

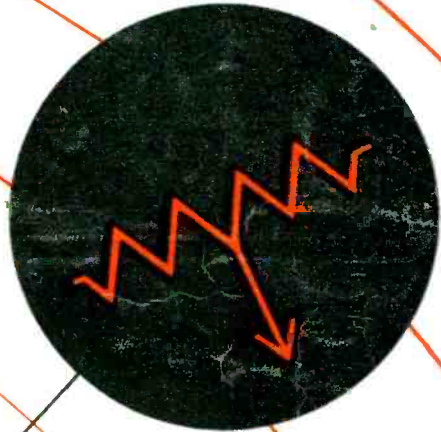
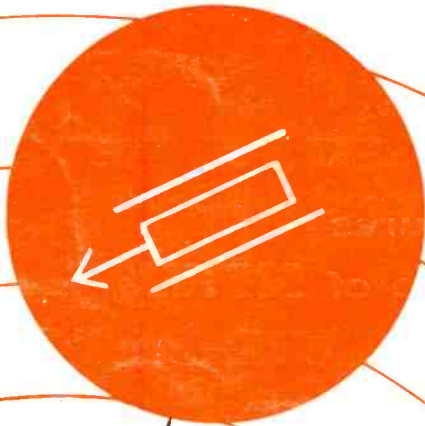
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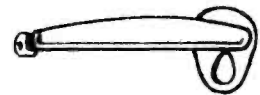
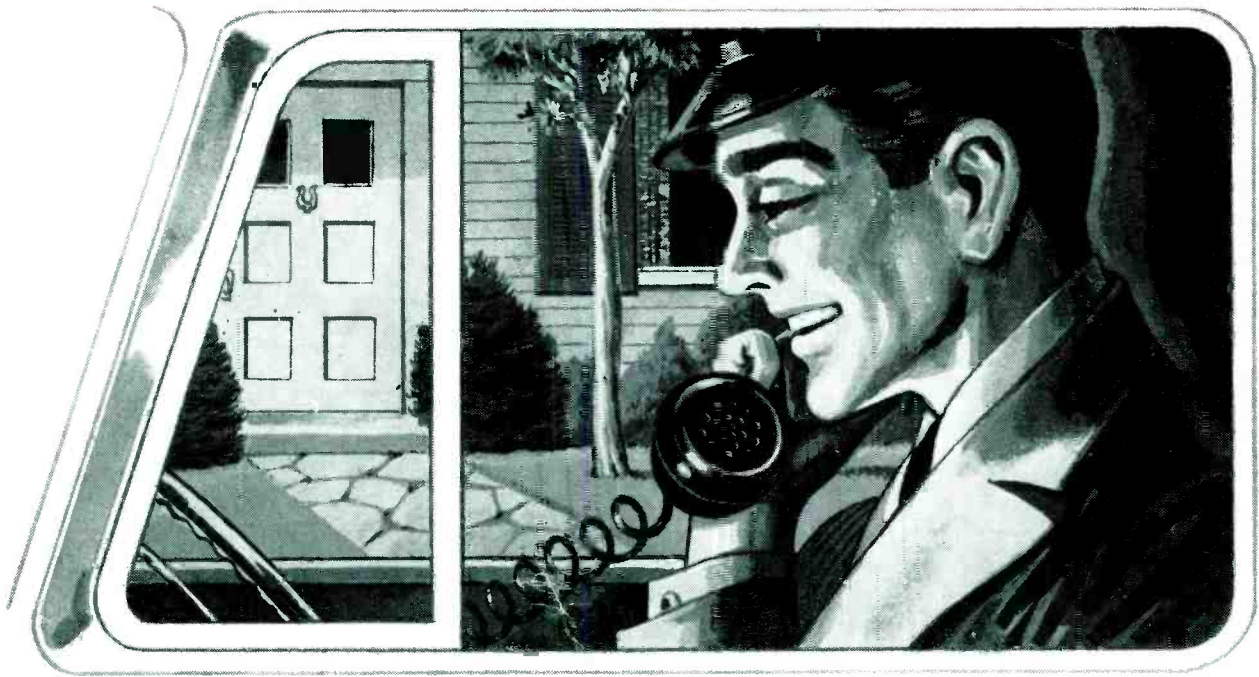
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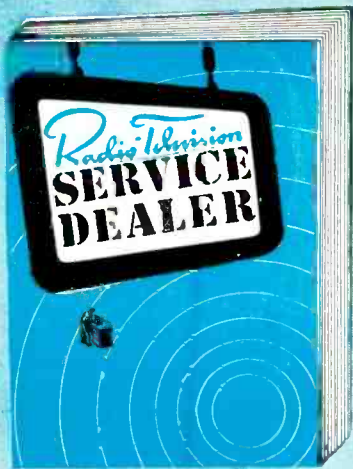
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Publisher

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Editor

SAMUEL L. MARSHALL

Editorial Production

CHARLES W. GARDNER, JR.

Contributing Editors

ROBERT T. DARGAN

PAUL GOLDBERG

OSCAR FISCH

SAN D'ARCY

Cover by

MIKE LOYER

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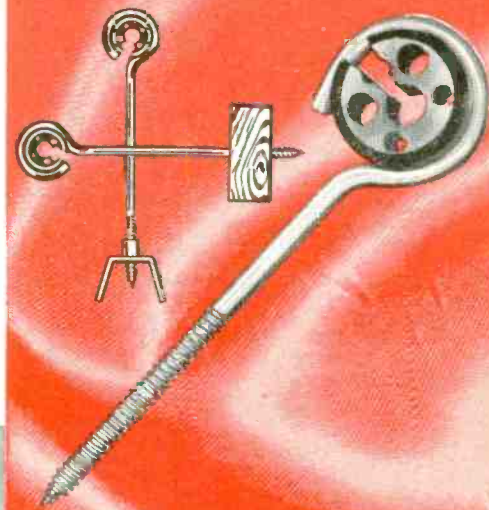
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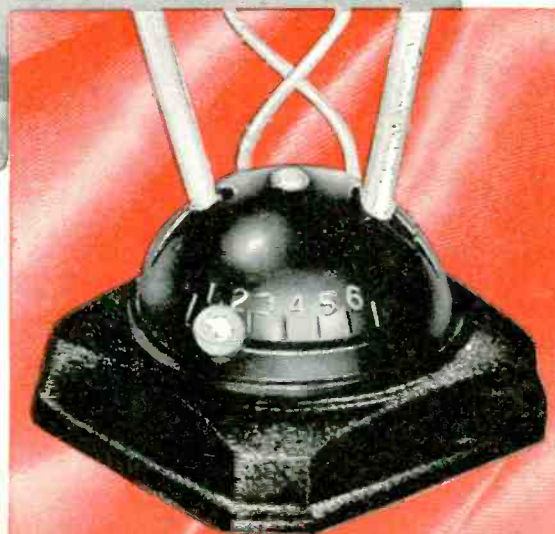


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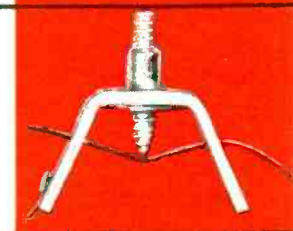
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EDITORIAL... by S. R. COWAN PUBLISHER

Becoming Servicemen—The Hard Way!

What a strange world we live in! Many of our youngsters today obviously only want to start out as servicemen "at the top."

Of late several men have written to me saying that they have recently graduated from a radio school or that they have just completed a TV course and that now they are finding it difficult to get a good-paying job as an employed technician. Most of these men say that service firm owners want them to start as apprentices with moderate starter's wages. Evidently these "newcomers" to the service field fail to recognize that a service shop owner is quite justified in expecting raw recruits without practical experience to start at the bottom, prove their ability and then work their way up to good-paying jobs.

Thanks For Cooperating

All of our paid subscribers recently received a questionnaire form-letter from us asking pertinent questions about the nature of their work; whether they are full or part-time servicemen; shop owners or employees, etc. (Of course the information obtained is kept confidential in our files.) Within 2 weeks over 30,000 replies came back—and for that fine cooperation we are very grateful. We hope that those who have not yet returned their questionnaires filled-in will do so soon.

Such a readership survey permits a publisher to accomplish 2 basic things: 1)—To comply with Business Publisher's Audit Membership regulations (so we can issue to advertisers an accurate record as to what our subscribers' activities are); and 2)—To guide our editors in selecting the kind of text material that will be most helpful to all radio-TV servicemen regardless of whether they live in big cities, in suburbs or fringe areas.

Several thousand subscribers also voluntarily wrote very flattering comments as to how much they enjoy reading every issue of SERVICE DEALER. Our staff appreciates these compliments. They give us added incentive to work harder on behalf of our subscribers. We don't have time to acknowledge individually all the lovely notes received, but we'll say this: "Thanks from all of us to all of you!"

We note from the survey replies received to date that during the past year over 3,000 radio dealers discontinued selling lines of receivers because, as many commented, "the discount house competition got too tough." These dealers report that they

now concentrate on servicing only. So, service firm competition is evidently getting tougher too. Many of the radio dealers who have discontinued handling franchised radio and TV set lines advise that they are now specializing in the sale and installation of Hi-Fi and Audio equipment and in the selling and renting of Public Address equipment. This is a very sound and far-sighted move in the right direction and we believe that all service firms, regardless of whether or not they want to become retailers, should also evaluate the profit potential there is in the fast-growing P.A., Sound and Hi-Fi sales and installation business.

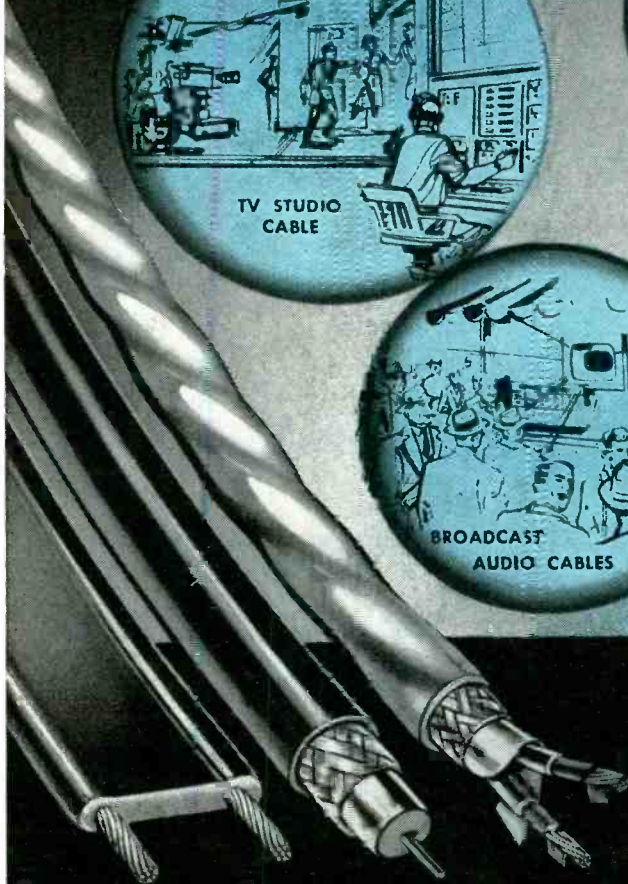
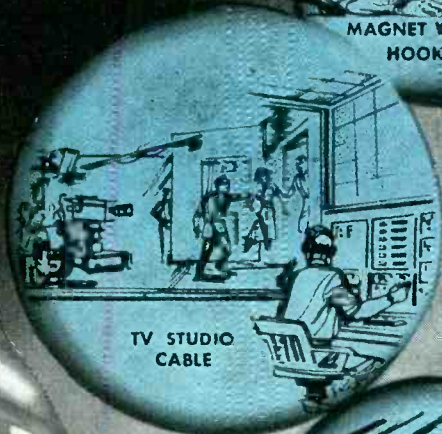
Letterheads Are Business Assets

Every month we receive several hundred letters from servicemen on many diverse subjects. Such mail is always welcome. It keeps us closely in touch with servicemen's doings in all parts of the country.

Of late we have noted about our mail one fact that is quite disturbing. It seems that as time passes more and more independent servicemen and even service shop operators write to us in longhand on plain white paper. Possibly these men prefer not to use their business letterheads for "ordinary" letters but we're inclined to believe that many use ordinary paper because they just don't have business stationery. Letterheads are not expensive—and it is not extravagant to use them. Every time someone sees your letterhead you get prestige plus an advertisement—and both of these are valuable business assets.

Every serviceman and every servicing firm should have and should always use business-like printed letterheads, cards, office forms, etc. Such material is inexpensive but mighty effective and will pay for itself many times over in many ways. We repeat, prestige is worthwhile! Neatly printed letterheads, invoices, shop and job-record forms will induce prestige whereas plain paper won't, regardless of how large an operator or how competent a technician you are. Many manufacturers who receive requests from servicemen and service shop owners on ordinary paper won't even send their costly literature out to such requesters. Can you imagine a department store, a manufacturer or any other legitimate business firm writing in longhand on ordinary paper to their suppliers or customers? Of course not! Then why should radio-TV servicemen "be different?" Every item with your name printed on it is an advertisement.

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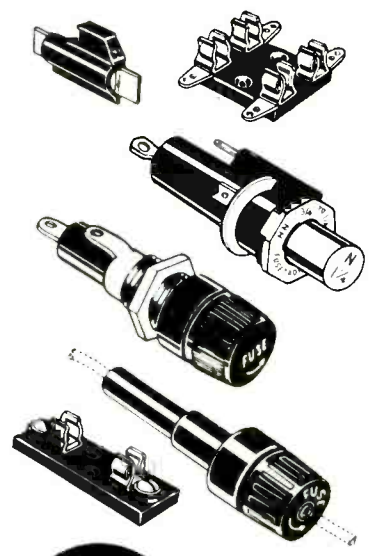
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PHONO PICKUPS

THEIR CONSTRUCTION, OPERATION AND SERVICE

by **RALPH OGILVIE**

FOR many years the crystal phonograph pick-up was by far the most widely used and held a virtual monopoly in the field. The problem of the serviceman was comparatively simple, since this was practically the only one with which he had to be familiar. With the coming of the era of high fidelity, the crystal pickup is no longer alone in the field. In an unending effort to improve response, and to decrease record deterioration by reducing the stylus pressure, manufacturers have introduced many new types of pickups. Today, a competent serviceman should be familiar with the characteristics of and service procedures for the following types of pickups.

1. Crystal pickup
2. Ceramic pickup
3. Variable Reluctance pickup
4. Moving Coil pickup
5. Variable Resistance pickup
6. The Variable "Q" pickup
7. The FM pickup
8. The Photo-Electric pickup

It is the purpose of this article to provide the serviceman with the essential information for each type of pickup.

Equalization

There are two important factors which contribute to frequency distortion in the signal at the output of the pickup. One of these is the frequency characteristic of the pickup itself. The other factor involves special techniques used in the process of recording. These techniques come under the heading of the combination of constant velocity and constant amplitude recording, and the use of pre-emphasis for the higher frequencies. While certain important advantages are obtained by such recording procedures, they nevertheless introduce frequency distortion. In order to compensate for distortion from each of these

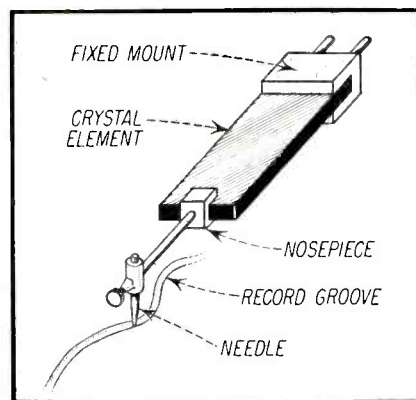


Fig. 1—Crystal pickup details, showing basic construction.

two sources, equalizing circuits are used in the amplifier to which the pickup delivers its output. The basic principle involved is to introduce an equal and opposite distortion in the amplifier, so that the overall response is flat.

Space limitations prevent a detailed discussion of the problems and circuits involved in equalization at this time. However, a brief description of the equalization required for each pickup will be given.

To begin with, suppose we list the important features of any pickup, from the serviceman's point of view. These would fall under the following headings:

1. Construction and operation.
2. Frequency response.
3. Voltage output.
4. Recommended load resistance.
5. What equalization, if any, is required.
6. Needle force.
7. Servicing procedures.

In the description of the various pickups which follows, each of these items will be dealt with.

The Crystal Pickup

Figure 1 is a simplified sketch to illustrate the basic ideas in the construction and functioning of the crystal pick-

PART 1

up. It is not intended to be an accurate representation of the actual mechanical arrangement in any particular model. The operation of the crystal depends upon a phenomenon discovered many years ago, namely, that certain crystal-line materials have the peculiar property of generating a voltage between opposite faces when pressure is applied. This is known as the "piezoelectric" effect.

Referring to Fig. 1, it can be seen that the crystal plate is held in a fixed position by the mounting at one end. The other end of the crystal is mechanically coupled to needle. As the tip of the needle moves from side to side, following the record groove, it distorts the shape of the crystal by twisting it. This action has the same effect as the direct application of pressure. A voltage is therefore developed between the upper and lower faces. This voltage will vary in step with motion of the needle, thus producing an audio voltage. The crystal material used is practically always Rochelle Salt (sodium potassium tartrate.)

The frequency response of the crystal element itself is very wide. In practice however, the mechanical considerations involved in mounting the crystal and coupling it to the needle cut down its range. The ordinary commercial crystal pickup delivers a fairly flat response from about 1000 cps up to a frequency between 4500 to 7000 cps and then drops off sharply. Recent improvements have extended the range of certain special types to 10,000 cps.

The voltage output of crystal pickups is comparatively high. The lowest is about $\frac{1}{2}$ volt, while some crystal cartridges deliver as high as about $4\frac{1}{2}$ volts. When compared with an output of .01 volts for the variable reluctance pickup, Fig. 2, it can readily be seen that the amplifier requirements for the

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crystal pickup are considerably less.

Since the crystal is a high impedance device, the input circuit which it feeds must have a high impedance in order to realize as much of the total output voltage as possible. The usual arrangement makes use of a resistance of about 1 megohm as a load for the crystal.

As pointed out previously, the typical crystal pickup has a response curve which falls off below about 100 cps and above about 7000 cps. Between these two frequencies there is usually a gradual drop in response amounting to a total of about 10 db. In many applications no attempt at equalization is made. When equalization is used, the design is such as to boost the response at the low and the high ends. The techniques used in making the recording, as mentioned previously, require a greater

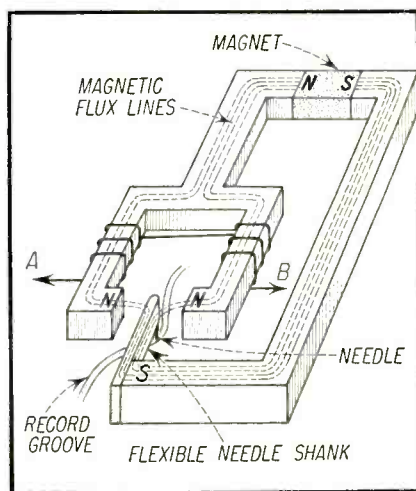


Fig. 2—Magnetic path flowing through core of reluctance pickup.

boost at the high frequency end than would be indicated by the response of the pickup alone.

Although the minimum needle force required to obtain satisfactory groove tracking varies with the particular model, the average value is about 8 grams.

Rochelle salt crystals are soluble in water. Under conditions of high humidity the crystal tends to dissolve. Under conditions of low humidity it tends to lose its "water of crystallization." Either of these conditions may permanently damage the crystal. A well-designed crystal is usually treated with a protective coating to protect it from these effects.

High temperatures also affect the crystal. It will become permanently damaged above 130° F. The best operating conditions for long crystal life are at a temperature of between 70 and 80 degrees F, and a relative humidity of about 50%. It is important to keep these points in mind when the storing of crystal pickups is considered.

The servicing procedures in the case

of the crystal pickup are comparatively simple. In the case of no output from the speaker, the first step is to determine whether the trouble lies in the pickup or in the amplifier. A quick check would be to touch the finger to each of the output leads where they connect to connect to the pickup unit. One of these should produce a loud hum or buzz from the speaker. If this hum is *not* heard we may safely deduce that there is trouble in the amplifier or the leads from the pickup to the amplifier. The pickup unit may be assumed to be good with the rare exception of an internal short in the unit. If the characteristic hum is *heard*, the crystal may be assumed to be at fault. It is impractical, if not impossible, for the serviceman to make repairs on the crystal unit. When internal trouble in the crystal unit develops, the cartridge should be replaced.

Since excessive heat may damage the crystal, care must be used in making soldered connections to it. Where soldering lugs are used, the iron should not be held at the joint any longer than necessary.

Where the connections to the crystal are made by friction fitting plugs which slide over the terminal pins of the crystal, remove the lugs first and replace them *after* the soldered connections have been made.

If a crystal pickup is in a circuit where there is a possibility of voltage being applied to it (through a leaky coupling condenser for example), the leads to the pickup should be checked for the presence of such a voltage before the pickup is replaced. It takes only a few volts to damage the crystal. In cases where the crystal is suspected of being responsible for a distorted output, the easiest way of finding out is to try a replacement. (Make sure you checked the needle of course.)

The Ceramic Pickup

It has been found that certain ceramic materials may be processed so that they exhibit piezoelectric properties. Barium Titanate is most frequently used for this purpose. This material may be formed in any desired shape, including plates similar to Rochelle salt crystals, and as such they are used in ceramic pickups.

The construction and operation of this pickup are similar to that described for the crystal pickup and therefore do not require repetition.

An important advantage of the ceramic pickup is its ability to stand up under extremes of temperature and humidity. The output of ceramic pickups varies from about ½ volt in some models to about one volt in others.

[Continued on page 54]

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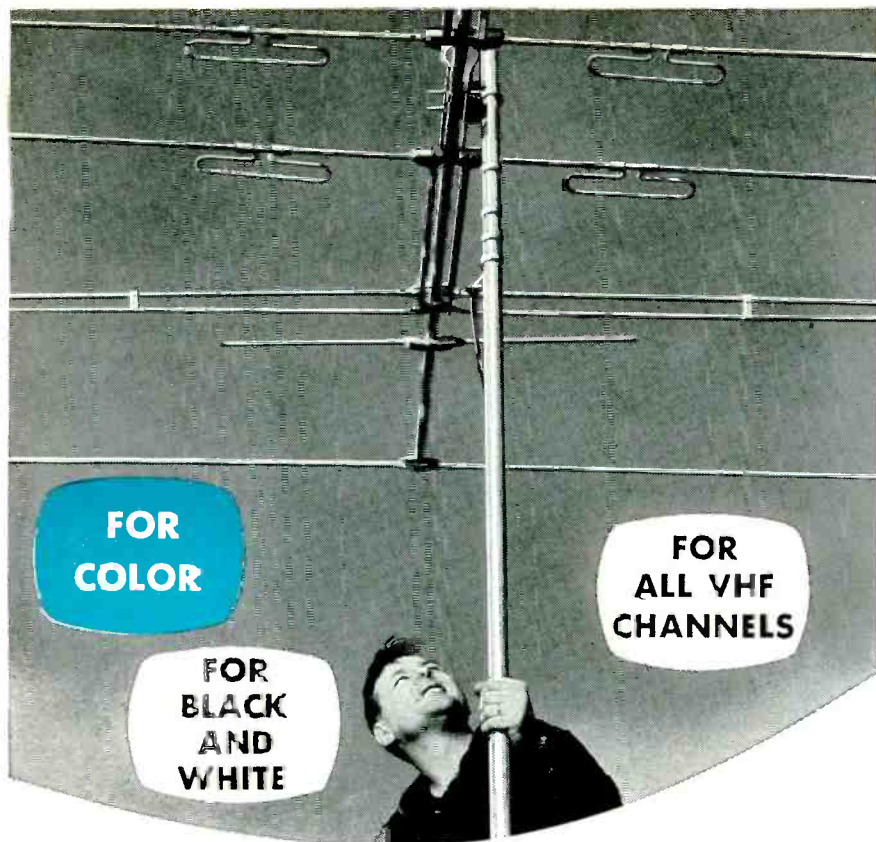
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 In Canada: Mackbusch Electronics, Toronto 4, Ont

TV Guild of Long Island

Election results for the year 1956 for this organization were as follows: President—Murray Barlowe; V.P.—James Lyons; Treasurer—Abe Smolowitz; Correspondent Secretary—Chris Stratigos; Recording Secretary—Art Cyr; Sergeant-at-arms—George Volkens. At a recent meeting Mr. Winston Starks, Chief Engineer of Wintronix presented a most interesting and informative program. His talk covered the use of instruments on a color TV chassis as well as trouble shooting procedures for black and white receivers.

The Television Service Association of Michigan

TSA has inaugurated a new technical program which covers the following topics: Instruments and their Application, Black and White TV Circuitry, Service Management and the Color Tube. These sessions are to be run through February, March, April and May. Application for attendance to these meetings may be made directly to TSA of Michigan, 8242 Woodward, Detroit 2, Michigan.

Radio & TV Servicemen's Association of Pittsburgh, Pa.

B. A. Bregenzer, Editor of the RTSA "Video Scope" writes a very earthy editorial entitled "Unity—Dream or Reality" in which he points out that present misunderstanding between the two large national service groups because of the Indianapolis meeting should be explored with level-headedness by both groups, and that a conference of some type should take place to further the possibility of unity. He concludes as follows: "Let us all refrain from doing or saying anything that will antagonize any other segment within our industry and keep always before us that goal which we all seek, national unity within this profession."

Philadelphia Radio Service Men's Association

PR SMA advises that Almo Radio Company will sponsor a NEW LOOK contest for radio and television service shop operators in the firm's trading area.

The contest is unique in the fact that its participants are not required to buy or sell anything. By virtue of having a shop that is adjudged neatest, most



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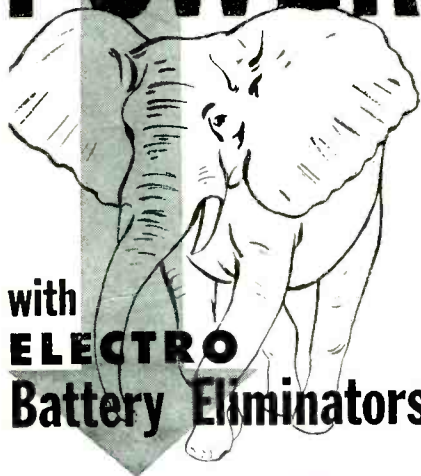
Meeting all of these requirements correctly is of course the final test of maximum performance and value. In these Jensen authentic high fidelity coaxial loudspeakers the maximum combination of performance and value is guaranteed by the recognition accorded Jensen products for more than a quarter century as the world's quality standard.

Other Jensen coaxial speakers are priced from \$24.85; Jensen G-610 TRIAXIAL* at \$252.75 and complete systems in enclosures from \$49.50 to \$525.00. 2 and 3-way Speaker Kits from \$10.50 to \$184.50. Write for Folder HH.

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Judges for the contest will be L. D. (Doc) Lowery, Raytheon representative; Bob Fisher, General Electric district manager; Bob Hoffman, Sylvania representative; Albert M. Haas, of Philadelphia Radio & Television Service Associations Council; and Paul V. Forte, former executive secretary of the Television Contractors Association.

Radio Servicemen's Association, Inc. (Trenton, N. J.)

At a recent election of the Radio Servicemen's Association, Inc., of Trenton, N. J. the following members were elected to office, for 1956 and 1957: President—Francis J. Wolff; Vice-President—David Van Nest; Secretary—Michael E. Toth; Treasurer—Charles A. Rebman. Frank J. Guest has been retained to serve as a member on the Board of Directors.

Television Electronic Service Association of St. Paul, Inc.

Second Annual Banquet of Television Electronic Service Association of St. Paul, Inc., was held on Saturday, January 14th at the Midway Civic Club Building, St. Paul, Minn. More than 150 people attended, including members and wives as well as distributors and other invited guests. New officers for 1956 were introduced at the banquet—Harry Winkler, President; Robert Tohweder, Vice President; James Dorfman, Treasurer; Joe Driscoll, Secretary.

Television Service Association of Oklahoma, Inc.

Application for membership in this organization can be made by payment of a fee on agreement of maintaining the integrity of the association—these measures being designed to insure good will on the part of the public.

Associated Radio-TV Service Dealers, Columbus, Ohio

Officers for 1956 are: Pres.—Jim Cumbow, Vice-Pres.—Harry Walcutt, Treasurer—Bob Hawthorne, Secretary—Jack Voigt, Board of Directors—Dick Lytle, Dave Ramsey, Chas. LeRoy, Fred Colton, Dick Kassian.

West Central Region of NATESA

The West Central Region of the National Alliance of Television Electronic Service Associations (NATESA) held a regional meeting in Oklahoma City, December 11th at the Skirvin Hotel. The meeting was planned by Vincent Lutz, executive officer of the NATESA West Central Region, and NATESA Vice-President; William Briza of

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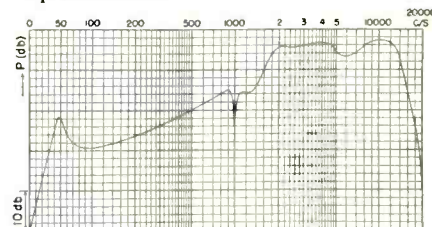
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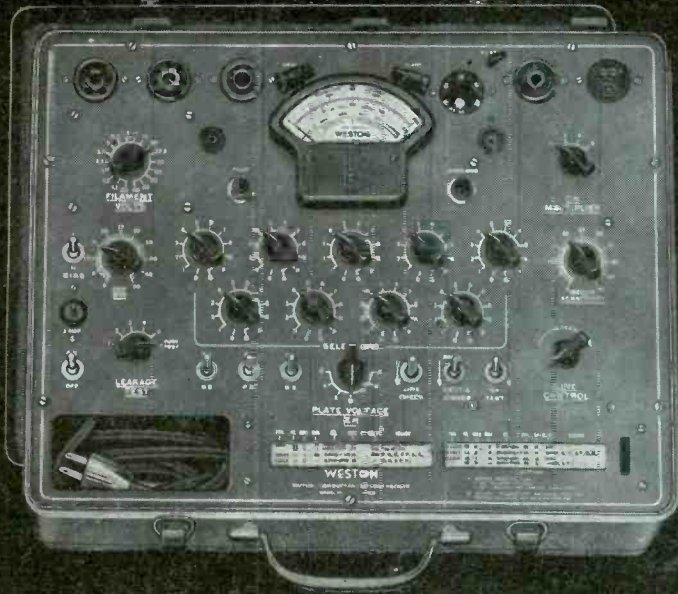


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G_m MEASUREMENTS— G_m measurements are made more accurately by using filtered d-c plate, screen grid and control grid potentials. A precision voltage divider network and selector switch allows a proportionate value of signal voltage to be chosen for *resting tubes having transconductances up to 30,000 micromhos*. Signal voltages of 5.2, 2.6, 1.3, and 0.65 volts peak-to-peak having a frequency of 5000 cycles are provided.

GRID BIAS, SCREEN GRID AND PLATE VOLTAGE: Filtered d-c potentials of 90, 130, and 220 volts are available for plate and screen potentials. A variable filtered d-c voltage in two ranges of 0-5 and 0-20 volts are used to obtain better resolution of Grid Bias settings. *Far greater accuracy is obtainable with filtered d-c potentials than previously possible in portable tubecheckers.*

METER MEASUREMENT OF HIGH LEAKAGE RESISTANCE—Since tube leakage as high as several megohms can cause poor performance in TV Receivers, this tubechecker is designed to provide an accurate meter measurement of leakage resistance as high as 5 megohms between tube elements, thus being particularly useful for TV servicing and TV line production assembly.

TWIN SECTION TUBES—Three toggle switches make it possible to rapidly check and compare the respective sections of twin section tubes at only one setting of the selector switches.

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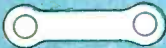



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Omaha, North Plain Zone Governor; Harrol Eales of Oklahoma City, South Plains Zone Governor; and Joseph Driscoll of St. Paul, West Central Region Secretary. The Oklahoma City Radio & TV Service Association were hosts and Mr. Eales, a past president, was the chairman in charge of details and program.

Membership in NATESA is made up of individual local service associations who also belong to state associations. There are four major NATESA regions, each under the jurisdiction of a NATESA vice-president. The regions are sub-divided into either two or three zones whichever is geographically convenient, and each zone has a Zone Governor. Each of the state associations is headed by a State chairman. National officers are elected at the annual convention with each local affiliated association casting their own votes. Regional, Zone, State and Local group officers are elected by members from within the particular division and each group is 100% autonomous.

NATESA

Frank J. Moch, President of NATESA has resigned, as of December 8th, from the post of Governor on the Spee-D-Servus program sponsored by a service management publication.

Radio TV Association of Santa Clara Valley, Calif.

Responsibility for the local supply of electronics technicians was placed squarely in the lap of RTASCV at the last dinner-meeting when members were addressed by a representative of the State Division of Apprenticeship Standards, Department of Industrial Relations.

Area Supervisor Ted Timpone told his listeners that journeyman radio-television repairmen cannot be produced by the technical schools.

"Schools can prepare them for entry into the field," he said. "But the schools can't turn them out, so you'll have to train them," he added.

Speaking on the state's apprenticeship program as applied to the radio-television industry, Timpone urged RTASCV to set up a training program sponsored by the Association.

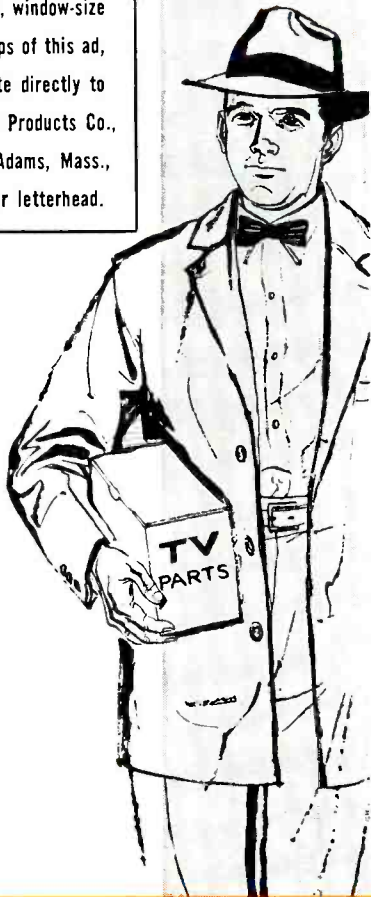
Radio TV Tech. Ass'n, Santa Monica, Calif.

No more "bait" advertising or "price ads" can be used by TV repair shops who employ the yellow pages of the classified telephone directories throughout the Los Angeles area. Servicing well over one million subscribers, the Pacific Telephone Co. and the General Telephone Co. cooperated with the R.T.A. (Radio Television Technicians' Ass'n)

[Continued on page 48]

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IN this second and final installment on FM tuners various circuits will be analyzed, and desirable features in these circuits will be pointed out.

The cascode type of amplifier is often made use of in *rf* stages. A cascode amplifier is characterized by the use of dual triodes contained in one envelope and connected in series fashion as shown in Fig. 1. The plate of the first triode is coupled to the cathode of the second triode. This circuit provides as much or more gain than the pentode type of amplifier. Noise generated in pentodes is greater than in triodes. Therefore, the choice of cascode amplifier is more suitable for weaker signals because of its higher gain and lower noise factor.

Figure 1 illustrates the cascode *rf* amplifier stage in the Craftsmen Model C900. The antenna coil, tapped for 300 ohm antenna input impedance, is in parallel with a fixed 10 μ f condenser, the trimmer condenser and the variable tuning condenser. These components comprise a resonant *rf* circuit in the input of the first triode that is tunable to the FM broadcast frequency of from 88 to 108 megacycles. The variable condenser is ganged to the other variable in the plate circuit of the second triode forming another parallel resonant circuit. These condensers are also mechanically coupled to the oscillator for tracking purposes, as in the circuit perviously discussed.

Antenna and RF Input Circuit

As in the case of Fig. 1 the antenna input circuit of many tuners is designed to have a 300 ohm input impedance. Therefore a standard 300 ohm folded dipole antenna with 300 ohm lead-in is most suitable for exact matching

NEW FM

In this second and final installment on FM tuners the various circuits that make up an FM tuner are analyzed with pertinent examples of each type in use in representative commercial types.

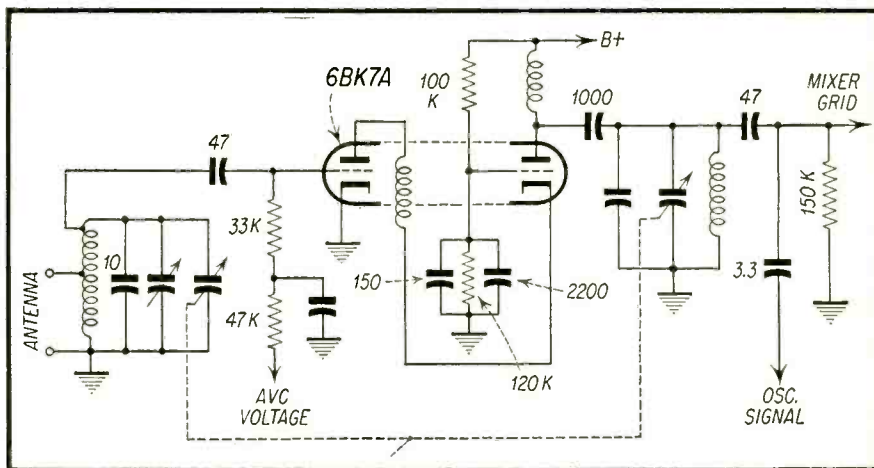


Fig. 1—Cascode *rf* amplifier stage of Craftsmen Model C900.

purposes and best performance. However, it will generally be found that a 75 ohm antenna may be employed without too much mismatch and reduction of available signal.

Local Oscillator Drift

Negative temperature compensated

condensers and automatic frequency control (*afc*) circuits are commonly employed to counteract for and prevent drift in the oscillator circuit due to temperature or line voltage changes. AFC permits a broader tuning range for each station and eliminates critical adjustment. However, there is a possibility that an *afc* circuit will pull the oscillator frequency towards a strong undesired signal and away from a weak signal being tuned in. It is quite possible under these conditions to have the *afc* voltage hold the oscillator tuned to the strong station for such a broad tuning range that when the strong station has been passed the weak signal is also passed over. If an *afc* circuit is incorporated it is desirable to have a means of disabling the system, or making it inoperative for weak signal reception.

Figure 2 illustrates a tuner utilizing *afc*. Connected in parallel with the oscillator tank circuit is a reactance tube. The current through the reactance tube is governed by the grid bias voltage. Lack of space prevents a discussion of the theory of *afc*. However reference to any comprehensive text will provide the reader with a basic background on its operation. In any event, in *afc*, due to the choice of components connected to this circuit the grid and plate voltage

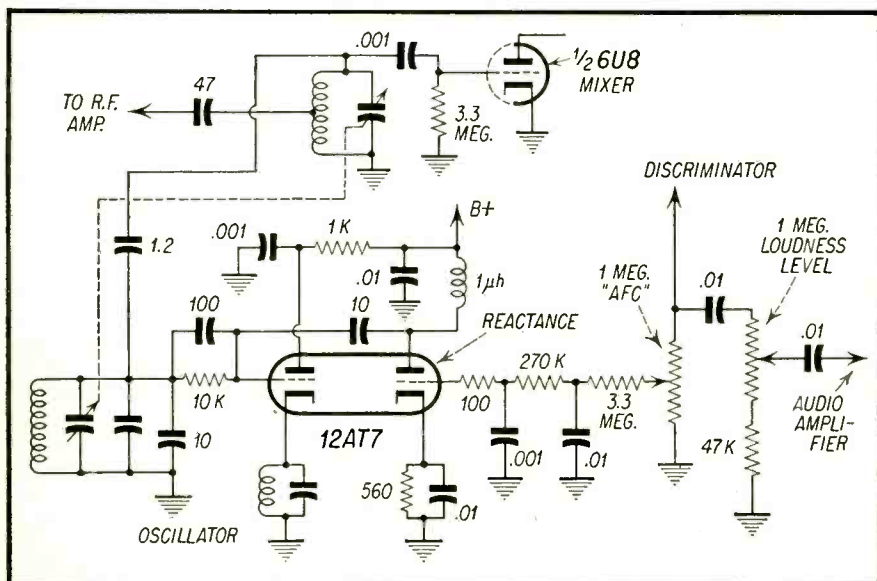


Fig. 2—Oscillator, *afc*, and mixer stages, Harman-Kardon A-400.

TUNERS

Part 2

by

STEVE TRAVIS

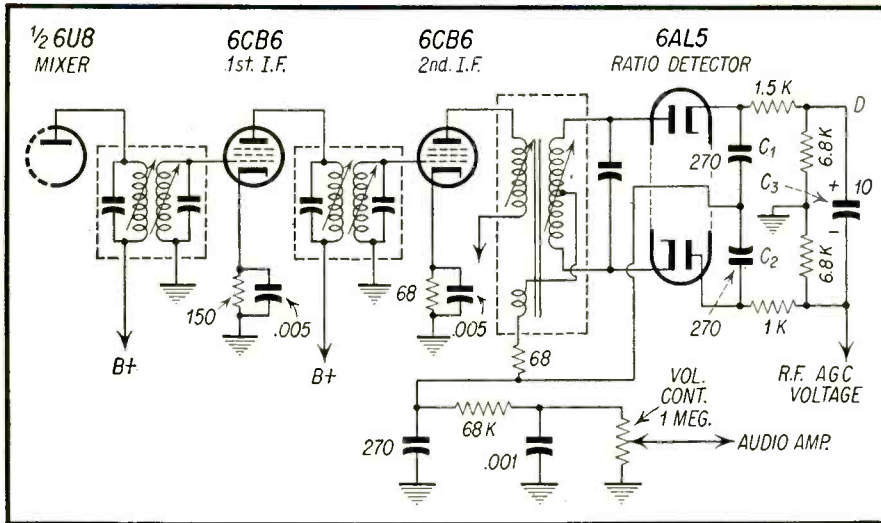


Fig. 3—IF and detector stages of Heathkit Model FM-3.

are 90° out of phase. Under these conditions the plate current leads the plate voltage by 90° and the circuit appears as a capacitive reactance. The amount of leading quadrature current through the tube, controlled via the grid bias, can be reduced or increased, causing the effective reactance to be reduced or increased. Therefore the reactance circuit, acting as a condenser in the oscillator circuit, changes the oscillator frequency in proportion to the *dc* potentials applied to the reactance tube grid.

If a negative voltage is applied to the grid of the tube the capacitance presented by the circuit is reduced and the oscillator frequency is increased. A positive voltage applied to the reactance tube grid increases the capacitance and the oscillator frequency is reduced.

In some receivers when it is not desirable to control the oscillator at the time of tuning to a station a switch is provided to remove the *afc* voltage from the reactance circuit. This is shown in Fig. 7.

The Intermediate Frequency Stages

In the *if* stages the bandpass width, overload tolerances, gain and noise

factors as well as the flatness of the top of the response curve are some of the important design considerations. It is most desirable to have the *if* bandpass flat to a width of 150 kc. Of course, beyond these frequencies it is necessary to have a minimum of response so as to reject adjacent station signals.

It is in the *if* circuits that considerable gain is accomplished. In examining Fig. 3 it will be found that two stages of *if* amplification are employed previous to the ratio detector. These stages use transformer coupling of parallel resonant circuits tuned to 10.7 mc. The second *if* amplifier drives the ratio detector transformer which in turn feeds the detector diodes in a conventional manner. One point that might be noted in passing is the way in which the *age* voltage is obtained in this receiver. Many FM tuners don't employ *age* circuits, depending rather on ratio detectors or limiters to effect better signal to noise ratios. In the Heathkit receiver an *age* voltage is provided by the charge on the filter condenser in the ratio detector circuit. The condenser charges up negatively in proportion to the amplitude of the received signal and therefore is an excellent source from which

to obtain a voltage negative in polarity for *age* purposes.

Limiter Circuits

Noise generated due to atmospheric conditions, autos, electrical apparatus, etc., must be prevented for quality reproduction. These bursts of energy are all too often greater in amplitude than the desired signals. Following the conventional *if* amplifiers specially designed stages called "limiters" are employed to clip the tops of the *if* signal, thereby removing any interfering higher amplitude interference transients from the signal.

A limiter circuit can be identified by its use of much lower plate and screen voltages than in a conventional *if* amplifier. The use of lower plate and screen voltages allows amplitude clipping due to plate saturation and the cut-off characteristics of the amplifier. Fig. 4 shows a typical relationship between the input and output voltages of a limiter and demonstrates how limiting reduces the amplitude at the output to a relatively constant value above a certain amplitude input.

AGC Application

An *age* circuit employed in an FM tuner is shown in Fig. 5. In examining this circuit it can be observed that it is of the grid rectification type. When the *if* signal is applied to the 6AU6 grid of the 3rd *if* stage the signal drives the grid positive and causes it to draw a small amount of grid current. The grid current flows through the coil of the parallel resonant circuit and charges up the 47 μf condenser. The electrons that leak through the 47K resistor as a result of this charge cause the development of a negative voltage across the resistor. This negative potential is the source for the *age* biasing of the controlled stages. The greater the strength of the signal received the greater the *if* signal applied to this grid and therefore the greater the charge built up across

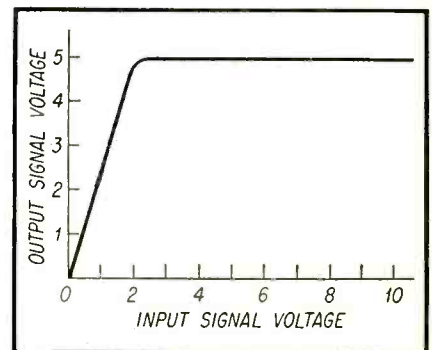


Fig. 4—Voltage relationships between input and output signals applied to a limiter stage.

the 47 μf condenser. Decoupling and dropping resistors are employed to reduce this available voltage to the desired control level; and the filter condensers are used so that only a *dc* voltage is supplied to the grids of the *rf* and *if* amplifiers under control.

FM Demodulators

The FM demodulator stage of an FM tuner, if it has not been given careful consideration in its design, can cancel out other expensive features with resultant poor audio fidelity. Although there are many types of demodulator circuits for recovering the audio signal the Foster-Seeley discriminator circuit and the ratio detector circuit are most generally employed in FM tuners.

An example of a Foster-Seeley FM discriminator circuit is shown in Fig. 6.

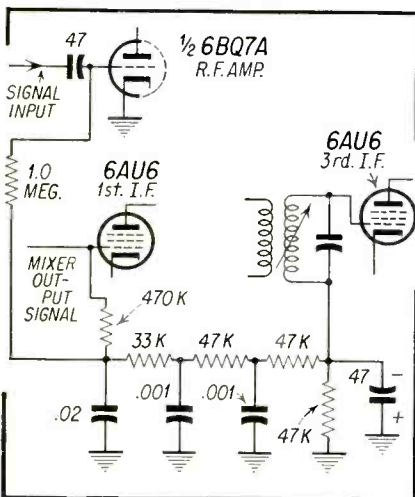


Fig. 5—AGC circuit used in H. H. Scott 311S FM tuner.

The Foster-Seeley discriminator utilizes a pair of diodes which are supplied at their plates with the FM signal from the secondary of the transformer. The plate circuit of the limiter is also capacity coupled to the center of the secondary. The load on the diodes is connected from cathode to cathode and the audio signal is obtained at the ungrounded cathode indicated as point A in Fig. 6.

As can be noted in the circuit of Fig. 6 a special output terminal is provided for high amplitude requirements as well as the normal output terminal. A de-emphasis circuit consisting of a 47K resistor and a 1000 μf condenser correct for the emphasis necessarily introduced at the broadcast transmitters to help keep the signal-to-noise ratio for the high audio frequencies at a maximum. The de-emphasis network, a low pass RC filter connected at the output of the FM discriminator, is used to de-emphasize the high audio frequencies. This network is also used following

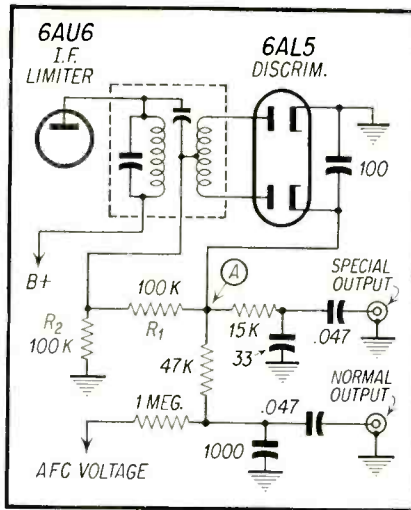


Fig. 6—Foster-Seeley discriminator stage of Bogen Model FM50

ratio detector circuits. The output of the de-emphasis network is then coupled to a volume control that generally follows, or an audio amplifier stage as the case may be.

Ratio Detectors

The ratio detector circuit has been given its title because the voltage across condensers C1 and C2 (see Fig. 3) have a constant ratio regardless of the magnitude of the *if* signals applied to the circuit. An apparent difference between the ratio detector and the Foster-Seeley discriminator circuit is in the arrangement of one of the diodes. This may be observed by an examination of Figs. 3 & 6. Notice also that the transformer of a ratio detector circuit provides a tertiary winding connected at the transformer center. The other end of the tertiary coil connects to the de-emphasis network from which

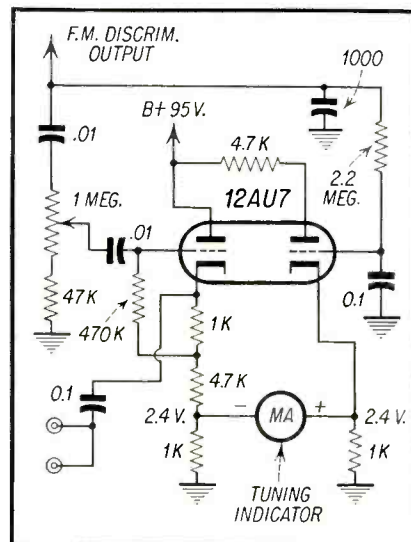


Fig. 8—Tuning indicator and cathode follower of Harmon Kardon A-400.

the compensated audio signal is obtained.

Another difference between the two types of FM demodulator circuits is the inclusion of a large filter condenser in a ratio detector circuit as shown in Fig. 3 as C3. The purpose of this condenser is to absorb amplitude variations and noise pulses present in the applied signal. Noise and amplitude variations occurring at a fast rate are swamped by the large capacitance value. The time constant of R and C is so large that the condenser retains a constant charge corresponding to the strength of the signal being received. If the *if* signal strength should increase this charge increases and vice versa. It also acts as a biasing voltage on the diodes. If the network were not employed the audio output would contain the amplitude

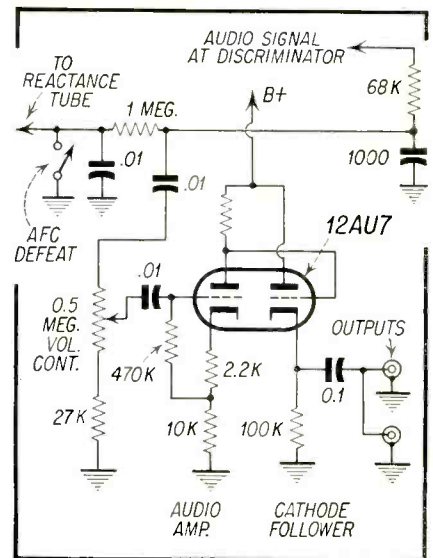


Fig. 7—AFC defeat switch used in Bell Model 2254.

variations in the form of an audio signal that could be heard.

Tuning Indicators and Meters

Some FM tuners provide a meter on the front of the cabinet for tuning in weak signals and for making faster, accurate settings of the stations. This meter may be a signal strength indicator but is more often a means of indicating the error in *if* frequency occurring as a result of incorrect tuning.

If the meter is a *signal strength* type it is a simple matter to adjust the station for maximum visual indication to obtain correct tuning. This type also proves useful in orienting the FM antenna at the time of its installation.

The other type of indicator, a *center of channel* meter, is more generally encountered. This is the type that displays the error in frequency that is occurring and the direction, either higher or low-

[Continued on page 54]

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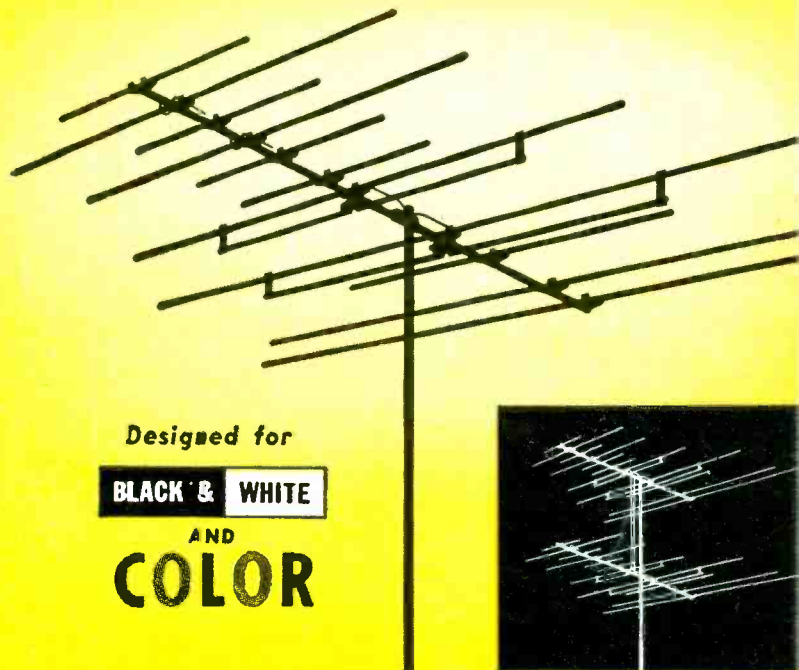
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TC3-B	2	3	4	5	6	7	8	9	10				
TC3-C	2	3	4	5	6		8	9	10	11			
TC3-D	2	3	4	5	6				10	11	12	13	
TC3-E	2	3	4			7	8	9	10	11	12	13	
TC3-F	2	3	4			7	8	9	10				
TC3-G	2	3	4				8	9	10	11			
TC3-H	2	3	4						10	11	12	13	
TC3-I		3	4	5	6	7	8	9	10	11	12	13	
TC3-J		3	4	5	6	7	8	9	10				
TC3-K		3	4	5	6		8	9	10	11			
TC3-L		3	4	5	6				10	11	12	13	
TC3-M			4	5	6	7	8	9	10	11	12	13	
TC3-N			4	5	6	7	8	9	10				
TC3-O			4	5	6		8	9	10	11			
TC3-P			4	5	6				10	11	12	13	



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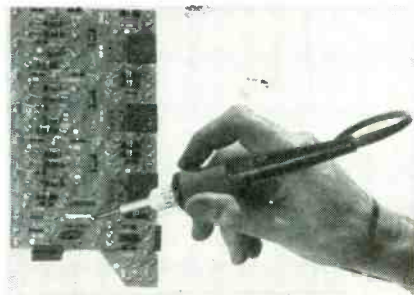


IN PRINTED CIRCUIT RECEIVERS

by **RICHARD ARBIB**
Multicore Solders Ltd.

THE servicing of receivers or sub-assemblies which are made from printed circuits, raises many problems which will be new to the serviceman who has previously undertaken the replacement of components on conventional chassis. It must be remembered that generally, components on the standard type of chassis have been soldered to lugs by the use of an iron and that these lugs are normally insulated from one another. The unsoldering of a wire to a lug is merely the soldering operation in reverse to that which was made originally, using furthermore, similar equipment for the operation.

The original soldering of components to printed circuits is generally undertaken by a dip process. The solder is not only used for the attachment of any wire from a specific component to the circuit, but at the same time the whole printing on the panel is soldered simultaneously. It is obviously impracticable and indeed undesirable, to unsolder wires by a dip process. A soldering iron must be used but great care must be taken to ensure that in unsoldering any



The Ungar iron shown above is very well suited for printed circuit soldering.

specific wire, that other wires are not unsoldered at the same time. In other words, the heat must be localized as much as possible, for whereas in a conventional chassis each lug is insulated from the other, except for connecting wires bridging them, with the printed circuit chassis many wires from components are connected to one another by the printing on the circuit.

One difficulty that servicemen have frequently had to overcome in unsoldering wires from lugs of conventional chassis, has been the fact that these wires are often wound through and around the lugs. Some considerable practice has been necessary to unsolder these wires by applying heat, at the same time unwinding the wire or loosening it from the hole in the lug. In the unsoldering of wires from printed circuits, this problem does not generally arise.

It must be remembered that the circuit on the chassis is a very thin copper laminate and extreme care is necessary when applying heat to a circuit to prevent the laminate coming away from the insulated panel. It is therefore essential when unsoldering and re-soldering wires to printed circuits, to use a soldering iron of the correct bit temperature and when re-soldering, to use a solder of the highest quality and lowest melting point.

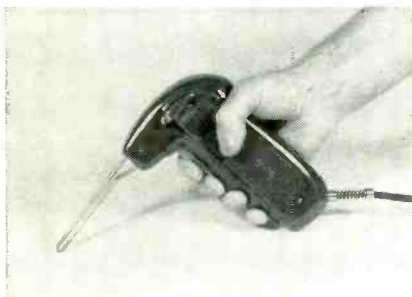
As in the design of many printed circuit receivers, smaller components will have been used than in conventional chassis, and as these will frequently be cramped into too small a space, it is usually necessary to use irons of small dimensions. On the other hand, it is quite essential to use irons with as high a bit temperature as possible and employ them for the shortest possible time. By undertaking this procedure, heat will be localized, whereas if a low bit temperature iron is used, and this is kept on the job for an undue length of time, the heat will tend to run along the circuit and other wires will become unsoldered.

The procedure, therefore, should be as follows:

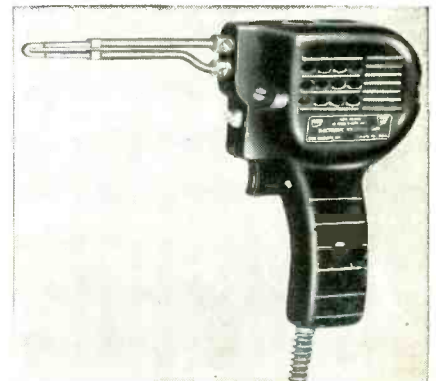
(1) Make sure that the iron has a fine bit of dimensions which will not touch other wires when being applied to the circuit.

(2) Ensure that the bit is clean, filed to the right angle and well tinned by having already applied to it some low melting point high quality cored solder. Ersin Multicore Solder, 60% tin, 40% lead alloy is particularly suitable for resoldering and could also be used for

[Continued on page 53]



This soldering gun by Esico will be found to be practical for printed circuits.



Illustrated above is a soldering gun by Wen which is well adapted for soldering on printed circuit chassis.

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John F. Rider Publisher, Inc., 48C Canal Street, N.Y. 13, N.Y. announces that Volume 17 of the popular Rider TV Manual Series is now in production and will be available on February 15, 1956. The volume presents complete, factory authorized and approved servicing information, and covers all the production runs of over 35 manufacturers for the period—August 1955 through December 1955 including the latest 21" color Tv.

Basic Television thoroughly initiates the Student into the Subject of Television. Its broad coverage of principles, standards, definitions and circuits will serve to guide the practical approach of any Student or Class to better training for the future. Howard W. Sams & Co., Inc., publisher.

1956 Edition of 'Electronic Phono Facts' a 22-page book of data, of great value to veteran and beginning music lover alike, written by a pioneer in electro-acoustics and high fidelity, Maximilian Meil. Includes authoritative facts on pickups, styli, tone arms, turntables, "hidden pull", styli wear tests, brushes, "static removers", pre-emphasis and de-emphasis, record care, etc. Regularly sells for \$1.00, but now available free at your dealer or from Audak Company, 500 Fifth Avenue, New York 36, N.Y.

The Merchandising Department of Electronic Products Sales, Sylvania Electric Products Inc., has announced the release of a new 20-page booklet, entitled, "A Guide to Good Business," published and distributed as an aid to the company's present and future electronic service dealers throughout the country.

The new booklet is free and may be obtained from the Sylvania Central Advertising Distribution Department, 1100 Main Street, Buffalo, N.Y.

Sprague's new "Auto Radio Replacement Capacitor Manual" provides complete information for every auto radio manufactured from 1946 through 1955. Each brand is listed alphabetically. The proper Sprague "Twist-Lok" electrolytic capacitors are then fully described in terms of capacitance, voltage rating, and list price, and cross-referenced to the original part numbers.

Copies are available free from all Sprague Distributors or by writing for Manual K-300 to Sprague Products Company, 71 Marshall Street, North Adams, Massachusetts.

The David Bogen Co., Inc. has just published a 24-page reprint of a series of three highly-informative articles covering the fundamentals of sound systems operation and installation. Co-authors of this series, titled "What You Should Know About Sound Systems", are Morty Sumberg of David Bogen Co. and J. F. McPartland, Ass't Editor of McGraw-Hill's Electrical Construction and Maintenance. Copies of the 24-page reprint are available from David Bogen Co. Inc., 29 Ninth Ave., New York 14, N.Y. for ten cents per copy.

The new Precision Catalog No. 23. It illustrates and describes in detail the entire line of Precision test instruments for industrial and radio-TV-communications service and other electrical and laboratory applications. Precision Apparatus Company, Inc., 70-31 84th Street, Glendale 27, L.I., N.Y.

Vaco Products Co., 317 E. Ontario St., Chicago 11, Ill. New 1956 edition contains 40 multi-colored pages teeming with striking illustrations, covering complete Vaco lines including screwdrivers, nut drivers, wood chisels, pliers, kits, specialty tools, plastic mallets and amazing variety of famous vari-board merchandising displays and tool assortments for developing quick, steady sales—also contains wealth of reference diagrams, correct procedures, hints and specifications.

Sarkes Tarzian, Inc., have announced a full line of high temperature selenium rectifiers that are capable of operating at plate temperatures of 150°C without derating. Bulletin HT-1 that shows ratings and characteristics, is available by writing Sarkes Tarzian, Inc., Rectifier Division, 415 North College Avenue, Bloomington, Indiana.

Alpha Wire Corp., 430 Broadway, New York 13, N.Y., has announced publication of Catalog S-55 of audio wire, which contains descriptions, specifications and illustrations of the company's IN STOCK line of 145 audio items—largest and most complete in the industry.

EICO (Electronic Instrument Co., Inc.) Brooklyn 11, New York; announced publication of the company's new 1956 catalog which describes 54 models of professional electronic test instruments in both Kit and Factory-Wired form. It is available FREE from [Continued on page 46]

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COLOR SYNC ANALYSIS

Discussion Of Phase Detector Operation In Color TV Receivers

PART 3

by **Bob Dargan and Sam Marshall**

from a forthcoming book entitled "Fundamentals of Color Television"

IN THIS installment an analysis of phase detector circuitry and operation is made. The position of the phase detector in the overall color sync section is shown in Fig. 1. It will be noted that the phase detector is that part of the oscillator which compares the phase of the color burst signal with that of the color oscillator.

If this phase difference is in quadrature (90°), no correction voltage is developed. On the other hand, if the phase difference is not in quadrature, a *dc* correction voltage is developed which is applied to the reactance tube. Here the correction voltage is converted into an equivalent increase or decrease in capacitance. This capacitance change is, in effect, connected across the crystal of the oscillator circuit, and tends to bring the color oscillator signal into phase quadrature with the color burst signal.

It is important to keep in mind that if the 3.58 *mc* reference oscillator frequency is adjusted so that it is equal to the burst signal frequency two conditions will be effected by virtue of the APC loop operation, these being:

- 1) The correction voltage will be zero.
- 2) The phase of the reference oscillator signal, with reference to the burst signal, and applied to the phase detector, will be 90° .

Except for the types of signals utilized, the automatic phase control system employed in color receivers is similar to the reactance tube types of *afc* used in black and white receivers. Comparing the two systems, the incoming black and white horizontal sync pulse is analogous to the incoming color burst, and the black and white horizontal oscillator is analogous to the local 3.58 *mc* color oscillator.

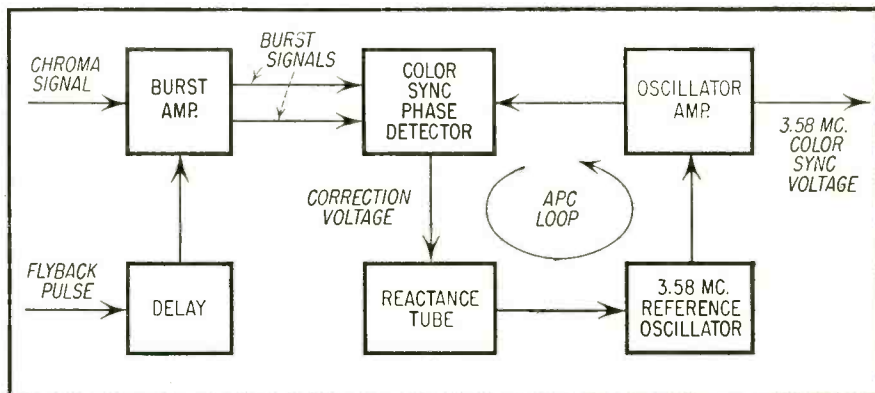


Fig. 1—Color Sync block diagram.

An analysis of the signals fed into the phase detector, as shown in Fig. 2, reveals that both are sine waves. The color burst signal is fed into the phase detector, through a center-tapped transformer, as a pair of 180° signals. The signal from the color oscillator, as shown in the figure is fed into the phase detector 90° out of phase (in quadrature) with the color burst signals. This phase is a necessary condition for proper operation of the phase detector circuit as will be developed shortly.

As indicated previously, the net effect of burst and reference signals in the phase detector is to produce a correction voltage which when applied to the reactance tube corrects the reference oscillator frequency for any difference between burst and reference frequencies. This correction voltage may be zero, positive, or negative depending on the frequency difference between burst and reference and which frequency is higher than the other.

A simplified circuit diagram of a typical phase detector is shown in Fig. 3. As an aid in understanding its operation the symbols shown in the figure are explained as follows:

1. *E4* is the color burst signal.
2. *E1* is the color burst voltage developed across the top half (*L1*) of the burst transformer.
3. *E2* is the color burst voltage developed across the bottom half (*L2*) of the burst transformer.

4. *E3* represents the oscillator voltage which is developed across an oscillator output load *L3*.

5. *C1* is a condenser which feeds the color burst signal *E1* to diode *D1*.

6. *R1* is the discharge resistor for *C1*.

7. *R2* is the discharge resistor for *C2*.

8. *RL* is an equivalent resistance which completes the *dc* path of both diodes to ground. It is shunted by a large condenser *C3*. Discharge currents flowing in *R1* and *R2* will flow to ground through *RL* in opposite directions and will result in a voltage drop between point *A* and ground if the discharge currents are unequal. If they are equal the voltage between point *A* and ground will be zero. If *RL* is removed a voltage across *C3* will be obtained if the discharge currents are unequal as a result of charging *C3*. If the discharge currents are equal the voltage at point *A* (with respect to ground) will be zero. In the latter case the charging currents through the condenser cancel each other.

Let us now analyze the effects of the burst and reference signals applied to this circuit one at a time. Consider the burst first. Notice that the incoming burst signal is split up into two 180° out of phase signals *E1* and *E2*. Connected as shown, the circuit is a pair of peak detectors connected in series and

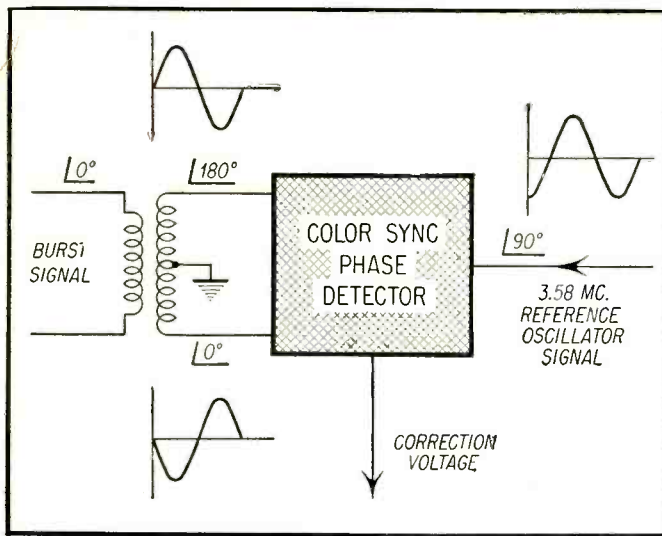


Fig. 2—Phase relations of signals at phase detector.

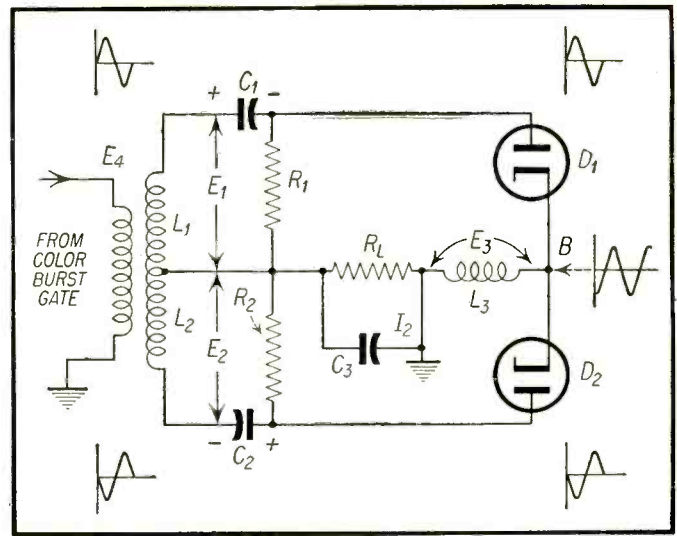


Fig. 3—Simplified circuit of phase detector.

charging $C1$ and $C2$ to the polarities indicated. The voltages across these condensers are the *peak voltages* of the applied signals $E1$ and $E2$.

Let us now see what happens when the oscillator reference voltage $E3$ is developed across $L3$. Recalling that $R1$ and $R2$ are comparatively high resistors (1 meg) diode $D1$ will have a voltage ($E3$) applied to it through the circuit comprising $C3$, $L1$ and $C1$. Similarly diode $D2$ will have a voltage ($E3$) applied to it through the circuit comprising $C3$, $L2$ and $C2$.

From the previous discussion it is evident that the voltage across $D1$ is the sum of $E1$ and $E3$. Similarly the voltage across $D2$ is the sum of the $E2$ and $E3$. Since these voltages are sine wave voltages and are not in phase with each other we add them vectorially.

In Fig. 4 we show cases 1, 2, and 3, these three cases indicating the voltages that exist across $D1$ and $D2$ for three different phase relations occurring between the burst and reference signals. To properly understand Fig. 4 we must first assume that the diodes are non-conducting (heaters are cold), and that no *dc* voltages exist anywhere in the circuit. We will also assume that $C3$ is very large compared to $C1$ and $C2$, and in no way affects the subsequent circuit behavior.

Now let us apply heat to the two diodes. Immediately voltage $E13$ will cause conduction through the diode $D1$ and charge $C1$ to the peak value of $E13$ in the polarity shown in Fig. 3. In like manner $C2$ will be charged to $E23$. If the angle (θ) between burst and reference is 90° as shown in case 1, then the voltages across $C1$ and $C2$ will be equal and the resultant discharge voltages across $R1$ and $R2$ will be equal. Under these conditions Point A will remain at zero potential.

Notice that up to the point of dis-

charge in our discussion $R1$ and $R2$ are not mentioned in the action taking place. Only after the application of the *ac* burst and reference signals and during the period of discharge of $C1$ and $C2$ (immediately following burst) do we consider the currents flowing in $R1$ and $R2$.

Cases 2 and 3 indicate situations where the angles are different from 90° . Under these conditions $E12$ and $E23$ are not equal. This means that the voltages developed across $C1$ and $C2$ are not equal, and the resultant potential between point A and ground will not be zero but will go positive or negative depending on the value of θ .

In case 2 the oscillator voltage $E3$ leads the burst voltage $E2$ by more than 90° . In this case $E13$ is greater than $E23$, causing more diode current $I1$ to flow in $D1$ than in $D2$. This will make

point A negative with respect to ground.

In case 3 the oscillator voltage leads $E2$ by less than 90° . In this case $E13$ is less than $E23$, causing more diode current to flow in $D2$ than in $D1$. This will make point A positive with respect to ground.

To further clarify the 3 cases discussed, when θ is 90° (case 1) the frequency of the burst is identical with the pre-set frequency of the local oscillator, and the potential of point A is zero. If the frequency of the burst should change or the frequency of the reference oscillator should drift an error voltage will be developed at point A (case 2 or case 3) which will maintain a tracking of these two frequencies . . . i.e., the frequency of the reference oscillator will always be identical with the frequency of burst regardless of which tends to change.

However, at all times that the final frequency is different from the original pre-set frequency of the local oscillator the potential at point A will be other than zero, and θ will be different from 90° by one or two degrees. This is a *phase error* introduced in the system which represents the price paid by the system for the dynamic electronic stability maintained by the system. Further discussion of this phase error will take place in the section devoted to the reactance tube operation.

The discussion up to this point has been one in which it was assumed that the frequency of the transmitter (burst) has been varying within the allotted FCC limits (± 11 cycles). It will later be shown that the corrective mechanism described above is equally applicable for the case where the burst frequency is constant, and the reference frequency tends to change due to internal conditions such as tube aging, thermal effects, etc.

It must be always borne in mind that

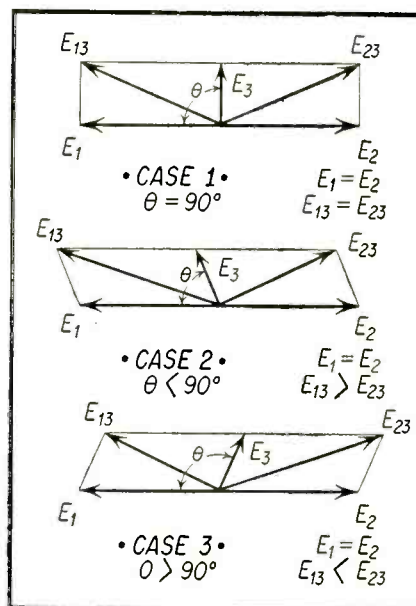


Fig. 4—Voltages applied to $D1$ and $D2$ result in various angles.

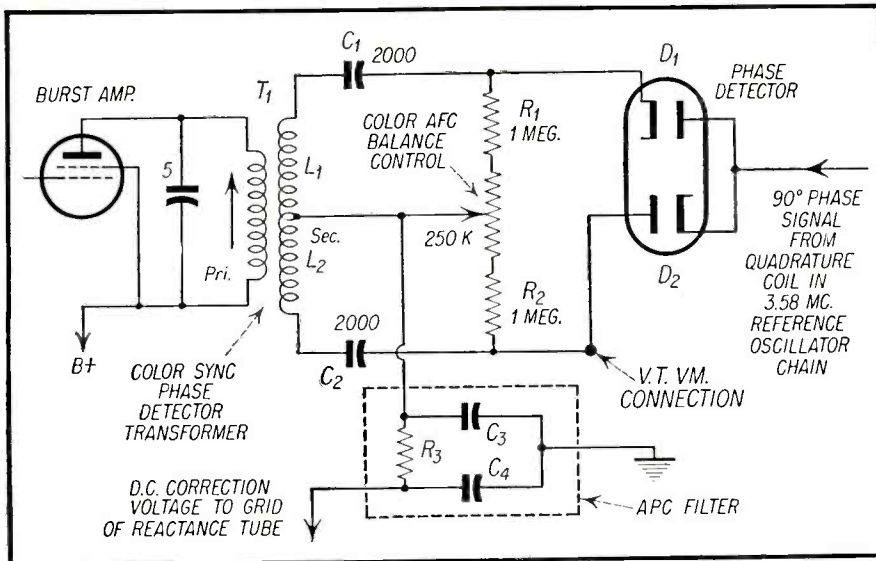


Fig. 5—Typical commercial phase detector circuit. Here a pair of 180° out-of-phase burst signals, and a single-ended reference signal is used.

the phase differences shown in case 1 and case 2 are produced in the APC system by the changes in frequency which tend to occur between the burst and reference signals. Furthermore, these phase differences are not original conditions we seek to correct but are in themselves the correcting phenomena developed in the APC system which activates the phase detector to correct for the original frequency difference. In the phase detector these phase deviations (from 90°) give rise to correction voltages which in turn reduce the frequency difference between burst and reference to zero and leave the residual phase error of one or two degrees previously referred to.

Color Sync Phase Detector Circuits

Except for minor variations of the component values, the color sync phase detector circuit employed in various color TV receivers is as shown in Fig. 5. One of the units shown in this circuit

and not previously discussed is the filter circuit comprising C3, C4, and R3. This filter is designed to provide substantially constant dc bias values to the reactance tube under conditions that might tend to cause extraneous correction voltages to appear, such as when high amplitude noise pulses are present in the signal. Further discussion of this filter will be continued in the section on "Reactance Tubes."

Another unit shown in this illustration is the AFC Balance Potentiometer R4. With this device adjustments are made to correct for any circuit unbalance caused by mismatched circuit components such as R1 and R2, C1 and C2, L1 and L2, and D1 and D2. In practice, adjustment of this control consists of disabling the reference oscillator, utilizing a chroma signal from a color bar generator, and adjusting the control for zero correction voltage output using a center scale indicator. An alternative method is to reduce the chroma signal

[Continued on page 55]

A full-fledged city-by-city sales program to market its 21-inch color TV set which is "so simple a child can operate it" was started early in January by the Raytheon Manufacturing Company. Henry F. Argento, vice president and general manager of the company's television and radio operations, Chicago, said the city-by-city sales campaign would be the "most dynamic and energetic in the company's history." It will follow a pattern Raytheon has developed in selling its black and white TV sets and its new, complete line of all-transistor portable radios, he said. "After several years of the television industry juggling and fumbling color TV, it finally looks like 1956 will be the first big year with industry sales about 300,000 sets," he predicted.

The first all-transistor home radio that can be played anywhere in the house without the necessity of plug-in cords and electrical outlets was introduced at the recent CBS-Columbia National Distributor Convention. The introduction of the cordless receiver was described as the first practical use of transistors as replacements for vacuum tubes in the full sized home radio field. Heretofore, all transistor radio activity has been in outdoor portables, Norman C. Owen, Vice President in Charge of Sales, said. The new CBS transistor home radio operates on six transistors and a self-contained battery pack. The battery pack will provide upwards of 1,500 hours of normal radio listening.

A new RCA hi-fi AM/FM tuner, which features an electronic "eye" to facilitate pin-point radio tuning, was announced by the Theatre and Sound Products Department, Radio Corporation of America. The new tuner is electrically matched for plug-in use with associated RCA hi-fi components in home assembled music systems; features an extended frequency range of 20 to 15,000 cycles per second; and provides an audio output of 1.5 volts.

Retail sales on radios, excluding automobile receivers, increased in November from the October level to the highest point recorded in 1955, the Radio-Electronics-Television Manufacturers Association reported recently. Although sales of television receivers declined between the two months, more

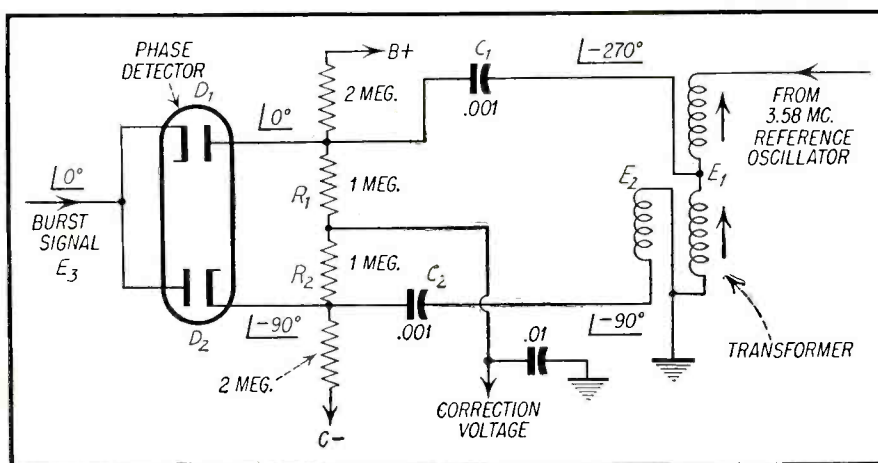


Fig. 6—Phase detector circuit employing a pair of 180° out-of-phase reference oscillator signals, and a single-ended burst signal.

FLASHES

sets moved through retail outlets in the first 11 months of 1955 than in the comparable period a year earlier, the Association added. Cumulative TV sales were reported as 6,487,617 in the first 11 months compared with 6,223,332 television receivers which moved through retail stores in the same 1954 period.

The Antenna Section of the Radio-Electronics-Television Manufacturers Association has announced the development of an antenna test program with color TV receivers. The program will enable manufacturers of color TV sets to evaluate the performance of TV antennas. According to Douglas H. Carpenter, Chairman of the RETMA Antenna Section, each participating antenna manufacturer will supply an antenna to be tested, along with pertinent technical data. The set manufacturer will test the antenna with a color TV receiver, and supply information based on the test results. When all antennas have been tested, the RETMA Engineering Department will distribute a resume of the results.

A major advance in the automotive radio field was revealed recently by the Delco Radio Division of General Motors, which announced the introduction of an automobile radio which now includes transistors. These Delco "Hi-Power" transistors, developed in Delco Radio's electronics laboratory, provide this new radio with one third more power, less distortion, a wider tonal range, greater reliability, elimination of vibrator buzz, and lowered current drain. It also points the way toward smaller and lighter radios to permit better instrument panel styling.

To meet the problem of the advancements and changes in tubes PRECISION is now making available to all owners of PRECISION tube testers an automatic, Roll Chart and Supplementary Tube Test Data Service on an annual subscription basis. Under this new plan, valuable new tube test data is published and forwarded automatically to subscribers. Included in the service will be a minimum of 2 new roll charts plus other supplementary test data mailings. Total cost for this completely automatic service is only \$2.00 for a full year subscription.

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[Continued on page 48]



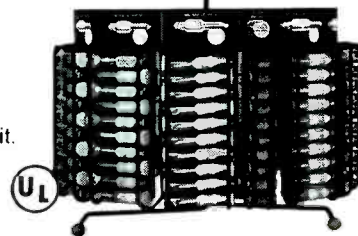
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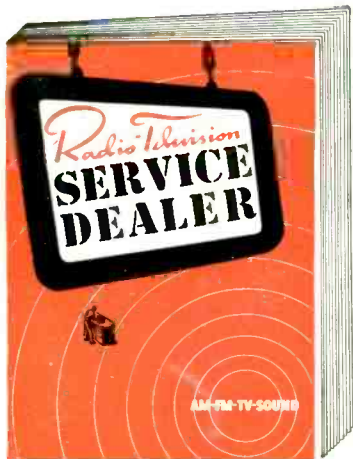


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THE WORK BENCH

Unusual Service Problems And Their Solutions

by Paul Goldberg

This Month's Problem:
Sync amplifiers using a 6CS6.

A THOROUGH knowledge of the sync pulse and its circuitry is necessary in solving the sync amplifier problems. Coupled with the use of a scope these problems should not prove difficult to solve.

Admiral 22A3AZ

The receiver was turned on and it was immediately noted that there was no horizontal or vertical sync. Because this was a composite sync problem, the 6CS6, V403, sync separator and noise limiter, and the 6SN7, V401B, the sync inverter, were replaced individually but had no effect.

The diagram was then studied. Referring to Fig. 1 it was noted that the positive going composite sync pulse and video signal is taken off at the plate load resistor of the video amp 12BY7 and fed through the isolating network, R323, R329, C315. From this point it is coupled by C308, .047 μ f to pin #7 of the 6CS6.

Video separation takes place due to this tube's low plate and screen voltages and due to the grid leak action of C308 and R414, which allows the 6CS6 to conduct only during the highest positive peaks (sync pulses) of the composite video signal. Now, while a positive going composite video signal is fed to pin #7 of the 6CS6, a negative going composite video signal from the plate load R315 of the video detector, $\frac{1}{2}$ 12AT7, is fed to pin #1 of the 6CS6.

It can be seen then that the composite signal on pin #7 is larger than, and 180° out of phase with, the signal on pin #1. The pin #1 grid is so biased by the positive bucking voltage from the noise gate control R463 and by the negative quality of the signal arriving from the video detector that any pulse greater than the amplitude of the sync pulses will cut the 6CS6 off thus preventing these transient pulses from entering the sync circuits and triggering the vertical and horizontal oscillators. If a noise pulse is superimposed on the

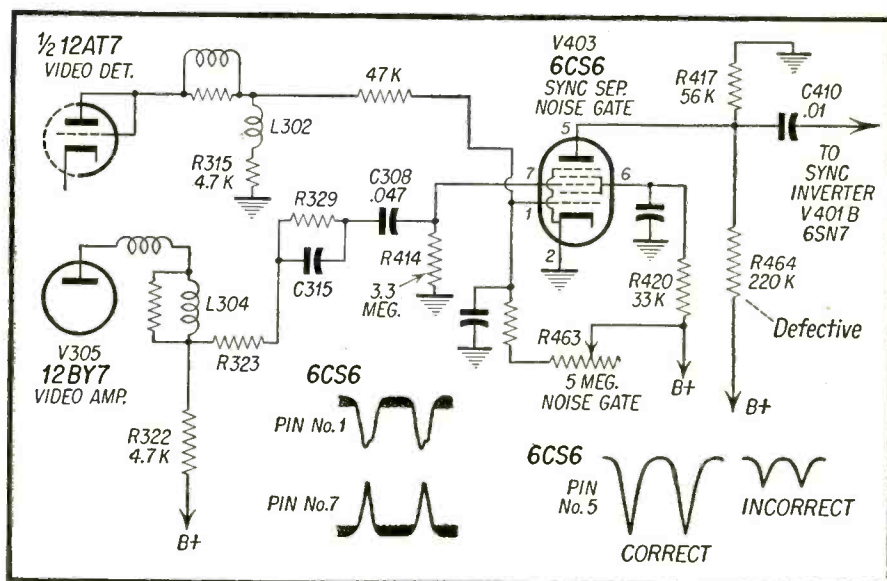


Fig. 1—Partial schematic of sync separator section of Admiral 22A3AZ receiver. A positive going composite video signal is fed to pin 7 of the 6CS6, and a negative going composite video signal from the video detector is fed to pin 1 of this tube.

sync pulse, the action of the circuit will eliminate both the noise and the sync pulses. When sync pulses are lost in this manner the flywheel effect of the oscillator will keep the circuit synchronized until the next sync pulse arrives.

Knowing these facts the oscilloscope was set up and a few waveform checks were made. The waveform was first checked at pin #7 of the 6CS6. The waveform was correct. Next a waveform check was taken at pin #1. The waveform was correct here also. A check was next made at pin #5, the plate of the 6CS6. The waveform at this point was not correct. The amplitude of the pulses were much too small. A voltage measurement was then made at pin #5. It measured about 3 volts positive instead of 43 volts positive. Resistor R464 was next checked and instead of reading 220K, it measured about 2.5 meg. This resistor was replaced with a new 220K resistor and the receiver functioned normally.

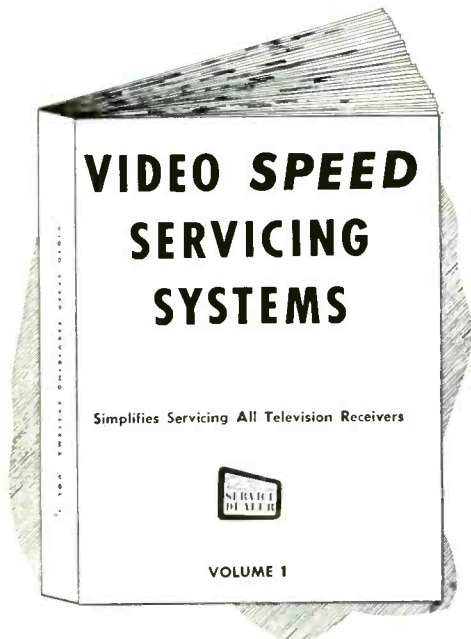
Philco TV440

The receiver was turned on and the picture was observed to be out of vertical and horizontal sync. The 6CS6 sync separator and the 6AM8, sync amp and if delay were replaced individually but had no effect.

The diagram was then studied. Referring to Fig. 2 it was noted that this receiver also uses a 6CS6 for sync separation and noise elimination. In this receiver the composite video and sync signal is fed directly from the grid pin #8 of the 6AN8 to the grid of the sync amp pin #2 6AM8. After amplification the composite video and sync signal is fed from the plate of the 6AM8 through C311 to the grid of the sync separator 6CS6, pin #7. Here, due to the grid leak action of C4, R5, R11, R6 and the cutoff characteristics of the grid pin #7, only the sync pulses appear in the plate circuit. The composite signal is also taken off the video detector load resistor R321 and fed through C7,

[Continued on page 54]

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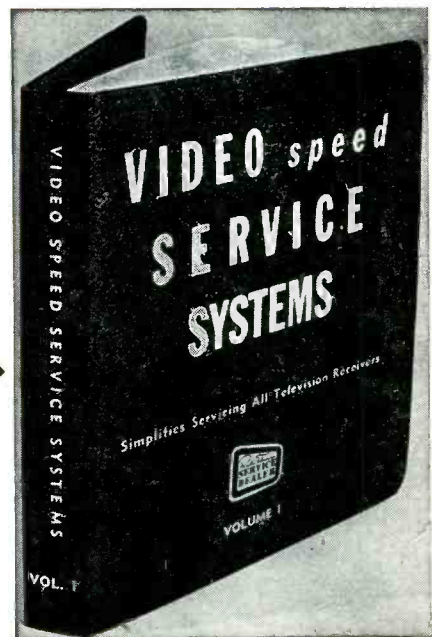
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SPEED UP YOUR SERVICING WITH THIS NEW CRT VOLTAGE TESTER



by **DON TERRANOVA**

AN effective yet simple instrument for checking the voltages on the pins of a cathode ray tube has recently made its appearance on the market. This instrument called the "VOLTA-CHEK" provides a quick means for making these tests.

In effect, this device checks the tube bias, the first anode and filament, low magnitude focus voltage from 400 to 1,000 volts and high magnitude focus

voltage from 1,000 to 3,000 volts.

In this manner the VOLTA-CHEK may be utilized to localize faulty circuit elements thereby determining whether the fault is in the tube or in some component in the set. It also indicates if a short exists in the cathode or grid side.

An additional feature of this instrument is its ability to check both parallel and series filament wired receivers.

Reference to the diagram in Fig. 1 indicates a 4 pole 5 throw switch. Reference to the illustration of the unit will quickly reveal the functions of each position on the switch. The circuit is

very simple consisting of a suitable neon tube in series with each circuit function to be tested.

The VOLTA-CHEK is plugged into the picture tube socket attached to the television set. By turning the function switch to the various positions the VOLTA-CHEK will indicate the presence, absence or sufficiency of:

1. Filament Voltage. Indicator will glow if filament voltage is correct.

2. Bias Voltage. The brightness and contrast controls can be checked to see if they are working properly when the function switch is in this position by merely turning these two controls which will increase or decrease the intensity of the Bias Indicator. If the Bias Voltage in the set is correct, the Bias Indicator will NOT light because the grid is normally biased below cutoff, which is in the vicinity of 45 volts in the majority of commercial television sets. Therefore an absence of light in the Bias Indicator means the Bias Voltage is correct.

3. First Anode Voltage. Indicator will glow if first anode voltage is present.

4. Focus No. 1 Voltage. Focus Indicator will glow when Function switch is in this position if the Focus voltage is correct. This position is for television sets that use electrostatic picture tubes with high magnitude focus voltages (1,000-3,000 volts).

5. Focus No. 2 Voltage. This position is used for television sets that use electrostatic picture tubes with low magnitude focus voltages (in the vicinity of 500 volts). The Focus Indicator will glow if the focus voltage is present.

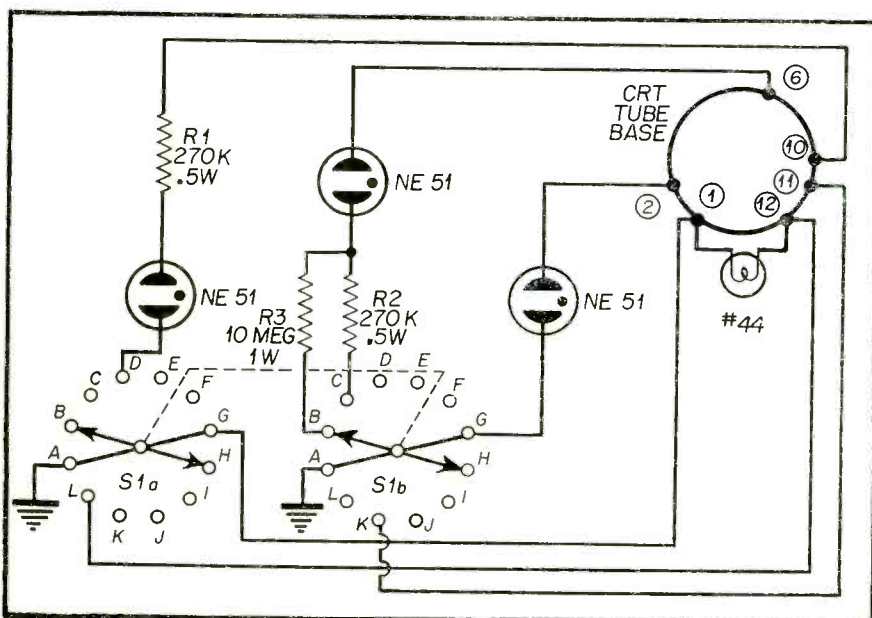
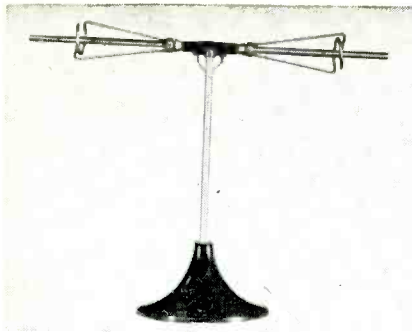
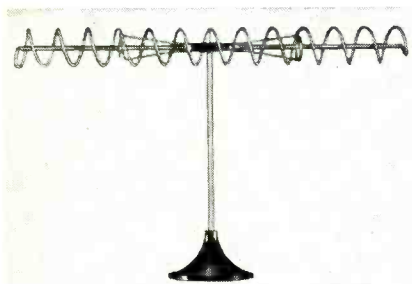


Fig. 1—Circuit diagram of Electronic Test Instrument Corp. VOLTA-CHEK for testing pin voltages at base of picture tube.

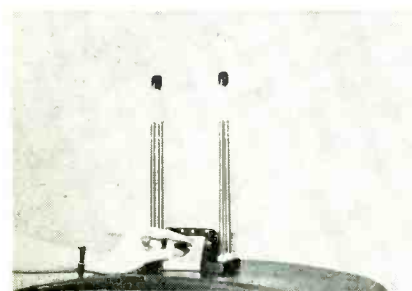
THERE'S PROFIT INDOOR



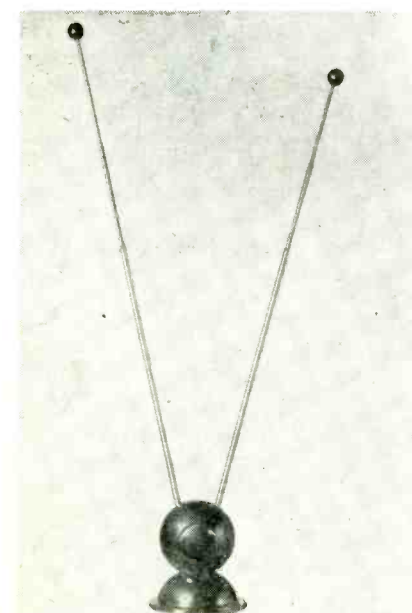
UHF antenna by Hi-Lo.



VHF-UHF antenna by Hi-Lo.



Adjustable antenna by Snyder.



Adjustable antenna by Radion.

by **San D'Arcy**

MANY servicemen and service dealers have had strong antipathy towards indoor antennas. They viewed them as "the curse" which sometimes prevented them from making an outdoor antenna sale with consequent loss of profit from the installation entailed.

This line of reasoning has caused many servicemen and service dealers to overlook the potential profits that can accrue from selling and using indoor antennas as well as outdoor types. So, if you are a "100% outdoor antenna man"—I'll ask you to act as a juror—listen to some factual evidence with an open mind—and then act accordingly. I'm going to prove that it will pay you to be an "indoor man" as well as an "outdoor man." I will *not* attempt to prove that technically an indoor antenna is as good as or better than an outdoor type. This article will deal solely with money-making, profit-making, customer satisfaction and good business practice.

All service firms, from the one-man operation up to larger multi-employee organizations, and all service dealers, can and will find many opportunities to sell indoor antennas. Remember, that on occasion a customer will not or cannot go for an outdoor antenna installation—so why lose a sale and profits, in cases like these, just because you've been mentally committed to or prefer outdoor antenna sales.

First, let's see how much of an investment is required by a service firm which is going to handle indoors—and let's see how that investment will pay off. Chart I illustrates, from actual case histories, what can be anticipated.

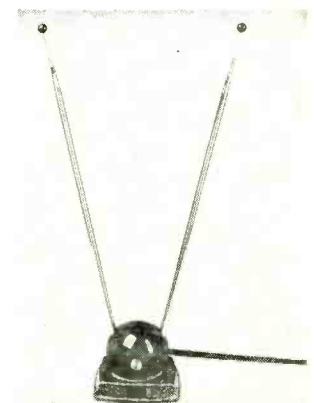
In actual practice many retailers have used the short-sighted policy of giving away free an indoor antenna to a set buyer who did not want to spend above a certain figure which did not permit an outdoor antenna installation too. Usually the "give-away" indoor antennas were of such low-cost, inferior quality and performed so badly that the

dealer, in time, lost the customer's good will. Would it not have been better, in cases like these, for the dealer to lend—say for a 3 month period—an indoor antenna to the set buyer—with the further provision that after that time the set owner either pay in full for the good antenna or even return it when the service dealer makes an outdoor installation? Such "sell up" practice is sound, and very profitable—besides it keeps the customer happy.

Many people live in apartment houses and other types of multiple tenant dwellings where the indoor is the only kind of antenna that can be used. Here it is the duty of the service man to give the customer an antenna and set installation that will do the job properly. Care should be exercised in locating not only the antenna, but also the set, as a slight change in location can materially change the quality of reception.

The multiple set installation, such as hotels, motels and hospitals is an ideal field for the indoor antenna. Here the improved appearance and lower cost will simplify a sale and save many critical man hours without any loss in profit.

The two set customer who has retained his old set when buying a new one is a prospect for a good indoor antenna, especially if he desires to save the cost of an additional outdoor installation or to guard against the possibility of unreliable reception due to interfer-



Colored antenna by RMS.

IN SELLING ANTENNAS

Scope Of Operation	Suggested Inventory & Cost	Potential Sales Per Week	Turnover Of Inventory Annual	Average Gross Profit Per Sale	Annual Gross Profit Potential
1 to 2 Man No Display Window	10 Antennas at \$40.00 to \$60.00	5 to 10	26 to 52	\$4.00	\$1040.00 to \$2080.00
1 to 2 Man With Window Display	20 Antennas at \$80.00 to \$120.00	9 to 15	24 to 36	\$4.00	\$1880.00 to \$3120.00
3 to 5 Man No Window Display	50 Antennas at \$175.00 to \$250.00	15 to 25	16 to 26	\$5.00	\$3900.00 to \$6500.00
3 to 5 Man With Display Window	50 Antennas at \$175.00 to \$250.00	20 to 35	20 to 36	\$5.00	\$5200.00 to \$9100.00
6 to 10 Man No Display Window	100 Antennas at \$250.00 to \$400.00	30 to 50	31 to 52	\$6.00	\$9350.00 to \$15,600.00
6 to 10 Man With Display Window	100 Antennas at \$250.00 to \$400.00	35 to 60	36 to 62	\$6.00	\$10,900.00 to \$18,700.00

The above chart illustrates the anticipated operational details involved in stocking and selling indoor antennas of various types.

ence and excessive losses due to operation of two sets on one antenna.

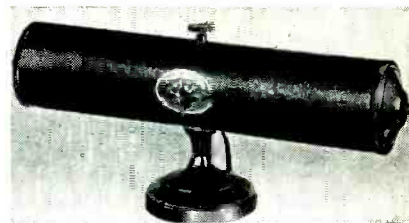
The intermixing of UHF and VHF stations has developed a market for indoor antennas which should not be overlooked. If a UHF station has been added to a VHF area or vice versa an indoor antenna installed in conjunction with an existing antenna gives a quick, profitable solution to all channel reception. Here the service dealer should not overlook the liability etc., that he assumes when he makes or adds to an

outdoor installation. These contingencies are eliminated when an indoor from a reliable manufacturer is installed.

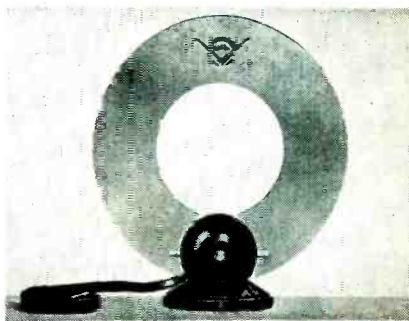
A problem which has long plagued the service establishment is what to do with available window space. The service man will find that a small investment in indoors plus an attractive window display will result in many off the street sales to neighborhood and impulse buyers in his immediate area and will give valuable contacts for future service work.

The manpower shortage and need of conserving man hours in the average over-worked shop makes the indoor antenna an ideal means of earning additional money without the necessity of finding or training additional technicians. The same work force can greatly increase sales and dollar volume if thought and effort are gunned toward the plus profits possible with sale of quality indoor antennas.

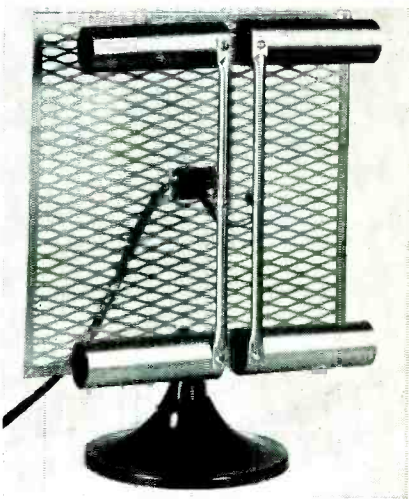
In conclusion, let us say that if the service man or service dealer will look around many more opportunities in the indoor field will present themselves. Here, however, it is important to remember, "Don't overlook or give away your antenna profits, make every antenna transaction a profitable one."



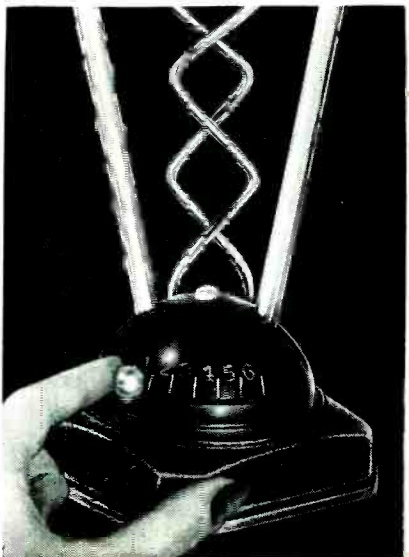
VHF-UHF antenna by Tricraft.



UHF antenna by Radion.



UHF antenna by Tricraft.



Glide-O-Matic by Channel Master.



Colored antenna by JFD.

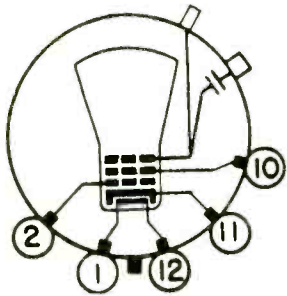
TUBES, RECTIFIERS and SEMI-CONDUCTORS

In requesting more detailed information on these products, please check the code number of the product on the convenient coupon on page 56, and send it, along with your company letterhead or business card, to New Products Dept., SERVICE DEALER, Suite 510, 67 West 44th St., New York 36, N.Y.



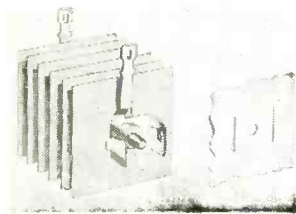
Amperex Miniature Tube

Amperex Electronic Corporation has announced the addition of a cold-cathode discharge miniature voltage reference tube to their line. It is designated as Type 5651 and is designed for use in DC amplifiers, stable regulated power supplies, oscilloscope calibrators and similar applications. Special processing of the tube and its elements insures extremely stable operation and freedom from long and short-term drift. For details, check T20.



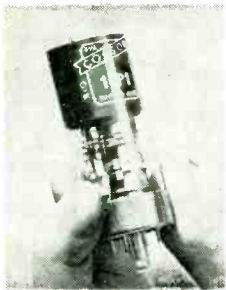
Raytheon Picture Tube

The 21WP4 is a direct view magnetic focus and magnetic deflection picture tube for television receivers. It employs a spherical rectangular filter-glass face plate for elimination of reflection and is designed to be used with an external ion-trap magnet of the single field type to prevent ion-spot blemishes. The external conductive coating, when grounded, serves as a filter capacitor. For details, check T21.



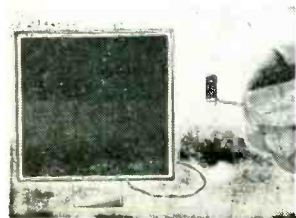
Federal Clip-in Rectifier

Selenium rectifiers equipped with a new spring-steel, snap-action mount permitting greatly increased ease of assembly have been announced by the Federal Telephone and Radio Company. The new type of mount now makes it possible to remove the rectifier from the radio or TV set without unbolting the chassis from the cabinet. The advantages of the new clip-in rectifier are listed as—minimum installation cost, rapid installation, no mounting hardware required, and no need for installation tools. For details, check T22.



Beam Self-Focusing CRT

The Cossor 1CP1, a new flat face 1" self-focusing cathode ray tube said to be ideal for monitoring purposes in a wide variety of electronic circuits, has been announced by Beam Instruments Corporation. The Cossor 1CP1 features automatic self-focusing at low anode voltage from 500 to 1500 volts and has 250 volt heater-cathode insulation, permitting considerable license in the selection of heater power sources. For details, check T23.

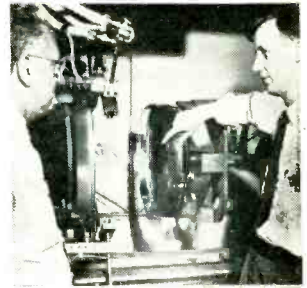


International's Sun Battery Cells

A new series of selenium Sun Battery Cells is now available from International Rectifier Corporation. The low cost and high self-generated output of these cells make them ideal components for transistor power supplies, control applications, photometric equipment, as well as experimental uses. These Sun Battery Cells are now in production in a wide range of sizes and power ratings—from 0.14 sq. in. to 10.5 sq. in. in photosensitive area and from 0.1 milliwatts to 15 milliwatts power output in direct sunlight. For details, check T24.

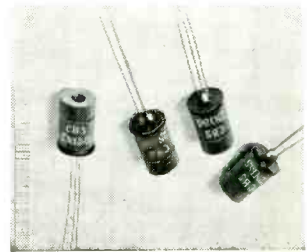
Westinghouse Color Picture Tube

Sealing process for the all-glass 22-inch color picture tube is demonstrated above by E. F. Dick, chief engineer for color tube manufacturing at Westinghouse, as W. J. Knochel, cathode-ray tube engineering manager, watches. The tube faceplate, with aluminized fluorescent screen deposited and shadow mask attached, is positioned for sealing to the glass funnel, at left. This improved electric sealing technique makes the finished all-glass bulb into one piece. For details, check T25.



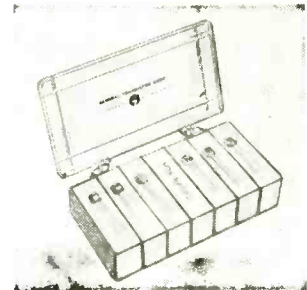
CBS-Hytron Power Transistors

A series of power transistors featuring high power gain and uniformity of characteristics has been developed by CBS-Hytron. Four variations are available offering a wide range of current gain and operating supply voltage. This permits a considerable versatility of circuit design. Highly efficient heat dissipation is an outstanding feature of these units. For details, check T26.



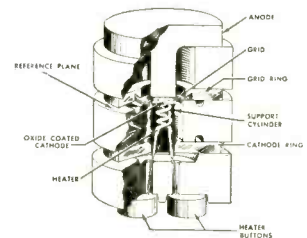
General Transistor Kit

General Transistor Corp. is now making available a kit of six diffused P-N-P junction transistors for all types of radio receivers through parts distributors. Designed for experimenters, engineers, and technicians, the kit includes: 1 converter-oscillator transistor, 2 intermediate frequency transistors, and 3 audio transistors—all packaged in a functional lucite box. For details, check T27.



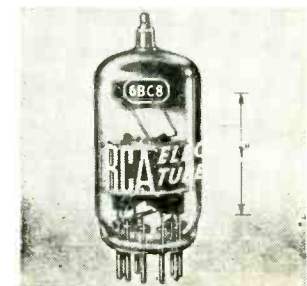
GE Miniature Ceramic Tube

Milestones in radio and television receiving tube development. At right, is a drawing of a new ceramic "micro-miniature" tube introduced by General Electric. This represents a revolutionary departure in vacuum tube design and construction. For details, check T28.



RCA Med.-Mu Twin Triodes

The 4BC8 and 6BC8 are medium-mu twin triodes of the 9-pin miniature type having a semiremote-cutoff characteristic. They are intended primarily for use in cascode-type circuits of vhf television tuners. The 4BC8 is like the 6BC8 except that it has a 4.2-volt/0.6-ampere heater having a controlled heating time to insure dependable performance in television receivers employing a series-heater string arrangement. For details, check T29.



RIDER SPEAKS

ONCE upon a time the "midget" variety of radio receiver carried a list price of \$6.95. When tube replacement was necessary it was discovered that the list price of the tubes was \$7.50—65¢ more than the price of the entire receiver! It was only natural, therefore, that there be a lot of fussing and fuming on the part of the set owner when he got his bill from the service technician. Perhaps the same situation will never again arise—then again, it's possible that it may, on a slightly different scale.

For instance, the printed circuit wiring technique is pointing toward the direction of lower priced receivers, both radio and TV. Maybe it hasn't happened yet but it's almost certain that given a reasonable amount of time the greater and greater use of printed circuits will reduce the production costs at the manufacturer. It is a natural consequence that the list price to the public will likewise be reduced. Psychologically, the public calling for service on radio and TV receivers expects that the lower the price of the merchandise he purchases the lower should be the price for service.

The degree to which the printed circuit wiring methods will reduce the list prices of radio and TV receivers is an unknown amount, but the situation is developing which may cause some irritation to the servicing group. In fewest words, it is that the use of printed circuit wiring can very easily lead to the necessity of charging *more* for the service than when conventional circuit wiring is used. This may make the public unhappy but at this stage of the game it doesn't seem that too much can be done about it. Recognizing the limited familiarity with printed circuit wiring, the service technician cannot help but find it a more than normally difficult matter to locate a fault. To say the least a tiny crack in the conducting surface is not as rapidly apparent as a broken wire. To "read" the bottom view is a new experience. Assuming that the fault is found, its repair just is not as simple as when working on a conventional receiver. We too thought that 20-watt soldering irons are suitable for patching these broken surfaces, but in altogether too many cases it has been found that the heat from even this iron is excessive, and some of the conductor just evaporates when repair is attempted.

It is, of course, silly to say that the



last kind of problem is going to remain forever. In time the proper types of techniques for effecting repairs will be found, but until then and perhaps even thereafter, it is safe to say that the repair of one of these receivers must cost the public more than the repair of a conventionally wired piece of equipment.

Perhaps the present price level of radio-TV receivers will not make the customer cognizant of the small increase that he is forced to pay for servicing this new type of receiver when something goes wrong with this part of the equipment. This is fine if it is so, but whether it is or not, it is of the utmost importance for the service technician to realize that the improvement of manufacturing techniques will not in all cases lead to economies in repair. This is not denying the numerous benefits which will no doubt arise from this method of receiver construction, but

those who have not yet repaired printed circuit devices must be mindful of the problems which face them.

The very fact that the service labor is more painstaking and must be done with more than the accustomed care is in itself time consuming—and time must be paid for—especially so when everything on the horizon points to a higher-than-ever valuation on time.

The use of the techniques which are embraced by the general term "printed circuits" is expanding very rapidly. Any economies which are made by one manufacturer in his production through the use of these methods forces all competitors to do likewise.

Examination of some of the 1956 models shows the use of printed circuits embracing more and more sections of the receivers. It would not be surprising if the 1957 version of radio and TV receivers will contain more examples of this kind of technique than the conventional. Whatever may have been the scale of prices charged for the diagnosis and repair of conventionally wired receivers, it is not unreasonable to expect that it will have to be "upped" when working on the printed circuit receivers. By how much we don't know, but certainly it behooves each service shop to examine his costs for such repairs and compare it with the normal costs on the conventionally wired product and act accordingly.

Some time ago we visited Western Electric Company and we saw an example of a technique which eliminated soldering at connecting points. By means of a power-driven device which resembles a power drill, the connecting wire is wrapped around the connecting post. Measurements indicated that the conductivity at the connection made in this fashion was as good, if not *better* than the normal soldered connection. Recently we saw examples of its use in some television receivers. As a production facility this method of making connections cuts down production time and having been proven out in the field tests, this wrap-around connection is destined to see widespread use.

We do not know how this is going to affect the solder manufacturer sales, but it is good news that the recommendation made to the service technician is that if he ever has to make a new connection at one of these specially prepared connecting points, it is okay to solder.

John F. Rider



give



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CRIPPLED CHILDREN AND ADULTS, INC.
11 S. LASALLE STREET, CHICAGO 3, ILL.



The ANSWERMAN

Inquiries Sent To The Answerman Will Be Acknowledged Only If Accompanied By Radio-TV Service Firm Letterheads Or Similar Identification.

by **RTSD**
Technical Staff

Dear Mr. Answerman:

I have an Admiral TV receiver on my service bench that is chassis 18XP4BZ. This set shows the following troubles. There is no sound and no picture, and the audio output tube becomes red hot after a short period of operation of the receiver. This occurs before I have much chance to make checks for voltages. I appreciate the fact that the trouble is somewhere in the cathode of the audio output stage but I haven't been able to determine which circuit it is in. The receiver uses some of the printed panels and therefore it is not possible to break into or unsolder junctions and measure the resistances in each leg to determine in which one the short circuit is occurring.

Can you give me any help on this as it would be very much appreciated.

B. G.
Kansas City, Mo.

The Admiral chassis 18XP4BZ uses a rather conventional split B plus voltage distribution, common to many receivers, as shown in Fig. 1 in that the lower positive voltage of 140 volts is obtained at the cathode circuit of the audio tube after feeding 250 volts *dc* to the plate. The 140 volt *dc* supplied by this tube is made use of in such circuits as the sound *if* stages, the tuner *rf* amplifier and others. As a point of interest it may be noted that an audio amplifier is not employed in this circuit and the sound is coupled from the output of the FM detector to the grid of the audio output tube, a 6AS5 pentode. The chassis is of the very popular vertical type and has the printed wiring panel for the sound system at the upper left hand side.

In considering the presented problem the very fact that the plate of the 6AS5 sound output tube becomes red is an indication that too much current is being drawn through the tube and that there is a short circuit in the cathode feed line or the two resistors

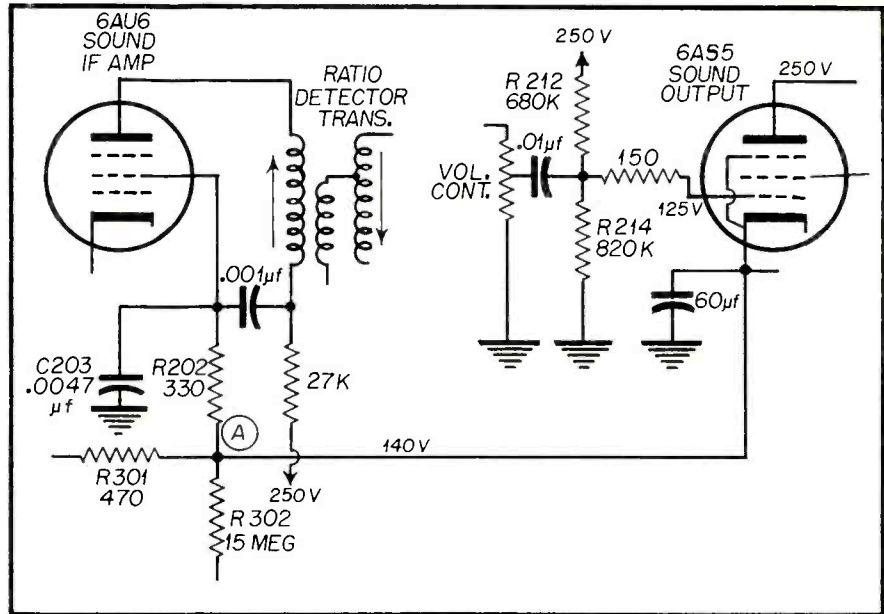


Fig. 1—Partial schematic of Zenith chassis 18XJ4BZ sound output section illustrating split B plus method of supplying B voltage to various sections of the receiver. No audio amplifier tube is used.

supplying the grid bias, R212 and R214. The voltage dividing resistors R212 and R214 can easily be checked with a meter or the voltage can be checked with the tube out of the socket as this voltage is not a part of the 140 volt system of the cathode circuit but divided down from the full B plus supply. It is possible to check it with the tube out of the socket because the receiver uses a parallel filament circuit arrangement and the other tubes will remain in operation except for those supplied by the 140 volt B plus.

With the receiver tuned off it is generally possible to check a shorted B plus line by measuring the resistance in the following manner. Although there are other circuits fed by the 6AS5 tube cathode take the junction point A of Fig. 1 as the point to be used in the illustrative example for locating the short without breaking into the leads.

Figure 1 shows three resistor legs branching off at point A and the resistance to ground at this point is most probably low, around a few hundred ohms otherwise the tube plate would not become red. At the other side of

R302 and R301 measure the resistance to ground. If the resistance is larger than at point A the short is not in these legs. If the resistance is lower, the short is in that leg in which it measures less than at point A.

Now, suppose the resistor R202 is checked at the junction of C203, the .0047 µf condenser. The resistance here will probably be found to be zero due to a short in this condenser to ground.

This particular condenser is of the upright type commonly used, that are becoming so familiar in the printed wire panels. The condenser conveniently stands upright with both pigtailed extending out of one end to fit through holes in printed panels where they are soldered onto the panel leads.

Of course there are exceptions to the troubleshooting procedure outlined above such as where the circuit is designed for a resistor to connect to ground in a bleeder network for voltage dropping purposes. However this can easily be noted in the schematic.

It should be pointed out that if the resistance is high at point A with the

[Continued on page 49]

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 - Variable Frequency Ranges: 0-2000 ohms, 0-10 volts RMS, ± 1 db. Accuracy: $\pm 2\%$ from 50 cycles to 200 KC. ± 1 cycle from 20 cycles to 50 cycles. Distortion: Less than 1% from 20 cycles through 200 KC. 20 KC Sq. Wave Rise Time: .5 microsec.
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- ★ Tube Complement: 1-5879, 1-6CL6, 1-6J6, 2-6AU6, 1-6BL7, 1-6AH6, 1-6X4.
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MODEL E-300 DELUXE (Illustrated): In blue-grey, hooded steel cabinet and 2-color brushed aluminum panel with contrasting knobs. 11 1/2 x 13 x 6 3/8". Complete with tubes, coaxial output cable and instruction manual. Net Price: **\$195.00**

MODEL E-300 STANDARD: Standard black ripple finished cabinet with black anodized aluminum panel. 10 1/2 x 12 x 6". Complete with all accessories, as above. Net Price: **\$190.00**



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- ★ Push-Pull, Wide-Band Amplifier: 10 MV/inch sensitivity. 2 Megohms, 22 mmfd. One DB from 10 cps. to 3.5 MC—3 DB at 5 MC.
- ★ Direct Reading, Peak to Peak Voltage Calibrator
- ★ Vertical Pattern Reversal Switching Facility
- ★ Push-Pull, Wide-Range Horizontal Amplifier: 100 MV/inch sensitivity. 2 Megohms, 25 mmfd. One DB from 10 cps. to 1.0 MC—3DB at 2 MC.
- ★ Linear, Multi-vibrator Sweep Circuit: 10 cycles to 100 KC with retrace blanking.
- ★ Amplified Auto-Sync Circuit
- ★ Four Way Sync. Selector provides for Internal Neg., Internal Pos., External and Line Sync.
- ★ 3000 Volt Intensifier Anode Potential provides utmost visibility of high frequency waveforms.
- ★ "Z" Axis Input for blanking, timing, marking.
- ★ Built-in 60 cps Phasing and Blanking Controls.
- ★ All 4 Deflection Plates Available directly (at rear), with full beam centering facilities.

- ★ Tube Complement: 12AV7 "V" Cathode Follower-Ampl. 6U8 "V" Ampl.-Phase Splitter, Two 6CL6 Push-Pull "V" Drivers. 6U8 "H" Cathode Follower-Ampl. 6C4 "H" Phase Splitter. Two 12BH7 Push-Pull "H" Drivers. 12AV7 Sweep. 6BH6 Auto-Sync. Ampl. 12AU7 Sweep Retrace Blanking Ampl. 0A2 VR tube. 5V4 Rect. Two 1V2 High Voltage Rect. 5CP1/A CR Tube.

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MODEL ES-550 DELUXE (Illustrated): In custom-styled, blue-grey ripple finished steel cabinet; 2 color brushed aluminum panel and contrasting blue knobs. 8 1/4 x 14 1/2 x 18 1/2". Complete with all tubes, including 5CP1/A CR tube. Comprehensive Manual. Net Price: **\$235.00**

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Write for latest catalog describing the complete **PRECISION** line of test instruments for modern electronic applications in industry, laboratory and service.



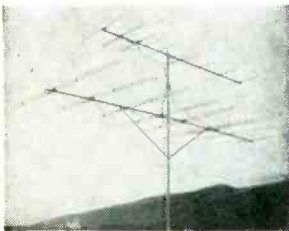
PRECISION Apparatus Company, Inc.

70-31 84th Street, Glendale 27, L. I., N. Y.

Export: 458 Broadway, New York 13, U. S. A. Cables: Morhanex
Canada: Atlas Radio Corp., Ltd., 50 Wingold Ave., Toronto 10

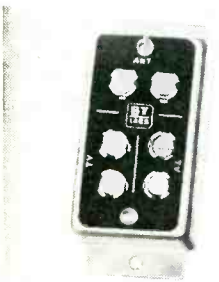
NEW ANTENNAS AND ACCESSORIES

In requesting more detailed information on these products, please check the code number of the product on the convenient coupon on page 56, and send it, along with your company letterhead or business card, to New Products Dept., SERVICE DEALER, Suite 510, 67 West 44th St., New York 36, N.Y.



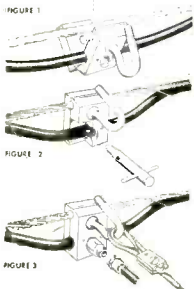
C-M "K.O." Antenna

Channel Master Corp. has announced its release of the "K.O." antenna, which the company claims has the highest front-to-back ratios ever recorded for any TV antenna. The "K.O.'s" front-to-back ratio range from 20:1 to 50:1 relative voltage on the Low Band, and up to 13:1 relative voltage on the High Band. The antenna exhibits extremely high gain characteristics: from 7 to 9 DB on the Low Band, and from 8.5 to 10.5 DB on the High Band. For details, check A20.



BT Coupler

Blonder-Tongue Laboratories is now delivering an impedance matched coupler to handle two TV or FM sets from one antenna. The B-T Coupler is flat from 0-900 MC and features 300 ohm screw terminals for all connections. Resistive isolation averages better than 12 db between TV sets. The unit may also be used in reverse to mix two antennas or amplifiers into one line. For details, check A21.



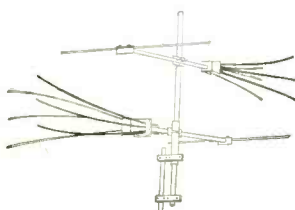
JE Cable Tap

A unique device for making permanent, weatherproof cable taps without severing the cable or stripping leads has been developed by the Jerrold Electronics Corporation. Developed originally to connect individual service drops to the main feeder cables used in community television antenna systems, the new Jerrold Pressure Tap likewise presents interesting possibilities as a low cost tap for utility, telephone, and control system cables. When coax is used, connection is automatically made to the center conductor as well as to all outer conductors. For details, check A22.



Telco "Globe-Tenna"

"Globe-Tenna," an unusual indoor UHF-VHF TV antenna produced by Telco Electronics Mfg. Co., is a world globe incorporating a built-in, high gain antenna. It features an authentic full color map made by one of the world's leading globe makers, and a bright brass base. It rotates to any position for best possible reception. Lead-in has a three-way quick clamp for easy connection to all TV sets. For information, check A23.



Holloway I.R.I.S. Antennas

I.R.I.S.—Infinite Rejection Interference System—gives infinite rejection of the interfering signal regardless of direction or channel or whether the interference is co-channel, adjacent channel or distortion from ghosts. The rejection of the interfering signal is accomplished by opposing the interfering signal with a signal of equal amplitude but of opposite phase, thus producing complete cancellation of the interfering signal. For details, check A24.

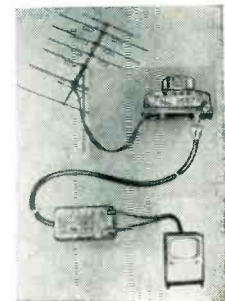
Mosley Coupler

A 4-Set TV Coupler has recently been announced by MOSLEY ELECTRONICS, INC. The coupler uses the same principles and design as the MOSLEY #902, which was rated No. 1 in tests of ten leading makes of 2-set couplers. It enables up to four TV sets to be coupled to one antenna with an absolute minimum of interaction and radiation between sets. Losses thru the coupler are extremely low—due to the excellent impedance match attained and the coupler is entirely satisfactory. For details, check A25.



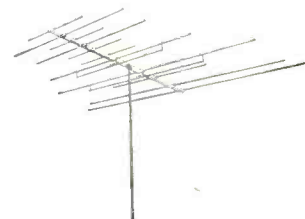
TACO Coupler

Designed to improve television pictures in localities affected by 'man made static', two coaxial cable couplers have been developed by the Technical Appliance Corporation. Technicians have experienced the problem of pick-up in transmission lines which has a detrimental effect on television reception. Conventional flat line can reduce some of this by twisting the line. A system of couplers perfectly matched to complement each other and transfer TV signal has been developed. For details, check A26.



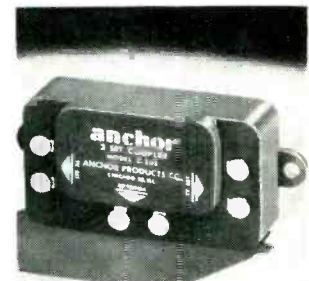
Winegard Combo

The Winegard Company announces the Combo—a new TV antenna that is available factory pre-tuned to 16 different channels. It meets 99% of all fringe area requirements. It is designed for both black-and-white and color reception, and constructed of all-aluminum and stainless steel. For details, check A27.



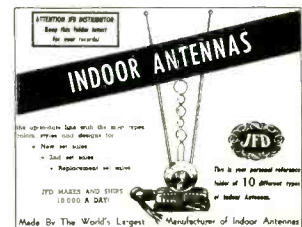
Anchor Coupler

A two-set TV coupler of High Frequency transformer type has just been put on the market by Anchor Products Company. This Model C-202 coupler has a matched impedance of 300 ohms, and it makes possible the use of one antenna for two television sets by transferring the signal from one antenna to both sets with remarkably little signal loss. At the same time it provides maximum isolation between the two sets, minimizing interference and insuring top reception on both. For details, check A28.



JFD Sales Aids

JFD Manufacturing Co. recently provided service-dealers with two handy, indispensable product portfolios, each covering an important phase of the dealer's business. First of these portfolios, "JFD Indoor Antennas", presents reference material on a complete line of 10 different types of indoor antennas. The second portfolio is a comprehensive presentation of JFD UL approved Lightning Arresters, covering eleven different types. For details, check A29.



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Designed TO INCLUDE ALL THE BIG FEATURES
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TRADE LITERATURE

[from page 25]

your neighborhood EICO distributor—or write directly to EICO, 84 Withers St., Brooklyn 11, N.Y.

Servicing TV Sweep Systems, by Jesse Dines explains the operation of television-receiver sweep systems, and providing step-by-step methods for trouble-shooting and servicing them. Howard W. Sams & Co., Inc. publisher.

Deal Cord Stringing Guide is Volume 5 of the widely-used Howard Sams'

Dial Cord Stringing Guides. Consisting of 328 clearly-illustrated stringing diagrams, this volume covers receivers made from 1953 through mid-1955. It also contains a cumulative index of all five volumes.

"*Technical Apparatus Builders*", 109 Liberty St. New York 6, N.Y., released a new catalog, PR156, which lists its new line of DC Power components, "TABTRON" Selenium Rectifiers, DC Power Supplies, "TABTRON" Chokes and Transformers.

A new eight-page brochure ECG-95 containing condensed specification and rating data on transistors and rectifiers

has been published by the Semiconductor Products Section of the *General Electric Company*. The new brochure or individual specification sheet may be obtained free of charge by writing to Semiconductor Products Section, General Electric Company, Electronics Park, Syracuse, New York.

Todd-Tran Corporation, 156 Gramatan Avenue, Mt. Vernon, N.Y., has released for distribution complete, new, authentic *replacement guides* for the CBS and Emerson lines of television sets. These sheets are 100% complete and up to date, and list all Todd authentic replacements for the original manufacturers' yokes and flybacks. Copies are available to the trade, free of cost, upon request.

A 16-page booklet dedicated to the future of community television has been printed by Entron Incorporated, of Bladensburg, Md., consulting engineers, pioneers in the CT industry and leading designers and manufacturers of fine electronic equipment, master and community television systems. Copies are free upon request.

Requests for the booklet should be addressed to Entron Incorporated, P.O. Box 287, 4902 Lawrence St., Bladensburg, Md.

John F. Rider Publisher, Inc., 480 Canal Street, New York 13, N.Y., announces the printing of a new fall-winter 1955-56 *catalog*, which lists and describes all of this organization's books on electronics, television, high fidelity, radio, electricity, and related technical sciences. Copies are available to anyone making request for same.

The *James Vibrapowr Company* offers a new *12 Volt Vibrator Replacement and Servicing Guide*.

The new James Replacement Guide outlines equivalent models for all 12 volt system cars. Included as part of the guide is a useful service bulletin. These new Guides are available through parts distributors or by writing directly to the James Vibrapowr Company, 4050 N. Rockwell St., Chicago 18, Illinois.

"*Guide to High-Fidelity Loudspeaker Systems*" has been issued by *Electro-Voice, Inc.*, Buchanan, Michigan.

This comprehensive booklet tells about the importance of the loudspeaker in any home music center and provides basic facts on how to choose a loudspeaker system for fullest enjoyment of high-fidelity music reproduction.

Hi-Fi Loudspeakers and Enclosures by Abraham B. Cohen. Loudspeakers are discussed in step-by-step detail, from



The Solution to Your Troublesome INTERMITTENT Problems!





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... monitors circuits without attention

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NEW for Television and Industrial Use

Performs 4 basic functions:

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basic principles through the variations which make for specialized high efficiency; high quality tone reproduction. Technical terms and names are explained and their meanings fully covered, as are multi-speaker information and crossover networks. *John F. Rider Inc., publisher.*

Television—How It Works (2nd Edition) by *J. Richard Johnson*. The present volume is a completely rewritten work, and the text covers the latest circuits and principles applied to TV receivers. The sequence of its contents is arranged so as to clearly explain the progress of the received signal, from the antenna to the picture tube and loud-speaker. The work is profusely illustrated for greater clarity of understanding. *John F. Rider, publisher.*

Ram Electronics Sales Company, Irvington, New York features a complete *catalog* and *service manual* on its transformers, yokes, linearity and width coils, etc., for a large number of current TV receivers. For additional information write *Ram Electronics Sales Company*, Irvington, New York.

A new *catalog* by *Channel Master Corp.*, Ellenville, New York provides information on its line of "Standout" insulators for TV antenna installations. For further information write direct to *Channel Master*.

Allen B. DuMont Laboratories, Inc., Tele Set Service Department, 760 Bloomfield Avenue, Clifton, New Jersey provides a new "Fix Faster" booklet on its RA 340-341, 342-343, 350-351 and 352 TV receivers. This booklet provides pictures as symptoms and corresponding receiver techniques in addition to pre-set control adjustments for these various receivers in a very interesting fashion.

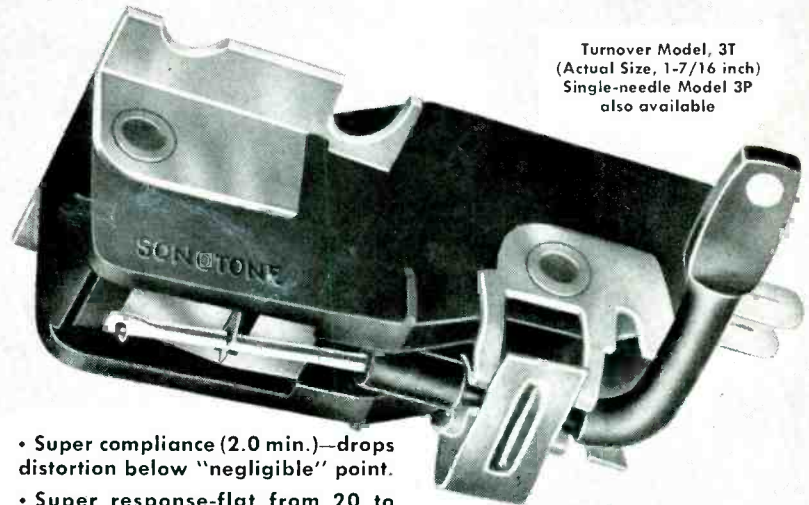
Vaco Products Company, 317 East Ontario Street, Chicago 11, Illinois makes available a new *catalog*, SD 56, on their line of hollow shaft nut drivers, screw drivers, pliers, wood chisels.

Rogers Electronic Corp., 49 Bleecker Street, New York City provides a *catalog* on their deflection yokes, flyback transformers and coils and combines this with circuit information on their installation.

Blonder-Tongue Laboratories, Inc., 526-36 North Avenue, Westfield, New Jersey makes available a new *catalog* on their amplified TV distribution systems. Also available is a booklet entitled "TV for 2, or 3, or More," which is a brief introduction to signal distribution of multi-set TV systems.

Give customers "hi-fi satisfaction" —profitably!

THE BRILLIANT NEW "3" SERIES SONOTONE CERAMIC



Turnover Model, 3T
(Actual Size, 1-7/16 inch)
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- Super compliance (2.0 min.)—drops distortion below "negligible" point.
- Super response—flat from 20 to 15,000 cycles, without equalization.
- Makes pre-amplifiers and equalizers obsolete.

If you've followed the development of ceramic cartridges since Sonotone pioneered them in 1946, you know of their enormous advances.

Now Sonotone presents the "3" Series, which sets utterly new standards of performance and opens the door to profitable "hi-fi" business for you.

The Sonotone "3" Series ceramic cartridge can be used as a replacement in nearly any phonograph circuit. It delivers a brilliance and clarity of sound which will be noticed and commented upon by delighted customers. Because these cartridges deliver a whopping 0.5 volts (roughly 50 times as much as most velocity types), they do not need preamplification and equalization circuits. And naturally the non-magnetic structure eliminates motor hum.

There are two basic models, a turnover (3T-S) for all record speeds and a single-needle model (3P-1S) for 33 and 45 rpm records. They have standard 1/2 or 5/8 inch mounting centers and fit any of the widely used tone arms. Prices begin at \$12.50 list (sapphire needles).

Use the brilliant new Sonotone Series "3" on your next replacement job. You'll find yourself on the way to profitable "hi-fi" business.

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Write Department CD-26 for free cartridge replacement chart.
In Canada—Atlas Radio Corp. Ltd., 50 Wingold Ave., Toronto.

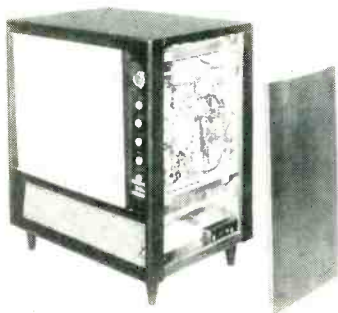
SION tube tester and form number of their present roll chart, when they initially subscribe for the service. All inquiries should be addressed to Precision Apparatus Company, Inc., 70-31 84th Street, Glendale 27, L.I., N.Y. Att: Tube Test Data Dept. Applications should include check or money order for the annual fee of \$2.00.

A practical method of visual tube inventory control—by which a service dealer can keep his tube needs literally at his fingertips—has been developed by the General Electric Tube Department. This new system, called the "See-Lect-a-Tube" method, now is available to radio and television service dealers through authorized G-E tube distributors. The system was developed after careful study of the number, types and



sizes of tubes most dealers keep in stock for replacement. It features dispenser units which hold 250 tubes in less space than any method previously devised. In addition to providing easy inventory control, the "See-Lect-a-Tube" method solves the heretofore unmastered problem of how to keep tubes stacked neatly and in logical order. The system can be used for over-the-counter sales or service bench work.

This exploded view of the 21-inch color television receiver manufactured by Hoffman Radio Division, Hoffman Electronics Corporation, reveals the complete accessibility of the chassis featured in all Hoffman color sets. By simply removing two wing nuts, the



entire side panel is easily removed to facilitate servicing. The removable panel feature enables the serviceman to perform all of the common servicing tasks without having to remove the chassis from the cabinet, and is also valuable for a field training program such as Hoffman has been conducting. Another aid to the serviceman, used on the Colorcasters as well as all Hoffman black-and-white sets, is a complete schematic diagram glued to the inside of the back panel for permanent reference.

JFD Manufacturing Co. Inc., and Channel Master Corp., have settled their differences and have agreed to license each other under their respective patents. JFD has also taken a license from Channel Master Patent Corp., under its patents, including Lo patent No. 2,691,730 covering the Channel Master CHAMPION antenna and the JFD DODO and SUPER DODO antennas.

A spokesman for the Board of Directors of Astron Corporation, 255 Grant Avenue, East Newark, New Jersey, recently announced the election of Mr. Joseph Frank as the company's new president. Also announced was the appointment of Mr. I. I. Ser to the position of company Sales Manager.

Admiral Corporation announced that it had taken the first step toward transistorizing its television receivers. According to Ray De Cola, director of engineering, the company has developed a tiny selenium phase detector that is replacing a vacuum tube (6AL5) in its TV sets. Unlike a tube, the selenium phase detector does not create heat and is practically indestructible, De Cola said. It consists basically of a small piece of selenium metal encased in a protective plastic covering. A member of the transistor or semi-conductor family, it holds a TV receiver in horizontal synchronization.

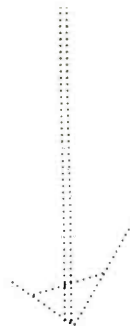
Mr. Jack M. Gutzeit, Chief Field Engineer of Rogers Electronic Corp. of New York will lecture throughout the United States on the proper method of "Sweep Circuit Trouble Shooting." The Forum will consist of three parts:

1. Theory and design of sweep circuits.
2. Trouble shooting techniques.
3. Question and answer period.

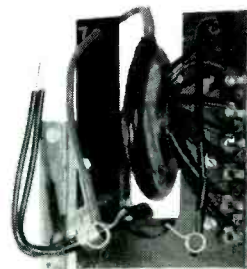
ANSWERMEN

[from page 42]

receiver turned off more than likely there is a short in a tube that does not show until the receiver is turned



MERIT, first in exact and universal replacement transformers, yokes, coils—the only manufacturer of transformers, yokes and coils who has complete production facilities for all parts sold under their brand name.



HVO-43 FOR EXACT REPLACEMENT IN AIRLINE, GAMBLE-SKOGMO, MONTGOMERY WARD, HUDSON, TELECRAFT, ARLINGTON, FAIRMONT, TRUETONE, CORONADO, WELLS-GARDNER... USED IN OVER 25 MODELS AND CHASSIS. Another in the complete MERIT line of exact and universal replacements—the only single source for all your transformer and coil requirements.

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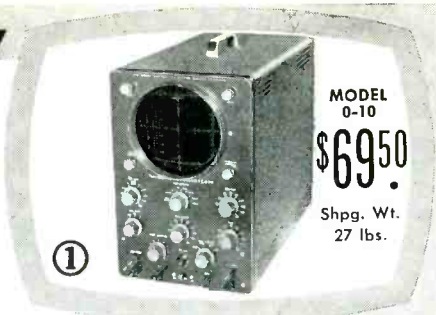
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① Check the outstanding engineering design of this modern printed circuit Scope. Designed for color TV work, ideal for critical Laboratory applications. Frequency response essentially flat from 5 cycles to 5 Mc down only 1½ db at 3.58 Mc (TV color burst sync frequency). Down only 5 db at 5 Mc. New sweep generator 20-500,000 cycles, 5 times the range usually offered. Will sync wave form display up to 5 Mc and better. Printed circuit boards stabilize performance specifications and cut assembly time in half. Formerly available only in costly Lab type Scope. Features horizontal trace expansion for observation of pulse detail — retrace blanking amplifier — voltage regulated power supply — 3 step frequency compensated vertical input — low capacity nylon bushings on panel terminals — plus a host of other fine features. Combines peak performance and fine engineering features with low kit cost!



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Heathkit TV

SWEEP GENERATOR KIT ELECTRONIC SWEEP SYSTEM

② A new Heathkit sweep generator covering all frequencies encountered in TV service work (color or monochrome). FM frequencies too! 4 Mc — 220 Mc on fundamentals, harmonics up to 880 Mc. Smoothly controllable all-electronic sweep system. Nothing mechanical to vibrate or wear out. Crystal controlled 4.5 Mc fixed marker and separate variable marker 19-60 Mc on fundamentals and 57-180 Mc on calibrated harmonics. Plug-in crystal included. Blanking and phasing controls — automatic constant amplitude output circuit — efficient attenuation — maximum RF output well over .1 volt — vastly improved linearity. Easily your best buy in sweep generators.



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on and the vacuum tube becomes active. There are exceptions to any servicing procedure. However, by following the above practice it is rarely necessary to break into a B plus feed line to determine in which lead the short is occurring.

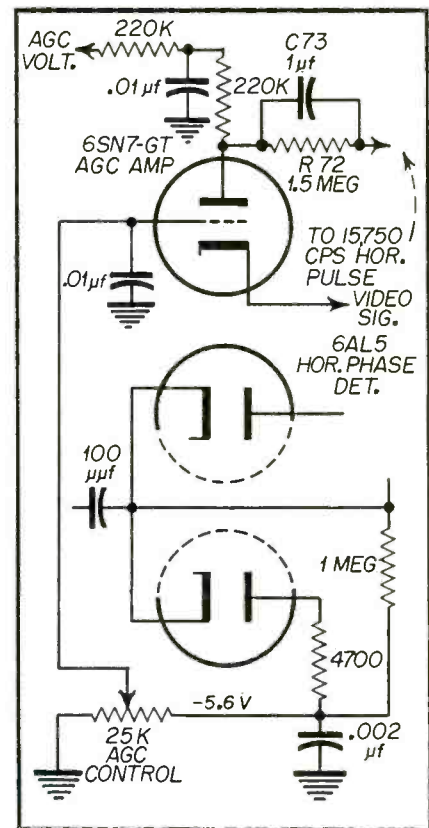


Fig. 2—Partial schematic of Zenith 22H20 agc circuitry.

Dear Sir:

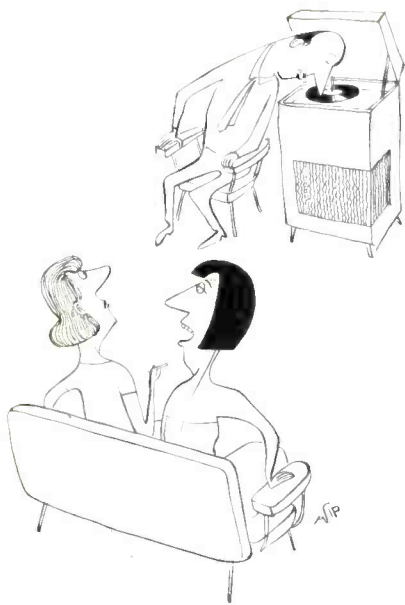
I have a Zenith chassis 22H20 that has a peculiar type of trouble. The picture does not fine tune properly in that it is overdriven at some points of the tuning and at others it has what appears to be very coarse snow such as might be seen with a very weak signal. There is a loud accompanying buzz in the audio and the picture exhibits a small amount of picture pulling.

I have gone over the agc circuit and the other possible circuits to no avail. I wonder if you might have run into such a complaint.

F. P.
Philadelphia, Pa.

The first examination to be made should be of the agc control. This potentiometer, R501, 25K as shown in Fig. 2 should be checked for possible poor action or adjustment and should be measured.

The difficulty that too often arises is that the technician who must service all makes of TV receivers and who is not too familiar with a particular type



"He does have a nose for good records, but you must try a JENSEN NEEDLE."

might not realize that an *age* control is employed in the chassis. The control is sometimes not marked on the rear apron. In this schematic it is located in the horizontal phase detector circuit where a technician is not likely to suspect an *age* pot to be positioned. Of course, if the circuit is traced carefully it will be found; but since it is dissociated physically and pictorially so far from the *age* amplifier it is often assumed that the chassis does not contain an *age* adjustment. If the control had been indicated at the rear the problem most probably would not have arisen. Of course, this is the type of thing that need only come up once, after which the technician is careful not to allow it to happen again. This is in the same category as troubles that are caused by tubes where the particular defective tube isn't checked until hours of troubleshooting have been wasted.

Most probably adjustment of the *age* control will remedy the difficulty in this Zenith chassis. Often the TV receiver owner meddles with adjustments on his set resulting in misadjustment of many of the controls. Also, with the aging of the receiver the control may require readjustment. Correction of the same symptoms in other manufacturers' chassis always requires investigation into the possibility of this type of misadjustment.

When making this adjustment the *age* potentiometer is turned to a position slightly below the point where distortion in the picture and buzz in the sound is introduced. This adjustment should be made on the strongest channel to be received.

The circuit employs a negative voltage at the horizontal phase detector as a bias voltage for the grid circuit of the *age* amplifier. Adjustment of the *age* control sets the level of conduction in the tube for the horizontal sync pulses supplied to the cathode against the horizontal pulses coupled to the plate from the horizontal oscillator. The amount of conduction that occurs when these two pulses are in phase is a function of the amplitude of the horizontal sync pulses from the video circuit and the bias adjustment, the horizontal voltage supplied to the plate being of constant amplitude. Conduction in the tube causes the .01 μ f condenser, C73, to take on a negative charge proportional to the signal strength received. This current as it discharges through the 1.5 megohm resistor develops a negative voltage at the plate side which as a bias voltage is fed to the *if* and *rf* amplifiers.

However, considering the problem from another angle, if the *age* control has little or no effect on the symptoms, check the 33 μ f condenser, C74. If the trouble is not due to this condenser

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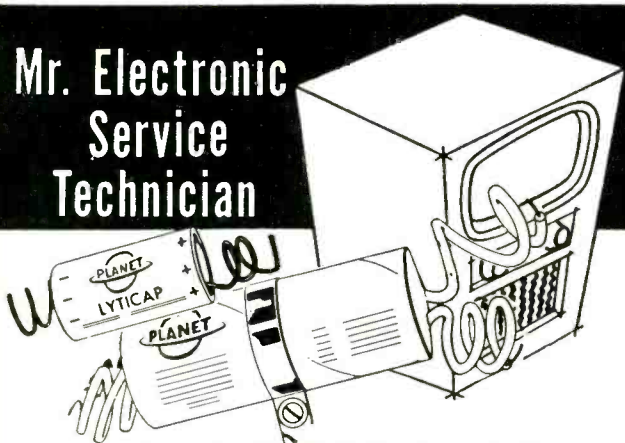
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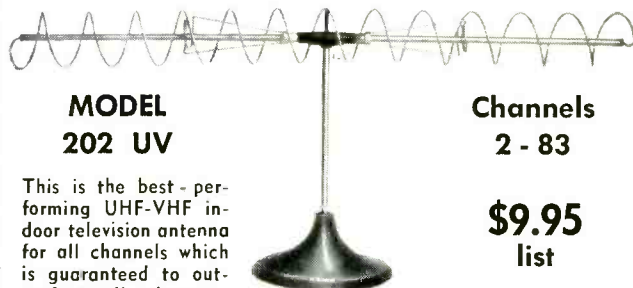


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being defective, test the 470 μ f coupling condenser C57 from the mixer circuit in the tuner to the input rf grid and C73, the .1 μ f condenser with its shunting 1.5 megohm resistor, R72.

Failure in any of these components can bring about agc overload and its accompanying symptoms. In the event that they are found to be in good condition replace the video detector crystal.

PRINTED CIRCUIT SOLDERING

[from page 23]

tinning the soldering iron or gun.

(3) Apply the iron to that point of the circuit where it is desired to unsolder the wire and as soon as the solder melts, pull the wire from the other side of the chassis.

(4) If, when the wires of the component are withdrawn, the hole in the circuit becomes filled with solder, then it should be cleared by applying the iron again and pushing through with a twisting motion, a needle or a fine



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picce of iron wire which will not tin easily. This is then withdrawn whilst the solder is still molten so that a clear hole is left, through which the wires of the replacement component must be placed.

(5) Having removed the component which it is desired to replace, use the wires from the defective component as a pattern for trimming the wires of the

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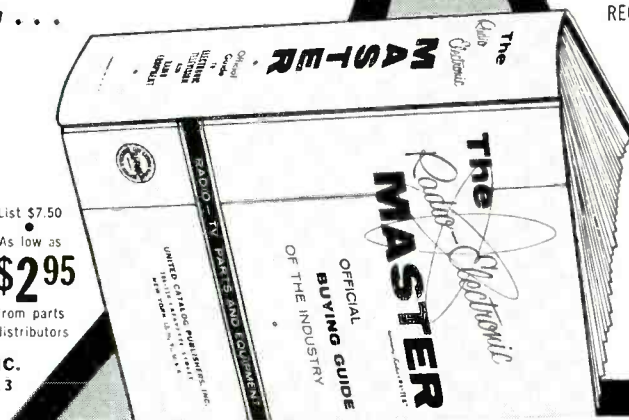
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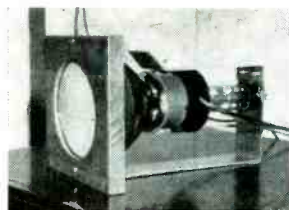
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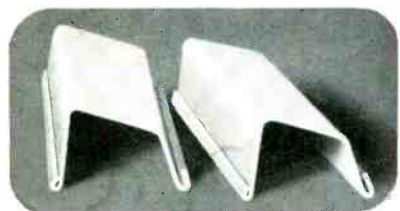
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replacement component to the same length and if necessary, bend them to the same shape.

(6) After the wires of the replacement component have been passed through the holes, they should be bent over at right-angles and a small quantity of the solder should be applied simultaneously with the iron. It might be thought that if there is plenty of solder on the circuit, there is no necessity to apply further solder. It must be emphasized that this is absolutely essential for it is inevitable that the wires from the replacement component will be oxidized and the flux from the solder must be used in order to overcome this oxidation and possibly oxidation that has formed on the old solder on the circuit of the chassis.

PHONO PICKUPS

[from page 10]

The frequency response is quite similar to that of the better crystal pickups. Some recent models however claim to give a flat response up to 15,000 cps.

The minimum required needle force, as with the crystal pickup, averages about 8 grams.

(To be continued)

FM TUNERS

[from page 20]

er. In this manner the direction to tune is easily and quickly determined according to the plus or minus frequency deviation indicated.

A tuning indicator of this type is shown in Fig. 8 and is employed in the

Harman-Kardon Model A400 tuner. As can be noted, in this partial schematic, when no signal is being received the voltage at the terminals of the meter measures 2.4 volts due to circuit design. This is for the condition of either no signal or a signal properly tuned in, and the meter needle indicates at the center of the scale zero deviation.

WORK BENCH

[from page 31]

R325, to pin #1 grid of 6CS6. The circuit constants, voltages, etc., are chosen so that any noise transients larger than the sync pulse will cause the tube to cut off, thus eliminating the possibility of noise pulses triggering the horizontal and vertical oscillators.

Knowing these facts a voltage check was first made at the plate and screen of the 6AM8 pins #6 and 3. The voltage at the screen measured correctly at about +140 volts, but the plate voltage measured incorrectly +270 volts instead of +175 volts. The B+ side of the 10K plate resistor R314 also measured about +270 volts. Obviously the tube was not conducting.

It was noticed at this point that R322, 270 ohms, the cathode resistor was burned. It was checked and found to be open. Resistor R322 was next replaced with a new 270 ohm resistor. But before turning the receiver on C311 was checked for voltage leakage as a possible cause of the defective R322. Condenser C311 checked OK. After checking a number of components we decided that the 6AM8 was the probable cause of the burned 270 ohm resistor. Therefore it was replaced. After checking the receiver for a num-

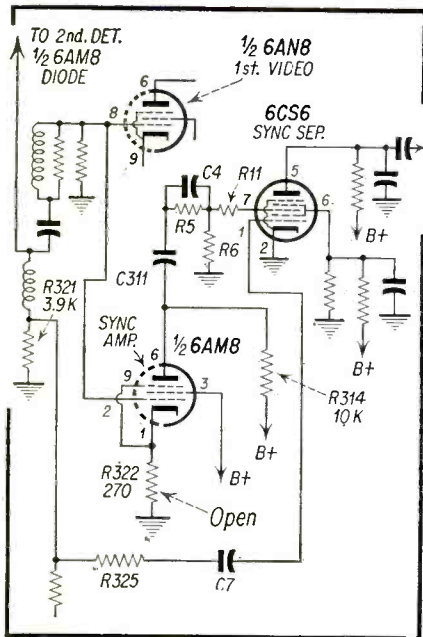


Fig. 2—Partial schematic of Philco TV 440.

ber of hours of satisfactory performance the receiver was sent back to the customer.

The 6CS6 is the answer to the manufacturer's problem of reducing the number of tubes in his TV receiver without impairing its performance. There is nothing mysterious in the operation of this tube. It simply does a job previously requiring two or more tubes and does the job well. It is a sync separator, sync clipper, sync amplifier and an effective noise gate.

COLOR

[from page 28]

to zero and to adjust the control for zero correction voltage against the reference oscillator signal.

The phase detector diagram in Fig. 5 showed a single reference oscillator signal, and a pair of 180° out-of-phase burst signals being fed into the phase detector. Another type of phase detector diagram is shown in Fig. 6. Here, the phase detector receives a single burst signal and a pair of reference oscillator signals, each of the latter being displaced 90° from the burst signal. These phase relations are obtained by means of the quadrature transformer shown. Further discussion of this device will be taken up subsequently. The signal phase relations shown in Fig. 4 apply equally to the burst and reference signals applied to the phase detector shown in Fig. 6. Notice that the same nomenclature used in Fig. 3 is used in Fig. 6 except for the fact that E1 and E2 now refer to the reference voltages, and E3 is a single-ended burst.

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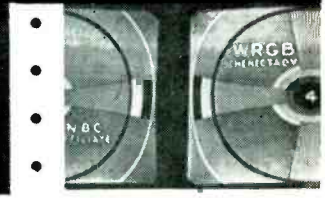
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CAUSE—Short in horizontal winding of Yoke.

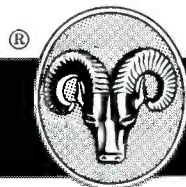


FAULT—Split picture.
CAUSE—Reversed AGC winding of H. Output Transformer; insufficient AGC voltage or reversed polarity.

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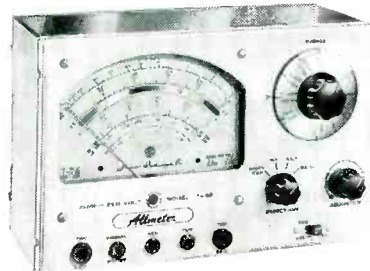
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1LC5	1.00	8AX5GT	.75	7W7	1.30
1LC6	1.00	8BA6	.65	7X7	1.00
1LD5	1.00	8BA7	.90	7Y4	.70
1LE3	1.00	8BC4	1.60	7Z4	.70
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5T4	1.75	8T6	.90	14R7	1.30
5U4G	.80	8U7GT	.75	15F7	1.25
5U4GB	.70	8VF5	.95	14W7	1.35
5U8	1.10	8SG7	.95	19B6G6	2.00
5V4G	.95	8SH7	.85	19T8	1.20
5V6GT	.70	8SJM	.75	25AV5GT	1.30
5W4GT	.80	8SK7GT	.75	25AX4GT	1.10
5X8	1.05	8SL7GT	1.00	25BK5	1.00
5Y3GT	.55	8SN7GTA/B	.80	25CD6GA	1.40
5Y4G	.65	8SR7	.75	25C6	1.35
5Z3	.90	8T8	1.05	25L6GT	.70
5Z4	1.25	8U8	1.05	25W4GT	.75
6A8GT	1.10	8V3A	1.30	25Z5	.80
6AB4	.65	8V6GT	.85	25Z6GT	.65
6AC5GT	1.15	8V8GT	1.30	35A5	.70
6AC7	1.10	8W4GT	.70	35B5	.70
6AD7G	1.55	8W6GT	.90	35C5	.70
6AF4	1.30	8X5GT	.55	35L6GT	.65
6AF6G	1.20	8Y4	.55	35W4	.45
6AG5	.75	8Z5	.95	35Y4	.70
6AG7	1.35	8Z6	.95	35Z5	.45
6AH4GT	.85	9A5	.95	41	.85
6AH6V	1.00	9A6	.80	42	.75
6AJ5	1.75	9A7	.85	43	.85
6AK5	.75	9A8	.80	5A5	.70
6AK6	.80	9B5	1.00	5B5	.70
6AL5	.60	9C5	.70	50C5	.70
6AL7GT	1.65	9D5	.80	50L6GT	.65
6AM4	1.55	9E5	.70	50X6GT	.90
6AM8	1.15	9F5	.80	50Y6GT	.80
6AN4	1.50	9G5	.80	50Y7GT	.80
6AN5	3.50	9H5	.90	70L7GT	1.55
6AN8	1.20	9I5	.80	117L7GT	.65
6AQ5	.70	9J5	.85	117N/P7	2.00
6AQ6	.60	9K5	1.20	117Z3	.70
6AQ7GT	1.20	9L5	.90	117Z4GT	1.15
6AR5	.75	9M5	1.20	117Z6GT	1.15
6AS5	.75	9N5	.85		
6AS6	2.25	9P5	.90		
6AS8	1.20	9Q5	1.20		

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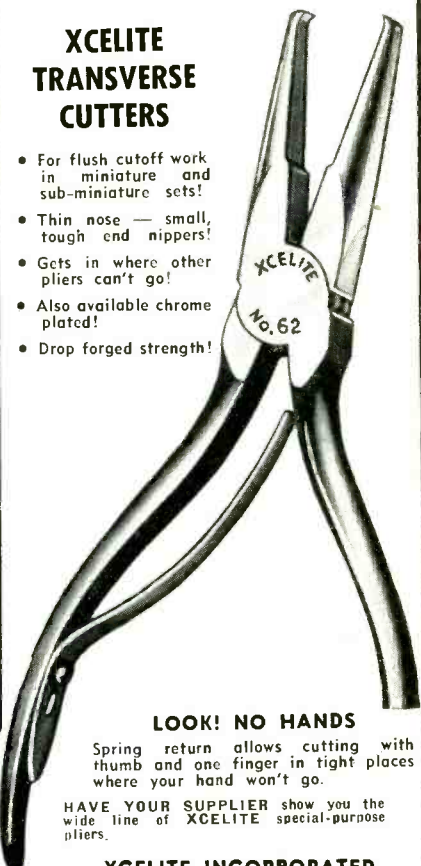
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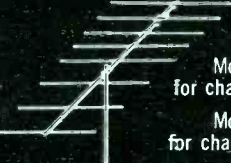
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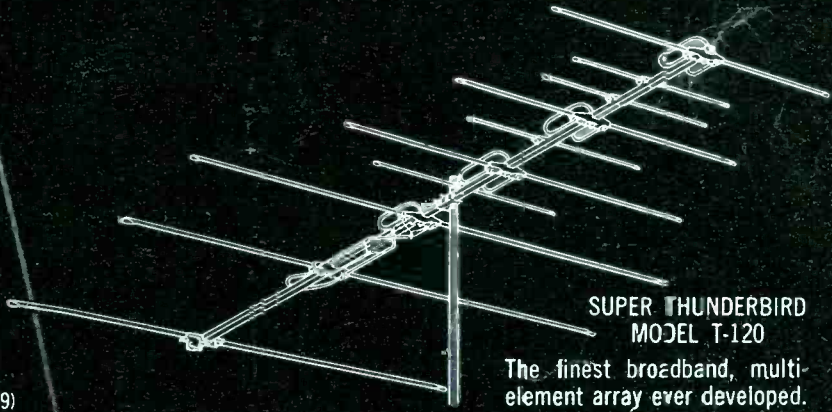
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