm f-m leadin)	0.85
Coaxial line (air insulated)	0.85
Coaxial line (rubber insulated)	0.60
Twisted pair	0.60

Most manufacturers give the propagation constant on every spool or roll of line intended for r-f transmission. To find the wavelength of a certain frequency on a specific line, multiply the wavelength in free space by the propagation constant.

Analysis of Different Types of Lines

The following types of lines are recommended for use as antenna leadins:

(*1*) Parallel polethylene insulated line.
(*2*) Coaxial plastic insulated line.
(*3*) Shielded pair, rubber covered line.
(*4*) Twisted pair.

The parallel polethylene insulated line has become the most popular type transmission lines for f-m antenna leadin in the average home. It is economical, easy to install, has low losses (about 1.5 db per hundred feet) and is available in a variety of impedances (Z_0), including 300 ohms, which is the RMA suggested standard input impedance for f-m receivers. For relatively short leadins (75 to 100 feet) this line is very satisfactory.

Coaxial Lines

The chief purpose of coaxial lines is to keep down radiation losses. In
(*Continued on page* 32)

two-wire parallel lines, the electric and magnetic fields extend out into space thus causing radiation losses and noise pickup from other sources. In a coaxial line, however, no fields extend outside of the outer conductor. All fields exist in the space between the two conductors. The coaxial line is, therefore, perfectly shielded. (This is not actually true in the flexible coaxial line, for there is some leakage through the flexible metal braid of the outer conductor. Losses also occur in the rubber or plastic insulation used between the inner and outer conductor.

Shielded pair lines usually consist of two parallel conductors separated from each other and surrounded by an insulating material, usually plastic, and contained in a copper braid tubing which acts as a shield for the conductors. This copper braid is usually covered with a protective coating of rubber to protect it from moisture and mechanical damage.

The most important advantage of the shielded pair is the fact that the two conductors are *balanced to ground;* that is, the capacity between each conductor and ground is uniform along the entire length of the line. To appreciate this improvement, let us consider the open pair or unshielded line. If radiation in such a line is to be prevented, the current flow in each conductor must be equal in amplitude to set up equal and opposite magnetic fields and thereby cancel out. This condition can be obtained if the line is well in the clear of all obstructions; but suppose that the line runs near some ground or conducting surface, and that one of the two conductors is nearer that obstruction than the other. A certain amount of capacity will exist between the two conductors and the conducting surface over a length of the line, depending upon the size of the obstruction. This capacity acts as a parallel conducting path for each half (conductor) of the line, causing a division of current flow between each conductor and the interfering, or stray capacity. Since one conductor is nearer the obstruction than the other, the current will be greater on one line than on the other; therefore, incomplete cancellaton will result and radiation will take place.

Since the spacing between the two conductors of a shielded pair is considerably less than that of an unshielded pair; the characteristic impedance of the line is lower. Also the propagation constant of a shielded pair is usually lower than that for an open line.

The twisted pair, as the name implies, consists of two insulated wires twisted to form a flexible line without the use of spacers. It generally is used as an untuned line for low r-f (standard broadcast band). It is not used at the higher frequencies because of the losses occurring in the rubber insulation. Its chief advantage is that it may be used where more efficient types of lines would not be practical, due to mechanical problems of installation and increased cost.

Summary on Choice of Lines

(*1*) An open or unshielded pair is commonly used as a leadin for f-m receiving antennas if the run is less than 100′ and economy is a factor.

(*2*) Coaxial lines are used as an *unbalanced line* where it is convenient to ground one leg of the circuit and where radiation losses from an unshielded pair might be excessive. A practical application of a flexible coaxial line is as a leadin for an a-m antenna in which the leadin must pass through a high *noise area.*

(*3*) The shielded pair is used where radiation losses from an unshielded pair would be excessive, but where it is desirable to maintain a *balanced line.* The cost per foot of the shielded pair is greater than either the open pair or the flexible coaxial line.

(*4*) The twisted pair is used as a leadin for center-fed or balanced a-m antennas designed for maximum noise suppression at nominal cost.

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Servicing Helps

(*Continued from page* 28)

effect of improving the frequency linearity of the stage. A falling off of the high frequencies may be compensated for by shunting the plate-isolating resistors with a small capacitor.

Since most amplifiers already have dual-input systems, two such preamp mixers, as shown in Fig. 6, may be used to increase the available input systems to sixteen. The circuits of Figs. 4 or 5 may be substituted for any of the input systems of Fig. 6. In addition, the gain of any input circuit may be decreased by either increasing the value of plate-isolating resistor, or by using a limiting resistor in series with the input pot.

The use of twin triode tubes with separate cathodes will also facilitate the design of the mixer. As shown in Fig. 6, the cathodes of the input triodes have been returned directly to ground. This presupposes the use of low-input voltage devices. Where a high-voltage pickup or radio input is used, it may be necessary to bias the tube to an appropriate level to prevent grid overdrive. By using tubes with separate cathodes, it is possible to compensate for this condition.

Ser-Cuits

(*Continued from page 22*).

cuit noise, in comparison to that present in a pentode amplifier stage. In addition, a triode r-f amplifier provides excellent circuit stability, without the use of tricky circuits or adjustments.

F-M Second I-F Amplifier, A-M Second Detector

Another interesting circuit feature in the Admiral is the second i-f 6BA6 amplifier used for f-m. Self-bias is developed in the grid resistor (R_{15} and R_{16} in series) of this stage. Since this d-c bias voltage is dependent on signal strength, it is used for avc purposes.

In the a-m setting of the bandswitch, plate and screen voltages are removed from this tube. The grid and cathode of this tube then function as an a-m second detector (diode) and avc tube in a conventional manner.

Ratio Detector

The receiver also features an f-m ratio detector.

In the a-m receiver the transmitted signal varies in amplitude in accordance with the sound being transmitted. The second detector of the receiver converts these amplitude variations into an audio signal, a duplicate of that used to modulate the transmitter. In the case of f-m, the transmitter frequency is made to vary in accordance with the sound to be transmitted. These frequency variations are again converted into an audio signal by a discriminator or ratio detector.

Discriminator Action

The conventional discriminator has the disadvantage of being sensitive to amplitude variations as well as to variations in frequency. Amplitude variations, such as might be introduced by noise signals, can be removed by the use of a limiter circuit ahead of the discriminator. However, the input signal to the limiter must exceed a certain minimum amplitude before limiter action takes place. Therefore, the limiter-discriminator type circuit does not always provide noise rejection on weak signals.

Since the ratio detector is relatively insensitive to amplitude variations, it can be used without a limiter stage. It provides noise rejection on weak as well as strong signals.

Band Switching

The band-switching arrangement in the Admiral also has many interesting features. For instance, when the switch is set for a-m operation, the 3 to 12-mmfd trimmer, C_7, is kept in the circuit. Due to its relatively low capacity, it does not bypass the signal around the r-f amplifier grid, but acts as a small portion of the tuned circuit capacity. The f-m r-f coil, L_4, is also left in the circuit and is in series with the feed to the r-f grid. It, like C_7, has no appreciable effect due to its low electrical value. A shunt feed system is used on the r-f amplifier grid, R_3 (470,000 ohms) being the grid return resistor.

C_{13} (25 mmfd) and L_5 (f-m converter coil) remain in series across the signal grid of the converter stage for a-m operation. They have no appreciable effect on the circuit since C_{13} has a very low capacity. The 3 to 12-mmfd trimmer, C_{14}, is also across this grid circuit, but its small capacity does not affect the circuit.

The band switch shorts the primary of the first i-f transformer that is not in use (the f-m first i-f transformer primary is shorted out for a-m operation). This prevents the production of undesired frequencies in the plate circuit of the converter. The unused i-f transformer windings, which remain in the circuit, have a very low impedance at the operating frequency since this frequency is far removed from the resonant frequency of the unused windings. Therefore, they have little effect on the operation of the circuit.

Series-Resonant Circuit

The r-f plate choke, CH_4 and 40-mmfd capacitor C_{10}, form a series resonant circuit at 10.7 mc. Since this series-resonant circuit is effectively connected from plate to ground on the r-f amplifier, it acts as an i-f wave trap for f-m operation, providing excellent rejection of any strong 10.7-mc signals which might be present in the input circuit of the receiver.

TV Amplifiers

(*Continued from page* 18)

across the diode-detector-load resistor to excite the control grid of the picture tube, no d-c restorer would be necessary. This is true because the signal output across the diode-load resistor has a fixed blanking level which conforms to the level held by the original modulation at the transmitter. All that would be necessary, then, if sufficient amplitude were available, would be to direct-couple it to the picture tube grid. Inasmuch as capacitive coupling is used in the amplification process, this level is lost and must once again be reinserted at the video output stage.

Briefly, the need for maintaining a fixed blanking level is to have the picture-tube control grid reach the blackout level for each blanking pulse regardless of the character and average content of the picture signal. Thus, changes in average brightness of transmitted scene in no way affects the blanking of the fluorescent screen. Instead the *average* bias on the picture tube grid rises up and down with changes in picture brightness as it should (referred to as the d-c brightness component), while the blanking level of the signal remains fixed. If this system were not employed the picture tube grid bias and, therefore, average illumination would remain constant and the blanking level would vary up and down.

Shift in the blanking level of the signal is caused by the charge and discharge characteristics of any capacitor-resistor coupling combination between stages. This defect is demonstrated in Fig. 2 which shows the effects of the capacitor on the blanking level. Here we have a signal with a low average brightness which, after it averages itself about zero signal level (as it would when being transferred through a capacitor) or negative grid bias level on succeeding tube, has a very low amplitude blanking level. If the signal has a high average brightness, the blanking level is only displaced a small amount and is of relatively higher amplitude. How this affects picture tube operation is shown in Fig. 3. In *a* we see that the shift in blanking level reduces the amplitude of the blanking level so much, in the case of a darker scene, that it does not supply a sufficient grid voltage level to blank out the fluorescent screen. Furthermore, the average brightness of the screen (d-c brightness component) remains unchanged, while it should actually shift because a darker scene is being transmitted. In *b* we note the improvement in light distribution when using a d-c restoration system. It will be seen that now the blanking level is held constant whether the scene is dark or bright, while the average level of the picture signal shifts, which is just what should occur to change the average brightness of the scene.

A typical d-c restorer system is shown in Fig. 4. The video output stage is operated without bias when no signal is applied (cathode grounded). As soon as a signal is applied the control grid draws current and this current, flowing through the grid resistor R_g, develops an average bias voltage, which is sustained by the capacitor C_c. Now the amplitude of this bias is set by the peak grid current drawn during the sync tip interval (functions similar to a peak vacuum-tube voltmeter). Since the amplitude of the sync tip has varied with average picture content up to this stage, the peak grid current and developed bias varies correspondingly, being high for a high amplitude sync tip and less for a low amplitude sync tip. Now just sufficient bias is added or subtracted, so the blanking level is held essentially constant while the average brightness component varies. This is the desirable condition.

After the d-c level has been reinserted into the composite signal, this level must be retained up to the grid of the picture tube. Thus, if the level is reestablished in the video output stage, this stage must be direct-coupled to the control grid of the picture tube. Therefore, we can consider the final stage a d-c amplifier, in the sense that it is direct-coupled to the following tube.

In the case of the video output stage of Fig. 4 it is direct-coupled to the picture-tube grid. Since the d-c blanking level is held constant on the grid of the video-output tube it draws a fixed amount of plate current through the plate resistor whenever the blanking signal is applied. Therefore blanking at the grid of the picture tube represents a fixed voltage level. The average plate current of the video output stage varies with scene brightness and in turn the average picture tube bias (direct-coupled) follows.

To summarize d-c restoration:

(*1*) The low and high average brightness signals as applied to the control grid of the d-c restorer video-output tube have different sync tip levels. The high average brightness signal has the greater peak amplitude.

(*2*) The high average brightness signal will draw the highest peak grid current through R_g (Fig. 4) and will put the highest negative charge on C_c. The time constant of R_gC_c is long enough to hold this charge between sync tips and the only time grid current is drawn is during the sync tip. During each sync tip the negative charge on C_c is replaced to its peak value; only a very minute discharge occurs between sync tips. It so happens that a higher peak charge is placed on C_c during the transmission of a high average brightness scene, because of the greater peak amplitude of the sync tip. Thus the average bias is more for a high average brightness scene, while the blanking level for both signals is at the same level.

(*3*) With a higher average bias (higher average brightness scene) the average plate current is less for the brighter scene. Inasmuch as the blanking level represents a fixed grid-voltage level the instantaneous plate current drawn during the transmission of blanking is also constant.

(*4*) When the average plate current is at least, as for a high average brightness scene, the d-c component of plate voltage of the video output tube is highest (less negative voltage drop across R_L) and, therefore, there is the *least* bias (direct-coupling) on the grid of the picture tube.

[To Be Continued]

NEWS

VECTOR-PHASE BOOK PUBLISHED BY RIDER

A pocket-sized book, *Understanding Vectors and Phase* by John F. Rider and Seymour D. Uslan, has been published by John F. Rider Publisher, Inc., 404 Fourth Ave., New York 16, N. Y.

Available in two editions, one paper-bound at 99 cents, the other cloth bound at $1.89.

* * *

SYLVANIA APPOINTS ZIMMER V-P IN CHARGE OF OPERATIONS

H. Ward Zimmer, former vice-president in charge of the radio tube division, Sylvania Electric Products Inc., has been appointed vice president in charge of manufacturing operations for all company divisions.

* * *

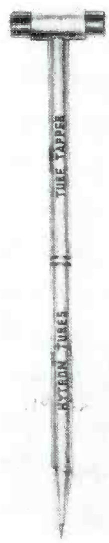
WARD LEONARD CATALOG

A catalog, D-30, describing *vitrohm* rheostats and resistors, and amateur relays has been published by the radio and electronic distributor division, Ward Leonard Electric Company, 53 W. Jackson Blvd., Chicago 4, Illinois. Information covers ring type and heavy duty plate type rheostats, and the following types of resistors; fixed tubular, adjust-ohm, stripohm, plaque, non-inductive, discohm, line voltage reducers, and fluorescent lamp resistors. Presented are dimensional data and basic resistor formulas.

Amateur relays described include types for antenna, r-f break-in, band switching, keying, overload, time delay, safety, sensitive, latch-in, and remote control.

•

HYTRON TUBE TAPPER



Tube tapper, in the form of a pencil, recently announced by Hytron.

SUPPLEMENTAL DATA FOR SYLVANIA TECHNICAL MANUAL

Supplemental data sheets, with information on new tube types, have been prepared by Sylvania.

Sheets are punched for a plastic binding and are inserted in the Sylvania News as they are issued. Sheets are printed to match pages of the original manual. Recent supplements covered technical data on 1B3GT, 1V5, 1C8 and 1W5 tubes.

* * *

ALMY JOINS DIXIE RADIO SUPPLY CO.

R. P. Almy has resigned as assistant general sales manager of the radio division of Sylvania, and joined the Dixie Radio Supply Company of Columbia, South Carolina, in which he has acquired part-ownership and become vice-president and assistant general manager.

* * *

ELECTRO-VOICE CENTURY MICROPHONE BULLETIN

A bulletin, No. 137, describing the *Century* type microphones developed for public address, paging, recording, and communications has been issued by Electro-Voice, Inc., Buchanan, Michigan.

Detailed specifications are given for the three types: crystal, dynamic, carbon.

* * *

G.E. TEST EQUIPMENT CATALOG

An 18-page test-equipment catalog, ESD-129, has been published by the specialty division of the electronic department of G. E.

Described are tube checker, type YTW-1; signal generator, YGS-3; 'scopes, types CRO-3A and CRO-5A; capacitance resistance bridge, type YCW-1; unimeters, types YMW-1A and UM-3; sine or square-wave generator, type YGA-2; and high-voltage multiplier, YYW-1.

* * *

STONE ELECTED PRESIDENT OF LOS ANGELES CHAPTER OF REPS.

Carl A. Stone has been elected president of The Los Angeles chapter of the Representatives of Radio Parts Manufacturers, Inc. Gerald B. Miller was elected vice president and M. D. Ealy was reelected as secretary-treasurer. Mr. Stone and Mr. Miller succeed Dave Marshank and George Tivy, respectively, who have held office for the past twelve months.

* * *

MARTIN FRIEDMAN BECOMES SNYDER REPRESENTATIVE

Martin Friedman has been appointed representative for the Snyder Manufacturing Company, to cover Eastern Pennsylvania, New Jersey, Maryland, District of Columbia and Virginia.

Mr. Friedman will headquarter at 1504 Real Estate Trust Building, Philadelphia.

* * *

AMPLIFIER DIAGRAM BOOK

A second printing of *Practical Amplifier Diagrams* has been announced by Os-tronic Publications, 196 West 37th Place, Los Angeles 7.

Written by Jack Robin and Chester E. Lipman, the book describes forty-five one to eleven tube amplifiers with phase inversion, inverse feedback, bass boost, treble boost, compression and expansion recording amplifiers, multi-channel amplifiers, pre-amplifiers, portable p-a amplifiers, etc. Price, $2.00.

* * *

CENTRALAB VOLUME-CONTROL GUIDE

The eleventh edition of the Centralab volume-control guide, with 96 pages of replacement data on volume and tone controls used in receivers made by over 150 manufacturers, has been announced by Centralab, Milwaukee, Wis.

The guide also offers information on custom controls and a cross reference in which controls made by other manufacturers are listed with electrical and catalog number equivalent data.

* * *

PREMIER MINI-SIGNAL GENERATOR BULLETIN

A four-page bulletin describing a crystal-controlled high-frequency Mini-Signal generator, type 117, has been issued by Premier Crystal Laboratories, Inc., 53-63 Park Row, New York 7, N. Y.

Appearing in the bulletin are a circuit diagram and instructions for zero-beating the crystal by means of a micrometer adjustment.

Offered too are data on the application of the generator in aligning a-m, f-m, and television receivers.

Signal Booster For TV

(See Front Cover)

A THREE-STAGE R-F AMPLIFIER which can be used with any type of tv receiver and transmission line to increase signal strength, appears on the cover this month.

The amplifier, known as the Telebooster[1], has a gain of 20 db. Its response is 6 mc at 6 db down and 4.5 mc at 3 db down. Input and output impedance is 75 ohms (unbalanced) or 300 ohms (balanced).

A rotating type band switch provides contact to six slug-tuned coils which are aligned at the factory to provide proper bandwidth for optimum signal-to-noise ratio. Slight readjustments can be made at the time of installation to compensate for production discrepancies in tv receiver inputs.

Input circuits have been designed to properly terminate a 75-ohm coaxial line; RG-59/U cable is recommended for runs up to 100′ and RG-11/U for longer runs to reduce line losses. The input terminals may be strapped for terminating a 300-ohm ribbon line, but this is not recommended except in extremely low noise areas. The output terminals may be connected to the antenna terminals of any tv receiver calling for either a 75-ohm single-ended or a 300-ohm balanced source.

To match tv sets having a 95-ohm impedance, a 140-ohm resistor can be placed across the 300 ohm terminals of the booster.

The unit may be mounted in any convenient manner. However, it has been mechanically styled to permit its mounting on the rear of the tv set cabinet at a point closest to the antenna terminals. When the unit is mounted in this manner, the controls will be available over top of cabinet.

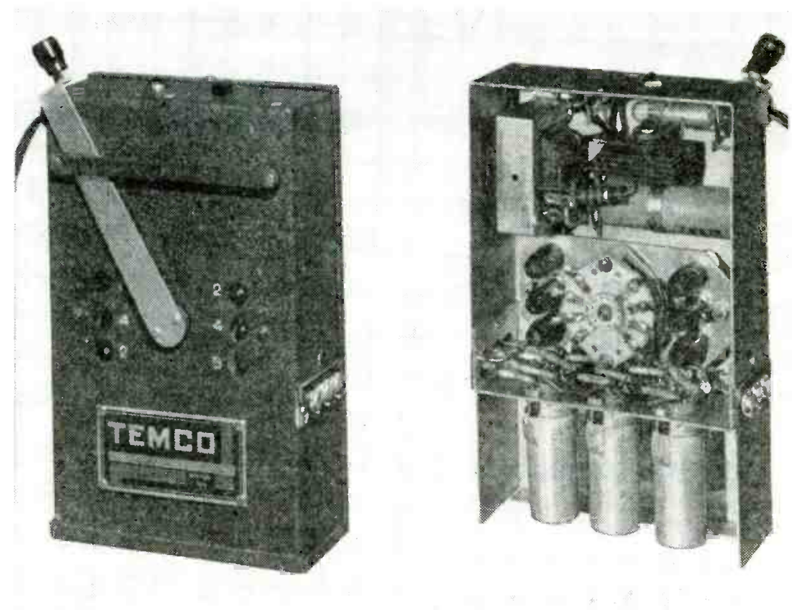
The booster operates best when used with a highly directional antenna with reflectors or reflectors and directors, which permits attenuation of signals coming from the rear of the antenna system. The location for the antenna should be selected as far from noise sources as possible. Good height above ground is essential to obtain the best possible signal-to-noise ratio. The use of coaxial cable is highly recommended to further reduce noise pickup.

The unit is aligned at the factory for the three required channels. No major alignment adjustments should be attempted in the field because of the critical bandwith requirements. However, slight adjustments may be beneficial under conditions of extremely weak signals, but these should only be made by fully qualified technicians with prior assurance that the tv set itself is in proper adjustment.

A selenium rectifier used in the independent power supply system runs at 25% of the rated load; thus the booster can be operated for long periods without fear of overheating.

[1]Temco Service Corp., New York City.

Fig. 1. Front and rear views of the Telebooster.



New Products

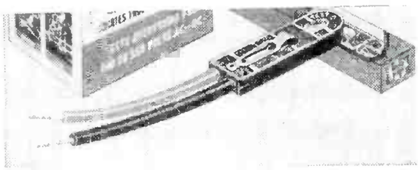
BRACH NEON POCKET TESTER

A neon pocket tester, Test-O-Lite, improved by the use of Koroseal leads, has been announced by L. S. Brach Mfg. Corp., 200 Central Ave., Newark 4, N. J. The contact points of the leads are not needle-sharp and cannot pierce pocket.

Test-O-Lite, originated by Brach in 1929, is capable of detecting the presence of current from 90 to 500 volts a-c or d-c, and able to distinguish between the live wire and ground, and on d-c to determine the polarity of the circuit.

Can be used for the location of blown fuses, determination of faults in electrical circuits, etc.

Has a resistor in each lead to eliminate any possible danger of flash-over on circuits in excess of 220 volts.



* * *

ELECTRIC AUTO-LITE SUPPRESSOR-TYPE SPARK PLUG

The development of a spark plug with a built-in 10,000-ohm resistor to suppress spark plug interference has been announced by the Electric Auto-Lite Company, Toledo 1, Ohio.

* * *

NATIONAL POLYTRONICS WIRE RECORDER

A wire recorder, model 5-A, with self contained amplifier and microphone, has been developed by National Polytronics, Inc., 2430 Atlantic Ave., Brooklyn, N. Y.

* * *

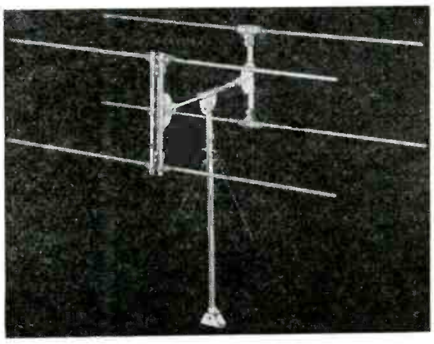
CAMCO DIPOLES AND REFLECTORS

Dipoles and reflectors for f-m and tv coverage have been announced by Camburn, Inc., 32-40 57 Street, Woodside, N. Y.

Antenna-reflector combination is said to provide a 5-db increase in signal strength with a 15-db rejection of interfering signals.

Reflector kits supplied with folded or straight dipoles.

(*Continued on page* 42)



New Products

(*Continued from page 41*)

STEPHENS CO-SPIRAL SPEAKER

A co-spiral speaker, model P-52FR, with a differential diffuser, which is said to provide high-frequency dispersion with an almost 100% spherical polar pattern of over 90°, has been announced by the Stephens Manufacturing Corporation, 10416 National Blvd., Los Angeles 34, California.

Frequency range is said to be from 40 to 14,000 cycles.

Supplied in both 12" and 15" cone diameters. Efficiency of over 50% said to be available with either 8- or 16-ohm voice coils; 15 watts of power input handling capacity.

Bulletin 109 contains complete data.

* * *

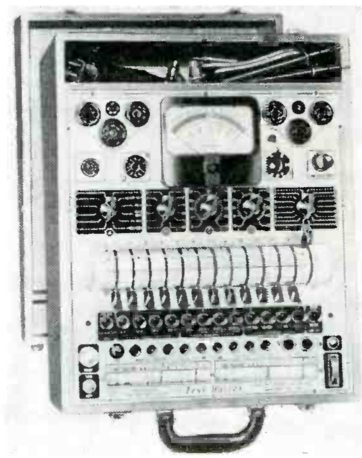
PRECISION APPARATUS ELECTRONAMIC TESTER

A tube, battery and circuit tester, *series* 10-54 *Electronamic Test Master*, has been announced by the Precision Apparatus Co., Inc., 92-27 Horace Harding Blvd., Elmhurst, L. I.

Tube tester has a twelve-element central-lever-selector system, free-point element short-check and performance test selection regardless of varying or multiple pin and cap termination; standard tube basing numbering system on all element selectors; brass geared test data roll chart and dual short-check sensitivity.

Circuit and battery testing section affords: 35 a-c and d-c ranges to 6000 volts, 60 microamperes, 12 amperes, + 70 db, 60 megohms. Meter sensitivity is 20,000 ohms per volt d-c, 1000 ohms per volt a-c.

Available in three basic models: 10-54-P, portable; 10-54-C, sloping counter-type; 10-54-PM, standard rack-panel.



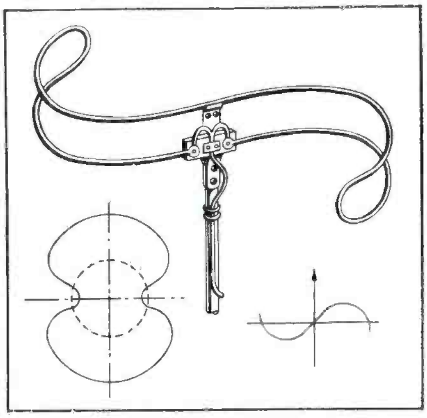
* * *

TACO OMNIDIRECTIONAL TV/F-M ANTENNA

An omnidirectional S-folded dipole antenna, type 624, has been announced by Technical Appliance Corporation of Sherburne, N. Y.

Dipole, which can be used for f-m and tv, made from 3/8" diameter non-corrosive aluminum tubing. Bakelite terminal block mounts a strain insulator for attaching the 300-ohm ribbon type transmission line. A 5-foot mast is supplied for mounting the antenna above the roof.

Field strength pattern in drawing indicates the intercepted signal strength around the compass. The dotted circle shows the relative signal of a circular antenna.



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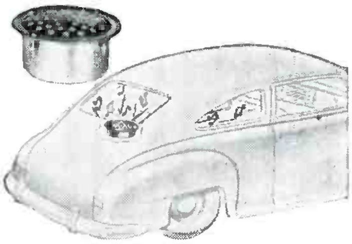
MUSICOLA AUTO RADIO EXTENSION SPEAKER

An extension speaker for car sets, with a three-way switching feature which permits speaker to be operated individually or together, has been announced by the Musicola Sales Company, 172 North Ada Street, Chicago 7, Illinois.

Speaker mounts on shelf behind the rear seat.



* * *

AIR KING PORTABLE WIRE RECORDER

A portable wire recorder and phono-combination, model A-750, with a 5-tube (including rectifier) amplifier, has been developed by Air King Products Co., Inc., 170 53rd Street, Brooklyn 32, N. Y. Recorder also plays either 10" or 12" records, and comes equipped with permanent needle. Recordings from the phono or receiver can be made directly through the amplifier without using the microphone. Voice can also be dubbed through the mike while recording from receiver.

(*Continued on page 44*)

New Products

(Continued from page 43)

ALTEC LANSING PORTABLE P-A AMPLIFIER

A portable 15-watt public-address amplifier, model A-324, has been announced by Altec Lansing Corporation, 250 West 57th St., New York 19, N. Y.

Frequency range said to be 35 to 12,000 cycles, within 1db.

Two of inputs provide 95 db gain for low-impedance microphones with individual volume controls on each input for mixing purposes.

Transformer in high-gain low-impedance microphone input circuits has 90-db shielding to guard against hum and noise pickup

Two other high-impedance inputs provide 72 db gain for receiver or phonograph pickup or high-impedance microphones; they are coupled to a dual type volume control.

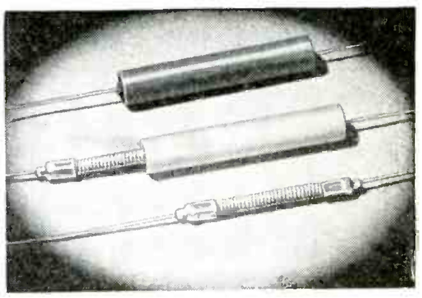
* * *

CLAROSTAT CERAMIC-CASED MIDGET WIRE-WOUND RESISTORS

Ceramic-cased midget wire-wound resistors, Greenohm Juniors, have been announced by Clarostat Mfg. Co., Inc., 130 Clinton St., Brooklyn, N. Y.

Resistors feature a wire winding on fibre-glass core, with axial bare pigtail leads clinched to the ends, placed in a steatite tube and filled and sealed with Greenohm cold-setting inorganic cement.

Standard Greenohm Junior, type C7GJ, measures 1¾" long by 5/16" diameter with 2" leads. It is rated at 7 watts. Available in values from practically zero to 5000 ohms max. Smaller type, C4GJ, measures 1" long by 5/16" diameter, and is rated at 4 watts, with maximum available resistance of 1000 ohms.

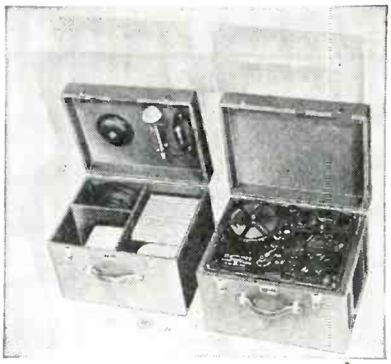


* * *

ACA PORTABLE MAGNETAPE RECORDING AND PLAYBACK INSTRUMENTS

Portable magnetic recording-playback units have been announced by the Magnephone Division of Amplifier Corp. of America, 398-3 Broadway, New York 13, N. Y. In one model, the case houses a self-contained recording and playback unit. Another case holds a microphone, microphone cable, extension line cord and contains additional space for 25 reels of Magnetape, plus cleaning and maintenance accessories.

Four models are available, depending on the frequency response desired One model, TP-800-C, will record and playback frequencies up to 12,500 cycles, with less than 3% distortion.



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MEISSNER F-M RECEIVER

An 8-tube f-m receiver, model 8C FM, has been developed by the Meissner Manufacturing Division of Maguire Industries, Mt. Carmel Ill. Audio output is said to be flat within ±2 db from 50 to 15,000 cps.

Uses two 6AG5s, two 6BA6s, two 6C4s, one 6AL5 and one 6X5GT/G.

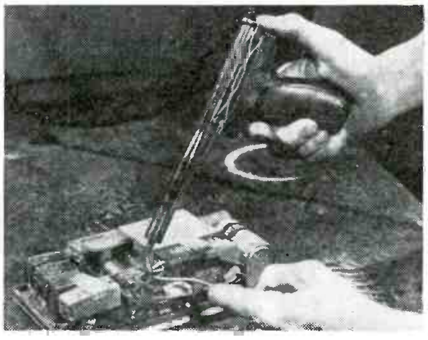
* * *

LENK GUNGRIP SOLDERING IRONS

A gun-grip type of soldering iron, available with four types of tips, has been announced by the Lenk Mfg. Co., Dept. B 30-38 Cummington Street, Boston 15, Mass.

Has a built-in rest stand.

Overall length, 9½" x 4¾".



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NEOLINE ELECTRIC CORD PLUG

A flush-type plug, Neoplug "100" designed so that the electric cord enters at the side of the plug, thus keeping the cord flush against the wall, has been announced by Neoline, Inc., 130 South Hewitt Street, Los Angeles 12, California.

Plug, flat and pancake in shape, extends about a half inch from the outlet. Made of Neoprene. Fits any standard outlet and is available in standard colors.

The 'Scope

(*Continued from page* 13)

analysis shows that since the voltage is identical at any instant in both directions, that is, up and down or left and right, a straight line can be the only result.

Next, let us take two similar a-c voltages, of identical amplitude and frequency, but with one voltage starting its cyclic swing ¼ of a complete cycle, or 90° later than the other; Fig. 4. It will be noted that voltage *A* starts ahead of voltage *B*. However, voltage *B* is shown as part of a continuous wave, which has a voltage value at the point where voltage *A* starts. Let us now analyze the picture that would result when two such voltages are applied to the deflection plates of the c-r tube. This is shown graphically in Fig. 5. The numbered points on the figure correspond to those of Fig. 4, and represent the position of the flying dot at regular time intervals, as interpreted by the voltage applied to the deflection plates. For example, point *1* represents a voltage of zero applied to the vertical plates, and a voltage of 8 negative applied to the horizontal plates. Point *2* represents a positive voltage of slightly more than 5.5 applied to the vertical plates, at the same time that slightly more than 5.5 volts negative is applied to the horizontal plates. If these points were connected, a perfect circle would result.

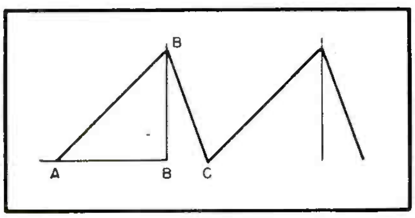


Fig. 8. In order to show a direct representation of the horizontal applied voltage, a sawtooth voltage is applied to the vertical plates. Represented in this figure is a graphical picture of such a voltage. Note that the voltage rises slowly to a peak from *A* to *B*, and then drops quickly back to zero at *C*. The line *BC* has been exaggerated somewhat to show that it is not actually a straight line.

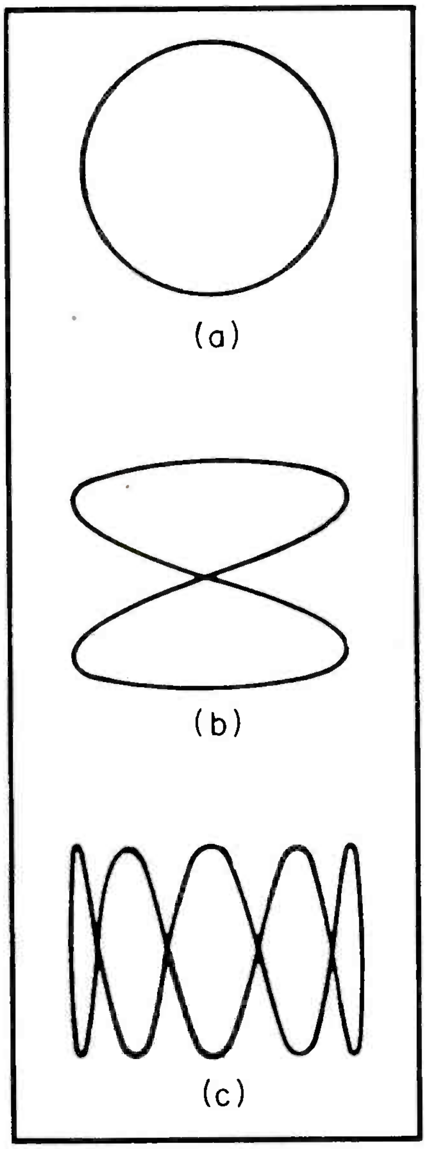


Fig. 7. Three types of Lissajou figures. In *a* we have a frequency relationship between the horizontal and vertical deflection voltages of *one* to *one*. At *b*, the ratio is *two* to *one*, and at *c*, *one* to *five*.

Phase Difference

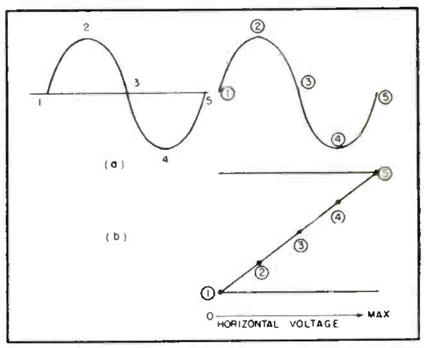
The difference in cycle-starting time is known as phase difference. If voltage *B* were to start ⅛ of a cycle later than voltage *A*, the resulting picture would be an ellipse. This would represent a phase difference of 45°. This is one of the confusing points in the analysis of 'scope pictures, in that several pictures may result from two voltages applied to the deflection plates, depending on the phase relationship of the voltages.

Fig. 6 shows the various pictures that result when two voltages of like frequency and amplitude are applied to the vertical and horizontal deflection plates, as the phase difference changes.

By a similar analysis, the frequency ratio of two voltages may be determined by the wave shape. Some typical figures are shown in Fig. 7. These are known as Lissajou figures, and are named after a famous scientist of the 19th Century.

Lissajou figures are indirect representations of sine voltages. That is,

Fig. 9. When a sine wave, show at *a*, is applied to the horizontal plates, and a sawtooth wave, shown at *b*, is applied to the vertical plates, the resultant picture, upper right, appears on the scope screen. Note how the sawtooth voltage spreads out the picture.



WHEN YOU CHANGE YOUR ADDRESS

Be sure to notify the Subscription Department of SERVICE at 52 Vanderbilt Ave., 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.

the figures shown are resultants of two applied voltages. C-r tubes may be set up to give a direct representation of the voltage-wave shape. This is done by applying a sawtooth wave (Fig. 8) to the horizontal deflection plates, while the unknown voltage is applied to the vertical plates.

In a sawtooth wave, the voltage rises slowly to a maximum at a uniform rate, and then drops quite suddenly to zero. This voltage does not alternate, but always rises in value in only one direction. An analysis of the action of this voltage is shown in Fig. 9.

To trace this analysis let us assume that the time interval required for one cycle of an a-c wave is identical to the time interval for one cycle of the sawtooth wave. The flying dot will then rise and fall on the screen as the a-c wave voltage rises and falls. However, it will also respond to the sawtooth voltage being applied to the horizontal deflection plates, and move lengthwise across the screen at a uniform rate. When it reaches the far end of the screen, it will then suddenly return to the starting point, and trace the next a-c wave. If the time constant of the waves applied to the vertical and horizontal plates are identical, we'll have a recurrent picture on the screen, which will faithfully reproduce the a-c wave as a function of frequency and voltage.

The relationship of the sawtooth wave to the signal voltage is that of a time base. In other words, it represents the time interval required for the signal voltage to pass through a complete cycle. By thus serving as a pure time function, the input signal may be represented in all its detail.

The previous examples were ideal examples, in that the frequencies and voltages were so arranged as to give the desired image. However, this is not always the case in practice. For example, the sawtooth frequency may be one half, or twice the frequency of the incoming signal. Or, the sawtooth wave may have a voltage amplitude twice or one half the incoming signal. A third possibility is that the phase relationship between the two signals may distort the image. All of these eventualities have been foreseen and accounted for on the control panel of the 'scope.

The controls are, in the main, voltage controls for the various elements of the c-r tube. Their effect is to produce the type of picture sought, regulate its size, and center it on the screen.

[To Be Continued]

JOTS AND FLASHES

Auto Radio Servicing will be quite a factor in 1948. According to Frank W. Mansfield, director of sales research for Sylvania Electric Products, Inc., 84% of the 1947 cars are radio equipped. Auto radio production has hit a new high of approximately 2,860,000 units, a gain of approximately 265,000 over the 1941 record. It is interesting to note that in 1934 there were only 780,000 receivers in use and in 1937 there were 1,750,000 auto receivers. . . . Admiral Corporation has set up a television training course for its distributors throughout the country. Ray Petersen, field service engineer, is directing the course. Others in charge of the course include Max Schinke, national service manager; Joseph Marty, assistant to the vice president in charge of the radio division and Ed Steinberg and Paul D'Arco, both of the service division. . . . Alfred Crossley and Associates, 549 W. Randolph Street, Chicago, have been appointed middle western representative for Clough Brengle. . . . Abner G. Updike has been named sales manager for the New England and east central states of the Mobile Communications Division of Farnsworth Television & Radio Corp. G. K. Dickenson has been named sales manager for the west central and southwestern states. . . . A. E. Stevens has been named general sales manager of American Radio Hardware Co., Mt. Vernon, N. Y. Mr. Stevens will also continue to serve as sales manager for Radio Essentials, Inc., which is the exclusive sales agency of ARHCO products to jobbers and distributors. . . . Wilfrid Graham, formerly of the Camden office of RCA, has joined the sales staff of Morris F. Taylor Co., Silver Spring, Maryland. . . . Salescrest Co., 222 West Adams Street, Chicago, Illinois, has been appointed manufacturers rep for Air King in the Illinois and southern Wisconsin area. Russell G. Akin is head of Salescrest. . . . A television magnifying lens, Walco Tele-Vue-Lens, which is said to magnify a 52-square inch area to 150 square inches, has been announced by the E. L. Cournand Company and is being distributed by Walco Distributing Co., 15 Exchange Place, Jersey City; Walco Sales Company, 76 Franklin Street, East Orange, N. J., and the E. M. Ward Sales Co., 224 S. Michigan Avenue, Chicago. . . . Burlingame Associates, 11 Park Place, N. Y. C., have been named representatives for all Vertrod Products in the New England states and New York, New Jersey, Eastern Pennsylvania, Delaware, Maryland and Washington, D. C. . . . G. E. has announced 52 additional types of tubes which are said to be needed for repair in receivers made as far back as 1933 and 1934. . . . R. W. Andrews, merchandise manager of the radio tube division of Sylvania Electric has been transferred from the Williamsport, Pa. office to the Emporium, Pa. office. . . . RCA plans to step up production of television picture tubes during 1948 in an additional plant at Lancaster, Pa., according to L. W. Teegarden, vice president in charge of the RCA tube department. . . . Over 10,000 attended the G. E. clinic meetings, which were held in 24 states, recently. R. D. Payne was in carge of the G. E. tour.

ADVERTISERS IN THIS ISSUE

SERVICE INDEX—JANUARY, 1948

OVERWHELMING ACCEPTANCE!

• Month after month, RCA Batteries continue to smash all previous sales records.

The reasons for this unprecedented acceptance are conclusive—

RCA Batteries are designed for *radiomen* . . . to sell through *radio* outlets. And they're backed by the greatest name in radio—RCA.

RCA Batteries are your assurance of immediate customer acceptance and greater profits.

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

TUBE DEPARTMENT

RADIO CORPORATION of AMERICA

HARRISON, N. J.