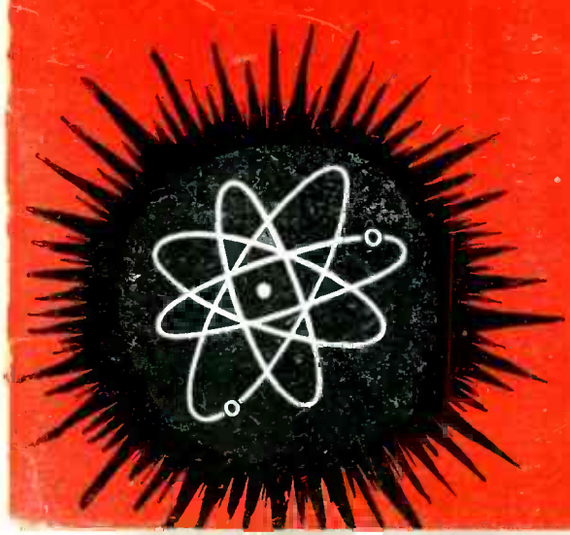
radio service dealer

DECEMBER, 1947



IN THIS ISSUE:

What's The Indian Rope Trick Got To Do With MALLORY CAPACITORS?

MALLORY originated and produced the first type "FP" capacitor. These have been famous for performance for so long—have been so consistently preferred for original equipment—it follows they naturally become first choice of radio servicemen. You might imagine there was some special magic in their making.

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EDITORIAL

Projected Service Clinics

On page 18 of this issue is an unabridged publicity release covering the proposed "plan to assist radio technicians" being sponsored by several major groups and associations of the Radio Industry. We endorse and propose to support all such educational clinics!

Any device, brochure, book, magazine, lecture or clinic that affords knowledge and guidance--technical and otherwise--to this country's legitimate radio service dealers and radio technicians is worthwhile. Service dealers and technicians who fail to avail themselves of all such aids render themselves a disservice. They personally, their business, their customers and their suppliers suffer to some extent if they fail to obtain all the knowledge possible about all phases of the industry that provides their livelihood.

TV Service Policy Renewals

A leading television set manufacturer announces that when their TV set owners' present one-year service policies expire the owners will be urged to renew the policy for another year at a fee slightly lower than the original one.

Those "exclusive service organizations" who held the original policies therefore stand a great chance to get the renewal--without much threat of a competitor getting it. To our mind this is not a fair or tenable condition. We favor free enterprise and open competition.

We realized that in the beginning when television sets were first being merchandized in volume, that it was to the best interests of the TV set manufacturers, who had enormous sums invested, that only thoroughly trained personnel, men who had been given specialized training in television, should be entrusted with installing and servicing same.

A year has passed since television's inception and in that period many thousands of service dealers and technicians have learned practically all there is to know about all phases of television servicing. As publisher of this journal we have this past year spent many thousands of dollars for articles on TV, FM and related subjects. Did we invest our time, money and effort in vain? We certainly did not restrict our magazine to only "appointed exclusive TV service organizations." Instead, we have brought all technicians up to a knowledge par with the so-called "specialists."

To "RSD" subscribers television and FM is no longer a mystery. We feel that all of them who wish to should now be allowed to openly compete for, and not be restricted from obtaining, any and all TV installing and service business that they are able to get. This is especially true in cases where original one-year service policies are expiring. It is a dangerous thing to restrict any phase of any business to a limited group, for it is axiomatic that competition stimulates business and makes for greater progress.

S. R. COWAN, *Publisher*

Member of the Audit Bureau of Circulations

radio service dealer

VOL. 8 NO. 12

SANFORD R. COWAN
Editor & Publisher

DECEMBER, 1947

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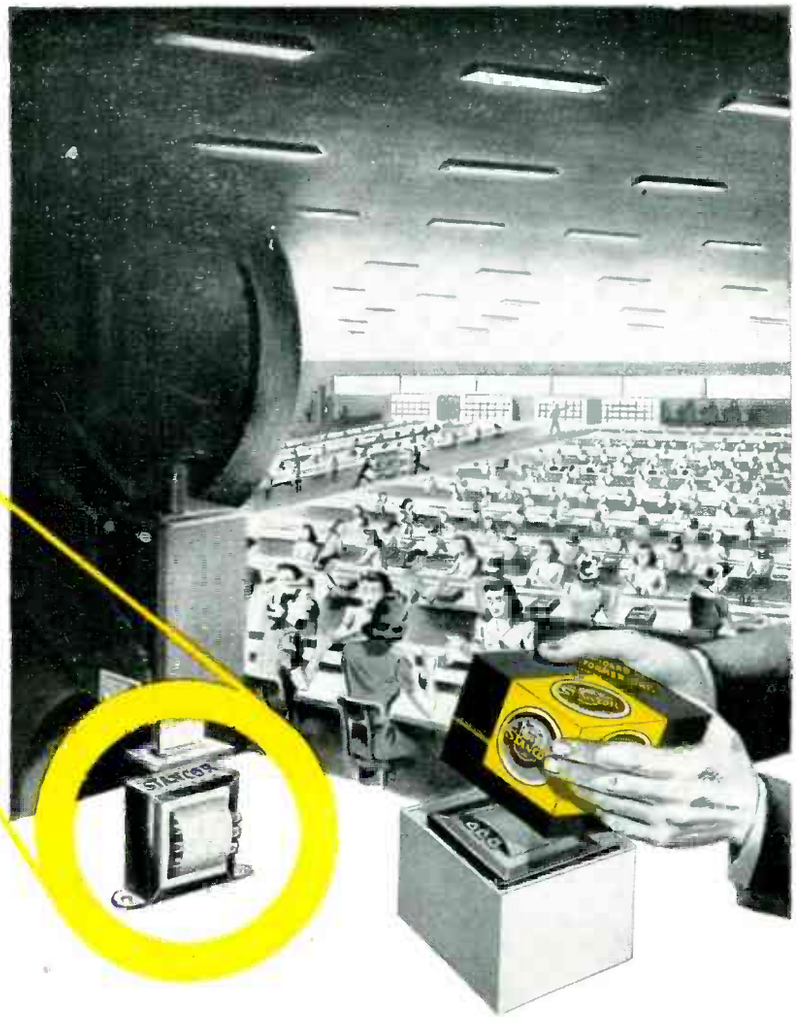

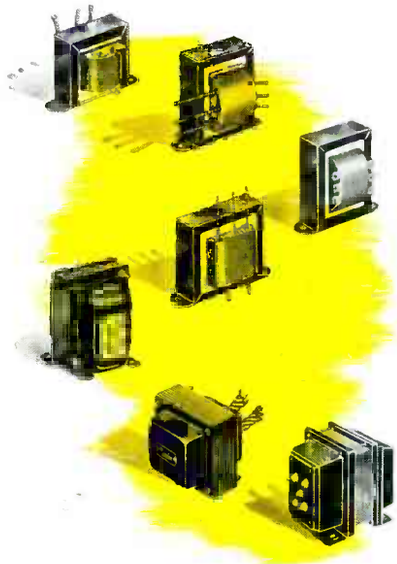

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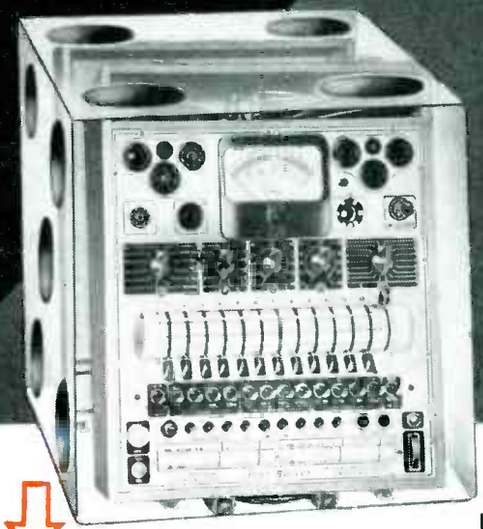

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- Requires nothing complex to learn
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- ★ Employs standard tube basing numbering system on all element selectors, permitting most simplified operation and comprehension of test results.

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- ★ 35 A.C. and D.C. ranges to 6000 volts, 60 microamperes, 12 amperes, 70 DB, 60 megohms.
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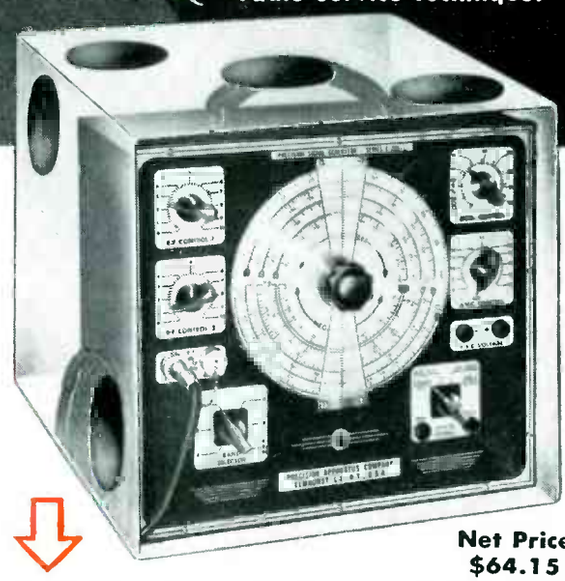
- ★ All standard ranges at Only Two polarized tip jacks.
- ★ Tests all standard radio A, B and C batteries under dynamic load conditions, simulating actual performance.



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- ★ Direct Reading Frequency coverage 88 KC to 120 MC for A.M., F.M. and T.V. alignment (absolute fundamentals to 30 MC).
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TRADE FLASHES

A "press-time" digest of production, distribution & merchandising activities

RCA Tube Reference Book

The 1948 edition of the RCA Tube Reference Book, a handy vestpocket booklet replete with technical data for radio servicemen, engineers, and technicians, has just been published and is now available from RCA, Cunningham and RCA Victor tube distributors.

A combination technical reference, memo book, diary, and radio directory, Reference Book contains up to-date data on RCA receiving tubes, condensed data on over 260 RCA non-receiving tubes, RMA color codes on mica and ceramic capacitors and resistors. It is, in addition, a world atlas with maps in full color, including an 8-page section of the United States.

The volume has been expanded this year to include several valuable new features. These include a "replacement directory" covering tubes for industry, communications, and special uses, and a listing of directly interchangeable RCA tube types as well as a listing of similar RCA types. Additional features are a battery interchangeability chart, a glossary of television terms, charts for calculating series resistance and parallel capacitances, and a table of metric equivalents.

New G-E Credit Offices

The General Electric Credit Corporation has opened new offices in Miami, Florida, Lubbock, Texas and Seattle, Wash., as part of a national program of expanded local coverage to take care of the increase in instalment sales paper from General Electric and Hotpoint dealers.

Stewart Warner Promotes Dreifke

E. H. Dreifke, has been promoted to assistant manager of the Radio Division of Stewart-Warner Corporation, Chicago, Frank A. Hiter, senior vice-president, has announced.

E. H. Dreifke

Kelly Now Farnsworth S-M

J. H. (Jim) Kelly, Southeastern District Manager the past three years for the Farnsworth Television & Radio Corporation, has been appointed Manager of the Farnsworth Sales Division.

Stewart Warner 35 Years Old

An Open House and plant tour for employees, their families and friends was held December 13, at the Stewart-Warner Corporation plants at 1826 West Diversey Parkway to mark the thirty-fifth anniversary of the founding of the company.

Mr. Harold Sperber of Radionic Equipment Co., Harry Reizes of Radio Service Dealer and Harold Becker, Sales Manager, Distributor Division, of the Espey Mfg. Co., (left to right) shown viewing a custom-built cabinet featuring the Espey 7B AM/FM chassis at a recent Espey party for the trade press.

Utah Radio Products In New Location—Hugo Sunberg Promoted

Philip Heckendorn, General Manager of Utah Radio Products, division of International Detrola Corporation, reports the consolidation of all Utah's manufacturing and sales activities in their new larger plant and offices at Huntington, Indiana. At the same time, Mr. Heckendorn announces the appointment of Hugo Sundberg as Sales Manager of Utah's jobber and industrial divisions.

Mr. Sundberg's new duties place him in complete charge of promoting and selling Utah's more than seventy models of permanent and electro magnetic speakers. He has been with Utah's jobber sales division at its former location in Chicago for the past twenty years and is widely known in the radio parts manufacturing industry.

Hugo Sundberg

Co-Op Adv. Campaign By W-C.

Entry of Webster-Chicago into a cooperative advertising campaign was announced today by S. T. Seaman, Advertising Manager for the company.

"Our cooperative advertising campaign with our dealers and distributors, abets our national and trade paper advertising program to get the fullest possible sales effect," said Seaman. "This is the first time Webster-Chicago has gone into cooperative advertising, and our dealers and distributors are enthusiastic over the plan."

The 33-year old company, manu-

[*Continued on page 28*]

FREE! 25,000,000 GALLONS OF GASOLINE

TEN TIMES MORE GASOLINE than this switchyard of tank cars could carry has been saved by Raytheon 0Z4 and 0Z4G tubes.

Raytheon 0Z4 and 0Z4G Tubes, it is safe to estimate, have already saved the American Motoring public some 25,000,000 gallons of gasoline!

Because they draw appreciably less power from the automobile battery and engine than substitute vacuum tubes, each Raytheon 0Z4 tube saves from two to three gallons of gasoline during its working life.

Raytheon 0Z4 and 0Z4G tubes are universally popular with auto radio designers and service men.

The name RAYTHEON on radio tubes stands for advanced design, precision manufacture, strong construction.

For peak performance
buy Raytheon Radio Tubes!

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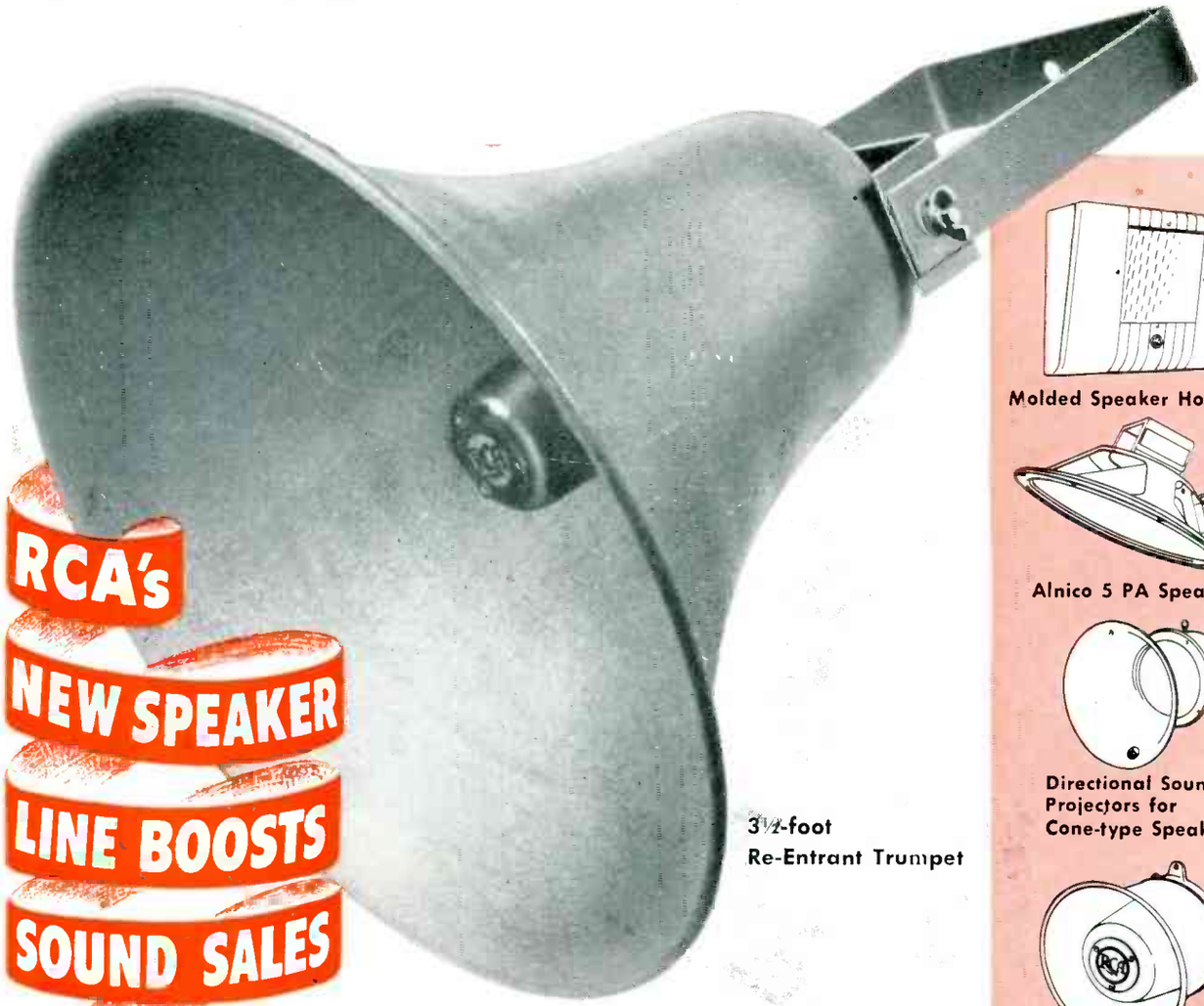

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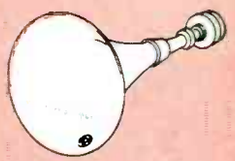

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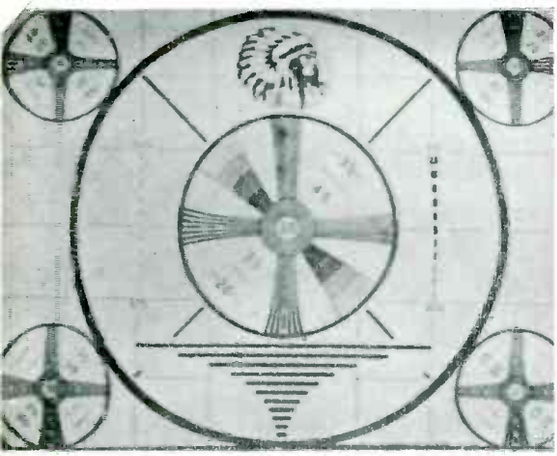
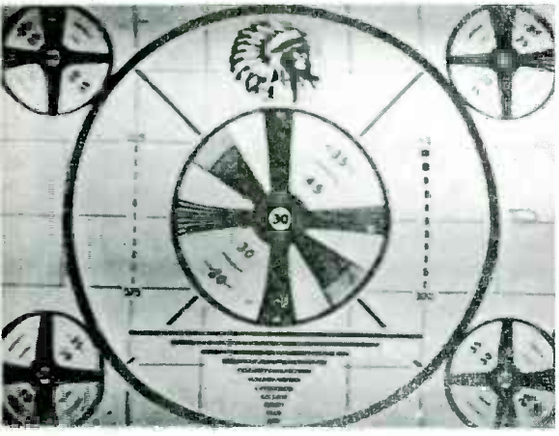
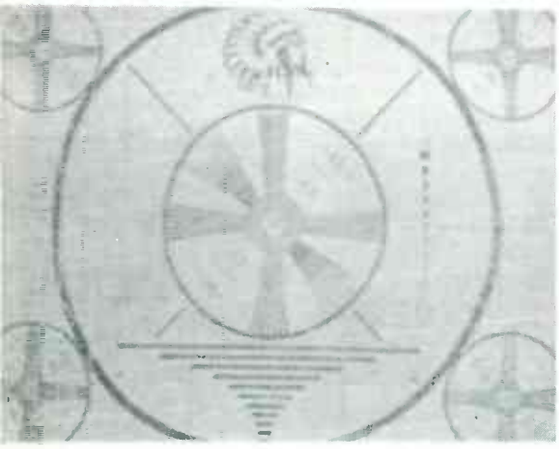


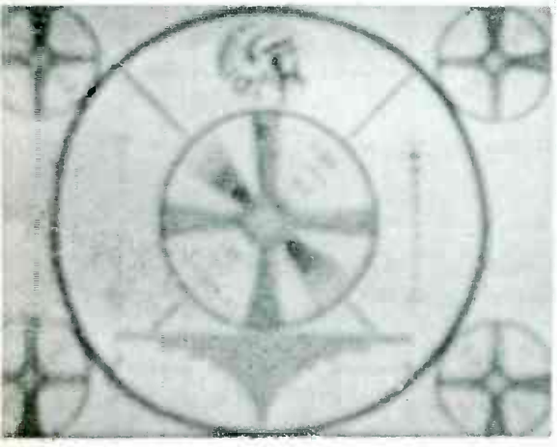
Correctly Adjusted



Contrast Too High



Contrast Too Low, Brightness Too High



Focus Control Misadjusted

cathode ray tube providing the picture and we will see how, with a little understanding of the television circuits and some logical reasoning, the more common defects likely to occur in a TV set can easily be located.

Every television receiver can be divided into four sections, according to the function they perform.

1. *The sweep circuits.*
2. *The video circuits.*
3. *The sound circuits.*
4. *The power circuits.*

The sweep circuits could be subdivided into the synchronizing pulse amplifier and separator, and the vertical and horizontal sweep circuits. The video circuits consist of a chain, including the r-f oscillator, mixer, also referred to as "front end," the I.F. and second detector, and last, the video amplifier with a d-c restorer.

The sound system usually has only an i-f section, a discriminator and the audio amplifier. Lastly the power circuits include filament voltage for all tubes, B+ and the high voltage supply for the second anode of the picture tube. The block diagram shows the sequence of these sections and their connection to the CRT.

Checking The Basic 4 Trouble Sources

By analyzing what we see on the face of the CRT we can usually tell immediately in which of the four sections the trouble originates. For example, seeing nothing on the face of the CRT, we throw a quick glance at its neck and at the other tubes to see if they light up. If they don't, we can measure the filament voltage directly at the transformer with our a-c voltmeter. The following ohmmeter checks are obvious. If all filaments are lighted we next try the brilliancy control. If that gives no results, we next would measure the B voltage at the brilliancy control, the bias on the grid of the CRT and other operating voltages. If the tube uses an Ion-Trap (most RCA tubes do), we might try adjusting that, but if we still cannot see anything on the face of the CRT then we can be reasonably sure that the CRT is not getting any second anode voltage. Usually the filament of the high voltage rectifier will be a fair indication whether it is working, but if we want to measure high voltage, say 9,000 volts, we can construct a little voltage divider that will do the trick. Connect twenty 10-meg. resistors in series with one 2-meg. resistor and ground one end of the latter. Connect the high voltage source to the top of this voltage divider, and your meter will read one hundredth of the high voltage, or 90 volts, between ground and the 2-meg. tap. In the above example the trouble must have been in the high voltage supply and the most obvious to

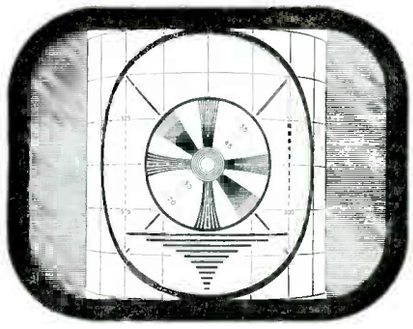


Fig. 1—Distortion due to maladjustment in the horizontal sweep circuit

suspect would be either the rectifier tube or one of the high voltage filter condensers. Ohmmeter checks would finish this operation.

The Sweep Circuit

But let us assume that we can see something unusual on the CRT, for instance a vertical line. It immediately tells us that no horizontal sweep is applied and by checking the operating voltages of the tubes in that section, especially the sawtooth oscillator, we will locate the defective part. On the other hand, if we can get only a horizontal line line on the CRT then we know it must be in the vertical sweep and there we can trace the signal with our earphones. When both sweeps are operating properly a raster should be seen on the CRT and, by adjusting the focus, brilliancy and centering controls, each line should be visible.

Next the sweep width and linearity controls should provide a raster of the proper size with an aspect ration of 3 to 4 and with straight edges. If no picture is visible but sound can be heard over the speaker, try adjusting the fine tuning condenser. This should, in succession, first permit you to hear the tone or whatever else is being sent over the sound channel, next you should hear a 60 cycle hum, which represents the vertical synchronizing pulses from the picture signal. Then some static may be heard, and then again the tone and picture signal repeated. If during this procedure no pattern appears on the CRT one must assume that the defect

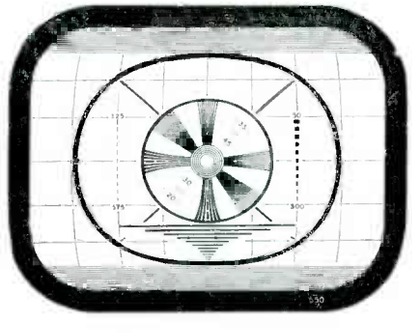


Fig. 2—Distortion due to maladjustment in the vertical sweep circuit

A NEW SERVICING TECHNIQUE...for TELEVISION RECEIVERS

A practical method for quickly locating basic faults in television receivers—Eliminates the mystery "bug-a-boo"

by WALTER H. BUCHSBAUM

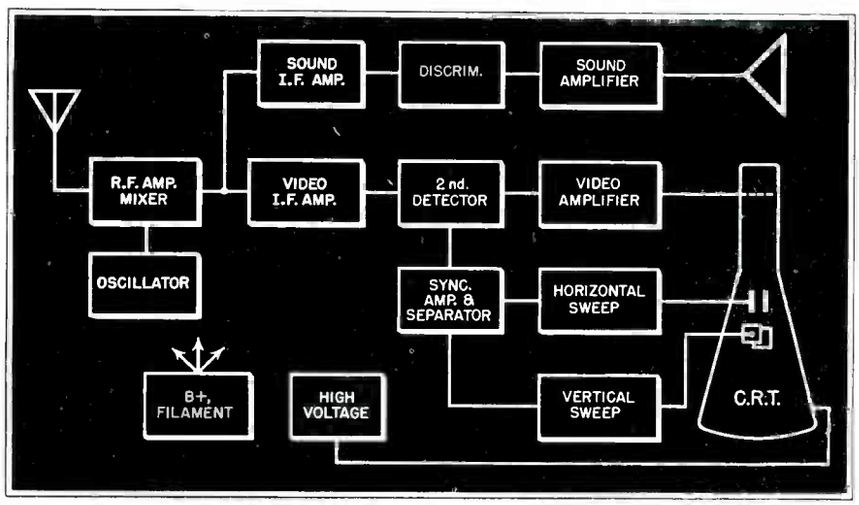
WHEN the average radio service dealer adds the word "Television" to his shingle he usually does not know in advance what he may be facing in the way of technical problems. He realizes that servicing an ordinary radio set requires skill and knowledge, but servicing television sets sometimes takes considerably more than ordinary technical skill. Just consider the average radio, having six to ten tubes at most, which can develop such a variety of troubles—and then imagine a radio set having between twenty-two and thirty-six tubes, using sine waves in some circuits, pulses and sawtooth waves in others, all working and influencing each other, each single component liable to defect and intermittent troubles. Obviously television servicing is liable to be very complex and difficult.

For one thing, so-called "screwdriver mechanics" will be out of luck with TV sets. Let them try to remove and check each of the thirty odd tubes in a modern set, or just bang components with a screwdriver handle! Their chances of finding the trouble are very slight. Their wasted time will run into hours. The risk that they may seriously damage a TV set by "messing with it" is genuine. Another sore spot with most servicemen, even those now operating a successful repair shop, is the fact that much of their test equipment will no longer be useful. Their signal generators, if not reasonably modern, will be too inaccurate on harmonics, their a-c meters unsuitable for the high frequency r-f or video signal. Many of these handicaps, however, can be overcome by adding for instance, a good r-f probe to the VTVM or building your own wave meter, etc. Since the circuits are much too complicated to trace out, servicemen will have to have right at hand all TV set diagrams and schematics in order to be able to work economically. Having proper diagrams and some basic instruments, the technician next needs *"a method."*

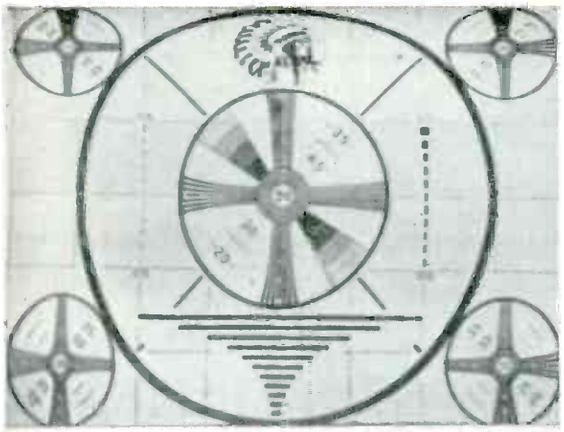
There are some who swear by the signal tracing method and tell of wonders it does when radio trouble shooting. But how can they use it for television sets? The video signal extends to 4 mc; the audio signal is frequency modulated. The only thing one can definitely signal trace by sound is the vertical sweep circuit which operates at 60 cycles and is clearly audible. Signal injection is also unsatisfactory because the sweep circuits create their own sawtooth waves, and a generator capable of producing a 4 mc sweep at 44 to 88 mc is hardly within the reach of the average serviceman. Signal injection can be used only in the audio and video amplifying stages, and there it is a good method.

Obsolete Service Techniques—Suggested New Procedure

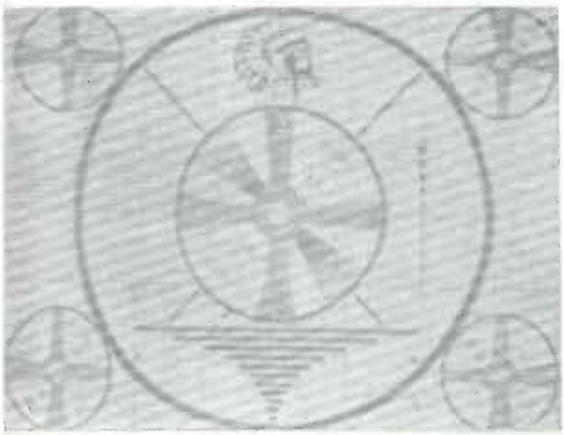
What then is a good way of locating trouble in a TV set? Well, the best way, of course, would be to be able to look into each part and see how the electrons are acting. That is literally possible, to some extent, with a good oscilloscope, which is one of the best and most useful instruments for the television serviceman. In the beginning, however, many servicemen feel they do not want to invest too much money, so we have developed another service method, requiring only such basic instruments as a Volt-Ohm meter, VTVM with an r-f probe, and a pair of high-impedance earphones. As basic indicator we use the



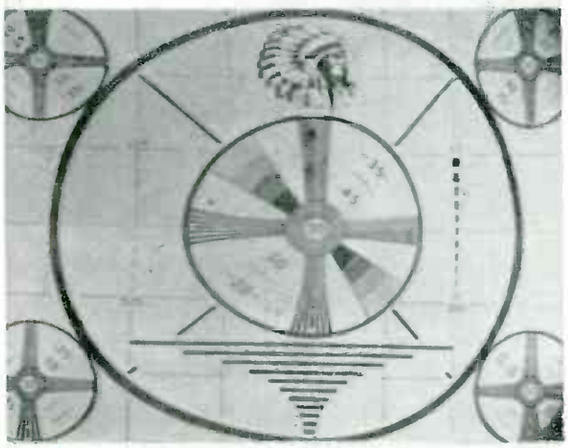
Block diagram of a typical television receiver circuit



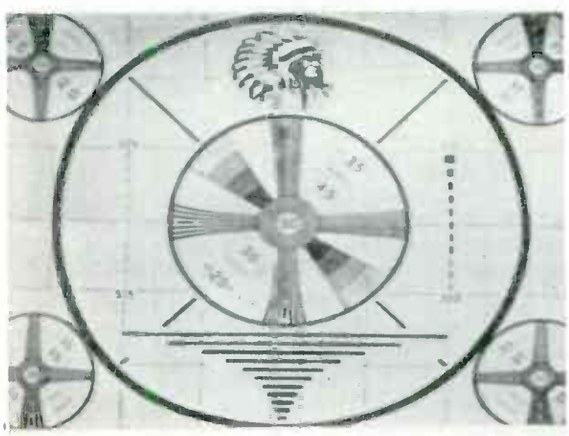
Vertical Linearity Control Misadjusted



R-F Interference Pickup on Antenna



Horizontal Linearity Control Misadjusted



Horizontal Width Control Misadjusted

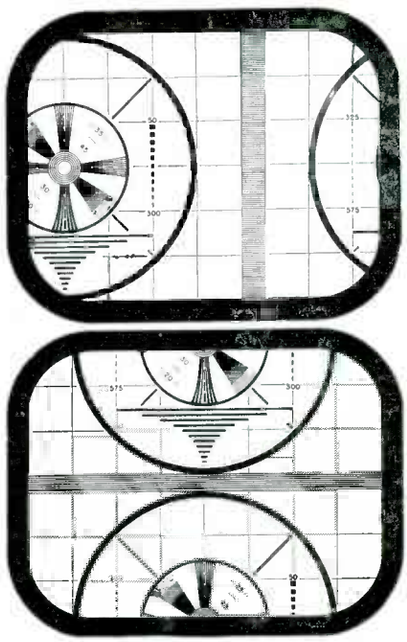


Fig. 3—Faulty synchronization in the horizontal or vertical sweep circuits results in "torn" pictures

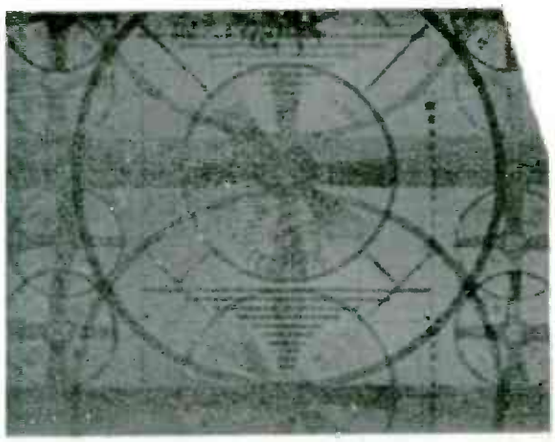
lies in the circuit between the grid of the CRT and the point where the sound I.F. is tapped off.

The Video Circuit

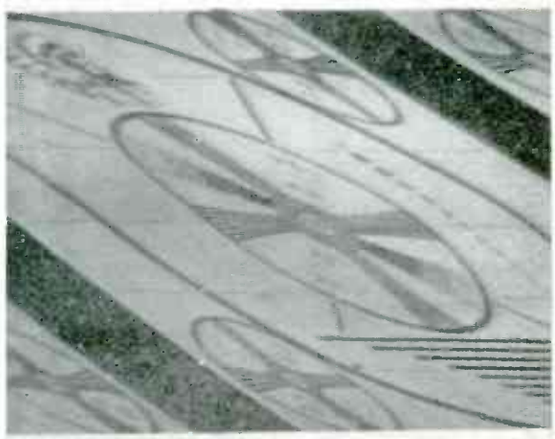
Again voltage analysis and possibly some ohmmeter checks will indicate the source of trouble. Or we can use the r-f probe and the VTVM to see if any signal appears on the output of the second detector. The outcome of this check will narrow the possible defect down to either the i-f or the video amplifiers. On the latter the r-f probe can be used to trace the video signal.

Assume now that a picture signal is visible on the CRT, but greatly distorted. That distortion may look as in *Fig. 1*, and it is obvious from that picture that it is due to the horizontal sweep circuit. Adjust the horizontal linearity control and if that does not help, try another voltage analysis. In an electrostatic type television set, check the plate resistors of the horizontal output amplifiers. They should have almost exactly the same ohmic value. Vertical distortion is shown in *Fig. 2*. Take same steps to locate its source.

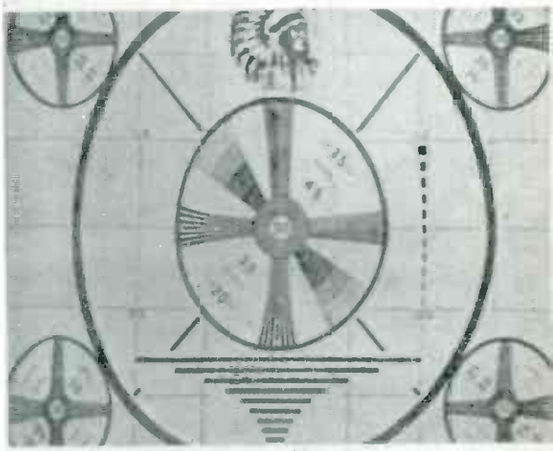
A common failure, and one of the most frequent reasons for calling in a television repairman is "loss of synchronism." The appearance varies if automatic frequency control is used but loss of sync is easiest defined by saying that the picture does not stand still. When the vertical sweep is not properly synchronized, then the picture will move up or down. Horizontal sync failure will present a torn picture or several pictures next to each other as in *Fig. 3*. In either of the above cases the defect must be located in the horizontal



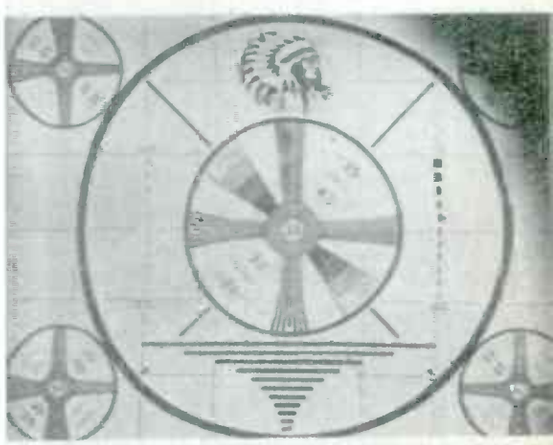
Vertical Hold Control Misadjusted



Horizontal Hold Control Misadjusted



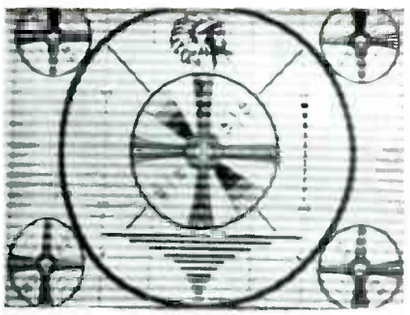
Vertical Height Control Misadjusted



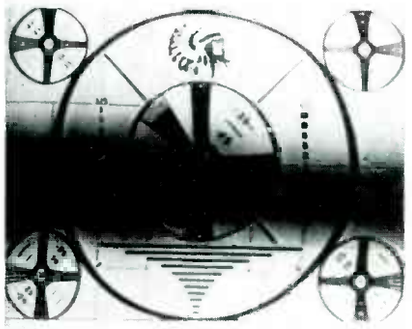
Ion Trap or Focus Coil Not Properly Adjusted

APPROXIMATE TABLE FOR TROUBLESHOOTING

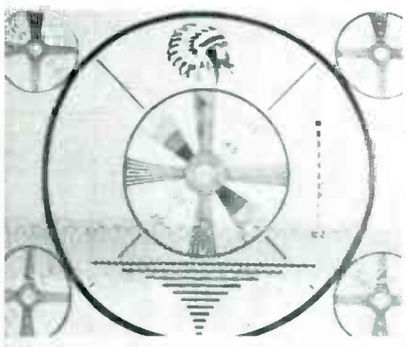
Symptoms	Probable Location	Remarks
No raster, no sound.	B +, Filament, AC line.	Visual check for fil. then B + check.
Sound, but no raster.	High voltage, B + section with brilliance control.	Try brilliance control, check HV rectifier, HV condensers.
Raster, but no sound or picture.	Antenna, oscillator, RF ampl., mixer.	Check osc. grid bias, antenna connections.
Raster, sound, but no picture.	Video IF, 2nd detector or video ampl.	Try contrast control, check detector output with RF probe.
Good sound, weak picture.	Video IF, 2nd detector or video ampl.	Check video tubes, voltages.
Impossible to focus.	B +, or focusing circuit.	Ohmmeter check of focus circuit.
Vertical distortion.	Vertical sweep.	Try linearity controls, check vert. ampl. plate voltages.
Horizontal distortion.	Horizontal sweep.	Same as above for horizontal sweep.
Picture moves up or down.	Sync. separator, vert. sweep oscillator.	Try hold control, check vert. osc. voltages.
Loss of horizontal sync.	Horizontal sync. separator, sweep osc.	Try hold control, check osc. and clipper voltages.
Partial loss of horizontal sync.	Sync. ampl., separator, horiz. oscillator.	Reduce signal strength by detuning RF. Otherwise as above.
Picture completely hashed up.	Sync. ampl., separator, clipper.	Check tubes, voltages.
Right side of dark lines smeared. (Bad low freq. resp.)	RF, IF, detector, or video ampl.	Check low freq. comp. network in video ampl.
Regular hash over picture.	RF-high voltage suppl. or outside interference.	Check filters on RF supply, grounds, short out antenna.
Hash, no or weak picture.	RF, or video IF, possibly video ampl.	Oscillations. Check bypass condensers, grounds.
Picture changes size when brilliance is adjusted.	High voltage supply.	Poor HV regulation. Check rectifier and transformer.
Several pictures from left to right.	Antenna, lead in.	Try rotating or moving antenna. Reflector or director.
Different stations at one time.	Antenna, RF tuning.	Try tuning RF ampl. and check bandwidth of IF. Rotate or move antenna.
Ignition or other interference.	Antenna.	Move antenna, use shielded lead in, ground shield.
Ham or diathermy interference.	Antenna, RF ampl.	Rotate or move antenna. Try filter in antenna lead in.



Sound Bar Interference Such as Adjacent Channel or Microphonics



Strong Diathermy or Hum in Video I-F, Detector, or Video Output



Weak Diathermy Interference

These pictures, (courtesy of General Electric Co.) show how maladjustments appear on the C-R tube in contrast to a normal picture

or vertical synchronizing circuits, depending on which way the picture seems to move. When only a sort of "hash" appears on the CRT, then both sweeps are out of synchronization and the trouble probably lies between the sync separator and the point where the sync pulses are tapped off the video signal. Very often servicemen will find that they merely have to adjust the vertical and horizontal hold controls properly to sync the picture.

The Sound Circuits

TV set owners somehow either do not read technical instruction booklets or attempt to understand them and rather than try to reason out anything so complicated naturally prefer to call their service organization, especially if the set is still under the sales guarantee. If it appears impossible to bring in both

[*Continued on page 39*]

RATIO DETECTION

and its applications

by S. L. MARSHALL

A basic knowledge of the principles underlying the operation of the balanced discriminator is essential in understanding the ratio detector. The first part of this article is devoted to this end

RATIO detection is a new type of F.M. detection in which amplitude variations interfering with the FM signal are almost entirely rejected. A balanced discriminator circuit is used, connected somewhat differently from the conventional type. In further contrast, no limiter action is required, since the ratio detector is itself inherently insensitive to amplitude variations.

Single, Tuned Series Resonant Circuits

Let us consider the manner in which the reactance of a series resonant circuit changes as the frequency is varied below and above resonance. This is shown in *Fig. 1*. Observe that the inductive reactance X_L varies from zero ohms at zero frequency to increasingly greater values of reactance as the frequency is increased. In comparison, the capacitive reactance, X_C, varies from an infinite value at zero frequency to zero reactance as the frequency is increased to infinity.

For a given value of capacitance and inductance there is only one frequency at which the capacitive and inductive reactances are equal. This is the resonant frequency, f_o, so indicated in the figure. At this frequency X_L and X_C are equal.

A conventional vector diagram corresponding to circuit resonance is shown in *Fig. 2*. Observe, first, that the circulating current, I, and the applied voltage, V, are in phase; a necessary condition of resonance. Now, the current, I, sets up a magnetic field which induces a voltage in the inductance which *leads* the current by 90°. The value of this induced voltage is, $E_L = I X_L$. Similarly, a charge is developed across the condensor which *lags* the current by 90°. The value of this charge is, $E_C = IX_C$. The induced voltage is balanced in magnitude and reversed

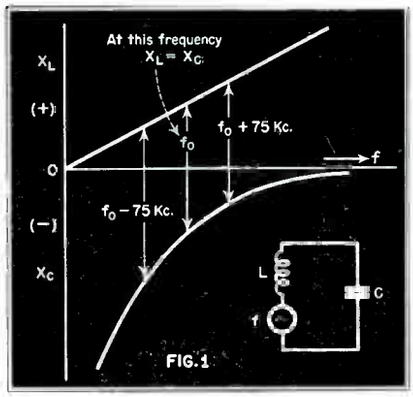


Figure 1

phase by the development voltage across the condenser. Because of this, the only opposition offered the applied voltage is the IR drop across the coil, assuming negligible resistance in the condenser.

Let us now reduce the frequency to a value slightly below resonance and see what changes take place. From *Fig.1* it is clear that when the applied frequency is lower than the resonant frequency the capacitive reactance becomes larger than the inductive reactance, and the net reactance, X_T, is equal to $X_C - X_L$. The corresponding vector diagram is shown in *Fig. 3*. The vector addition of R and X_T is equal to Z, the impedance of the circuit. Similarly,

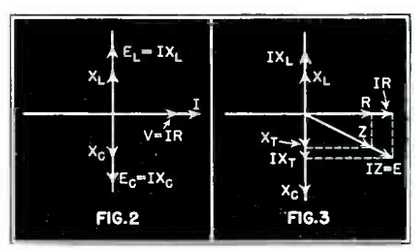


Figure 2 Figure 3

the vector addition of IR and IX_T gives us IZ which is equal to the applied voltage, V.

In this circuit, which is capacitive, the applied voltage, V, lags the current, I. However, the induced voltage in the inductance still leads the current by 90°. This is an important point to remember.

It can easily be shown, by a similar development, that when the incoming frequency is higher than the resonant frequency the applied voltage, V, leads the current. And to emphasize the point stressed above, the induced voltage in the inductance continues to lead the current by 90°.

With these basic principles in mind we can now proceed to analyze the less simpler relationships of voltage and current which exist in a tuned r-f transformer.

Untuned Primary, Tuned Secondary R-F Transformer

The illustration pertaining to the vector diagram of the tuned r-f transformer is shown in *Fig, 4*. Each vector, as it is explained and developed is numbered in numerical order, starting with the digit, (*1*). We start with the plate current, i_p, flowing in the primary coil, L_p, and lay off this current vector (*1*) as shown. Because of this current, i_p, a flux is set up which links the primary inductance, L_p, and the secondary inductance, L_s, inducing voltages, e_p (*2*) and e_{si} (*3*), respectively, in these coils. Since e_p and e_{si} are induced by the same flux they both have the same phase and lead the current by 90°. This principle was emphasized, particularly, in the previous section.

The induced voltage in the secondary, e_{si}, causes a current, i_s (*4*), to flow in the secondary. i_s is in phase with e_{si} because of resonance. However, this current induces its own voltage in the secondary, e_s (*5*), which leads *is* by

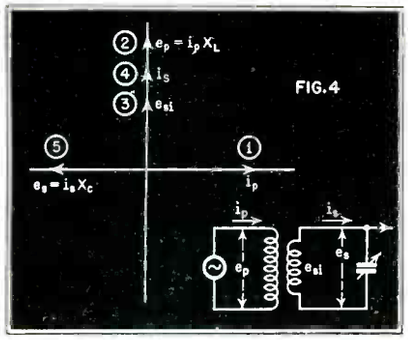


Figure 4

90°. In other words, e_{si} is like an applied voltage, as far as the secondary is concerned, causing the current, i_s, which in turn induces the voltage, e_s, in the secondary inductance.

We have now set up the essential voltage and current vectors in a tuned r-f transformer for resonant circuit conditions. Let us now see what happens when the incoming frequency differs from the resonant frequency of the transformer.

Assuming a frequency lower than resonance, the first point of departure will be the phase of the secondary current, i_s, with relation to the secondary applied voltage, e_{si}. It was shown previously that at frequencies below resonance the circuit becomes capacitive, and the applied voltage lags the current. This condition is illustrated in *Fig. 5*. Recalling, also, that the voltage induced in an inductance always leads the current flowing in it by 90°, the new position of the induced secondary voltage, e_s, is shown leading i_s by that amount.

Similarly, if the incoming frequency is made higher than the resonant frequency the applied voltage, e_{si}, will lead the secondary current, i_s, and the position of the vector, e_s, will be that as shown in *Fig. 6*. Since e_p and e_{si} are always in phase, being produced by the same flux, the phase between e_s and e_p varies with the incoming frequency.

Balanced Discriminator Transformer

The balanced discriminator transformer vector analysis is somewhat complicated by the fact that the primary is a parallel tuned resonant circuit. However, we can greatly simplify our analysis by considering the applied voltage in the primary as being caused by the signal, Me_g, developed in the tube. This signal causes a corresponding current, i_p, which in turn induces a voltage, e_p, in the primary inductance. The basic discriminator circuit is shown in *Fig. 7*, and the equivalent vector diagram corresponding to resonance is shown in *Fig. 8a*.

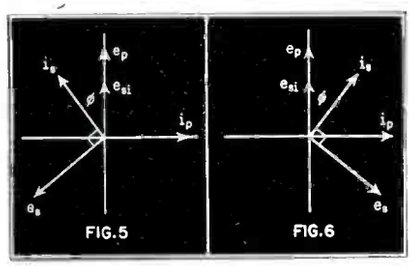


Figure 5 Figure 6

The voltage in the secondary may be considered as being made up of two equal quantities, $e_{st} = e_s/2$, the signal voltage in the top half of the secondary and $e_{sb} = e_s/2$, the signal in the bottom half of the secondary. Since the primary voltage, e_p, is applied to the center point of the secondary, the correct method of adding these two voltages is as shown in *Fig. 8b*. This applies for resonant circuit conditions; e_1 being equal to $e_{st} + e_p$, and e_2 being equal to $e_{sb} + e_p$. At resonance, e_1 and e_2 have equal magnitudes.

When the incoming frequency is below resonance the circuit becomes capacitive, and the applied secondary voltage lags the current, i_s, as shown in *Fig. 9a*. However, the induced voltage, e_s, remains 90° ahead of the current and assumes the position shown in the figure. The relative phase between e_s and e_p is now altered. The vector additions of e_{st}, e_{sb}, and e_p are illustrated in *Fig. 9b*. Observe, now, that for conditions below resonance e_1 and e_2 are no longer equal.

Similarly, when the incoming frequency is above resonance the circuit becomes inductive, and the applied secondary voltage leads the current. This is shown in *Fig. 10a* which also reveals the changed phase between e_p and e_s. The corresponding vector additions between these two signals is shown in *Fig. 10b*. Here again e_1 and e_2 have different magnitudes.

The manner in which E_1 and E_2, which are the rectified values of e_1 and e_2 (*see Fig. 7*) vary in amplitude as the frequency is varied below and above resonance as shown in *Fig. 11*. The reason why the maximum values do not occur at resonance is because of the effect of the primary inductance on the secondary tuning. Futhermore, the reason why one maximum occurs above resonance and the other below is because one-half of the secondary winding and the primary are in series *aiding*, and the other half of the secondary winding and the primary are in series *opposing*, resulting in two different values of effective inductance and two separate resonant frequencies.

In an ordinary FM balanced discriminator detector the output of these circuits are fed into two diodes as shown in *Fig. 12*. The combined output of E_1 and E_2 between *points a* and *c* results in the symmetrical "*S*" wave shown in *Fig. 11b*. Maximum deviation

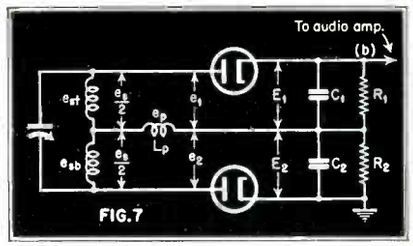


Figure 7

of the carrier frequency results in maximum amplitude of the curve. Zero deviation of the carrier frequency produces no amplitude. The audio frequency component of the signal which corresponds to the rate at which the carrier is frequency modulated is taken off at *point b* in *Fig. 6*.

The Ratio Detector

The action of the ratio detector may be divided into three functions. These are:

1. *The manner in which rectifications take place.*
2. *The development of the audio signal.*
3. *The manner in which amplitude variations are rejected.*

A study of *Fig. 12* will reveal that the ratio detector is a half-wave rectifier with the diodes connected in series. The instantaneous signals, $e_{st} + e_p$, and $e_{sb} + e_p$ are rectified only when the voltage at the plate of diode, D_2, is positive. The instantaneous rectified values of these signals appear across C_1 and C_2, and are E_1 and E_2 respectively. The current in the diodes, which flows through R_1 and R_2, is proportional to:

$$\frac{E_1 + E_2}{R_1 + R_2}$$

In contrast with the conventional discriminator, where E_1 and E_2 are applied in reversed polarity, in the ratio detector E_1 and E_2 are additive. The

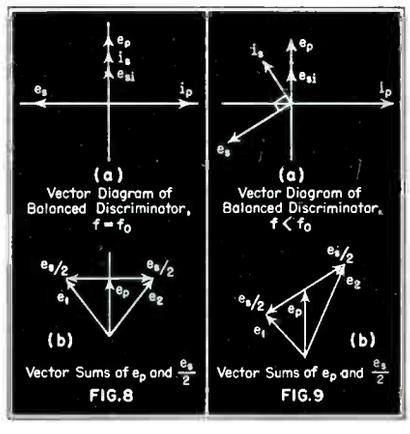


Figure 8 Figure 9

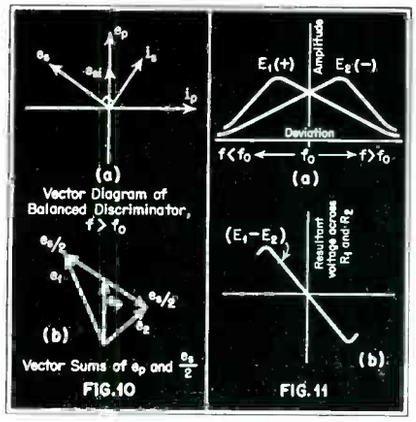


Figure 10 Figure 11

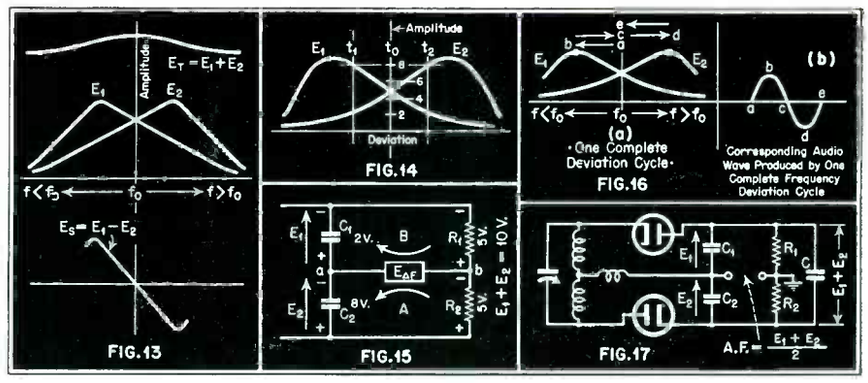


Figure 13 Figure 14 Figure 15 Figure 16 Figure 17

addition of these voltages produces the waveform, E_T, shown in *Fig. 13*. However, this waveform cannot be used for the detection of audio frequencies. To accomplish this we must obtain a waveform corresponding to E_S, which is an "*S*" curve identical in character to the "S" curve obtained in the conventional discriminator.

The development of the audio signal is rather unique. First, it must be borne, in mind that the rectified voltage drop, $E_1 + E_2$ across resistors, R_1 and R_2, is distributed equally across both resistors, and that $E_1 + E_2/2$ is the voltage drop across each resistor. Second, the values of E_1 and E_2 across C_1 and C_2 are not necessarily equal at a particular instant, but vary throughout the deviation cycle as shown in *Fig. 13*.

Let us assume that, at a particular instant in the deviation cycle, E_1 has a value of 8 volts and E_2 has a value of 2 volts. This is shown by the line, t_1, in *Fig. 14*. Since the curves are symmetrical, an equal frequency deviation in the opposite direction, corresponding to line, t_2, will result in E_1 being equal to 2 volts and E_2 being equal to 8 volts. The voltage distribution across the circuit components $t_0 - t_2$ will be as shown in *Fig. 15*.

For t_1 the total voltage, $E_1 + E_2$ will be 10 volts. In the lower nerwork, *A*, the audio voltage developed across the audio load will be $E_{AF} = 8 - 5 = 3$ volts. In the upper network, *B*, $E_{AF} = 5 - 2 = 3$ volts. Observe that the developed audio voltage for both networks is identical in amplitude and in the same direction.

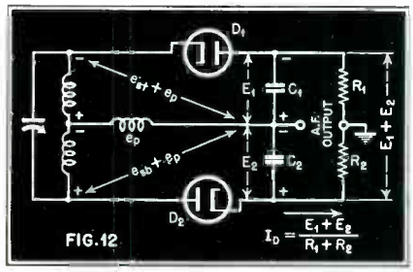


Figure 12

At the point where the deviation frequency is zero, corresponding to line, t_0, we find that $E_1 + E_2$ is also equal to 10 volts. We have drawn these curves so that $E_1 + E_2$ at any deviation is 10 volts. This is not necessarily true for all discriminator networks. However, in this case we can proceed on this assumption since it will shortly be shown that for other purposes $E_1 + E_2$ is kept at a constant value by the addition of a stabilizing condenser.

Since $E_1 + E_2$ is 10 volts, and since E_1 and E_2 are equal at the time t_0, E_1 and E_2 are each equal to 5 volts. Applying these values to *Fig. 15*, and solving for the audio voltage, E_{AF}, we find that it works out to be zero. This result is apparent considering the fact that for these values a balanced bridge circuit is obtained corresponding to zero current between *points a* and *b*.

Proceeding now to the deviation point corresponding to t_2, where E_1 equals 2 volts and E_2 equals 8 volts, and applying the same techniques outlined in the paragraphs just covered, we find that audio voltage is again 3 volts. However, this time the direction of current through the audio load is reversed. Thus, it should be obvious that a complete frequency deviation cycle applied to the input of this circuit produces a complete and corresponding audio frequency cycle. This is shown in *Fig. 16*, where the *points*, *a*, *b*, *c*, *d*, and *e*, corresponding to frequency deviations of zero, negative maximum, zero, positive maximum, and zero, produce the corresponding audio frequency amplitude cycle illustrated at the right.

The formula for the audio voltage at any instant is $E_1 - E_2/2$. This is in contrast to the audio voltage developed in a conventional discriminator, which is equal to $E_1 - E_2$. As a check on some of the results obtained above, we find that the audio voltage for t_1, utilizing the formula just given, if $8 - 2/2 = 3$ volts. This checks with the value obtained.

Amplitude modulation rejection is effected by placing a stabilizing condenser across R_1 and R_2 as shown in *Fig. 17*. This condenser must be large enough to maintain the rectified output voltage constant at any audio frequency. This means that the time constant of C and $R_1 + R_2$ must be about 0.2 seconds. A condenser of 8 μf is usually employed for this purpose. Since $E_1 + E_2$ is in parallel with this stabilizing voltage a constant potential will also be maintained across C_1 and C_2, even though the individual voltages across these capacitors vary throughout the deviation cycle.

Suppose that at a particular point of the deviation cycle the incoming signal is affected by some outside disturbance and the instantaneous amplitude is increased. The immediate result of this condition is that the diode current will increase. This increase is immediately absorbed by C. However, due to the time constant of this network the voltage across C remains constant. This applies also to any decrease in signal which would reduce the current in the

[*Continued on page 36*]

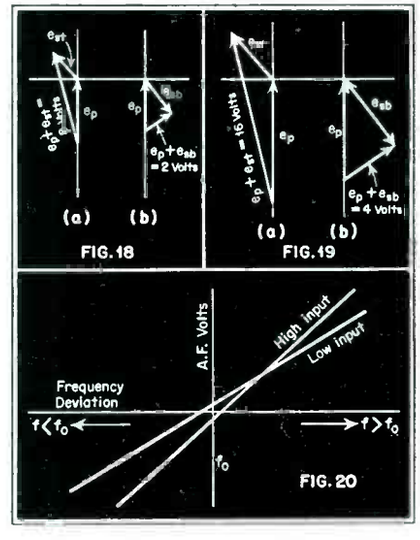
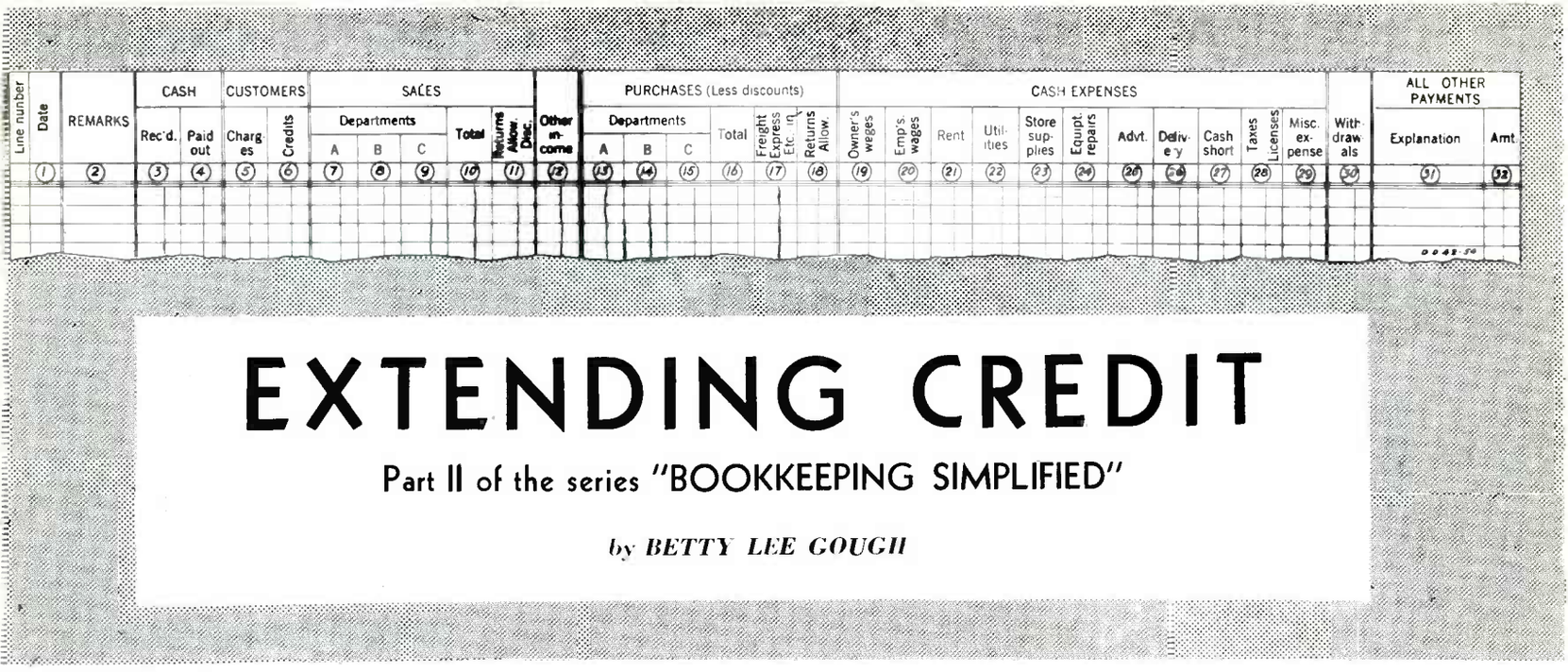


Figure 18 Figure 19 Figure 20



EXTENDING CREDIT

Part II of the series "BOOKKEEPING SIMPLIFIED"

by BETTY LEE GOUGH

Do you sell or do repair work on an extended time-payment or credit basis? Are you showing a profit on charge and credit term business? How is your cash balance and inventory? Do you take all earned discounts?

HOW many "slow" accounts are there on your books? How much is owed to you—and is it a healthy or an unhealthy percentage of your total sales? How much credit should any given customer be allowed? *How much credit can your store profitably carry, and are you undercutting it, hitting it on the nose, or exceeding it?*

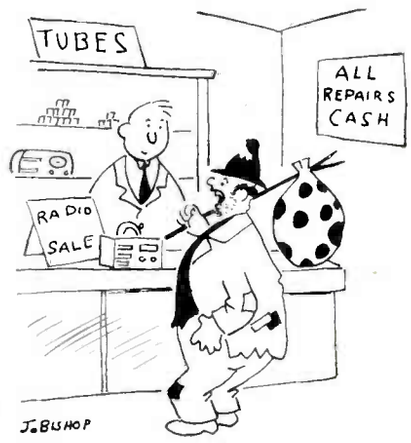
Many radio service dealers have failed because they carried too much credit. Accurately maintained business records would have warned these bankrupt service dealers that trouble was coming and would have told them, moreover, where the trouble was. In this second article, of a series on simple to maintain types of bookkeeping, let's look at how credit records can be kept with minimum trouble and maximum accuracy.

Three main factors govern successful credit selling, and when they are out of kilter the records flash a red neon warning. These three are (1)—the amount of capital the merchant has; (2)—the time period for which credit has been extended; and (3)—the fulfilment of ment of credit obligations by customers. Any of the three can cause failure if it is not right.

The amount of capital on hand is important because it governs the dollar volume of credit that can profitably be extended. Credit selling is no more than money lending. For example, if the radio store's operating capital is $5,000, and its accounts payable (the customers who owe money on charge or other credit accounts) totals $3,000, this means that the inventory has been decreased by $3,000, and that there is only $2,000 with which to replace the stock sold. Over a period of time, this would deplete the shop shelves to a dangerous point. Lower inventories mean fewer opportunities for future sales.

To illustrate point two, say again that, while $3,000 credit has been extended to customers, the radio service dealer has a credit of that size with his wholesalers so that he can immediately replace the merchandise sold on charge account by using his own accounts with distributors and jobbers. Usually, a merchant's credit with wholesalers is for thirty days. That means that the credit extended to consumers must be for no longer than a month, and preferably for a shorter period—for example, a week—to allow for the time taken to remit.

The average radio business can afford to carry very few "slow pay" customer accounts. Consequently, the records must show the complete status of each customer's account so that accurate controls can be kept on his credit buying. A radio service organization that does a lot of repair work, on a wholesale basis, for retail stores that "farm out" all such service work to them must be careful as the cost of parts and tubes can amount to large figures in a three or four week period.



"I'll take that Portable. Charge it."

Often, large department stores limit a customer's credit to so many dollars. When his account has passed the limit sum, his credit is stopped until he has reduced it below the maximum. This insures that sufficient amounts from the credit customers will be forthcoming so that inventories or cash balances are not reduced to the danger point. The same system is a practical one for all service dealers and service organizations to use in dealing with their customers regardless of whether the customer is an individual or department store.

If charge sales during the week amount to more than collections—as shown immediately by the one book control sheet—an effective stop light warning has been flashed. It is imperative to watch the next week, and the one after. If the trend of credit selling is fewer collections than dollar credit sales, one must *immediately* take steps to put the credit ledgers on a more healthy basis.

Daily Credit Records

Credit records are simple to keep. Insistence on proper marking of charge slips, and bearing down on seeing that the totals are promptly and accurately entered first on the customer ledger, second on the master control sheet. The ledger insures that credit purchases will be billed promptly and properly; the control sheet tells the radio service dealer the status of his credit selling

Before granting credit to an applicant, it is important to gather data on — and study — his rating and his ability to pay.

business at any given time. At the end of the day's business, the charge sales slips should be totaled and entered on this control sheet immediately. Then, they may be entered on the billing ledger (which can be a plain ten cent store notebook) immediately, or else filed away and entered on the last day of the month. Many radio service dealers have found it simpler to enter them daily, thus lessening the normally difficult end-of-month routine.

Sales slips should be filed away and kept for a least one year. Many radio service dealers simply put them in alphabetical files in an ordinary 5 x 8 inch cabinet. This is a good system.

The ledger on which figures from the sales slips are entered should indicate (1)—date of purchase; (2)—either the department or departments in which the purchase was made or the names of the merchandise bought; (3)—the total to date; and (4)—credits, so that a complete statement is available at all times. If a limit has been placed on a customer's charge purchases, the ledger sheet should have a space for this at the top, so that a quick glance at the "balance-to-date" and the "limit" figures enables the manager to decide instantly when a customer is using too much credit.

Credits to customers' accounts, like charge sales, should be entered on the end of the day on the master sheet. An easy way to do this is to issue receipts in duplicate, keeping the carbons with sales slips.

Your Own Credit Standing and Inventory

Do you know how much merchandise you purchased during last month? Where you purchased it? For *exactly* how much?

Do you know how much was bought for each section of your store? How much you now owe to each wholesaler and how much you have paid? Did you pay in time to take the cash discounts? Do you know the due dates of invoices still unpaid so that they can be paid in time to earn the percentage discount?

Accurate books that are simple to keep can tell this vital information at a glance. Let's look at keeping records of merchandise and equipment purchases and the inventories on which accurate purchasing and evaluation of sales policies depend.

Merchandise invoices received from wholesalers should be filed in a "tickler," which is a file set up by date. Since cash discounts are important—1% in ten days, while appearing to be a small figure, mounts into 36½% yearly—bills should be paid promptly. Orderly procedure calls for their being paid when due, but not necessarily before. That's where the tickler file comes in. A riffle through the day's date reveals each invoice that is due so it can be paid promptly.

A tickler file can be anything from a cardboard box to an elaborate card file box or even a filing cabinet. A good procedure is to insert thirty-one folders. As an invoice is received, it can be placed in the folder corresponding to the due date. A quick examination of the folder of the day, done at the beginning of each day's business, reveals invoices that must be paid that day.

When stock is received, it should be checked carefully against the invoice. Order clerks being human, mistakes happen occasionally in wholesalers' shipping rooms. (There's no reason why you should pay for another's mistakes). When an invoice has been paid (but not before), the sum should be entered on the master control sheet of the one-book system.

If the invoices are kept only the usual ten days before being paid—and good business practice dictates prompt payment—a quick check of only ten file folders gives the complete amount due wholesalers at any time.

It Pays to Buy New Equipment

Equipment payments, however, are different, as expensive radio service shop fixtures are often purchased on long term credit. The Department of Commerce, in an advice book, points out that "You should know what your costs are on your present equipment. These costs should be stated as so much a year, and should include annual repairs and maintenance (for example, the electricity required if any), and each year's proportionate share of the original cost. An estimate should also be made of these elements of expense for new equipment.

"The difference between the total annual cost of the present equipment and the estimated total annual cost of the new equipment, plus any savings in other store operating expenses, will show you whether you can expect to reduce total store operating expenses by buying new equipment. A comparison of the annual reduction in total store operating expenses with the cost of the new equipment will show you whether the purchase of the new equipment will be profitable. If the annual savings in store operating expenses will "pay for" the new equipment within a few years, then the savings in operating expenses in the remaining years of the life of the equipment will be a clear profit.

"The new equipment may not result in any savings in total expenses, but may even cause an increase in annual operating expenses. However, if the equipment is expected to bring more customers into the store, and thus to increase the sales volume, the purchase of the new equipment may still be profitable. If the expected annual increase in dollar gross margin (resulting from the increased sales) is sufficiently greater than the expected annual increase in dollar operating expenses then the purchase of the new equipment may be profitable."

Take Tax Deductions on Depreciation

Depreciating these store fixtures is simple. Take, for example, a counter that cost, let us say, $1,000, and which is expected to last for five years. At the end of that time, it is estimated that the counter will have a trade-in-value of $100. Dividing $900 by five years, the expected life of the fixture, we get $180. That is the annual depreciation. At the end of one year, your investmant in the counter is $720. At the end of two years, it is $540. At the end of five years, it is zero. The same system would apply to test equipment that you buy. It is necessary to know how to depreciate fixtures and other equipment in order to figure up the year-end profit and loss statement upon which income tax payments, among other things, are based.

To arrive at an accurate profit and loss statement, it is necessary to have beginning and ending inventories for the period. A simple inventory form can be made by ruling a large sheet of paper vertically and horizontally, and assigning merchandise item names to the vertical columns. Then the periods at which inventories are taken—weekly, monthly or whatever is the store practice—are marked on the horizontal lines. At a glance, this form shows what the inventory was at any given period. It indicates when stocks are getting low, when there is too much of an item on hand.

[*Continued on page 36*]

RADIO TECHNICIAN'S CLINIC

(see Editorial on page 3)

FOR THE first time in the history of the industry, all branches of the radio industry will join in sponsorship of a program to assist the radio technician with the presentation of a three-day Town Meeting of Electronic Technicians in Philadelphia, January 11, 12 and 13.

The program, which has been in preparation for several months, was announced by H. W. Clough of Chicago, chairman of the Radio Parts Industry Coordinating Committee as a joint undertaking of the Radio Manufacturers' Association, the Sales Managers Club, Philadelphia members of the National Electronic Distributors Association, the Electronics Parts and Equipment Manufacturers, and the Mid-Lantic Chapter, The Representatives, with the assistance and cooperation of the Federation of Radio Servicemen's Associations of Pennsylvania and the Philadelphia Radio Servicemen's Association.

Format of the meeting to be held in the Bellevue-Stratford Hotel, will provide radio technicians of the area with latest electronics technical information and with expert advice on various phases of small business management. Most of the technicians for whom the program is designed either work for others or operate shops with from one to 10 employes, Clough explained.

"Success of the Philadelphia show will be watched by the entire industry," he said. "For too many years, we in the radio industry, preoccupied with the problems of building a new industry in a new and rapidly developing field, have neglected the needs of the radio technician. The people to whom he should look for help in his business are manufacturers and distributors of parts and sets.

"I consider the Philadelphia experiment a significant step forward in terms of industry relations. It is a sign of industrial maturity and a recognition of industrial responsibility. Success in Philadelphia undoubtedly will encourage further cooperative ventures.

The Philadelphia program is in charge of Harry A. Ehle, chairman of the Coordinating Committee's subcommittee on the Town Meeting of Radio Technicians.

As presently projected, the program will open with a keynoting session Sunday Night, January 11. All-day sessions Monday and Tuesday are calculated to give technicians the latest information on management and technical subjects designed to be most useful to him in his own shop. Extensive coverage of television and FM, unfamiliar to most technicians, will be designed to furnish the basic information necessary for him to understand repair work in those fields.

The program will de-emphasize brand names and all manufacturers will abstain from merchandising during the sessions. Only exhibits from within the industry will be those of test equipment manufacturers which will be displayed as matters of technical information without sales effort.

Ehle said the program is being built on the basis of questionnaires circulated to technicians in the Philadelphia district. Chief requests were for the following subjects: technical information, advertising, computing charges, profitable servicing methods, purchasing and budgets.

"As a consequence, we have built a program with wide appeal to every type of radio technician," Ehle explained. "Monday we will have a morning and afternoon session on television, with sessions on finance and merchandising. Tuesday we will have a morning and afternoon session on FM, with others on cost accounting, billing, and Citizens' Radio."

The Town Meeting of Electronic Technicians will be held in conjunction with a meeting of the Federation of Radio Servicemen's Association of Pennsylvania Sunday, which will be followed by a banquet of the Philadelphia Radio Servicemen's Association Monday night. Registration for the Town Meeting will be handled by the PRSMA on Sunday and Monday.

TOWN MEETING OF RADIO TECHNICIANS—TENTATIVE PROGRAM

Bellevue-Stratford Hotel, Philadelphia, Pennsylvania

11, 12, 13 Jan., 1948

SUNDAY, 11 JANUARY

1 p.m. Joint registration opens. PFRSM in charge. Clinic registrants received badges. Clinic exhibits open.

8 p.m. First session. Keyed to discussion of importance of clinic program to radio serviceman . . . future of electronics for servicemen . . . needs of small business. Four national speakers.

MONDAY, 12 JANUARY

9 a.m. Registration.

10 a.m. First television session: 2 20-minute papers, 2 10-minute Q & A sessions.

11 a.m. Recess.

11:10 a.m. Two papers, 1 joint Q & A session, business subjects: capital requirements, budgets, accounts, finance.

12-12:30 p.m. 5 basic pieces of test equipment on simultaneous display with attendants.

12:30-2 p.m. Luncheon.

2 p.m. Second television session: 2 20-minute papers, 2 10-minute Q & A sessions.

3 p.m. Recess.

3:10 p.m. Two papers, 1 joint Q & A session, merchandising subjects: public relations, advertising.

5 p.m. 5 basic pieces of test equipment on simultaneous display with attendants.

6 p.m. NEDA cocktail party to officers and delegates of Federation.

TUESDAY, 13 JANUARY

9 a.m. Registration.

10 a.m. First FM session: 2 20-minute papers, 2 10-minute Q & A sessions.

11 a.m. Recess.

11:10 a.m. Two papers, 1 joint Q & A session, business subjects: cost accounting, how to compute charges.

12-12:30 p.m. 5 basic pieces of test equipment on simultaneous display with attendants.

12:30-2 p.m. Luncheon.

2 p.m. Second FM Session.

3 p.m. Recess.

3:10 p.m. Two papers, 1 joint Q & A session, Citizen's Radio.

5 p.m. 5 basic pieces of test equipment on simultaneous display with attendants. Open session, experts available, for elaboration of clinic Q & A? Drawing of registration tickets for television set?

The ELECTRONAMIC Tube Tester

For checking the overall efficiency or "figure of merit" of a tube

by L. S. RICH

IN THE early days of radio, commercial tube testers made available to the service trade were of the static transconductance or grid shift type. In this type of circuit the plate current of the tube under test was measured under specified values of d-c plate and grid potentials, following which a given value of grid voltage change was applied and the corresponding plate current change noted. A diagram of this circuit is illustrated in *Fig. 1*. Since a tube normally operates under dynamic conditions of a-c grid voltage and plate current (aside from the d-c potentials applied to its elements) this type of tester does not necessarily give a true indication of the overall merit of a tube.

In view of the apparent limitations imposed by static instruments many more modern tube testers are of the dynamic type. Instead of a d-c value of grid shift an a-c voltage is applied to the grid of the tube under test, and its corresponding plate current effect observed by a suitable indicating device. See *Fig. 2*. Observe that in the conventional type of dynamic transconductance tube tester a limited a-c grid voltage is applied to produce a limited a-c plate current reading. A.C. or D.C. basic power supply may be used for element operating potentials.

Instruments in which the entire true range of dynamic operating potentials may be selected and applied to the tube are much too complicated as well as expensive for ordinary use. Such instruments are confined primarily to laboratory measurements.

Recently, a new type of tube tester has been placed on the market which incorporates a unique method of testing the overall efficacy, or figure of merit of a tube. In this method a substantial degree of dynamic operating potentials are applied to the tube under test.

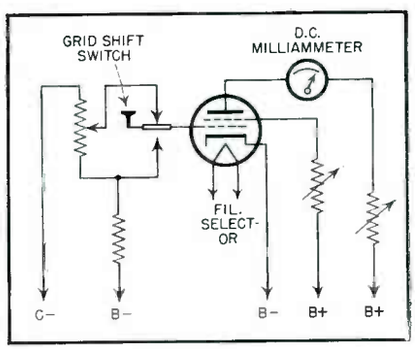


Figure 1

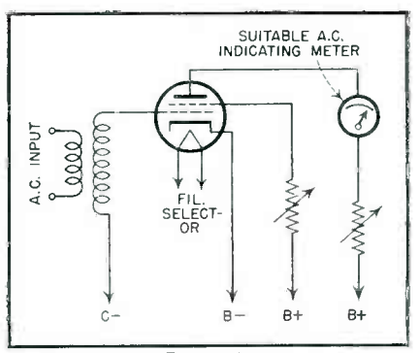


Figure 2

Referred to by the manufacturer as the Electronamic Tube Tester, its basic operating principles are given here.

Fig. 3 illustrates the wiring diagram of this tester, and *Fig. 4* shows the simplified circuit of the electronamic tube testing portion of this instrument.

In the lower left portion of the diagram the switch assembly S_1, by means

[*Continued on page 34*]

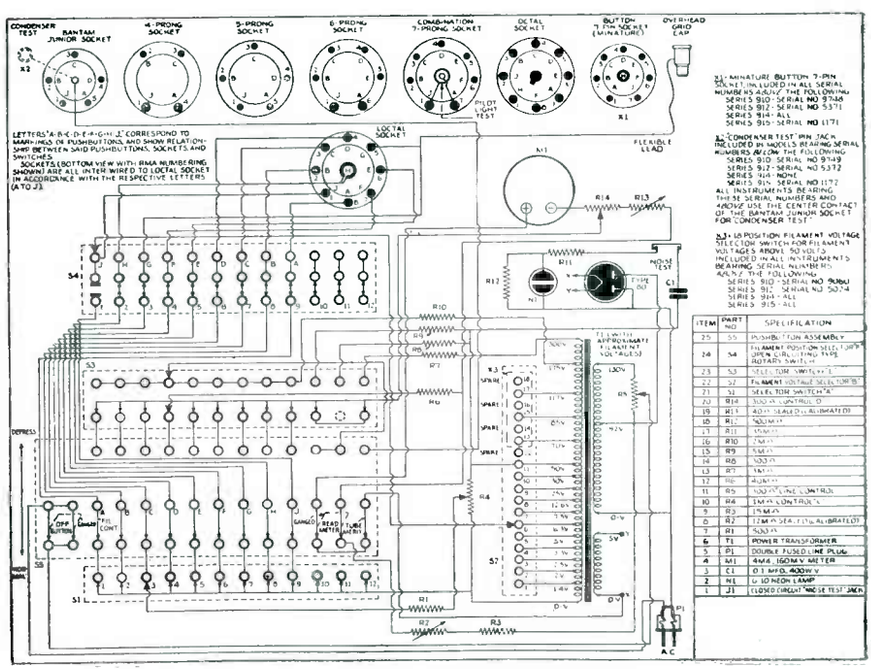


Figure 3. (Precision, Models 910-12-14-15).

EXTERNAL CROSS MODULATION

—ITS CAUSE AND CURE—

by DUDLEY E. FOSTER*

A puzzling phenomenon that has caused untold grief to competent radio technicians is explained in detail

SOME years ago reports began to be heard concerning a type of interference with broadcast reception which had never before been noticed. The interference occurred only in localities having high field strength from one or more local stations, and its new characteristic was that the program of the strong local station was heard when the receiver was tuned to one particular other station, but not to others. The effect was not due to lack of selectivity because when the receiver was tuned the local station could be tuned out and then would reappear when a certain other station was tuned in. Occasionally, two local stations would be heard together on a frequency which was quite different from that of either one of them.

This type of interference also had other peculiarities. In the area in which it occurred, it would be found in one house whereas the house next door would be free from interference even when the same set was used. In those houses where it occurred, any make or model receiver, including battery sets, experienced it. Still another puzzling factor was that the interference was not constant, being much more severe at one time than at others, and occassionally disappearing entirely for a period.

These characteristics led to the deduction that the interference was not caused in the radio receiver, but by some agency external to the receiver itself. This type of interference was designated "external cross modulation."

A location was found where the cross modulation existed consistently and a study was made to determine the fundamental cause and a remedy. In this location, a battery receiver with a short antenna exhibited cross modulation inside the house, but when the receiver was a few feet outside the house, cross modulation ceased. A trap circuit in the antenna was of no benefit, which was further proof that the difficulty was external to the receiver. It was observed at this location, as well as at others where the effect was serious, that the house wiring was of the knob and tube type and the service mains from the distribution transformer were overhead. A filter near the receiver, consisting of two 0.1 uf capacitors across the line with the center point grounded had only a slight effect on the interference, but an additional capacitor across the line where it entered the house greatly decreased the cross modulation. It was further found that by placing the antenna at a distance from the power lines and using a shielded lead-in, the external cross modulation disappeared.

This very timely article is reprinted with permission of the editor of RCA RADIO SERVICE NEWS.

Rectification a Cause

This experience showed that the cross modulation was due to rectification of radio frequencies in the power wiring, with resultant new, spurious frequencies being introduced in the antenna or lead-in. Radio signals were picked up by the power wiring or other metallic conductors near the receiving antenna and at some point along the conductor were impressed on a rectifier or non-linear circuit element. A simple laboratory test confirmed the observations. Two antennas were placed a few feet apart and to one of them a radio receiver was connected. An impedance was connected between the other antenna and ground, and when a simple diode was connected across this impedance, cross modulation of the signals in the first antenna occurred.

The question arises as to where the rectifier may exist in the field. Wherever there is a poor connection between any two metallic bodies, expecially if oxidation is present, rectification can take place. The poor contact may be in the lighting lines, in piping, or even in the antenna itself. When such a rectifier exists, and one or more powerful signals are present, new frequencies are generated by the rectifier. Where only one powerful signal is present, the only new frequencies made by the rectifier are multiples of the fundamental, that is the second harmonic, third harmonic, etc., of the signal frequency. Where two strong signals exist, a number of cross modulation combinations take place. Let us call the frequency of one of the strong stations "a," and that of the other "b." Then the rectifier generates the following frequencies:

a+b	2a—b
a—b	2b+a
2a	2b—a
2b	3a
2a+b	3b

An effect also takes place whereby the modulation of station with frequency "a" is heard on station "b," and the modulation of station "b" is heard on "a."

Let us suppose that two stations are so located that in the region between them signal strengths of 0.1 volt per meter occur from both, and that one station is on 650 kc. and the other on 750 kc. Then the following table shows the frequencies produced.

a = 650 kc.	2a+b = 2,050 kc.
b = 750 kc.	2a = b+550 kc.
a+b = 1,400 kc.	2b+a = 2,150 kc.
a—b = 100 kc.	2b—a = 850 kc.
2a = 1,300 kc.	3a = 1,950 kc.
2b = 1,500 kc.	3b = 2,250 kc.

In this example these two stations would produce five new frequencies in the broadcast band and five new frequencies outside the broadcast band where one or both the stations together would be heard. It can be appreciated readily that a large amount of interference will be produced in this manner. The interference produced by station of frequency "a" on frequency "b" and vice versa has been found to be serious

[*Continued on page 35*]

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PART 6

TECHNICALLY SPEAKING

Chapter 18. Control Room and Studio Equipment, 19. The Broadcast Studio, 20. Transmitter and Transmission. Book Bibliography. Appendix.

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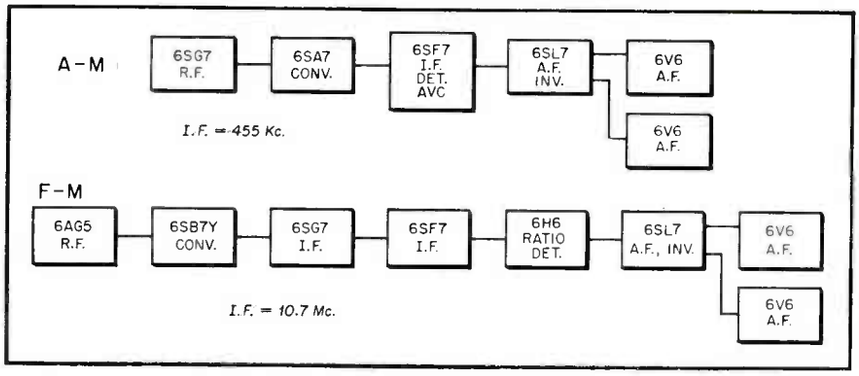
CIRCUIT COURT

Farnsworth GK 100 Series

This 9 tube instrument provides reception on the regular broadcast and FM bands. A unique circuit arrangement is employed. Reference to the block diagram will make an understanding of the tube uses clear.



Block diagram of Farnsworth GK 100 Series

In the AM position, the loop (or external antenna — if used) is tuned and connected to the grid of the 6SG7 RF stage. The amplified output is impedance coupled to the 6ST7 convertor, whose oscillator circuit is also tuned.

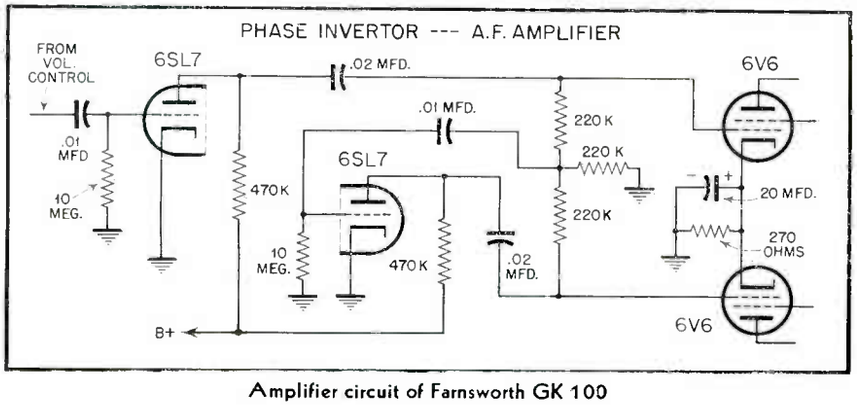
The 455kc i.f. developed by the 6SA7 is amplified in the pentode section of a 6SF7. This amplified voltage is rectified by the diode section the same tube and AVC is developed also.

The audio signal is amplified and inverted by the 6SL7, to be used to drive the 6V6 output tubes.

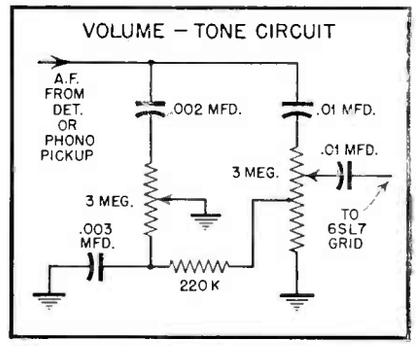
When the set is switched to FM, a radical change takes place. A separate signal frequency circuit is brought into play. The signal is first tuned and fed to a 6AG5 miniature r-f amplifier. Another tuned circuit precedes the 6SB7Y convertor. The oscillator section is, of course, tuned. A 10.7 mc i-f signal is developed. The first 10.7 mc amplifier is the 6SG7 which served as r-f amplifier on the broadcast AM band. Additio nali-f gain takes place in the 6SF7 stage and a 6H6 Ratio Detector serves as demodulator. The a-f circuits are as described for AM performance. AVC for the FM controlled stages is taken from the negative output of the ratio detector.

The use of the 6SG7 as r-f amplifier and i-f amplifier in the two positions is indeed unusual. No undue complication arises and the only switching occurs in the grid circuit. No switching of the critical FM signal circuits is needed. B voltage is switched from one convertor to the other when changing bands.

The circuit of the simple tone control is shown. It will be noted that both tone and volume controls are 3-meg. units, the latter having an appropriate tap for bass compensation. The signal is arriving from a high impedance source so as the grounded arm of the tone control moves up it shunts off the highs, at the same time the bass boost circuit consisting of the .003 and 220 K items comes into full play, as the arm is moved down the tone control fewer of the highs are by-passed and the .003 condenser is gradually shorted out. The result is more highs and less lows.



Amplifier circuit of Farnsworth GK 100



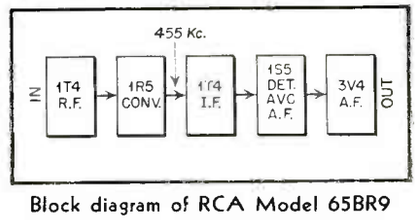
Tone control circuit of Farnsworth GK 100

Some near-center point could provide a well balanced response.

A schematic is shown of the simple a-f amplifier and phase invertor circuit which feeds the 6V6s. A 6SL7 tube has both cathodes grounded, the grids returned to ground via 10 meg. resistors and similar 470 K-ohm. 02 μf. Values in the plate coupling circuits. The little bias required by the triodes is developed across the large grid resistors. The second section is seen to pick up its a-f voltage from thenet work in the grids of the 6V6 tubes.

RCA Model 65BR9

This is a portable set capable of operating on a built-in storage battery or from the 115 volt a-c line. The circuit of the set, exclusive of power supply, is fairly conventional and only a block diagram is shown. The antenna (loop) and oscillator circuits are tuned, the r-f plate and mixer grid being R-C coupled.



Block diagram of RCA Model 65BR9

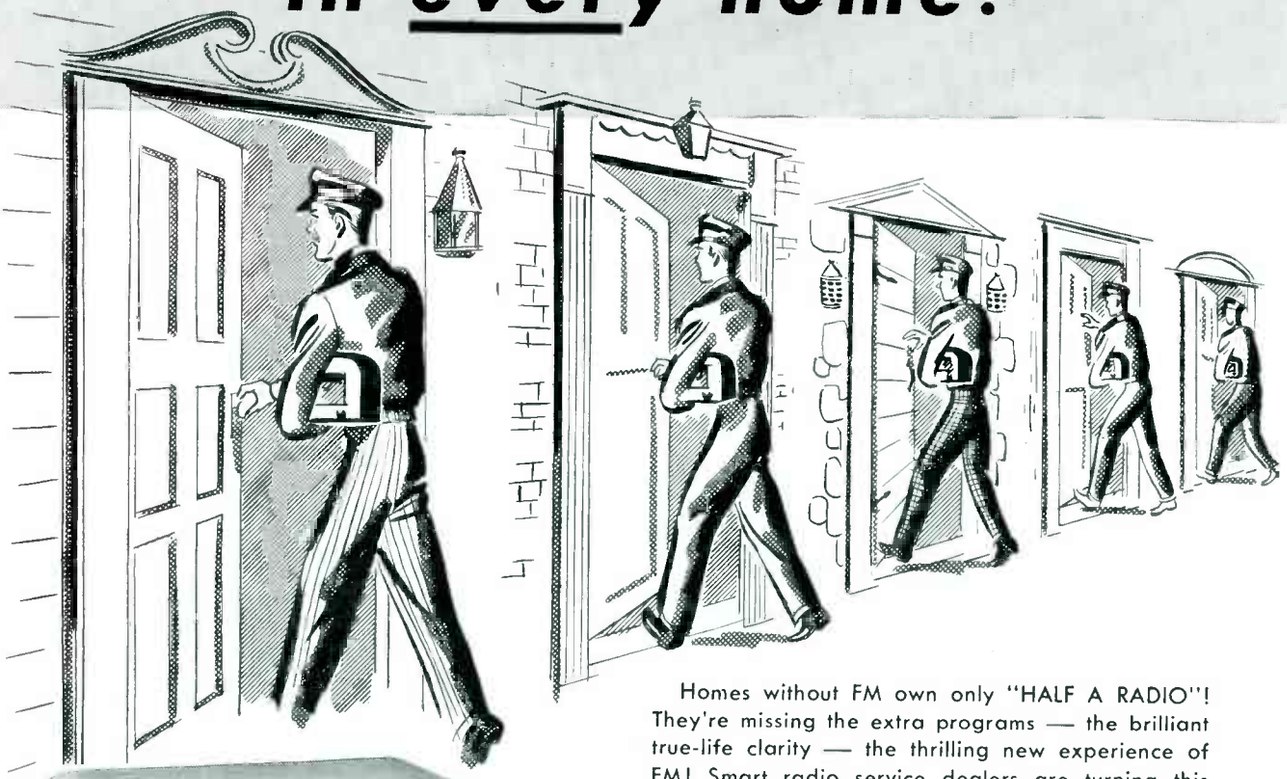
The battery being a 2 volt, lead-acid type, calls for a dropping network to supply the desired 1-4 volts to the tube filaments. As shown in the filament diagram, the 50 mil tubes are paired and supplied via a 7.5-ohm resistor. The 3V4 output tube, with filaments in parallel, drawns 100 mils and has its own 7.5-ohm resistor.

Provision is made to operate in either of two modes, Battery or A. C., and to charge the battery from the a-c line without playing. A single switch assembly having four positions, marked: OFF—BAT—AC—CHG performs all switching functions. The charging circuit is shown, and will be seen to consist of a transformer to step the live voltage down to 3 volts, a dry disc-full wave rectifier and a choke. This assembly provides 1.75-amperes output

[*Continued on page 24*]

Mr. Radio Service Dealer

Put an FM Pilotuner in every home!



to retail at $29.95

- 3-gang copper condenser
- 5 tubes plus selenium rectifier
- Built-in FM antenna • Handsome wood cabinet
- Approved by Underwriters' Laboratories.

Homes without FM own only "HALF A RADIO"! They're missing the extra programs — the brilliant true-life clarity — the thrilling new experience of FM! Smart radio service dealers are turning this *hot* waiting FM market into *cold* cash, — with the amazing FM Pilotuner . . . which brings in glorious FM from ANY radio, yet retails at only $29.95.

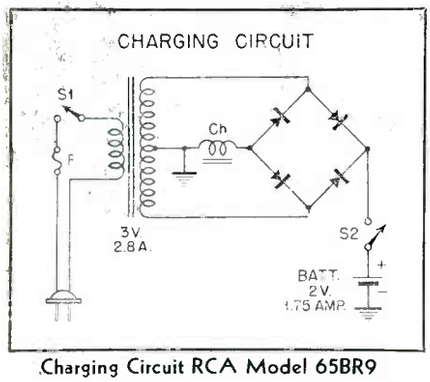
"Live Wires" are taking PILOTUNERS along on EVERY call . . . sending them out "on approval". . . letting customers "hear for themselves"— in their OWN homes. Sales results are *astonishing* . . . actually almost *100%*. Get your share of this ready, waiting PROFIT! Write for details.

THE PERFECT XMAS GIFT!

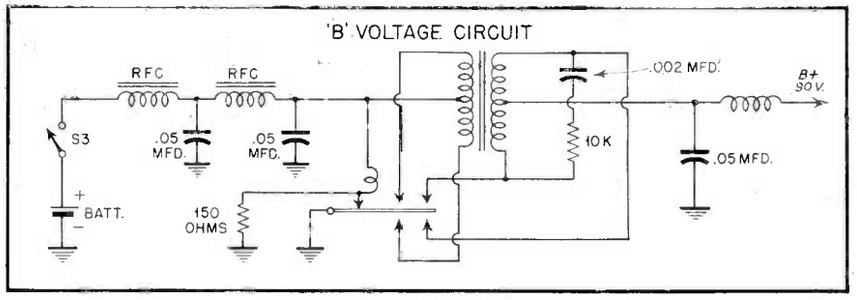
A Yuletide "best seller". . . unusual—wanted—priced right! Give PILOTUNER a real Xmas display!

PILOT RADIO CORPORATION, 37-06 36th ST., LONG ISLAND CITY, N. Y.

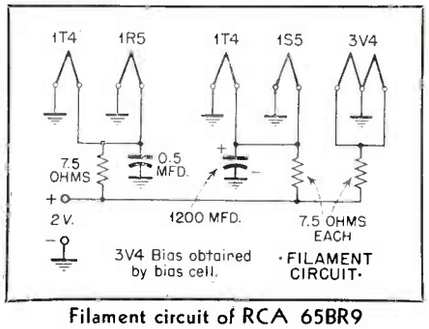
Makers of PILOTONE VINYLITE RECORDS • PIONEERS IN SHORT WAVE • FM • TELEVISION



Charging Circuit RCA Model 65BR9



"B" Voltage circuit of RCA Model 65BR9



Filament circuit of RCA 65BR9

at 2 volts. The filaments and B supply draw 1.25-amperes. Thus, either the entire 1.75-amperes or .5-amperes can be applied to the battery, depending on whether the switch is set for CHG or A.C.

The B voltage for the set is provided by a synchronous rectifier type of vibrator. A circuit of the components involved is shown. Note the elaborate filtering to prevent vibrator hash from appearing in the set as noise. A buffer circuit consisting of .002-μf and 10K ohms is connected across the high voltage winding to correct the waveform of the interrupted output. Filtering, not shown, is done by a 1000-ohm resistor and two 15-μf condensers in the B circuit. Charging and vibrator components, as well as the battery, are mounted in separate metal boxes to provide adequate shielding. All switches shown are parts of the single assembly.

TRADE-INS HELP CREATE SET SALES

Mr. Richardson and customers

by R. H. BRADY

MR. A. E. RICHARDSON, of Nowata, Oklahoma, has developed a wide trade area by utilizing "trade-ins" to pave the way for sales of new radios. Measured in terms of results attained within a comparatively short time his methods seemingly possess considerable merit.

Perhaps it might be well to point out that the firm was for some time county distributors for several lines of gas and electric appliances and at first radios were simply a sideline. However, while an integral part of the company's activities, the radio department now operates as an independent unit, with strong emphasis on complete service, and proper merchandising.

Located at 111 West Cherokee Street, in Nowata, Oklahoma, situated in the center of a rich agricultural and livestock region, the firm caters to hundreds of customers, both city *and* rural. 24-hour maintenance service is afforded their patrons.

Within the store proper, a leading receiver line is featured, carefully arranged for proper demonstration and customer convenience. All types of sets are available ranging from table models to combinations. No so-called "high-pressure" salesmanship is used. When prospective customers enter the radio department, highly trained salesmen, after asking a few questions, lead them to easy chairs and proceed with a demonstration.

However, due to thorough training, the customer may be invited to listen to, or try the radio set out, while the salesman turns to greet another person, or group, who are looking around the store. Such procedure keeps every one satisfied, and sales are usually completed without wasted motion or

[*Continued on page 32*]

Now Available...

New, important additions to the most complete line of Speakers and Driving Units made

NEW SPECIAL PM HORN UNIT, having Alnico V magnet ring, completely watertight housed in a heavy aluminum spinning. Provides extremely high efficiency reproduction with minimum input. Handling capacity 35 watts continuous, 60 w peak.

NEW SMALL RE-ENTRANT HORNS, extremely efficient for factory inter-com and paging systems; for sound trucks, R.R. yards and all other industrial installations where high noise levels are prevalent. Watertight, corrosion-proof, easily installed. Two new models — type RE-1½, complete with Baby Unit, handles 25 watts, covers 300-6000 cps, type RE-12, complete with Dwarf Unit, handles 10 watts, freq. response of 400-8000 cps.

NEW RADIAL RE-ENTRANT SPEAKER, excellent for all types of industrial sound installations. Provides superlative and complete 360° speech intelligibility by efficiently over-riding factory high noise levels. Frequency response 300-6000 cps. Handling capacity 25 watts continuous, 35 w. peak. Has mounting bracket. Size 12" wide by 12⅝" high.

To the more than 60 different type and size speakers and horn units that already compromise the RACON line—these new models have been added. There is a RACON speaker and horn unit ideal for every conceivable sound system application.

RACON has not only the most complete line, but also the most preferred line. For over 20 years leading Soundmen have recognized and specified them because of dependability, efficiency and low-cost, and because the reproducers are trouble proof.

Here is a partial list of the various types of RACON products now available:

PM Horn Driving Units, 10 types
Re-entrant Trumpets, 7 types
Tweeter & High Frequency Speakers, 3 types
Radial Horns and Speakers, 3 types
Straight Trumpets, 21 types
Re-entrant Fone Speakers, 7 types
Flat bell straight trumpets, 2 types
Armored Cone Projectors, 7 types

In addition there are cellular and auditorium horns, intercom, paging, monitor, and dwarf speakers, cone speaker housings, etc., besides all basic accessories such as swivel brackets, mounting units, cone housings, multiple horn throat combinations, etc.

Write for free catalog

RACON ELECTRIC CO., INC.
52 East 19th St. New York 3, N. Y.

RACON

NEW PRODUCTS

Low Price TV Set

Hallicrafters Co., Chicago, announces a table model television set with 22 tubes and 13 channel push-button selectivity, goes into production immediately, and should be on the market by the first of the year. The selling price will be $169.50.

The metal cabinet, finished in gray and silver, was designed by Raymond

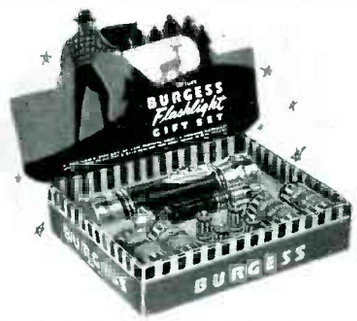
Loewy, and is equipped to accommodate a detachable lens accessory to bring larger images.

Other features of the new set are a full seven inch image, push button for fine tuning and dials for simplified volume control, horizontal and vertical image adjustment.

The video set will be merchandised through distributors of both the Hallicrafters Carnegie Hall line of radio consoles and the Hallicrafters amateur line.

Burgess Xmas Kit

Burgess Battery Co. of Freeport, Ill. is offering a flashlight-battery kit for dealers to suggest as a Christmas Gift item. The kit which retails at



$2.98 includes a No. 146 prefocused flashlight, a No. 92 penlight and a complement of extra reserve batteries for each.

Outdoor-Indoor Fluorescent Lights Introduced

Fluorescent Christmas tree lights which can be used outdoors as well as indoors have been announced by Sylvania Electric Products, Inc. The new sets have waterproofed cords and

are equipped with special gaskets to be placed inside the sockets for protection from the elements.

The fluorescent bulbs, which come in soft blue, green, coral, yellow and orchid colors, have a screw type base, and are independently operated. Each lamp consumes about four watts of current and has an average life of 1000 hours. The strings need no special auxiliary equipment in order to operate.

Cord sets will retail at $4.95, plus tax, with individual bulbs costing 45c apiece, plus tax.

New Simpson Tube & Set Tester

A new tube and set tester, Model 445, is announced by Simpson Electric Co., Chicago.

The 20,000 ohms per volt tube tester is of the plate conductance type, with dial indicating percentage of rated plate conductance. This can also be considered as percentage of mutual conductance since, in most cases, the

amplification factor remains constant. Simpson has included its own Automatic Reset mechanism which returns all switches to normal automatically at the end of each test. Sockets for all types of tubes are provided, including the new nine-pin miniature, also the sub-miniature as used in hearing aids, etc.

Model 445 is housed in a durable, easy-to-carry case. Panel is molded bakelite, unusually heavy. All figures and letters are recessed on the mold and filled with white for easy reading and long wear. Meter is the large 4½" size. Jobbers now have Model 445 testers in stock.

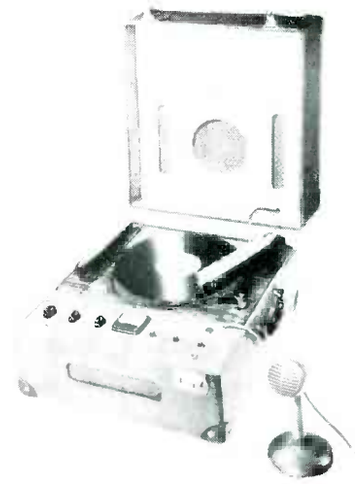
Utah Auto Replacement Speakers

Utah Radio Products announces three new auto radio replacement speakers, Models SE5S6, SE6S6 and SE7Y6. These electro-dynamic speak-

ers are available in sizes of five, six and seven inches. Each model incorporates a 3-ohm voice coil and 4-ohm field coil. Speaker mountings are square type. These new replacement speakers supplement Utah's line of Electro-Dynamic and PM Alnico-V types, including oval and auto replacements. For more information write to Utah Radio Products, Huntington, Indiana.

New Recorder

The Speak-O-Phone Recording & Equipment Co., 23 W. 60th St., New York, N. Y. announces their new model HR-48 dual speed home recorder.



The features of this combination recorder, playback and public address unit are a dual speed motor, visual volume indicator, compensating tone

Meets *EVERY* Testing Requirement *BETTER*

NEW model 3413 ...*Lever Switching*... tube tester

THIS INGENIOUS LEVER SWITCHING
"Pictures your circuit"
FAST • SIMPLE • FLEXIBLE
Provides individual control of each tube element

With the new Model 3413 you can make your settings instantly—just snap the switch up or down. You actually "picture" the circuit. Usually not more than five of the ten lever switches need be set, yet you have individual control of each tube element. Many other convenient features make Model 3413 the buy of its field—such as the handy, built-in SPEED-ROLL tube chart, the larger easy-reading meter, the handsome new case with streamlined design. For either counter or portable use you will find Model 3413 a quality-packed tester that you'll be proud to own. Write today. Address Dept. P127

STANDARDS ARE SET BY TRIPLETT

Precision first ...to last

Triplett

ELECTRICAL INSTRUMENT CO. BLUFFTON, OHIO

control, radio input and head phone monitoring jack.

The amplifier contains 2-7C7's, 1-7C5 and 1-7Y4 tubes. This recorder, while built for the home recorder price field, is said to have the quality of professional recording instruments. Further details and literature available free from the manufacturer.

Appliance Tester

A compact, portable, universal-type electric appliance tester is announced by Hanlan Company, 1419 West Jefferson Blvd., Los Angeles 7, Cal. Designed for appliance repairmen, the new Model 60 tester, will show the true condition of any electrical appliance, checking open circuits, continuity, grounds, short circuits, etc.

The a-c ammeter range of from 0 to 15 amps covers the most commonly used ranges for appliance testing. A high sensitivity Neon tube is provided for making high resistance tests.

Size of the instrument is 7-¼" high, 6" wide, 2" deep. Its protective steel case has a durable, instrument crackle finish. Shipping weight of the unit is only 3 lbs. For details and price, write the manufacturer.

New Nylon Needle

A rare osmium alloy tip is used for the first time in the new Webster-Chicago "Black Nylon" phonograph needle.

The manufacturer claims it delivers a remarkably true reproduction of both vocal and instrumental recordings and virtually eliminates needle and record scratch.

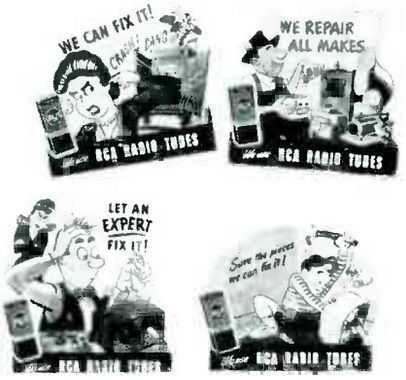
TRADE FLASHES

[Continued from page 6]

factures wire recorders, phonographs, phonograph needles, and record changers.

New Comic Sales-Service Aids

Ralph Stein, famed GI cartoonist of Yank, the Army weekly, has created a series of comic art displays for the RCA Tube Department. Prepared for radio



dealers and servicemen, the cartoons are used on counter displays, newspaper ad mats and postcards.

Albert N. Giddis (front left), winner of the Rider Contest $500 first prize shakes hands with Henri Jappe of A. W. Mayer Co., Boston, who as his jobber was awarded $100. John F. Rider, Manual Publisher (rear left) and Leo D. Gaumont, whose store's service department is managed by Giddis, look on.

RCA Offers PM Speakers

A standard line of PM speakers for general replacement and sound-systems work has been announced by the Renewal Sales Section of the RCA Tube Department.

The line includes a "controlled-resonance" 12-inch speaker, a 4 inch and a 5 inch speaker, a 4 by 6 inch elliptical speaker, and a 2 by 3 inch elliptical speaker.

Rated at 12 watts power-handling capacity, the 12-inch speaker has a unique filter which automatically eliminates needle scratch and other objectionable high-frequency noises.

The 4 and 5 inch speakers are specially designed to meet the radio serviceman's small radio requirements.

The 4 by 6 inch and 2 by 3 inch elliptical speakers are designed for table-model combinations and portable radios.

Complete specifications and descriptions of the RCA speakers are included in Catalog sheet 2F384R available from RCA Tube and parts distributors, or the Renewal Sales Section, Tube Department, Harrison, N. J.

S-W TV Service Appointments

Twelve more appointments under the installation and service plan for Stewart-Warner "Videorama" television receivers have been made. Those appointed are under direct contract with Stewart-Warner but also are subject to supervision by the company's territorial distributor.

Named as "Authorized Stewart-Warner Television Service Stations" for their respective cities or territories were Highland Radio & Electric, Highland, Ill.; Electronics, Mechanicville, N. Y.; Ben Ruyle Radio Repair, Alton, Ill.; Davidson Radio Service, Belleville, Ill.; Television Installation & Maintenance Co., Detroit, Mich.; Alpha Television and Radio Services, Mount Vernon, N. Y.; Schordine Appliances, Patchogue, L. I., N. Y.; Konig, Inc., Milwaukee, Wis.; Seidel Electric Shop, Milwaukee, Wis.; Television Installation, Mount Ephriam, N. J.; Precision Radio Company, New Haven, Conn., and Williams Radio Service, Waterbury, Conn.

Rider Offers New Service

John F. Rider Publisher, Inc., 404 Fourth Ave., N. Y., has announced a new continuous service for radio servicemen. Photostatic copies of schematics and servicing data that have not yet appeared in Rider Manuals will be available.

The photostats of diagrams available will sell for 10 cents for two pages consisting of schematic, alignment and voltage data, parts list (if available) and whatever else can be included in these two pages. There will be a charge of 5 cents for any additional pages up to seven pages, and 3 cents for any additional pages above seven. The photostats will be 8½ x 11 inches, with the double-page (17 x 11 inches) schematic spreads being counted as two pages.

Servicemen desiring this service are asked to send twenty cents with each order, either in stamps, coins or postal note. The difference in cost, if less, will be returned with the photostats. If the cost is higher—depending upon the number of pages necessary—this infor-

SPRAGUE TRADING POST

SWAP — BUY OR SELL

SELL OR TRADE—National Schools radio course, 120 lessons without equipment, $45 or will trade for good signal generator. Harold Dorsey, 325¼ Fulton St., Mankato, Minn.

FOR SALE—First quality 12SA7, 50L6, 35Z5 radio tubes at 95c each postpaid. Jones Radio Company, Box 93, Douglassville, Pa.

FOR SALE—Precision 830 multimeter, $13.50; RCA 94 BP1 portable radio, $16; RCA automatic record changer, $13; also parts, books, and tools. Write for list or will trade for 8mm projector in good condition. G. H. White, 449 Wellington Rd., Mineola, Long Island, N. Y.

WANTED—813s for 803s, will sell Guthman hetrodyne, direct calibrated, freq. meter U10 complete and in good shape, $22. Milton Kalashian, 2 Congress St., Newburyport, Mass.

FOR SALE—Have quantity of old radio tubes such as 201A, WD12, 199, 11, 8S100, etc., also some other old parts. R. A. Boydston, 417-45th St., Brooklyn 20, N. Y.

WILL TRADE—Williams Fundamentals of Radio, Maedel's Math. for Radio and Comm., Ghirardi's Modern Radio Servicing, Rider's Servicing Superhets, Radiotron Designers Handbook, Smith's Elements of Physics, Hick's Principles of Servicing, Fink's Principles of Television Engineering and Radio News Jan. '46 to July '47. Want commercial signal generator in good condition. M. Gottlieb, 1745 Fulton Ave., New York 57, N. Y.

FOR SALE—Approved signal generator A-200 used only 3 months; Triplett analyzer #710; G-E 0-9 amperes 2" meter, tube tester meter 3" 0-1ma, Emerson portable less batteries and tubes; army telephone, 40 watt Vulcan Iron and book, Understanding Radio. N. Gregory 36 Lenox Road, Peabody, Mass.

FOR SALE—Supreme 543S at $14 and Triplett 666H, $15, both in good condition, D. Brucato, 574 Sixth Ave., Brooklyn 15, N. Y.

WANTED—Movie cameras EK cinespecial, Victor V and other 8 and 16mm cameras and projectors. Have complete listing of tubes, radios, parts, etc.; 1942 Willy's American 4 door sedan in perfect condition, $1000 Will sell small, old established shop and good business heavily stocked $4500 cash. Have good lease and low rent. Phoenix Radio, 2208 Phoenix Ave., Jacksonville 6, Fla.

FOR SALE—Sylvania tube tester 140, $60 plus postage; also Rider's manuals 7, 8, 9, 12 and 13 in good condition, each $10 plus postage. Frank J. Poliuski, Box 118, Warren, New York.

SELL OR TRADE—1934 auto radio, $20. Want Rider's Manual #15. Bill's Radio Center, 2104 Prospect Ave., Scranton 5, Pa.

FOR SALE—RCA VR150/30 tube in cartons, $1 ea. Rubane Radio, 117 McMechen St., Baltimore 17, Md.

FOR SALE—QST from January 1938 to December 1944 and Radio Amateurs Handbooks dating back to 1927 all in excellent condition. Veto M. Twaska, 3321 W. Carson St., Pittsburgh 4, Pa.

WANTED—8X-18 and 8 mm movie camera and projector. J. M. Fraser, Binscarth, Manitoba, Canada.

FOR SALE—SCR-274-N aircraft command set $28, some plugs wired; will sell parts. Harry M. Books, Jr., 318-11 Street, New Cumberland, Pa.

FOR SALE—Radio parts such as condensers, resistors and transformers. What do you need. Philip Mills, Box 312 Hoisington, Kans.

WANTED—Separate power pack for Temple radio 81 using tubes 1-80, 2-45, 2-24A, 4-27. State price and condition or will trade other used transformers. National Radio Service, 1809 Jackson Ave., Portsmouth, Ohio.

FOR SALE—Well established radio and record service shop complete with full equipment, best location, selling due to bad health. Write for full details, J. J. Peters, P. O. Box 298, Iverness, Fla.

FOR SALE—Sparx 905 signal tracer. $35; AC Bridge analyzer with signal tracer BR44, $45 and C-10 signal tracer, $10. C. E. Harmon, 419 Fourth St., Chester, W. Va.

WANTED—3" oscilloscope. Will trade RCA recording play back unit complete with astatic B-17 pickup and magnetic cutting head, less amp and mike. Richard Gilbert. Box 511, Vernal, Utah.

FOR SALE—SW5 AC power supply, SW-5 plug in coils; 12 in all; Shure glider pickup 93A, crystal mike for desk or hand use; 52db new. Want dial face for Emerson 301 from 1940 also Utah VPT4, 50ma power transformer with 300-0-300v secondary 5v, 2 amps. 6.3v, 2 amps. Chester Wegrzy Nowski, 104 Beck St., Buffalo 12, N. Y.

WANTED—Modern portable typewriter in good condition. Will pay cash or trade Triplett tube checker, 2413 in perfect condition. Fred Cobin, 158 E. 7th St., New York 9, N. Y.

FOR SALE—New R.C.P. tube tester and combination multi-tester, $45 or will trade for good VTVM A. Dubner, 2691 Reservoir Ave., Bronx 63, N. Y.

FOR SALE—115 self mounting dry electrolytics, 40-20 mfd, 150v, 1" x 2" can; list $1 will sell for 45c ea. Peter M. Simonetti, 21 Carlton Ave., Brooklyn 1, N. Y.

WANTED—Table model receivers, 1935-39 with push-pull and 8" speaker; also Hallicrafters same years, any condition. Will trade meters, parts, pickups, mikes or cash. C. J. Seymour, Los Angeles, Sanatorium, Duarte, Calif.

FOR SALE—Complete radio shop with 2 test instruments, 6 Riders manuals, 360 tubes, 200 condensers, 200 resistors, 42 volume controls, transformers, speakers, sockets, fuses and misc. parts, mostly new. List $1250, will sell $750 plus postage. Butch Sellers, Bishop, Calif.

WILL TRADE—Latest N. R. I. course and tester, less batteries. Want used signal generator in working condition. Frank Wurst, 242 Dayton Ave., Clifton, N. J.

FOR SALE—Phono oscillator ready to use with phono pickup or mike; also telephone mike to use with the oscillator, $5; single unit earphone, 50c. Robert Culver, Brocton, Ill.

WANT—Radio instruments; have three Bavaria German beer steins to trade. Smith Radio Service, 132 S. 7th St., Steubenville, Ohio.

WILL TRADE—2 Stancor mike transformers; Thordson output transformer; Triplett a-c voltmeter 0-50, used; Westinghouse m.a. meter 0-100 used; 4 tubes 1612 new; ¼" used electric drill, no bits. Want good tube tester. L. L. Waite, CSK, Supply Dept., U.S.N. School, Bainbridge, Md.

SELL OR TRADE—Hearing aid, W-E in perfect condition less 505 AX tube plus new batteries. R. B. Chrismon, Box 93, Elon College, N. C.

FOR SALE—Back number radio magazines; 5 tube super het self power supply tuner and 10 tube custom built f-m tuner with own power supply built in, 88 to 108 meg; also heavy duty p-m speaker in bass reflex cabinet. Frederick G. Freeman, 617 W. 169th St., New York 32, N. Y.

FOR SALE—Hallicrafters S-28A and speaker, $185; ARR5 f-m and a-m with own power supply $125 and Eastern amplifier with 25 watt output $40. L. G. Rankin, 738 Patterson Ave., San Antonio, Texas.

WANTED—Technical manual for BC-375-E surplus transmitter, 100 pages, 60 cuts or more, diagrams, etc. Not the 33 page TM. An-08-10-225. L. C. Chapman, 511 Cedar St., Demopolis, Ala.

FOR SALE—Hammarlund comet-pro complete with metal cabinet tubes and separate matching speaker; Motorola car radio #80 complete with tubes and speaker; #5 Underwood typewriter. Want Super-Pro or similar, Precision tube tester or E-200 generator. Glenn Watt, Chanute, Kans.

WANTED—Back issues of Radio News, Radio Craft, QST & CQ. Will exchange signal generator or CA11 tracer. R. Wilson, 1389 West 39th St., Los Angeles 37, Calif.

FOR SALE—EC1 Echophone receiver, $22; small table model air King, $9; #4 Gernsback service manual, $3.50; Supreme Radio Service Course, $2; Army portable radio receiver, 2 to 6 mc, with case and batter, $15; earphones with plug, $1; Philco phono oscillator, $15. Want BC-221 frequency meter, VFO, communication receivers. A. Livingstone, 1202 Ellis Ave., Fair Lawn, N. J.

FOR SALE—25 watt loudspeaker, 14½" diam. 2½" voice coil, pressed cone, 40 lb. magnet (pm dynamic) with 500 ohm transformer and flat baffle, like new, $39.50. Karl Greif, 16 Cornish Road, Binghamton, N. Y.

FOR SALE—National NC-173 receiver, practically new and in excellent condition, $150. Roger Nutter, 4½ Lebanon Court, Sanford, Me.

FOR SALE—Radio shop with stock of parts, 400 tubes, Rider's Manuals, some instruments (Silver Vomax & spark, Supreme, Philco) go with shop $2250 selling price, $40 a month rent, sone dealer service. W. G. Eslick, 124 E. 5th St., Casper, Wyo.

URGENTLY NEEDED—April, 1943 Radio Craft and April and October, 1947 Radio News. Gustavo Campos, Gral, Cano 187-Dpto. 8, Tacubaya, D. F., Mexico.

FOR SALE—Jackson tube-checker 634, Supreme set-checker 89D, Clough-Bringle oc signal generator, $65. Charlie G. Richeson, P. O. Box 431, Henryetta, Okla.

FOR SALE—Magnavox fm tuner, 88-108 mc band including 8 tubes, $30; also McElroy tape puller in case, $10. L. H. King, 746 Irving Park Road, Chicago 13, Ill.

FOR SALE—Silver "Vomax," $45. like new, also most types of tubes, some transmitting. Write for your needs and we'll send list. Richard Hutchison. 934 S. Euclid Way, Denver, Colo.

FOR SALE—Complete stock hearing aid repair parts, will sell at cost, $202.39. Buyer will receive supplier connections and aid in getting started. All inquiries answered. W. Mathewson, Canonsburg, Pa.

mation will be given in the letter bearing the photostats.

Orders will be filled on day received. Printed copies of schematics and servicing data that have already appeared in Rider Manuals will also be available under the above cost schedule.

New IRC Sales Manager

International Resistance Company has announced the appointment of Mr. Robert D. Ferree as Sales Manager of IRC's Merchandise Division. Mr. Ferree succeeds Bob Baggs who leaves IRC

Bob Ferree (standing) with Bob Baggs

to assume the duties of General Manager of a Philadelphia advertising agency.

Bob Ferree has been associated with IRC's jobber and industrial sales activities for seven years.

Mallory To Aid Service Dealers

At a meeting of the entire sales organization of P. R. Mallory & Co., Inc., in Indianapolis recently, announcement was made of a new merchandising program being instituted by the company's Wholesale Division.

Walt Harvey, Manager of the Wholesale Division, outlined complete details of the company's "Good Service for Good Business Plan," designed to assist radio servicemen in developing their business. The plan makes available to servicemen a complete kit of material for improved shop identification, customer follow-up activity and simplified service records.

A program of service meetings is getting under way immediately, under the sponsorship of Mallory distributors, at which a sound film will cover all details of the plan, together with information on recent developments on Mallory products which are of interest to the service trade.

Tube Tapper

Along with many sales aids, Hytron is offering to dealers a "Handy Tube Tapper" in the form of a pencil. Reaction to this handy combination pencil, eraser, and tube tapper (for discovering intermittent "shorts" and "opens") is excellent. The Tube Tapper is ruggedly constructed and does just as nice a job

"WE REPAIRMEN ARE SOLD ON KEN-RAD LEADERSHIP IN TUBE DESIGN."

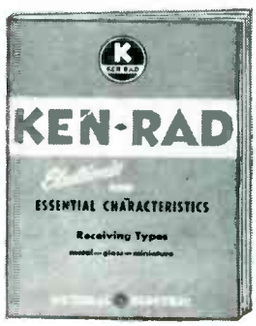
MAKE KEN-RAD DOUBLE ACCEPTANCE a sales-and-profit tonic for your business!

SET your course with an eye to the popularity of Ken-Rad tubes with both radio experts and owners of sets! *Install and sell what the trade endorses, what the public approves!* That's your path to success as service-man and tube dealer.

Those who repair radios, know that G-E and Ken-Rad research is creating tubes with ever-greater *strength*—increased *rigidity* to ward off the effects of vibration—improved *electrical constancy*.

Owners of radios have discovered that Ken-Rad tubes play better for a longer time. SUPERIOR PERFORMANCE to them sums up the results of what the trade recognizes as DESIGN LEADERSHIP.

You can use Ken-Rad popular acceptance as a strong stimulus toward bigger sales volume. For *more* business, for a *more profitable* business . . . in tubes, in parts, in billable repair time . . . handle Ken-Rad radio tubes!



● "Essential Characteristics"—Ken-Rad's Booklet ETR-16—is a "must" for the dealer or service-man who wants a convenient, concise, and comprehensive guide to the selection of radio tube types. Your free copy will be mailed you promptly on request. Write for it today!

"WE RADIO OWNERS ARE SOLD ON KEN-RAD TUBE PERFORMANCE."

178-F11-8850

KEN-RAD *Radio Tubes*

PRODUCT OF GENERAL ELECTRIC COMPANY

Schenectady 5, New York

as a factory test mallet. Its compactness permits using it on tubes either in a tube tester or in the set chassis itself. The Tube Tapper can be ordered in lots of 25 for $1.25.

Mueller Clip Displays

The Mueller Electric Co., 1583 E. 31st St., Cleveland, Ohio announces new display boards are now available for Radio-Electrical jobbers.

The boards show the complete line of clips and may be mounted on a wall or placed on a counter. Identifying code numbers are printed under each items and the clips are detachable from metal pegs on which they are secured. For prices, write Mueller.

Robert Williams of Hickok Passes

Robert Williams, Sales Manager of the Hickok Electrical Instrument Company, passed on October 28th, at his home in Cleveland. Mr. Williams became interested in radio service in 1926 and joined Hickok as a sales representative. Within six months, he took over the position of Sales Manager, and since that time had been very influential in molding the present position of that company in the radio service instrument field.

Telecast So. Bend To Chicago

Television brought the Army-Notre Dame football game, played on November 8 at South Bend, Ind., to an estimated audience of some 175,000 persons. A new television relay from South Bend to Chicago, arranged by Capt. W. C. Eddy, manager of Station WBKB, permitted many thousands unsuccessful in securing admission to "see" the game close-up. In the Chicago area alone, nearly 10,000 television receivers received the telecast of the game. Another 5,000 saw it on the screens of television receivers installed at many points on the University's campus.

TRADE-INS CREATE SET SALES

[*from page 24*]

loss of time, yet are handled in a decidedly courteous manner.

On the display floor immediately to the left of the office is a well equipped radio repair shop with two expert technicians in charge. It is enclosed by means of a counter so the customer may bring in his radio and stand and watch while it is being tested if he so desires. The two service technicians are never to busy to answer questions, or discuss individual problems with the customer, yet they keep right on with their work. Other repair work is also carried on by additional skilled repairmen in the rear of the shop proper, and several outside technicians are always available for emergency service calls.

Extensive advertising is used by the firm. Streamlined sales technique is used within the store, and similar ideas are carried out through personal calls, etc., over the entire area served by the firm.

In connection with their appliance business the company has several trucks making trips to install, or repair appliances. Every one of those truck drivers and maintnance men are also thoroughly trained in the selling of radios. In other words, when a call is made in the country irrespective of the reason for the call, the employee makes it a part of his duty to check-up on the radio situation in that particular home. He carefully notes down all of the facts, and turns them into the office.

Such facts are checked, and filed away under a cross-index system after a letter has been written, and mailed to the prospect relative to present or potential radio needs. The letter invites the prospect to drop into the store to look over the new line of sets on display. After a time if the individual fails to respond, a follow-up is made either by letter, or through a personal call.

Effort is made to sell the customer a new radio, but if for some reason that is impossible at the moment, quite

often a repair job is secured to offset the cost of the call, etc. In rural homes having no radio the firm offers one for trial use. The prospect is offered his choice of a good used "trade-in" or a new model demonstrator. This usually prepares the way for the sale of either the used set, or the new radio in that particular home. Richardson explains. In fact he insists that his demonstrators are in reality one of his best salesmen. He gives due credit to other factors, advertising, adequate service facilities, and thoroughly trained personnel, but believes trade-in demonstrators, when properly used, greatly aid in boosting business.

"As you know, the Rural Electrification program has made electric power available for the first time for many farm homes," Richardson said. "This in turn opened up a wide market for radios. True, a limited market existed before for battery sets, or those operating off of small farm power plants. However, with the installation of regular electric service in rural homes, a much wider market opened up for the usual type of radios. *That's* the market we are after.

"Farmers are now in excellent financial shape, hence, they are able and ready the purchase the kind of radio they have always wanted. We may not be able to deliver the set they desire immediately, but we book the order, and if they have an old set which is faulty, we gladly accept it as a trade-in on the new radio, and at the same time place one of our used sets in the home for temporary use.

"If the home has no radio, we endeavor to place in it a used set for the family's use for the time being. This usually paves the way for a future sale. It is surprising the number of used sets sold in this manner, and it is even more remarkable the number of new sets ordered as a direct result of our loaning the family a used set for a short time. You know, it is a fact, once a home has a radio it will never again be without one again, all things being equal.

"We serve many city customers, both for sales and service, but at the moment we are concentrating on rural trade. By careful use of our 'trade-ins,' and proper merchandising of our new radios, we are gradually developing a nice volume of business."

At hte present time the firm has a long list of orders "booked" for future delivery—yet they are ever reaching out seeking more. Incidentally, they purchase, or accept as a trade-in, almost any kind of a used radio. Seemingly, these used sets are utilized advantageously to help boost business, both now as well as in the future. In fact, indications are the firm will not

only be able to maintain their present sales and service levels during the period just ahead, but will continue to increase volume business more and more as supplies become available in sufficient quantities.

ELECTRONAMIC TUBE TESTER

[*from page 19*]

of the moving contact designated with the arrow, selects the grid of the tube to connect it through R_1 to the arm of the potentiometer R_4 across the 50-volt winding of the transformer, thus supplying anywhere from 0 to 50 volts a.c. to the tube grid. The remainder of the switch contacts are shorted together and connected to the *O* end of the transformer winding.

The switch S_5 is a push-button assembly serving various functions. The first two positions at the left act as an ON-OFF switch. The three switches at the extreme right end of the group are used for inserting the meter in either the tube plate circuit or in the a-c line for line voltage adjustment. Positions *A* to *J* normally pass all tube elements down through S_1 to O volts on the transformer or to the grid voltage supply. When any of these switches are depressed corresponding tube elements are moved up to the lower deck of the upper switch S_3 where the moving contact picks off the screen and the shorting ring selects the plate.

The upper deck of S_3 is used to select various a-c potentials through load resistors R_{10}, R_9, R_8, or R_7 to the transformer where 50, 175, or 300 volts a. c. are available. Switch S_4 is used to pick off the proper filament return.

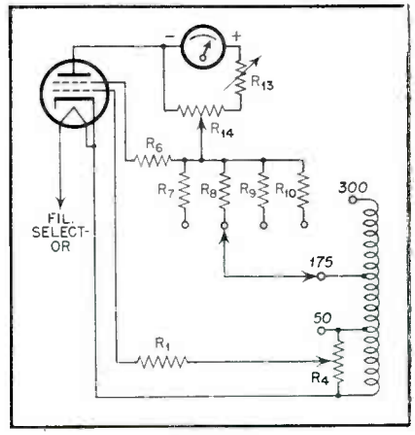


Figure 4

In operation, the tube under test is subjected to a predetermined grid voltage swing, the plate and other elements being adjusted to their proper operating potentials. The E_p/I_p characteristic curve for this test is shown in *Fig. 5*. Observe that through the application of appropriately place individual ele-

ment potentials the tube under test is dynamically swept over a path of operation on a sinusoidal time base encompassing a wide range of plate family characteristic curves. In brief, the tube under test is made to perform on a basis which involves its ability to operate at a multiplicity of potential peak conditions rather than at just one arbitrarily chosen point.

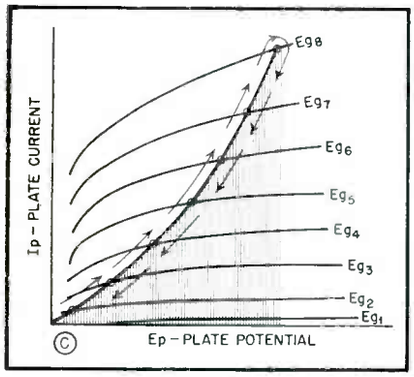


Figure 5

The d-c meter in the plate circuit automatically integrates or averages the area under the curve. The value read is thus a measure of the overall figure of merit of the tube. The mutual conductance of the tube under test becomes a relevant factor inasmuch as the total plate current is a function of the applied control grid voltage. The mutual conductance of a tube is the ratio of plate current change caused by an applied grid voltage.

EXTERNAL CROSS MODULATION

[*from page 20*]

only when the rectifying action is particularly severe because the modulation of the strong desired station usually masks the interfering modulation.

It may be seen also that there is a possibility of hum modulation being introduced when a rectifying condition exists in the power wiring. In this case, one of the frequencies is that of the signal carrier and the other that of the lighting system, which is usually 60 cycles. The rectifying action then imposes a 60-cycle modulation on the carrier.

Some instances of modulation hum in receivers at certain locations have been traced to this source. Hum of this type would be present in a battery receiver at the same location. The remedy is the same as for interference between stations, namely elimination of the rectifying condition or changed installation of the antenna to avoid pickup of resultant spurious frequencies.

Manner of Diagnosis

In investigating a situation where interference exists, the first step should be to determine whether or not it is due to external cross modulation by observing the frequencies at which interference exists.

For example, with the two strong signals at 650 kc. and 750 kc., if the program from both is heard at 550 kc., 850 kc., and 1,400 kc., it may be safely assumed that the trouble is due to external cross modulation. If the interference is not due to external cross modulation, shortening the antenna or installation of a wave trap tuned to the interfering signal, or both, will remedy the situation.

Cross modulation, may of course, be produced in the radio-frequency or first-detector stage of the receiver if the tubes are not of the remote cut-off or variable-mu type or if the operating bias, for any reason, incorrect. Cross modulation occurring in the receiver can be differentiated from that due to external causes by use of a short antenna, a wave trap tuned to the strongest interfering station, or by substituting another receiver.

Eliminating Rectification

As seen from some of the cases, the rectifying element may be in the power wiring, piping, or in the antenna itself. *Therefore, the first step in eliminating the trouble should be to make sure that the antenna and grounds connections to the receiver have secure, tight joints throughout soldered joints in the antenna being*

preferable. If this does not cure the interference, the next step is to endeavor to find the rectifying element elsewhere. If the rectifier is in the power wiring, connection of two 0.1 uf capacitors across the lighting lines, with the center point going as directly as possible to a good ground, should produce at least some decrease in the cross modulation.

If the source of rectification cannot be located, it still is usually possible to secure interference-free reception by the proper type of antenna installation. The location for an antenna which is free from cross modulation can be readily found by the use of a portable battery receiver equipped with a short antenna It will be found that the cross modulation occurs in the battery receiver when it is within the house, but disappears a few feet outside the house. By this exploration means, a location for the antenna may be found where cross modulation does not exist. The spurious frequencies will, however, be picked up on the lead-in unless it is thoroughly shielded. In some cases metallic braid shielding may not be good enough and concentric transmission line cable must be used.

EXTENDING CREDIT

[*from page 17*]

There is one last item which must be entered before figuring the profit and loss statement. This is wages. The record should show the gross wage paid; the amount deducted for Federal old age benefits; the sum (if any) taken out for state social security; the income tax withheld from wages; and the net salary.

The amount which is entered on the final profit and loss statement is the gross wage paid. However, the other information is necessary in filing quarterly social security and withholding tax returns for the Collector of Internal Revenue.

The next article in this series will detail how to make a profit and loss statement and how to use this in filing income tax returns, as well as pointers on what deductions may legally be taken off the gross income for tax purposes.

RATIO DETECTION

[*from page 15*]

diode and thereby discharge the voltage across C.

With regard to the voltages across C_1 and C_2, since the voltage aross C remains constant, $E_1 + E_2$ also remains constant. Now, let us see how the individual voltages across C_1 and C_2 are affected as the incoming signal is varied. Assuming an original signal where E_1 = 8 volts, and E_2 = 2 volts, we can set up the vector relationships, as shown in *Fig. 18*.

Suppose, now, that the incoming signal is doubled. The corresponding vector diagram is given in *Fig. 19*. Notice the $e_p + e_{s1}$ is now 16 volts, and $e_p + e_{sb}$ is now 4 volts. Ordinarily, $E_1 + E_2$ would be equal to 16 + 4 = 20 volts. However, due to the action of the stabilizing condenser which maintains the sum across C_1 and C_2 constant at 10 volts, the 20 volt value cannot possibly exist across C_1 and C_2. The apparent difference in signal voltages at the input and across C_1 and C_2 may be explained from the point of view that the larger

signal results in a correspondingly larger diode current which causes a larger voltage drop in the tubes. Since the ratio of E_1 and E_2 remains unchanged ($e_1/e_2 = 8/2 = 16/4$) and since the sum of $E_1 + E_2$ remains the same, the original values of E_1 and E_2 remain the same, that is 8 volts and 2 volts,

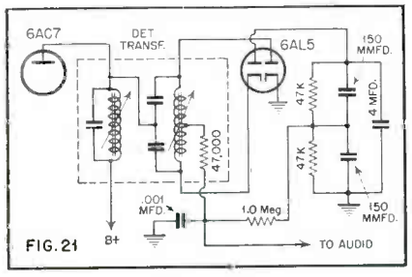


Figure 23

respectively. Thus, no change in audio output results.

Because this action depends on the ratio of C_1 and C_2 and hence E_1 and E_2, remaining constant for any amplitude of an incoming signal, at any point on the frequency deviation axis, the term, ratio detector, is applied.

Commercial Applications

It has been found, in adapting this circuit commercially, that certain unbalanced circuit conditions present in particular receivers result in a slight unbalance of the output signal during the frequency deviation cycle. The effect of this unbalance is shown in *Fig. 20*. As indicated, the crossover point, which should occur at zero deviation, has been shifted to some other point. This condition is due to unbalanced circuit components and the variations of the input capacitances of the diodes with incoming AM signals. The overall effect of this condition is

"If it's and FM set can I hear programs on it in the AM and PM?"

unsatisfactory AM signal rejection.

One method of reducing this unbalance is to insert a resistor of about 50,000-ohms in series with the tertiary winding, as illustrated in *Fig. 21*, which is a circuit used by Transvision in their television kits. This resistor has the effect limiting the diode currents, at high input levels, and thereby reducing the unbalanced effect produced by the AM component.

A second method which may be used is employed by R. C. A., and utilizes two unequal resistors, 1,000 and 1,500 ohms in series with the diodes. Referring to *Fig. 22* it will be observed that

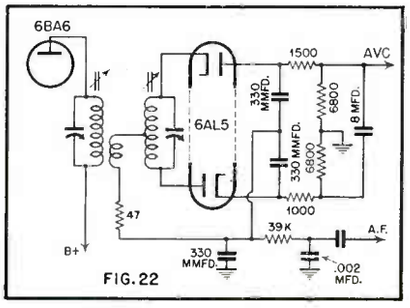


FIG. 22

Figure 22

these resistors affect the resultant audio voltage. Hence, any unbalanced conditions inherent in the circuit may be balanced by an equal and opposite set of unbalanced voltages developed across these resistors. In practice, these resistors are adjusted until zero audio output is obtained for zero frequency deviation.

A slight variation of the discriminator circuit involving the method of obtaining and combining e_p with e_{st} and e_{sb} is presented in *Fig. 23* which is the detec-

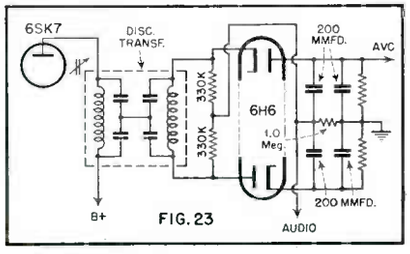


FIG. 23

Figure 23

tor circuit diagram of the Farnsworth Model GK 140. In this circuit the primary of the last i-f transformer is fed to an equivalent center-tap of the secondary circuit, this equivalent being formed by a center-tapped condenser combination. In a similar manner the diode currents are returned to an equivalent center-tap of the discriminator secondary formed by a center-tapped resistor combination.

Alignment

The alignment of a radio detector is comparatively simple. A typical pro-

ADDRESS CHANGES . . .
Subscribers to RADIO SERVICE DEALER should notify our Circulation Dept. at least 3 weeks in advance regarding any change in address. We cannot duplicate copies of RADIO SERVICE DEALER sent to your old address. Old and new addresses MUST be given.

Circulation Dept.
RADIO SERVICE DEALER
342 Madison Ave., New York 17, N. Y.

cedure is given with reference to *Fig. 22*. First, an unmodulated signal corresponding to the center i-f frequency is fed into the grid of the last i-f tube. The primary of the discriminator transformer is adjusted for maximum output as indicated by a VTVM connected at the AVC take-off point. Following this, the VTVM is shifted to the audio take-off point and the secondary is adjusted until the d-c voltage observed at this point is zero.

For a complete treatment of the ratio detector the reader is referred to the June, 1947 issue of the *"R. C. A. Review,"* and the article entitled, *"The Ratio Detector,"* by S. W. Seeley and J. Avins.

A NEW SERVICING TECHNIQUE FOR TV SETS

[*from page 12*]

sound and picture at the same time, then either the sound or the picture i-f channels are detuned. Since the sound I.F. is much simpler to adjust, it is usually best to just get the picture and then tune the sound I.F. and discriminator to the best sound output.

Test patterns serve as indication of the amount of resolution, or detail the TV set will produce and that depends on the bandwidth of the r-f and i-f channel and the frequency response of the video amplifier. Poor horizontal resolution, when the horizontal lines seem to merge and cannot be distinguished all the way to the center, is usually due to misalignment of the video i-f amplifiers. Their overall bandwidth should be about 4.5 mc for best results. Another indication of misalignment is when the sound appears on the face of the CRT. It looks like some hash, varying as the sound does, superimposed over the picture, or, if the sound is a steady tone, as horizontal bars. (*Fig. 4*).

Other troubles such as interference, ignition noise, diathermy, or weak signals and "ghosts" will become easily

[*Continued on next page*]

recognizable once the technician gets a little practical experience. Most of these are not due to any fault of the television set, but may be due to poor location, insufficient antenna input, bad antenna location, line reflections, etc. These things should be taken care of at the time of the installation, but sometimes it is impracticable to overcome them perfectly. For instance, a TV set owner, located next door to a powerful "ham" station is "out of luck." His only cure can be either to move or to silence the "ham!" The above is merely

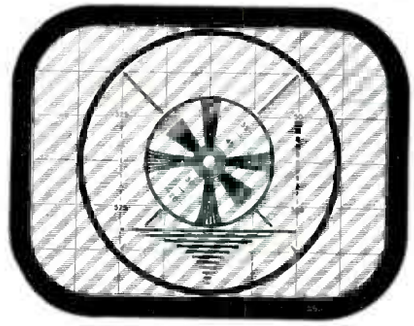


Fig. 4—R-F interference, which appears like this on C-R tube, cannot be prevented

an outline of a method of servicing television receivers, and it is up to the individual to perfect this method. Obviously, it is impossible in this limited space to give a full discussion or mention all the possible symptoms.

The attached table gives some hints for servicemen. The author does not claim this table to be absolutely complete or 100% perfect but it will serve as an approximate and basic guide as to where to look for the trouble. To use it, simply check the left hand column for the symptoms fitting closest to what you can observe on the face of the CRT. Next look in the center column for the probable location of the defect and last in the right hand column for convenient checks, hints or remarks.

Unfortunately, at the present time, there is no comprehensive handbook for the television serviceman on the market, at least none that has the very latest models or their improvements. However, several individuals and publishing houses * are considering such literature and, when it comes out, it will undoubtedly prove invaluable to anyone going into the television servicing field.

* "Photo Service" sets issued monthly by Howard W. Sams & Co. Inc., generally contain one or more of the latest available schematics of popular TV models. "Rider Manual" Vol. XVI covers some 1947 TV models.

Line drawings for figures 1, 2, 3 and 4 were furnished by Belmont Radio Corp.

Ad Index

TALK ABOUT

ACCEPTANCE!

Even distributors' salesmen want to own these great new radio-phonographs!

THE ALLEGRO *(dark mahogany)*

THE INTERPRETER *(dark mahogany)*

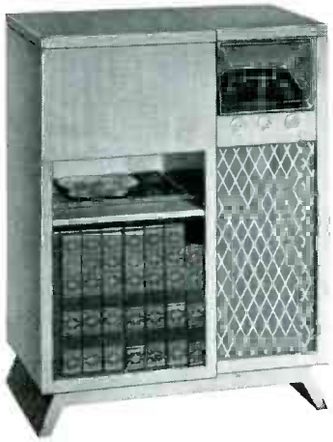
NEW STEWART-WARNER

"TERRIFIC" is the only word to describe the dealer reception given these completely new Stewart-Warner sets for 1948 . . . the line that's *red hot right now!*

THE NEW MINSTREL *(walnut)*

Performance sells—and what performance these new combinations deliver! In style, tone, features they have *plenty* of what people want . . . at prices you'll never believe!

Only Stewart-Warner gives you all these great features: new Shadow-Box Dial, new Electro-Hush Reproducer, new retractable Dura-Point . . . and the great Strobo-Sonic Tone System.



THE INTERPRETER *(blond mahogany)*

Have YOU heard this "sell" record?

Available now—special new demonstration record! Play it for prospects—it sells and entertains all at once!

It's one more great Stewart-Warner exclusive! Ask your distributor for it—today!

THE GAD-ABOUT *(portable)*

The Really Lucky Dealer Has

Stewart-Warner *for 1948*

AM RADIOS FM • RADIO-PHONOGRAPHS • TELEVISION

CHICAGO 14, ILLINOIS

You've been waiting for it...

HERE IT IS!

The new RC-15
RCA Receiving Tube Manual

Months of planning and preparation went into the new RC-15 Receiving Tube Manual to produce what is unquestionably the most complete and authoritative reference guide to receiving-type tubes ever published.

Patterned after the famous "RC-14," it has been extensively revised and expanded. Features RCA's complete receiving line including miniatures and kinescopes. The highly popular introductory section on tube and circuit theory has been increased to 55 pages and includes new reference data on FM applications. The widely used Resistance-Coupled Amplifier Charts are in entirely new form, and provide 27 combinations for each tube type. The completely revamped circuit section gives diagrams and parts values for up-to-date receiver and amplifier designs.

You'll find the new RC-15 indispensable in your work. Get your copy today from your local RCA Tube Distributor. It costs only 35 cents!

CHECK WHY IT'S BETTER THAN EVER

- ✓ Up-to-the-minute
- ✓ Contains over 240 pages
- ✓ More data than ever before
- ✓ Abbreviated style . . . easier to use
- ✓ Tube types easy to find
- ✓ New circuit section
- ✓ Enlarged Introductory Section on Circuits and Theory
- ✓ Modernized and expanded Resistance-Coupled Amplifier Charts

THE FOUNTAINHEAD OF MODERN TUBE DEVELOPMENT IS RCA

TUBE DEPARTMENT
RADIO CORPORATION of AMERICA
HARRISON, N. J.