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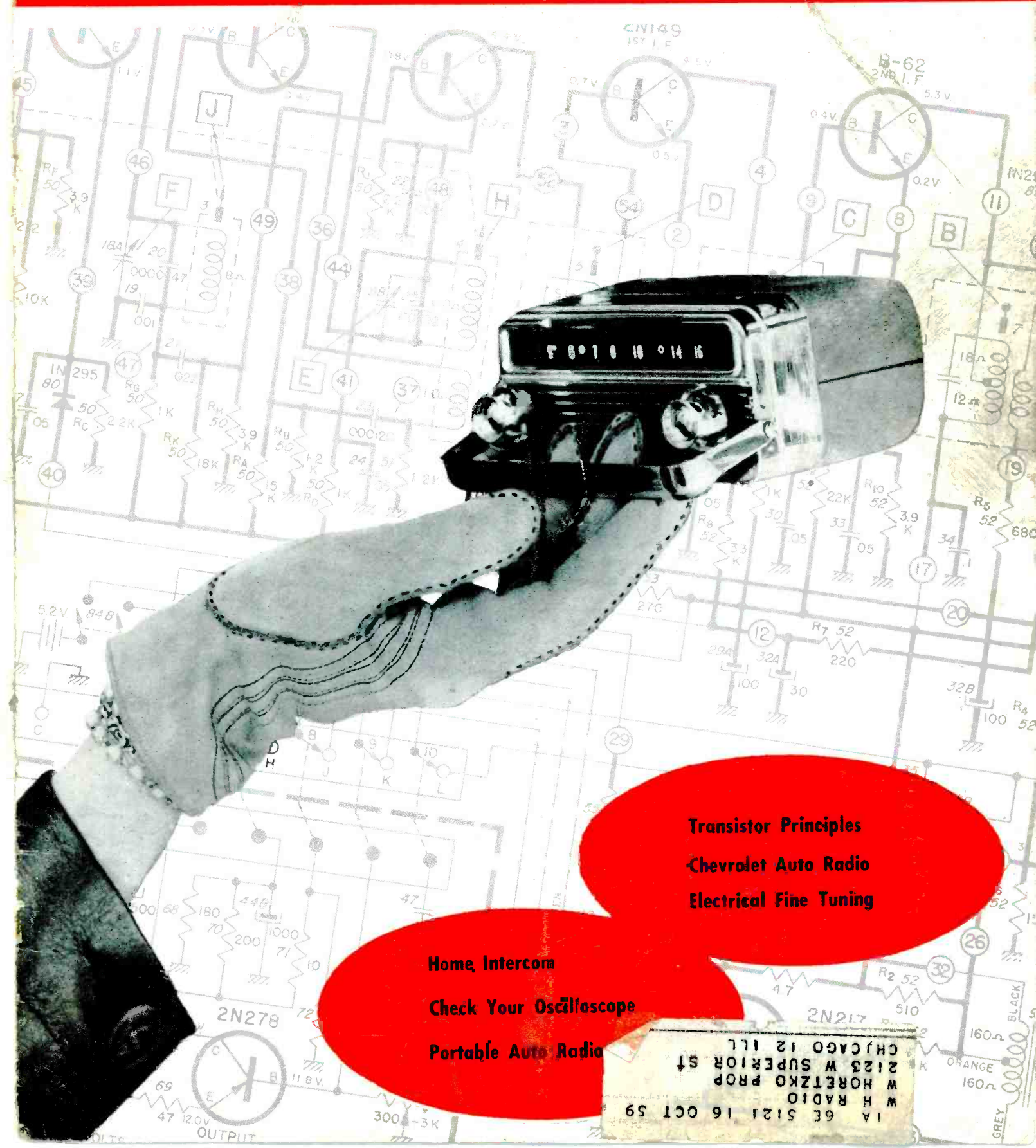

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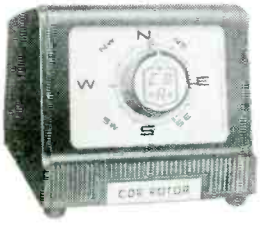

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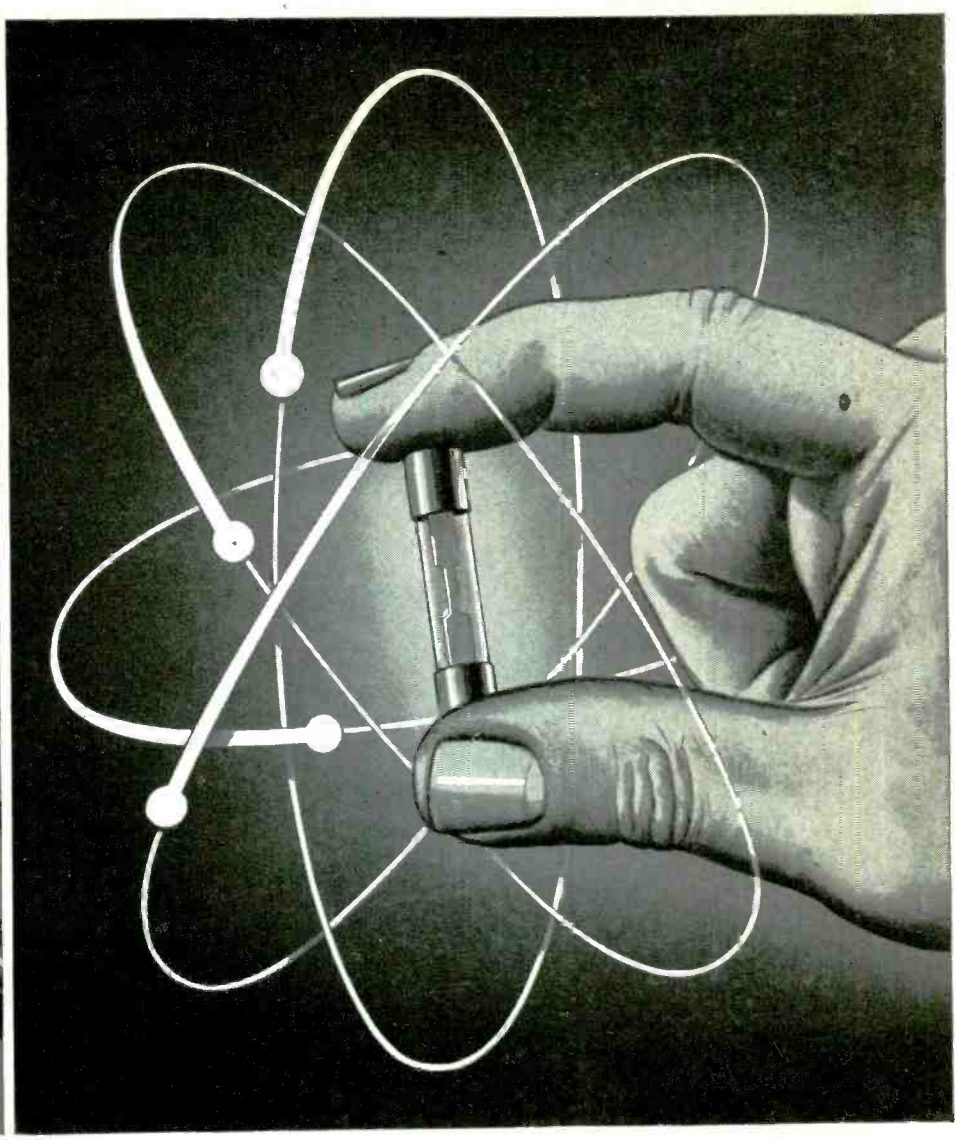

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Introduction To Transistor Theory

Part 5

by George Browne

In this installment, some of the processes used in the manufacture of transistors are discussed, along with the effect these processes have on transistor characteristics.

IN a broad sense transistors can be classified, from the point of view of construction, as point contact or junction types. In a point contact transistor the emitter and collector leads are sharpened to fine points and mounted in contact with the surface of a *p*-type or *n*-type semi-conductor wafer as shown in *Fig. 1A*. In a junction transistor the emitter, base and collector are arranged in sandwich fashion. *Fig. 1B* illustrates one type of junction transistor.

The great majority of transistors used today are of the junction type. This is because they are easier to manufacture and result in a product capable of being mass-produced with more consistent characteristics. Although point contact transistors were the first to be investigated and produced, their operation is not as well understood, and they are not as predictable as junction types. However, their operation involves many interesting principles relating to semiconductors which will be discussed subsequently. Point contact transistors are presently used in very limited applications. In this section we will first discuss junction transistors and then the point contact types.

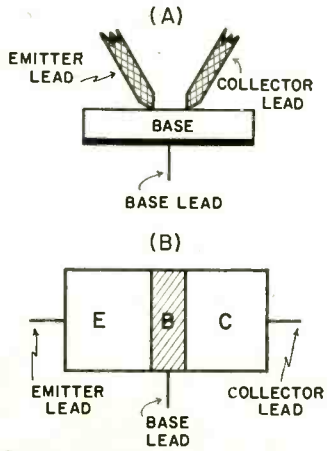

Fig. 1—Point contact and junction transistor construction.

Classification of Junction Transistors

Junction transistors in general consist of a large family of transistors which can further be classified as follows:

1. Alloy junction
2. Grown junction
3. Diffused base

Another type of transistor is the surface barrier type which has junction transistor characteristics, and which will be discussed later.

Transistors may be further classified in accordance with the following applications:

1. Audio
2. Power
3. RF

Manufacture of Alloy Junction Transistor

As a first step in the study of the alloy junction transistor we refer to the crystal pulling process described in the previous section where a single-crystal seed of an intrinsic semiconductor material is dipped into an *n*-type or *p*-type melt of germanium or silicon and slowly rotated, at the same time that it is withdrawn from the melt. The result is a cigar-shaped piece of *n*-type or *p*-type semiconductor depending on the type of doping used.

This cigar-shaped object is now sliced with a diamond saw into a large number of discs in the manner shown in *Fig. 2A*. Each disc is about 1 to 2 mils thick. The discs obtained in this fashion are then sawed vertically and horizontally in the manner shown in *Fig. 2B*. The result of this "dicing" is a large number of small wafers. In a typical product each measures approximately 10 mils square. Many thousands of these wafers may be obtained from a single grown crystal

The wafers obtained in the process just outlined are then mounted in a jig which contains a number of receptacles arranged in the manner shown in *Fig. 3*. In the manufacture of *p-n-p* alloy junction transistors these receptacles generally contain pellets of indium and *n*-type germanium. Of course any other *p*-type metal may be used. These pellets are positioned above and below each wafer, whereupon the jig is placed in an oven for heat treatment at about 530 deg. C.

Since indium melts at a lower temperature than does germanium, the indium pellets melt while the germanium remains in the solid state. The liquid indium then slowly diffuses into the *n*-type germanium. Careful control of temperature and time permits sufficient diffusion of the indium into the germanium to convert the *n*-type to *p*-type

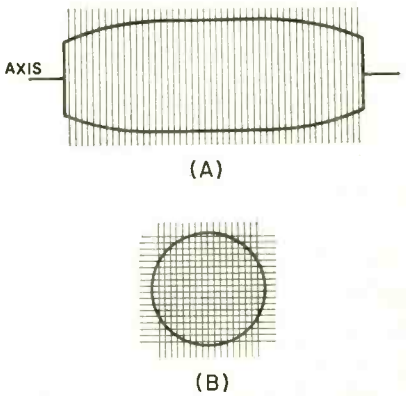

Fig. 2—"Dicing" is accomplished by slicing the crystal as shown.

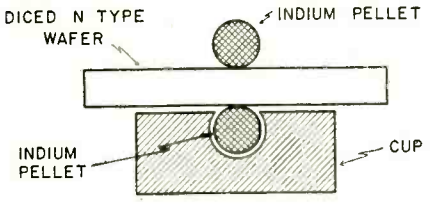

Fig. 3—Jig holding the transistor material prior to heating.

germanium in the areas near the indium pellets. These *p*-type areas are indicated by the shaded portions shown in *Fig. 4*. The unit is then "quenched" or cooled resulting in a *p-n-p* alloy junction transistor. This type of transistor may also be referred to as a "fused junction" or a "diffused junction" transistor.

It will be seen that this type of construction lends itself to the production of transistors with extremely thin base sections. A thin base, you will recall, is desirable for good high frequency response and for a high "alpha." As previously pointed out, however, the temperature and time must be accurately controlled. Too little diffusion will result in too small an acceptor concentration in both emitter and collector, and too wide a base region. Too much diffusion will cause the emitter and collector regions to merge, and thus short circuit through the base. This alloy layer is referred to as a "junction."

In the complete assembly leads are attached to the emitter, collector, and base. These leads are either fused or soldered to the different sections of the transistor.

Notice in *Fig. 4* that the collector area is somewhat larger than the emitter area. This construction is resorted to in order to assure collection of most of the carriers coming from the emitter. Carrier diffusion in general, takes place along a radial rather than a direct path, so that the larger the collector area the greater will be the number of emitter carriers going into the collector. Alloy junction transistors may be made for handling small or large signals.

Power Transistors

When used in computer switching or audio output stages, considerable power may be delivered and dissipated by the transistor. Unless this power is properly taken care of, the developed heat may injure the transistor.

To properly dissipate this heat the large signal transistor is built somewhat differently from its small signal prototype. *Fig. 5* illustrates the cross-section of a typical power transistor. Notice that the transistor itself is an alloy junction type. The collector and emitter areas, in this transistor, are larger than in the small signal device, this being necessitated by the larger current being handled. Heat developed in the collector is transferred by conduction from the collector to a metal body, through a thin insulating mica washer into a heat sink. The construction is such that the latter is generally mounted on the receiver chassis. Where additional heat transfer efficiency is required the metal case which enclosed the transistor may be fluted as illustrated in *Fig. 2* of the previous installment. (See page 6 November issue "Electronic Servicing").

High Frequency Considerations

It was previously pointed out that high frequency transistor operation may be improved by:

1. Reducing collector-to-base, and emitter-to-base capacitance.
2. Using low resistivity base material.
3. Keeping the base width as thin as possible.

Alloy junction transistors made in the manner just described, produce conditions in which the surfaces between the junctions are not smooth because of the very nature of the fusion process whereby one metal is alloyed into another. This is indicated in *Fig. 6*. Here we show, in an exaggerated manner how the process of fusion results in an irregular boundary between the alloyed metals. This results in different distances "W" at various points between the emitter and collector. This variation in base width affects frequency response. The effect becomes noticeable at high frequencies.

If the frequency of the incoming signal is high enough, that is if the wavelength is short enough, there may be considerable differences in transit time of signal carriers across the three paths W1, W2 and W3. In fact, the phase displacement produced by these time differences may be high enough to result in a reversal of signal phase along one path compared to that along another path. The resulting cancellation, due to out of phase components produces an attenuation of the total signal being transferred from emitter to collector. It is evident that if we can produce a transistor with a smooth planar surface along its junction, better high frequency operation will result. Such a transistor is the *grown junction* type now to be described.

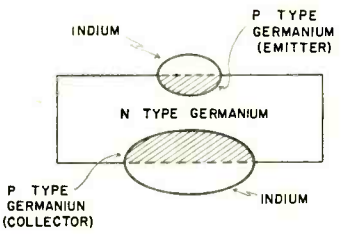

Fig. 4—Diffusion of indium into n-type germanium forms transistor.

Grown Junction Transistor

In the crystal pulling described in the previous section it will be recalled

[*Continued on page 44*]

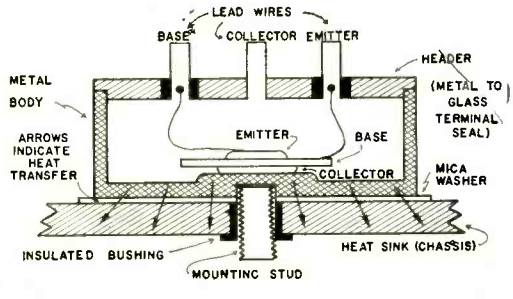

Fig. 5—Cross section diagram of a typical power transistor of the alloy junction type. Note the larger emitter and collector areas and the heat sink which are necessary to accommodate large currents.

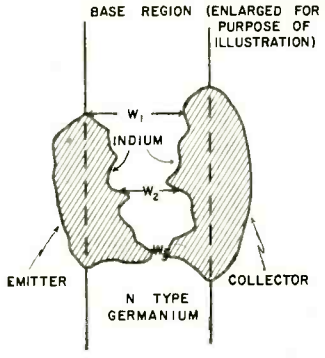

Fig. 6—Uneven junction surfaces result in poor high frequency response.

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The unit is housed in a sturdy black bakelite case with moulded, reinforced walls and corners. The handle, attached to the sides of the case, may be used to support the meter in a sloping position on the bench top.

DC Voltage Ranges

Voltage ranges from 0-250 microvolts up to 0-5000 volts are available in eight steps. The upper limit of 5000 volts may be extended to 25 or 50 *kv* by the use of special probes available from the Simpson Electric Co. Note that there are two *dc* positions on the function switch marked plus *dc* and minus *dc*. The two switch positions permit reversal of the test lead polarity without removing them from the circuit.

The *dc* ranges all have a sensitivity of 20,000 ohms per volt and an accuracy of plus or minus 3%.

AC Voltage Ranges

The *ac* ranges of the meter have a sensitivity of 5000 ohms per volt and they are divided into six ranges covering from 0-2.5 volts up to 0-5000 volts. The frequency response is essentially flat from 20 to 50,000 cycles per second.

In addition to the conventional *ac* ranges, the instrument provides an output meter connection for measurements where both *ac* and *dc* voltages are mixed. This jack places a blocking condenser in series with the measured *ac*. The blocking condenser reduces the frequency response of the meter in the output position only.

The same *ac* ranges are calibrated in decibels based on zero db being equal to 1 milliwatt across a 600 ohm line.

All the *ac* ranges are accurate to within plus or minus 5%.

Direct Current

The direct current ranges measure from 50 microamperes to 10 amperes divided into 6 scales. The polarity reversing action of the function switch operates for the current ranges as well as the voltage ranges. The accuracy of the current ranges is plus or minus 3%.

Resistance Ranges

Three resistance ranges are provided with a maximum range of 20 megohms on the R x 10,000 scale. The three ranges are:

R x 1	12 ohm center
R x 100	1200 ohm center
R x 10,000	120,000 ohm center

Five 1½ volt batteries are needed to operate the ohmmeter section. One size D cell is used to operate the R x 1 and R x 100 scales. Four additional size Z cells are needed for the R x 10,000 scale.

Maintenance

A most frequent maintenance problem encountered in any volt-ohm-meter is replacement of the ohmmeter batteries. The five batteries are made accessible by removing the four screws on the bottom of the case and slipping the unit out. The batteries snap into place and the polarities are marked on the mounting board.

Almost all of the components used in the meter are mounted on a printed circuit board, thus simplifying construction. To facilitate trouble shooting, the part number of each resistor is printed on the board, enabling you to locate each component without going through the difficult task of circuit tracing.

MOTOROLA TU546 PORTABLE TEST SET

SIMPLICITY of use is featured by a new, multi-purpose portable test set just announced by Motorola. A transistorized electronic *ac* voltmeter and a full view, 4", meter have been incorporated in the new test set. It is designed to facilitate the aligning and testing of all Motorola mobile and base station transmitters and receivers.

By combining the functions of a number of instruments into one compact set, this new test set greatly reduces the time and equipment required to service two-way radio units on the bench or in the field. Its various uses include those of a voltmeter, milliammeter, *rf* power output indicator, relative field strength meter, signal generator and crystal checker. In addition, it contains a built-in *pm* speaker for audio reception. The unit is very easy to use. Simply connect the test set to the radio set with the metering cable that is supplied and set the selector switch for the desired test reading.

Maximum reliability and minimum battery drain are assured by the use of long-life, trouble-free transistors. A transistorized audio frequency electron-

[*Continued on page 43*]

Electrical Fine Tuning

By George Kravitz

THE Westinghouse "Deluxe" Series of television receivers for 1958 feature a new electronic circuit—Electrical Fine Tuning (EFT). Westinghouse EFT provides this important advantage: The fine tuning control may be remotely located and wire connected to the receiver. The user of a Westinghouse Model H-985 Remote Control Unit may adjust the fine tuning control from the easy chair across the room. A conventional fine tuning control could not be used in this manner because of the capacity in the connecting lead. The fine tuning control, mounted on the receiver front panel, is also wire connected to the tuner. This arrangement eliminates the need for mechanical coupling to the tuner which is mounted at the rear of the chassis.

Fine Tuning Principles

To understand EFT, consider first the principle of the conventional and more familiar form of fine tuning.

The usual type of fine tuning arrangement consists of a small variable capacitor connected across the oscillator tank coil. This variable capacitor serves as a vernier adjustment to tune for best picture detail. When the capacity of the variable capacitor is made to change slightly, the oscillator frequency is changed slightly. Usually, the capacitor is mechanically adjustable, but it need not be. A fixed capacitor may be used in series with a variable resistor, *R1*, as shown in *Fig. 1*. (Electrical Fine Tuning equivalent circuit.)

If the resistance of *R1* is changed, the effective capacity of *C1* is changed. To understand why this is so, consider the resistor as being shorted (with the sliding arm at the top of the resistor). The full capacity will be across the oscillator tank coil, causing the oscillator to be tuned to a lower frequency. As the slider is moved down, inserting progressively more resistance in series with *C1*, the effective capacity is progressively reduced and oscillator frequency increases. Finally, if the resistance is made very high (practically an open circuit), the capacitor will have no effect on the oscillator frequency. Thus, frequency increases as series resistance increases.

Crystal Diode as Variable Resistance

Although a variable resistor is shown in *Fig. 1*, a crystal diode may be substituted, as shown in the simplified circuit, *Fig. 2*. The crystal diode may be made to act as a variable resistance by causing the crystal diode current to vary. If more current flows through the crystal, it acts as a low resistance. If less current flows through the crystal, it acts as a higher resistance. Current through the crystal is made to vary by changing the resistance of *R2* which represents a remote variable resistor. The crystal diode acts as a higher resistance (draws less current) as *R2* is made higher. As *R2* is made smaller, it loads the crystal, causing it to act as a lower resistance.

Principles of Operation

Referring to *Fig. 2*, the following questions may arise: What is the source of crystal diode operating voltage? Why does the variable load, *R2*, cause crystal current to vary?

Positive crystal diode anode voltage is provided by the positive alternations (half-cycles) of oscillator *rf* voltage. When oscillator voltage is applied, the crystal diode draws current when its anode is positive with respect to its cathode. This voltage is applied through *C2*. Condenser *C2* charges to the polarity shown in *Fig. 2*. Assume that no discharge path exists for *C2*. Under this condition, *C2* will hold a fixed negative charge on the crystal diode anode. When *C2* becomes fully charged, the crystal diode is cut off. Why? Because no current will flow through the diode until the voltage on its anode becomes more positive with respect to its cathode. This will not happen if *C2* cannot discharge. Condenser *C2* receives a full charge and holds it. The applied oscillator voltage will equal this value, but will not *exceed* it. When a leak-off path is provided by *R2*, *C2* discharges through *R2* between alternations of applied oscillator voltage. Hence, the anode side of *C2* becomes less negative. The more *C2* discharges between alternations, the less cut-off voltage exists across the crystal diode and the longer the period of current flow through the crystal diode when positive alternations are applied.

In summary, a short time constant, which would be provided by a low resistance of *R2*, causes a rapid capacitor *C2* discharge. Under this condition, applied oscillator voltage exceeds *C2* charge (cut-off) voltage for a longer

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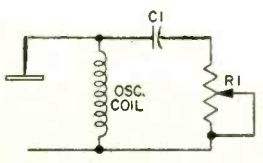

Fig. 1—Basic circuit demonstrating electrical fine tuning.

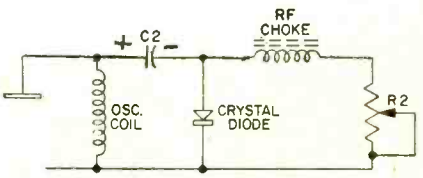

Fig. 2—Diode in this circuit acts as variable capacitor.

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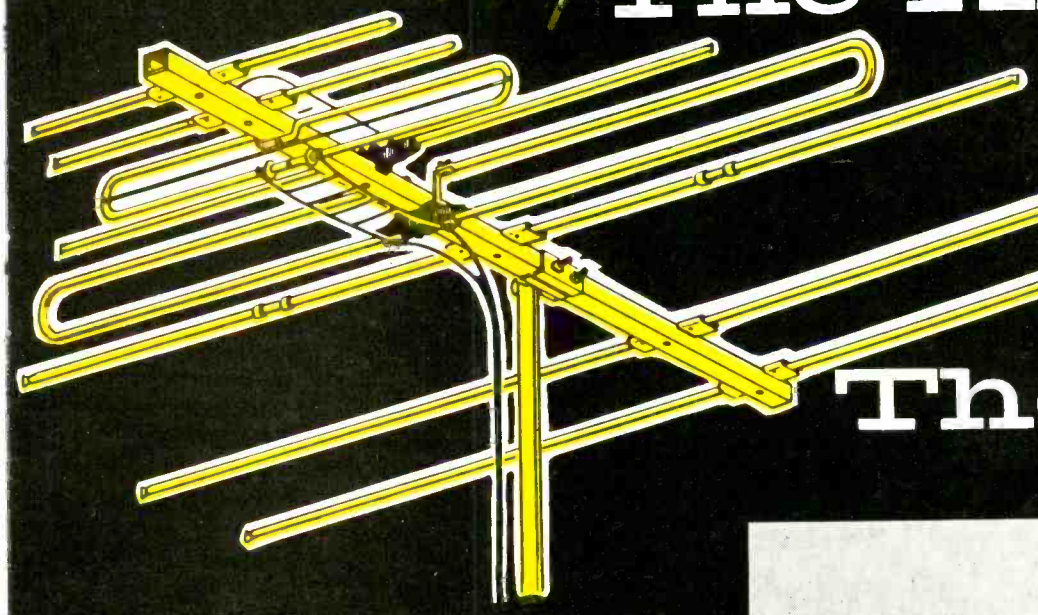

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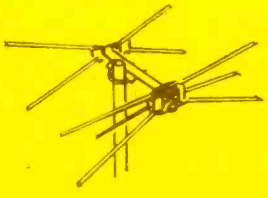

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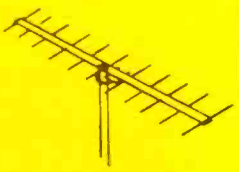

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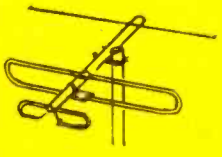

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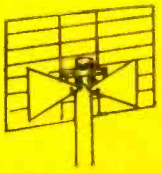

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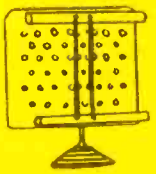

ANTENNA KITS

Auto Radios For 1957—Chevrolet

Servicing procedures, installation and removal notes, and structural features for these receivers.

by Andrew Doppel

TRANSISTORS, printed circuits and improved tuners all contribute to more compact, better performing auto radios offered for the 1957 Chevrolet. Four different models are offered for custom installation. Single and dual units, each with separate 6" x 9" eliptical PM speakers, compromise the radio group and all models interchange with all types of Chevrolet cars. Delco, a division of General Motors is the supplier.

Structural Features

The standard model, part #98757B is a single unit, five tube plus rectifier set. The custom deluxe model, part #987575 is also a single unit, five tubes plus 1 transistor. The custom deluxe #987693 is a two unit set with six tubes plus rectifier. The custom deluxe #987577, an electronic tuning set, has a circuit identical to the #987693 except for the addition of a 12AU7 with a circuit to trigger the automatic tuning feature.

The single unit sets and the tuner section of the two unit sets mount directly in the center of the instrument panel above the glove box. The power audio section of the two unit jobs mount on the right hand side of the instrument panel. The speaker, on all models mounts directly above the tuner section, below a grille on the top of the instrument panel. Manual or power antennas are available and mount on the front or rear fenders. Auxiliary rear seat speakers are optional. Five mechanical push buttons are standard on all models.

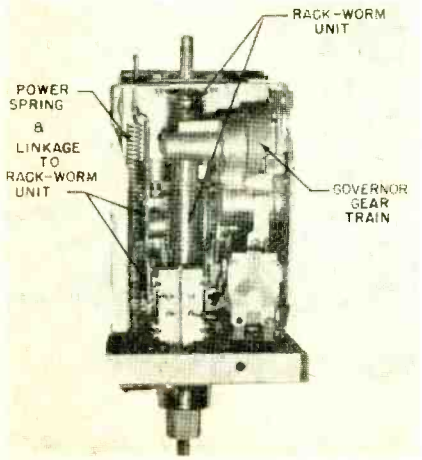

Fig. 1—Mechanical assembly used in the wonder bar tuner.

Removal Procedures (All Models)

1. With a short phillip's screw driver, remove the eight screws holding the glove box to the instrument panel, (do not remove screws holding the glove box door latch), push box forward, down and out.

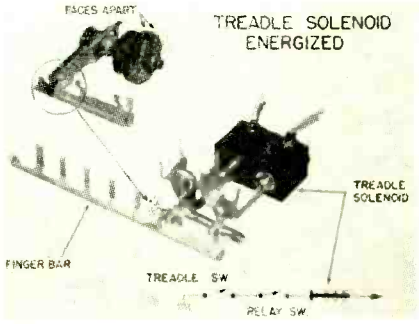

Fig. 2—Solenoids for power spring and operating treadle.

2. Remove the front panel control knobs and plates. (Knobs are push on type).
3. With 5/8" deep socket remove the two front panel mounting nuts.
4. Disconnect the antenna and speaker wires. If it is a two unit set, also disconnect the green wire and the three prong connecting plug. Remove the "A" plug connection.
5. With a 7/16" wrench remove the nut on the right hand side, holding the set to the mounting bracket, supporting the unit to prevent falling and bring forward, down and out.
6. If it is a two unit set, remove the two bolts holding the audio power pack with a 7/16" wrench and remove unit.

Speaker Removal

1. Remove the four nuts holding the speaker grille to instrument panel, and then remove the grille.
2. With a small screw driver, remove the four threaded bolts holding the speaker instrument panel and remove speaker.

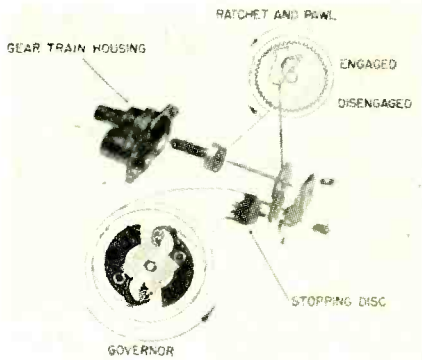

Fig. 3—The gear train makes up a compact unit. Note that the unit incorporates a governor.

Installation Notes

Conventional suppression is used throughout and no other precautions are necessary.

The antenna trimmer adjustment is located on the right hand side of the rear of the tuner unit. Adjust the trimmer for maximum volume with set installed. Turn volume on full and tune to a weak station between 600 and 1000 *kc* before adjusting.

To adjust push buttons it is necessary to:

1. Pull button to left and out.
2. Tune in selected station manually.
3. Push button all the way in.

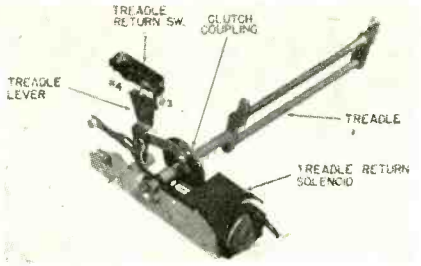

Fig. 4—Treadle switch and operational components.

Service Notes

The wonder bar tuner series F2 (see *Fig. 1*) for 1957 is entirely new, so some explanation as to its operation, testing and trouble shooting is essential.

Two solenoids are used (see *Fig. 2*). One is the power solenoid for cocking the power spring and the other is for the operation of the treadle. This moves the tuning cores in and out of the coils. The gear train has been redesigned to a more compact unit which also incorporates a governor (see *Fig. 3*). Separate power and treadle switches are used for better control and adjustment (see *Fig. 4 & 5*).

In bench testing a wonder bar set with the F2 tuner, it is important that a constant 12 volt supply be maintained for proper operation of the two solenoids. If a battery eliminator is employed a setting of 16 volts should be used to insure a constant 12 volts while the solenoids are operating.

If a bind is evident in the tuner it must be determined whether the bind exists in the rack worm assembly or the treadle core bar assembly. To determine this depress a push button far enough to disengage the clutch and with power on press the wonder bar. The rack and worm unit will now operate independently of the treadle, and if no bind exists, will operate smoothly.

With power off and a push button slightly depressed, test the operation of the treadle for bind.

[*Continued on page 36*]

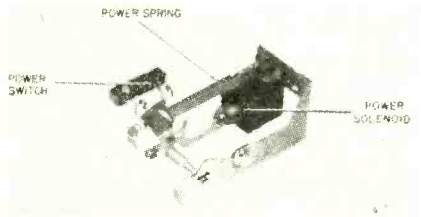

Fig. 5—Separate power switch used for better control.

THE ANSWERMAN

Mr. Answerman:

I have been asked to repair a Westinghouse V2311 TV chassis in which the vertical sweep is a little small. I would like to increase the height but don't know exactly which components should best be changed and by how much, so as to bring about additional height with proper linearity. Tubes and voltages have been checked and seem about normal. Would you have any suggestions?

M. O.
Miami, Fla.

As you probably realize, it is quite possible to have a normally operating set with small height when the line voltage is low as is sometimes found in small towns. A change of the following components will permit greater grid drive and greater vertical pulse amplification in the vertical output stage. By replacing the following components, shown in *Fig. 1*, the range of the adjustable height will be increased and the vertical linearity will remain normal. Increase the condenser *C403* from .02 *uf* to .047 *uf*. Reduce condenser *C405* from .1 *uf* to .033 *uf*. The positive voltage coupled to the charging condenser is then increased by reducing resistor *R415* in series with the height control from 4.7 to 2.2 megohms. Additional amplifications can be acheved in the vertical cutput stage by removing the bias generated by the cathode resistor, *R414*. Place a jumper across this resistor to effectively remove it from the circuit.

Dear Sir:

I have a receiver that presents a very snowy picture but with normal sound. If I adjust the *agc* control to correct for the snow condition, the picture becomes overdriven and distorted with pulling to one side. As far as I can see, the voltages are normal. The *agc* control action appears to be quite abnormal in that the picture goes immediately from a snowy to an overdriven condition with no middle setting possible. One aspect of the trouble is that when the receiver is turned on the picture is normal for about three or four seconds before it becomes snowy. The receiver uses an RCA KCS-97 chassis. Where can I look for the trouble?

J. L. A.
Brooklyn, N.Y.

Frequently, a service problem occurs in an *agc* system that is quite difficult to resolve. Waveforms are often helpful in service work but, in these cases, only prove what is already known—that the system is not functioning properly. A quick check might be to measure the *agc* voltage to the tuner and *if* stages from the points shown in *Fig. 2*. Again, this test also only shows that something is wrong.

Ordinarily, with an *rf* signal being received, as the *agc* control is adjusted an increasing negative voltage should be developed at the plate of the *agc* tube and applied to the different points to be controlled. More than likely, it will be found that the circuit does not produce an increasing negative voltage as the control is adjusted or produces too large a negative voltage.

The negative voltage developed in a *agc* stage is the result of the applied video signal, the *dc* potentials, and the pulse from the horizontal deflection system. The last two voltages can be easily measured. The applied video signal in the keyed *agc* system is more difficult to check since it is a result of the control achieved by the *agc* system.

One of the quickest methods of servicing this type of problem is to employ a bias box as a substitute for the *agc* voltage. The bias box can be adjusted so that the potential developed by the *agc* system is over-ridden by the bias box potentials and a proper bias is established. This will verify that the *if* circuitry and video amplifier system is capable of functioning properly when a proper *agc* bias is applied. It is then a matter of examining further, the *agc* system to determine the defective component, since it has been established that the other circuitry is capable of functioning properly when

[*Continued on page* 36]

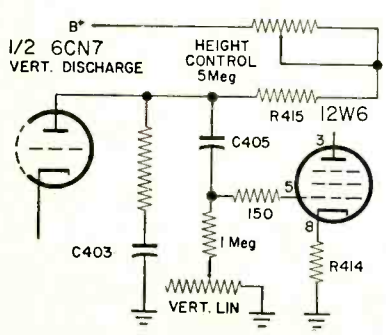

Fig. 1—Partial schematic of the Westinghouse vertical circuit.

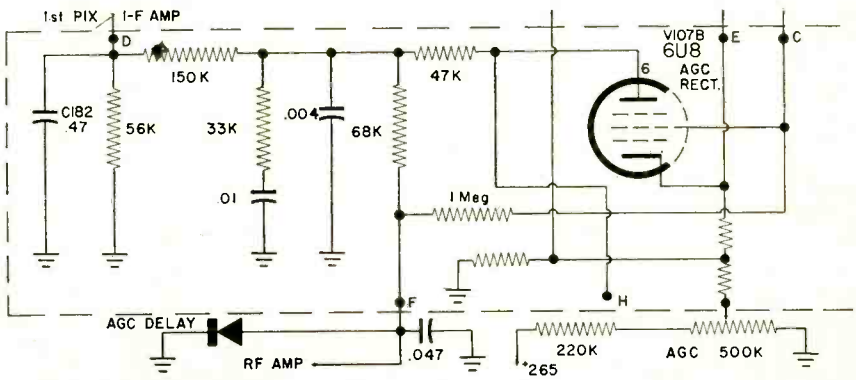

Fig. 2—Schematic of the *agc* stage, distribution network and delay circuit in the RCA KCS 97, which caused snow or distortion.

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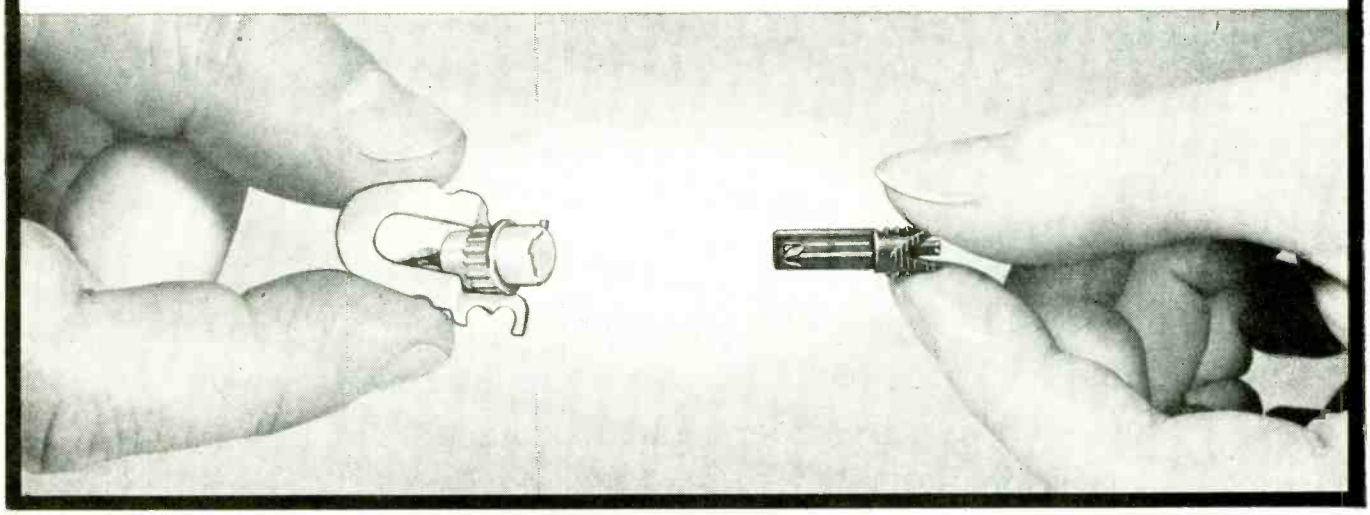

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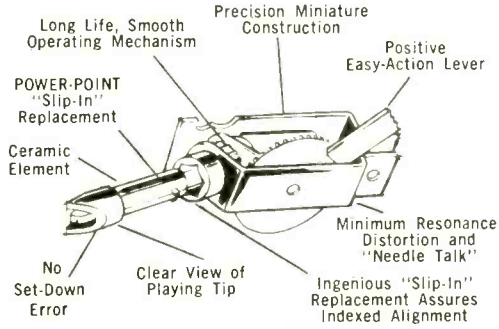

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Test Record RCA 12-5-49V.85 Volt Col. 10004M 1.75 Volt
PT1 Mount
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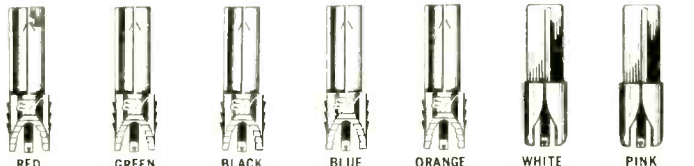

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NEW CASTLE
McGrath Radio & TV....207 Mills Way
PHILADELPHIA
Audio Service Co....131 North 10th St.
Lee Service, Inc.
N.E. Corner 40th & Walnut Street
Merit TV Sv.....6640 Ogontz Ave.
Radio Electric Service..112 N. 7th Street
Seattle TV & Radio..4672 Griscom St.
PITTSBURGH
Dealer's Radio Service....508 Chestnut
E. & M. TV Service.....3625 Butler
READING
George D. Barbey Co. 157 Penn St.
SCRANTON
Greene Radio Service.....405 Gibson
STRAFFORD
Boyd Radio Service 710 Lancaster Pike
WILKES-BARRE
Rad-Art Radio Service..13 Carey Ave.
WILLOW GROVE
Louis J. Smith Service Center 359 North York Rd.
YORK
Robert N. Tate.....802 So. Duke St.

SOUTH CAROLINA

CHARLESTON
Holst Radio Service Co. 428 Meeting Street
COLUMBIA
Colonial Radio & TV Shop 3207 Colonial Drive
FLORENCE
Tommy Ayers Radio Service 116 South Coit Street
GREENVILLE
Carolina Camera Repair 500 Rutherford St.

SOUTH DAKOTA

WATERTOWN
Jensin's Radio & TV Service 11 South Broadway

TENNESSEE

CHATTANOOGA
Northside Radio & Appliance Service 313 North Market Street
KNOXVILLE
Chemcity Radio & Electric Co. 2211 Dutch Valley Rd.
MEMPHIS
Denton Radio & T.V. Service 3515 Southern Avenue
NASHVILLE
Eddie's Radio & TV Co. 265 Hermitage Ave.

TEXAS

ABILENE
Howard Television Service..1511 Pine
AMARILLO
R & R Electronics Company 707 South Adams
AUSTIN
Friendly Radio & Television 119 Congress
BROWNSVILLE
Blackburn's...747 East Elizabeth Street
CORPUS CHRISTI
Harken Company..3001 Leopard Street
DALLAS
Bradley Radio-TV Service 912-914 North Peak Street
EL PASO
The Telectronix Company! 108 West Paisano Drive
FORT WORTH
The Cearley Company 517 Pennsylvania
HOUSTON
H&H Television, Inc....3307 Chenevert
Miller Audio Co. 4811 Gulf Freeway
LUBBOCK
Radio Lab.....1501 Avenue Q
NAVASTA
A-Z Television Service 1209 South La Salle Street
PORT ARTHUR
Carl's TV Co.....1816 Seventh St.
SAN ANTONIO
Spangler Radio & TV 322 Marquette Dr.
VICTORIA
Sam Niel TV Service...204 So. Moody
WACO
Radio Center Television..1813 Speight
WICHITA FALLS
Perry & Bob.....1104 Grace

UTAH

SALT LAKE CITY
Electronic Service & Supply 115 E. Broadway

VERMONT

RUTLAND
Vermont Television Service Co. 28 Allen Street

VIRGINIA

HARRISONBURG
Chew Brothers..242 East Water Street
NORFOLK
Bradshaw's T.V.-Radio Service 810 W. 25th Street
RICHMOND
Lakeside Radio Service 5101 Lakeside Avenue
ROANOKE
Wagner Electric Company 2902 Williamson Road, N.W.
STAUNTON
Southern Electric Corp. 818 Greenville Avenue

WASHINGTON

CLARKTON
Orin's Radio Service.....724 Sixth St.
SEATTLE
Seattle Radio Supply, Inc. 2117 Second Avenue
SPOKANE
Mu-Sonic Services 208 Symons Building
TACOMA
Ajax Electric Company 747 Faucett Avenue

WASHINGTON, D. C.

Emerson Radio of Washington 1522 - 14th Street, N.W.
National Radio & T.V. Co. 6902 Fourth Street, N.W.

WEST VIRGINIA

BECKLEY
Haddad's TV & Furniture Co...112 Main
CHARLESTON
Pierce and Sodaro 325 West Washington Street
HUNTINGTON
Cunningham Television Co. 3437 Piedmont Road
PARKERSBURG
General Electronics Distributors 512 Seventh Street
WHEELING
General Electronics Dist.....735 Main

WISCONSIN

APPLETON
Tri-City T.V. Service, Inc. 605 North Superior Street
EAU CLAIRE
Luarken's Inc. 315 North Barstow Ave.
GREEN BAY
Video-Electronics..1514 No. Irwin Ave.
KENOSHA
Clear Vue T.V. Specialists 6821 - 14th Avenue
LACROSSE
Numsen TV & Appliance Service 1804 Jackson Street
MADISON
Chic Young TV Engineering Service 2503 University Avenue
MILWAUKEE
Mr. TV.....5407 West Center Street
OSHKOSH
Ra-Tel Service, Inc...394 Ceape Street
SHEBOYGAN
Van's Radio & T.V., Inc. 1511 South 12th Street
WAUSAW
Day's Hardware & TV Service 1910 - 6th Street

TRADE FLASHES

Hoffman Radio Division, Hoffman Electronics Corporation, has reduced the price of its Solaradio, a solar-powered all-transistorized portable radio. The Solaradio, which was introduced earlier this year, contains silicon solar cells, manufactured by the Hoffman Semiconductor Division, Evanston, Ill. These cells convert the energy from the sun or from an incandescent light into electrical energy to power the radio. Rechargeable batteries inside the radio store the power for use at night, thus providing for virtually endless life.

• • •

A Four-Point Clinic Program which will provide the latest service information on transistors, tape recorders, high fidelity, and color television for the benefit of RCA Victor Distributor, dealer and independent servicemen, was announced by the RCA Service Company. The two-day clinics, to be held in scores of major cities throughout the nation, include slide projector lectures by the company's Commercial Service Field Representatives, and demonstrations and workshop sessions conducted by either the field representatives or individual Distributor Service Managers. Each serviceman attending the clinic receives a special service booklet covering each of the four consumer products demonstrated.

• • •

Setchell-Carlson, announced its new 1958 line of Unit-ized Television Receivers. The new line is composed of 17″, 21″, and 24″ TV Receivers. All receivers feature straight *ac* operation with full size power transformers and new ultra-efficient Silicon Rectifiers, new extra-sensitive Cascode Tuners (continuous all-channel *uhf-vhf* tuners available for all series), new short-depth 90° aluminized self-focusing picture tubes, "Filter-Ray" removable safety glass, and the exclusive Unit-ized Chassis design, which consists of a Master Chassis on which functional "plug-in" units are mounted. Each unit

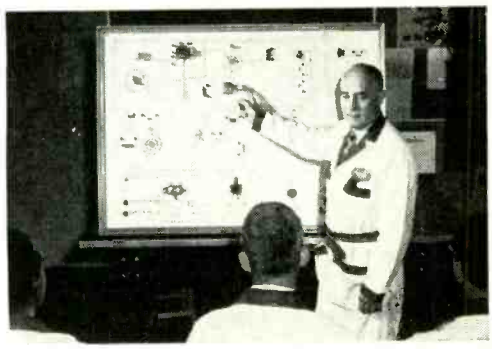
[*Continued on page* 44]

GUIDE

AUTRONIC-EYE®

TRAINING COURSES MEAN MORE BUSINESS FOR YOU!

Courses for experienced service technicians provide latest repair information—enable you to do the job faster and more efficiently.



Jumbo-size operational panel of Guide's Autronic-Eye Circuit puts all parts out front for better, more efficient instruction.

Quick, accurate circuit diagnosis and repair to factory specifications boosts your profits. That's why so many qualified auto technicians attend these Guide training courses at no cost other than transportation and living expenses.

The Guide Lamp diploma, awarded only to those who successfully complete the course, is proof that you're equipped to give more and better service to more people—and that means business.

If you're an auto radio service dealer, come yourself, or send your technicians. There's one of 30 GM Training Centers near you. Apply through your local United Motors Service Division Distributor or write

GUIDE LAMP DIVISION • GENERAL MOTORS CORP. • ANDERSON, INDIANA

Thirty modern GM Training Centers offer newest equipment and latest service techniques. There's one nearby . . . no matter where you live.

Check Your Oscilloscope Performance

by Robert G. Middleton

Part 3

International Director—Radio Electronic Television Schools

This concluding installment deals with the square wave technique in the analysis of oscilloscope performance

IN addition to the tests which have been described, the technician should check the *transient* response of his scope. The transient response concerns the ability of the scope amplifier to reproduce complex waveforms without introducing distortion in the form of *ringing and overshoot.*

Square Wave Testing

Square-wave signals are customarily used for checks of transient response. A typical good square-wave display is shown in *Fig. 1.* Before making square-wave tests, the following facts should be determined:

1. What is the *rise time* of the output from the square-wave generator?

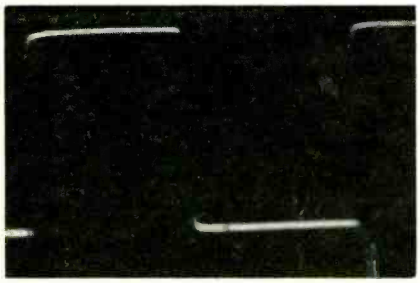


Fig. 1—Good frequency, phase and transient response.

2. Is the output from the square-wave generator free from *tilt* at low frequencies?
3. Does the output from the generator have *square corners* at high frequencies?

These are important considerations, because it is obvious that the accuracy of tests can be no better than the accuracy of the square-wave generator which is used.

If your scope has a bandwidth of 4 or 5 *mc,* the rise time of the generator must be 0.05 microsecond, or less, to obtain a useful test. On the other hand, it is undesirable to use a generator having extremely fast rise time, because the scope will "look bad" although it may be quite adequate for service work.

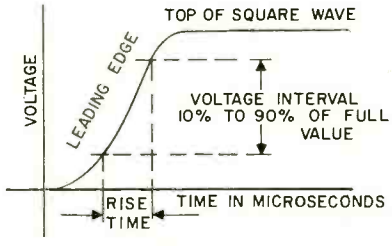


Fig. 2—Graphical representation of the meaning of rise time.

The meaning of "rise time" is illustrated in *Fig. 2.* The fraction of a microsecond required by the leading edge to travel from 10% to 90% of the total rise is termed the *rise time* of the square wave. Of course, a scope must have a fast triggered sweep if you wish to *measure* rise time. However, it is not necessary to measure rise time in the shop, because the ratings of generator manufacturers are quite reliable in this regard.

The rise time of common television receiver waveforms, such as shown in *Fig. 3,* are relatively slow. They are in the order of 0.08 microsecond, therefore a scope which reproduces a 0.05 microsecond square wave satisfactorily is quite adequate.

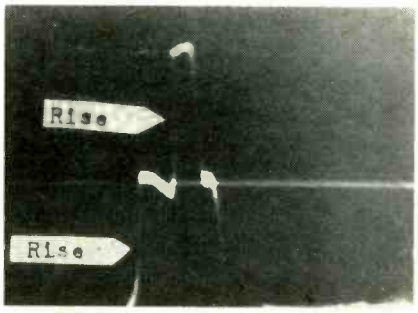


Fig. 3—Most TV signal and pulse waveforms have a rise time more than .08 microseconds.

Forms and Causes of Square-Wave Distortion

Ringing and overshoot, illustrated in *Fig. 4,* is termed *transient* distortion. The damped sine wave which is superimposed on the reproduced square wave is a spurious component. If a scope displays substantial transient distortion on a square-wave test, it is unsuitable, of course, for troubleshooting circuits which develop complex waveforms.

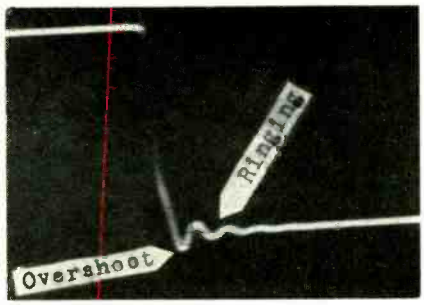


Fig. 4—Ringing produced by inadequate transient response.

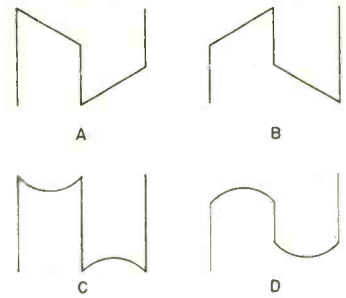


Fig. 5—Phase and frequency distortion produce above patterns.

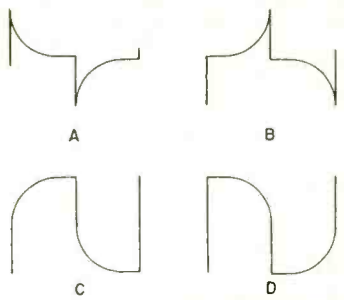


Fig. 6—Patterns when both types of distortion are present.

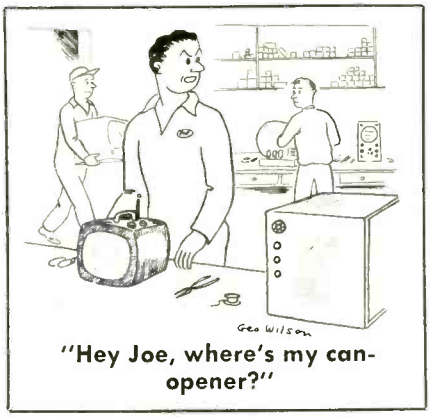
When transient distortion is encountered in a scope amplifier, it is usually caused by insufficient bandwidth, often accompanied by a rising frequency response—i.e., a frequency response which provides more output at high frequencies than at low frequencies.

Transient distortion can also occur in a scope amplifier if a peaking coil is under-damped, and causes a rise at some point in the high-frequency region of the response.

Frequency attenuation alone produces curvature in the tops of a reproduced square wave; while phase shift alone produces tilt in the top of the square wave, as depicted in *Fig. 5*. Of course, in practical circuit testing, simultaneous frequency attenuation and phase shift may occur, as illustrated in *Fig. 6*.

A coupling capacitor which is too small produces a low-frequency lag and attenuation. The result is shown in *Fig. 6B*. When the coupling capacitor is too small, its reactance is excessive at low frequencies, and a leading current flows through grid-leak *R*. But at high frequencies, the reactance of *C* is negligible and no phase shift occurs. There is also a low-frequency attenuation, due to the voltage-divider action of *R* and *C* at low frequencies (shown in *Fig. 7*). Otherwise stated, the coupling capacitor *C* and grid-leak *R* cause a *differentiating action* at low frequencies, although high frequencies pass through *C* without hindrance.

Next, let us take a look at *Fig. 8*. Here, we have series resistance feeding into shunt capacitance. When *C* is large, high frequencies are attenuated due to the voltage-divider action of *R* and *C*. Furthermore, the low-frequency voltage across *C* will lag. Otherwise stated, we have an *integrating circuit*, and the square-wave response appears as in "C" of *Fig. 6*.



"Hey Joe, where's my can-opener?"

Still other types of square-wave distortion are encountered in practical test work. For example, *Fig. 9* shows a case of *diagonal* corner *rounding* in a reproduced square wave. Diagonal corner rounding refers to the fact that one corner is rounded and the other is square at the top of the waveform — likewise, rounding and squareness are repeated along the bottom of the waveform.

It will be apparent that diagonal corner rounding is a situation basically similar to that illustrated in *Fig. 6C*, in which high-frequency attenuation and low-frequency lag are present. The difference is that in *Fig. 9*, *fewer* high frequencies are attenuated, which leaves most of the top portion flat.

Square-Wave Frequencies Used In Scope Tests

The best test information is obtained by using two frequencies of square-wave test. The first may be made at 60 cycles, and the technician will usually observe *tilt* as the most common fault in amplifier response. There is usually a minor amount of curvature associated with the tilt.

Note that to reproduce a 60-cycle square wave satisfactorily, the frequency response of an amplifier must extend much below 60 cycles—down to about 20 cycles, to avoid noticeable tilt. This is because the phase characteristic of an amplifier drops off *before* the frequency response drops off.

The second test may be made at a relatively high-frequency square-wave output, such as 200 kc. The technician will usually observe *diagonal corner rounding* as the most common fault, although some ringing and overshoot may also be observed. Such distortions become more prominent in an amplifier when the square-wave frequency is raised so high that an appreciable number of the harmonics fall outside the pass band of the amplifier.

Admittedly, only the bare essentials of square-wave testing can be covered in a single article. However, the points which have been discussed permit an appreciable number of practical tests to be made at the service bench. ■■

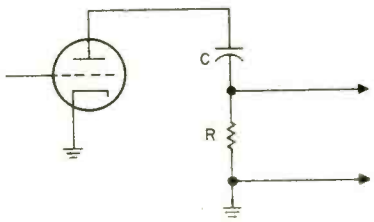


Fig. 7—Low frequency attenuation due to voltage divider.

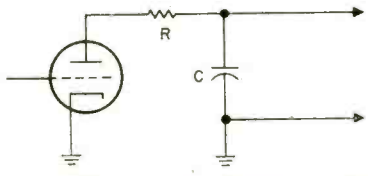


Fig. 8—Shunt capacitance causes high frequency attenuation.

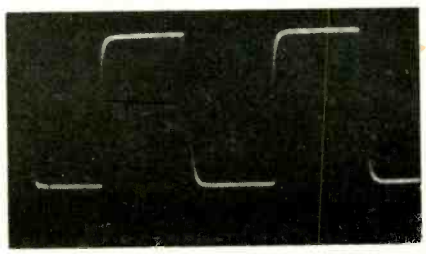


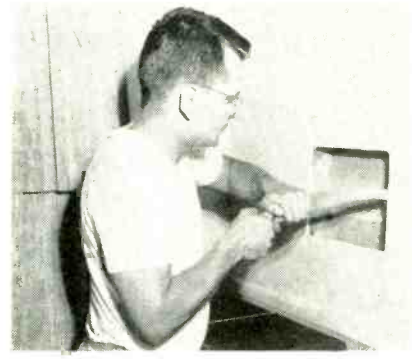
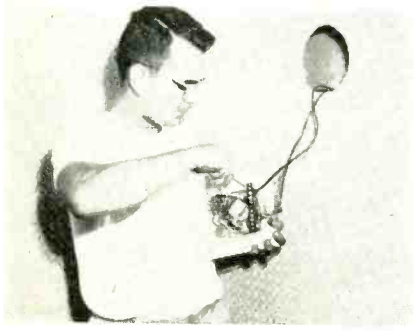
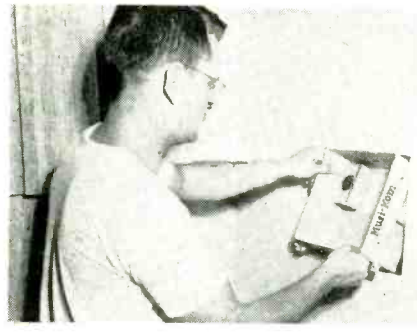
Fig. 9—Diagonal corner rounding from attenuation and lag.

The Home Intercom Market

by Engineering Staff
Home Music Systems Inc.

An outline of the attractive features of home intercom systems which make their sale and installation a profitable source of income




The techniques used in installation are similar to those used for ordinary house wiring.

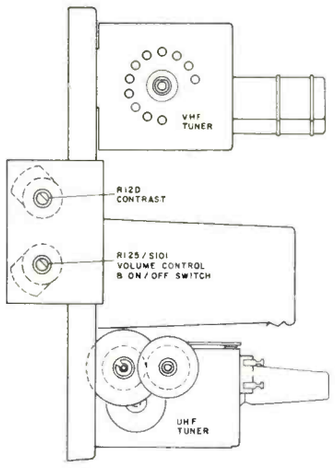
THREE short years ago, home intercoms were practically unheard of . . . today they represent a rich resource from which service and sound dealers may reap extra profits. Strangely enough, the *home builders* were the first to realize the almost magical appeal of these appliances. And despite their relative "newness" on the market, according to recent figures published by American Builder Magazine, 8% of all builders questioned stated that they included some type of home intercom system in their homes as original equipment. Since builders were so receptive to them, practically all of the companies manufacturing the systems slanted their sales efforts at the builder.

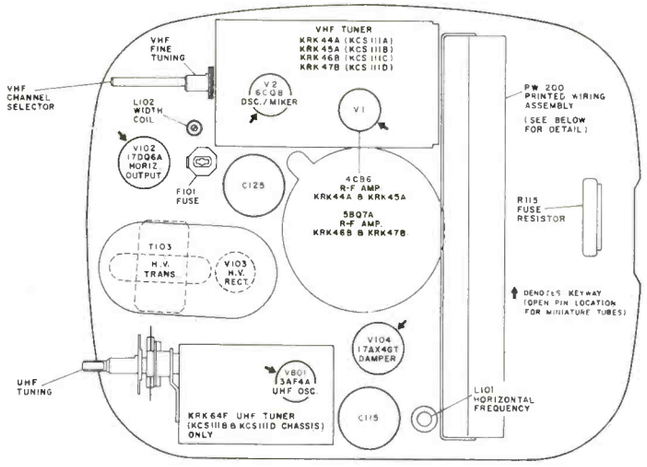
Obviously, the millions of existing homes in the United States constitute the greater potential market for systems of this type. That's where the service and sound dealers fit into the picture. According to S. D. Wooten, Jr., of Home Music Systems, Inc., who manufactures the Musi-Kom line of built-in radio-phono-intercom systems, the service and sound dealer is just beginning to take advantage of the sales and installation opportunity these systems present. Many Radio and T.V. parts houses are now stocking Intercom systems. A look at the multiple features offered by these shows why home owners are anxious to have their homes so equipped. Here they are:

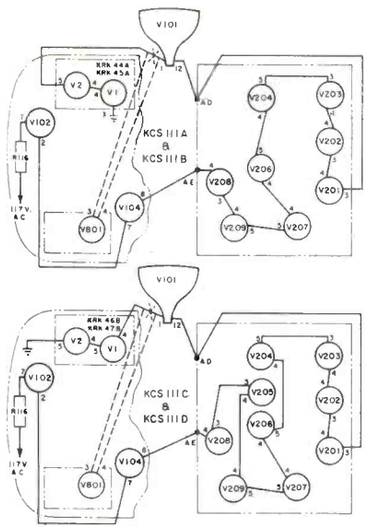
1. Radio programs in every room
2. Intercom from any room to all rooms
3. Phono jack for including record player into the system
4. Automatic Electronic Fire Alarm
5. Automatic Baby-Sitting from Every Room
6. Front Door Answering from Every Room

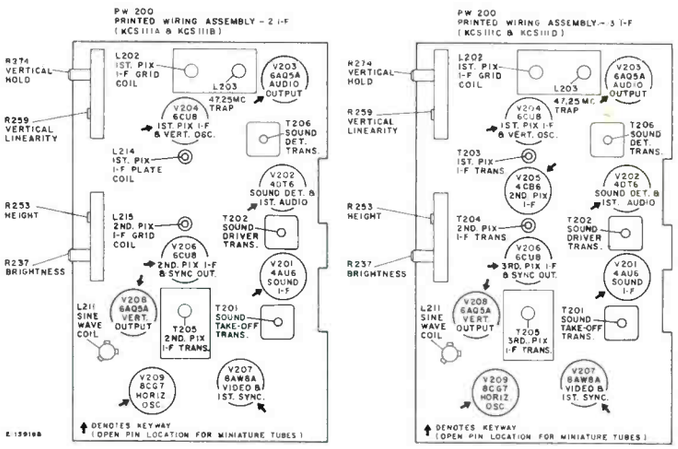
Installation is quite simple, and color coded wires also help make the installer's job easy.

Despite the tremendous potential, these systems are relatively unheard of out of the trade, because almost all advertising has been concentrated on builders. Thus while the service dealer can of course take advantage of the builder's knowledge of radio-intercom systems and sell to builders, the dealers real opportunity for volume sales is to educate the homeowner . . . particularly since remodeling and modernizing are becoming increasingly popular. Many cities now have radio stations that program music only, which means that with intercom in the home, the occupants can enjoy music constantly in any room they desire. Owners of 2 story homes are prime prospects also, as the genuine need for intercom facilities in such homes is quite apparent. Everday contact with homeowners gives the service and sound dealer a wonderful opportunity to tell a convincing story of new convenience, comfort, safety and music enjoyment through a home radio-intercom system. ■









CHASSIS REAR VIEW

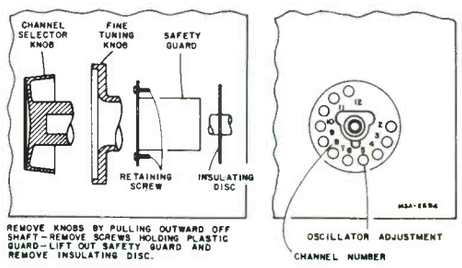
WIDTH AND SINEWAVE ADJUSTMENTS

It is possible to adjust the horizontal sine wave in the field by the following method when such adjustment is indicated.

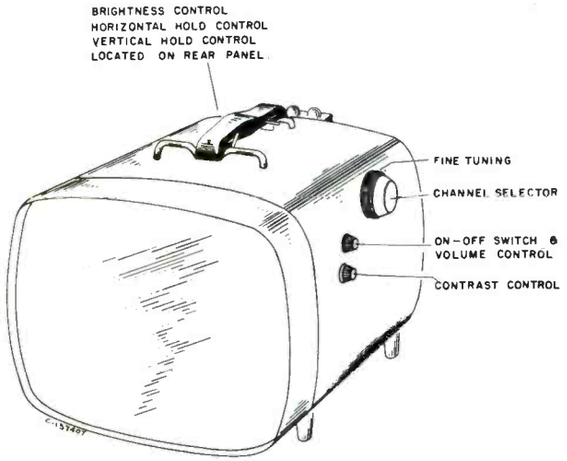
A. Adjust width for ½" overscan at each side, with normal line voltage and normal brightness.

B. Turn horizontal hold control to the left, out of sync, to the point where interrupted oscillation occurs.

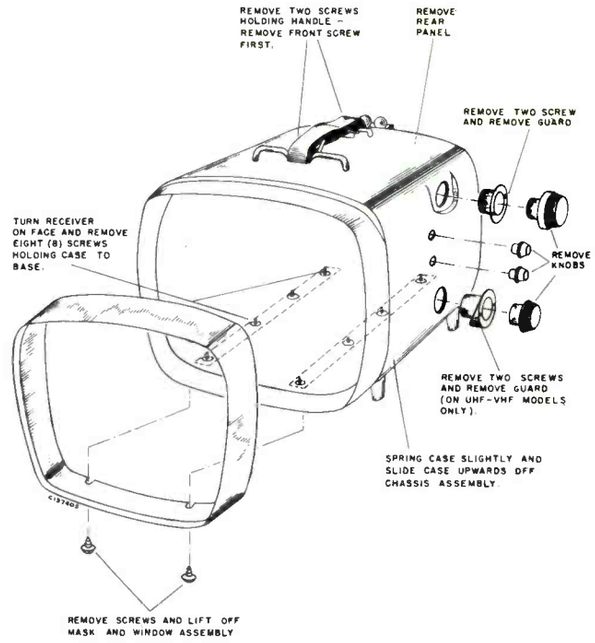
C. Adjust sinewave core, as the horizontal hold control is rotated to the left beyond the locked-in position, until 3 bars occur between the fall out point and interrupted oscillation.



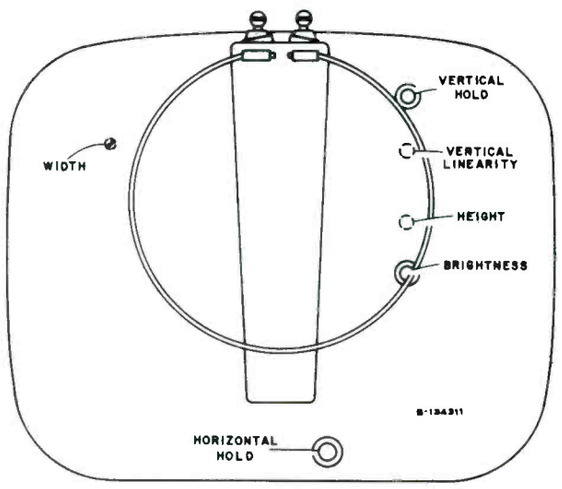
R-F OSCILLATOR ADJUSTMENTS



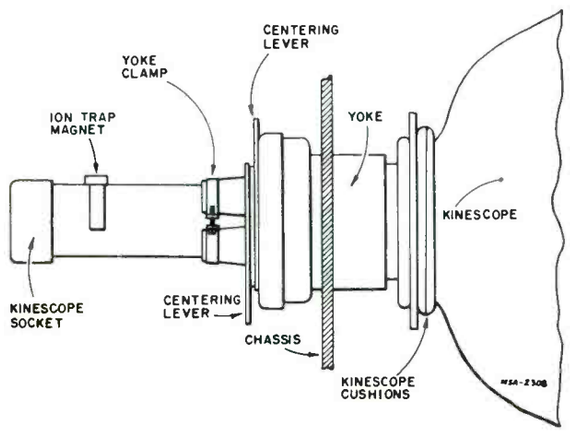
Receiver Operating Controls (VHF Models)



Chassis Removal

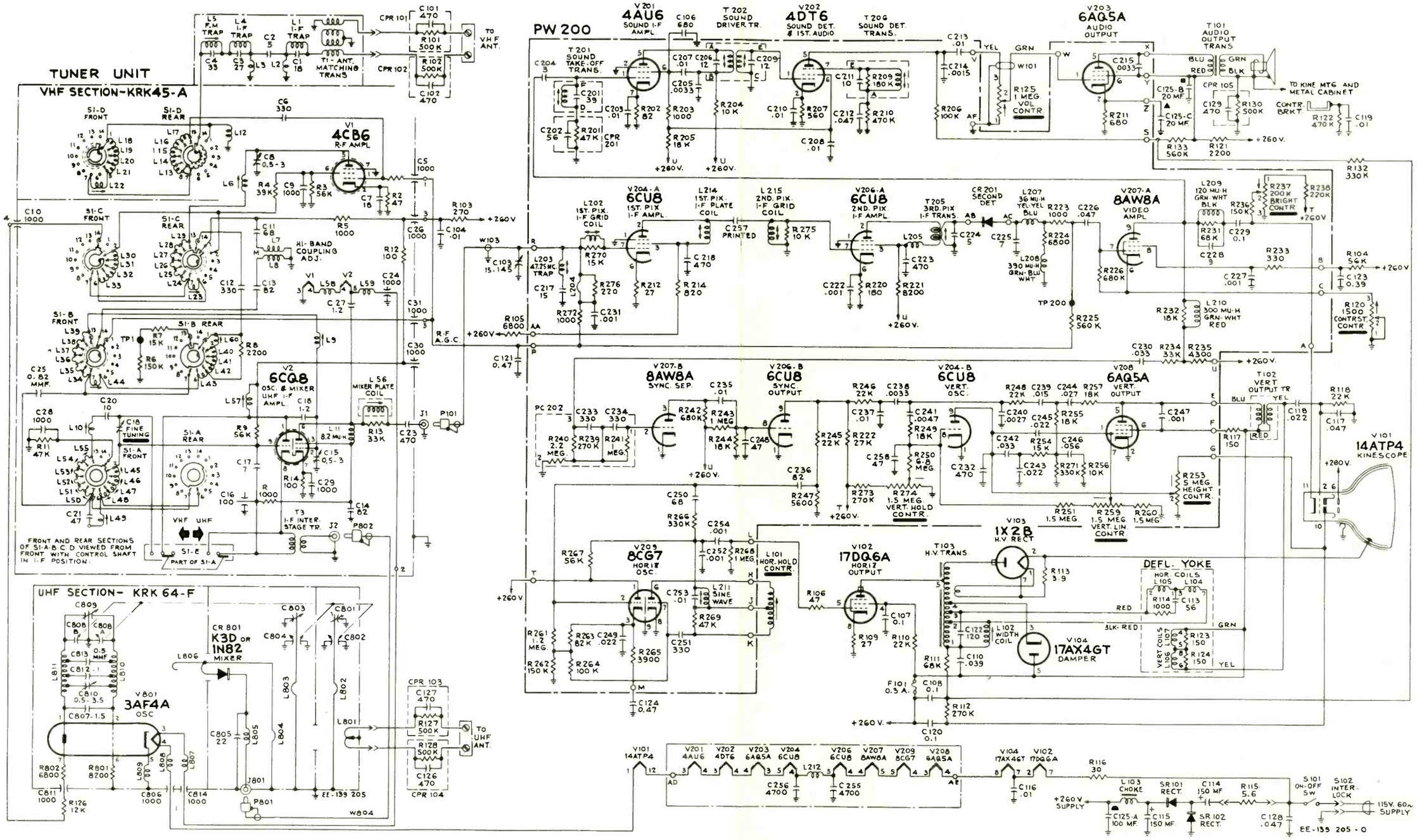


Rear Adjustments

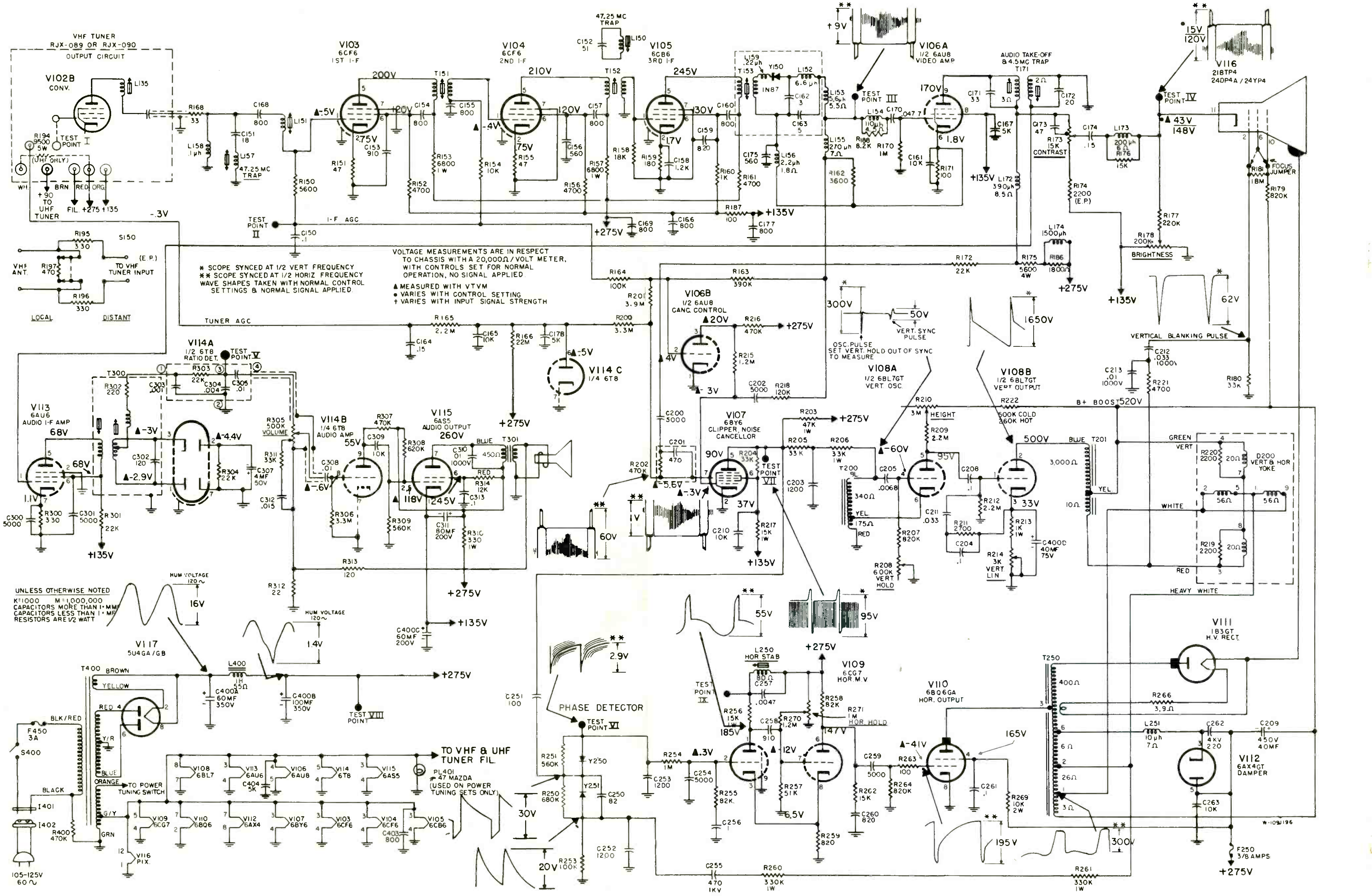


Yoke and Centering Magnet Adjustments

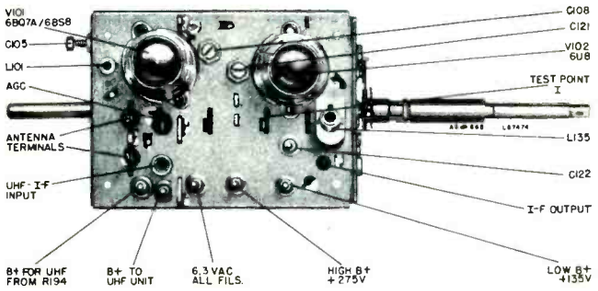
CHASSIS CIRCUIT SCHEMATIC DIAGRAM KCS111A & KCS111B
(KRK44A Tuner Used in KCS111A VHF Chassis)



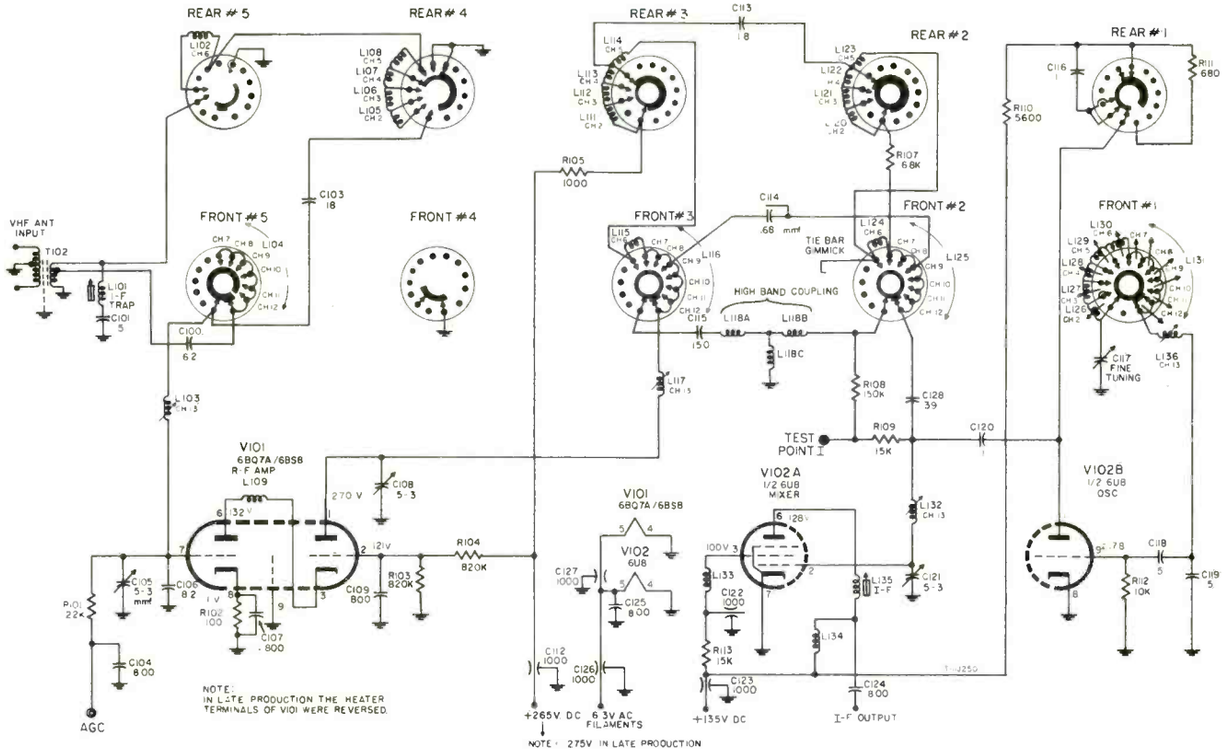
Direction of arrows at controls indicates clockwise rotation.



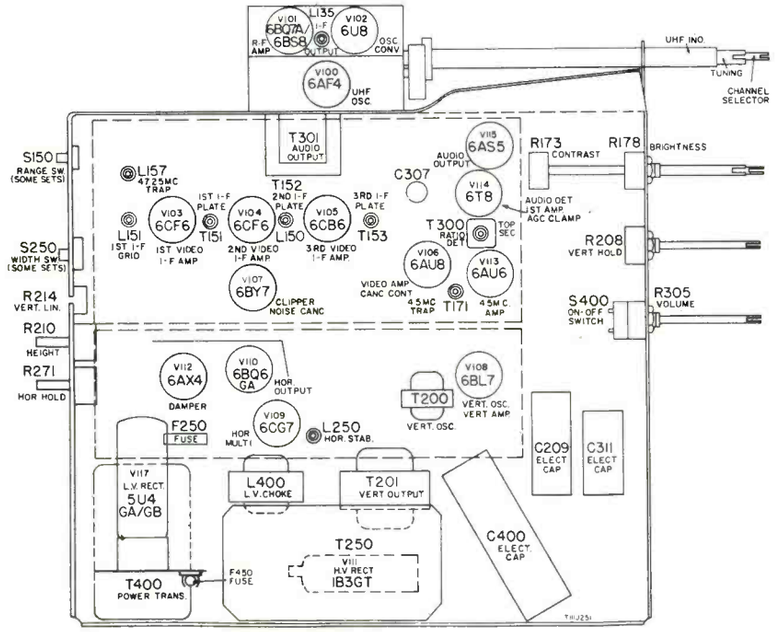
Main Chassis Schematic (Late Production) with Wave Shapes and Voltages



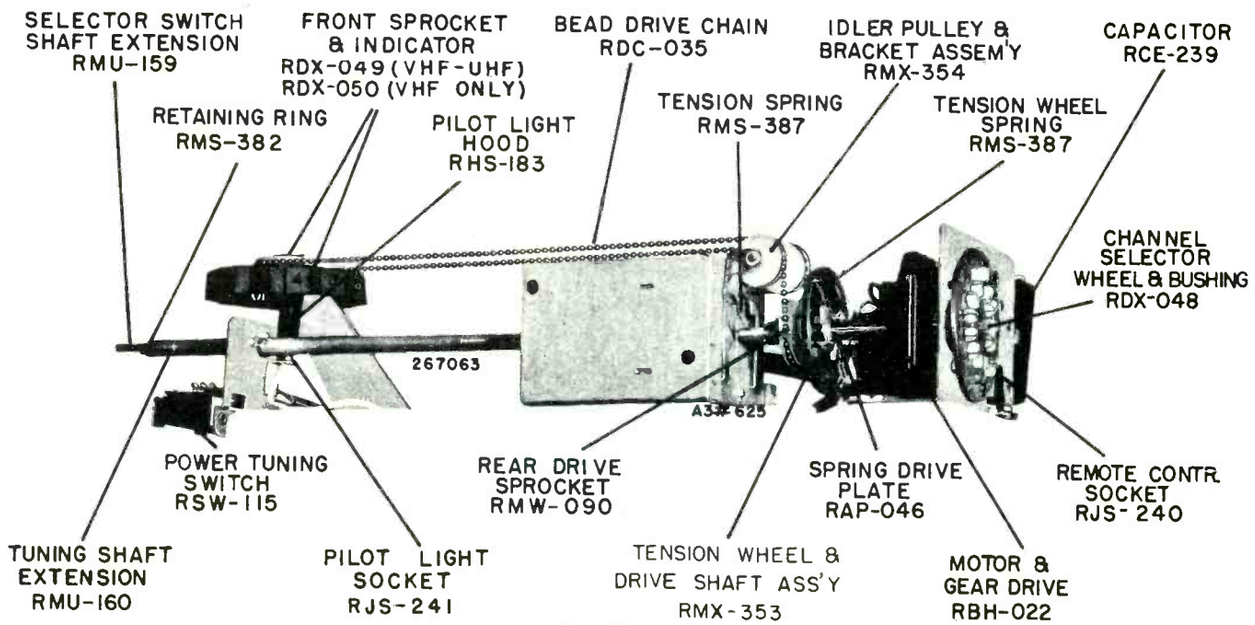
Top View of Tuner



RJX-090, RJX-090A Tuner Schematic



Location of Tubes and Trimmers



Power Tuning Assembly

Mfr: GE **Chassis No.** 14T016-7-8

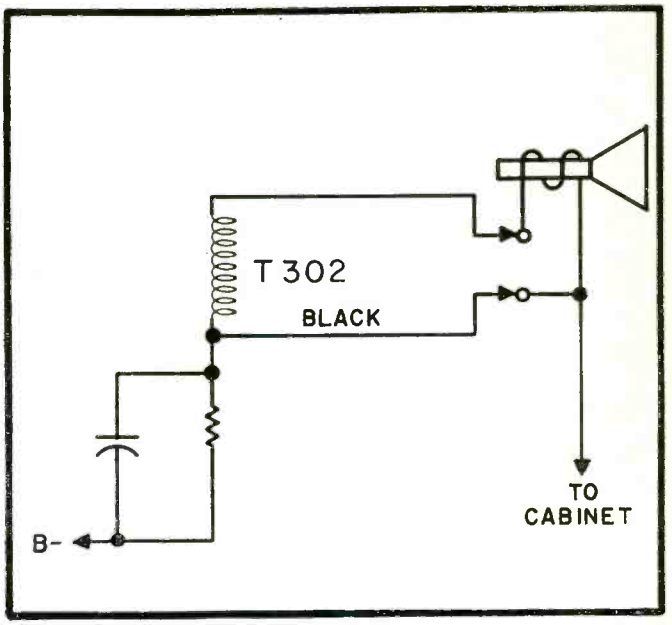
Card No: 14T016-1

Section Affected: Sound

Symptoms: Crackling and possible distortion

Cause: Speaker leads improperly connected.

What To Do:
Reverse speaker leads so that the black wire is connected to the ground lug on the speaker terminals.



Mfr: GE **Chassis No.** 14T016-7-8

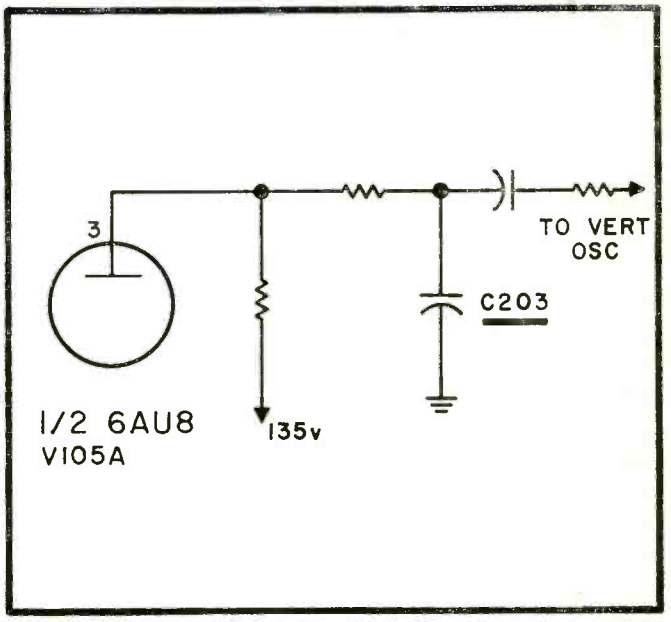
Card No: 14T016-2

Section Affected: Sync

Symptoms: No vertical sync.

Cause: Shorted capacitor in the vertical integrator.

What To Do:
Replace *C203 800mmf.*



Mfr. GE **Chassis No.** 14T016-7-8

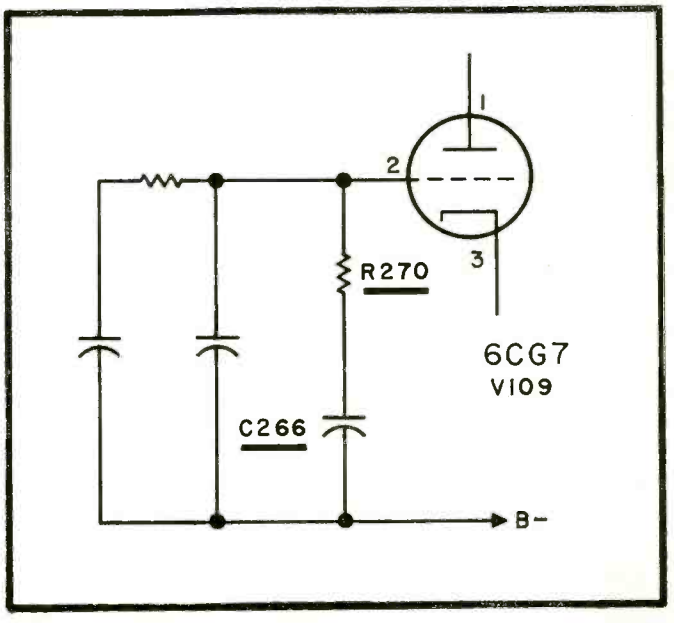
Card No: 14T016-3

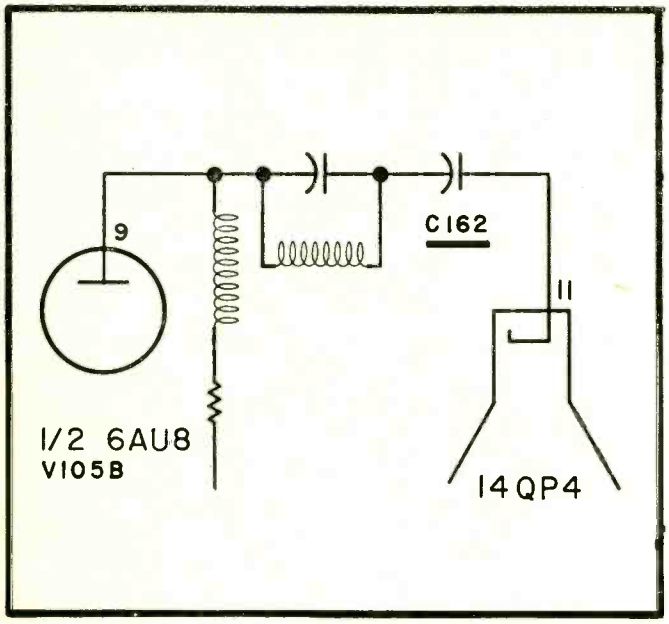
Section Affected: Sync

Symptoms: Gear tooth or cog wheel picture.

Cause: Defective *RC* filter in horizontal *afc.*

What To Do:
Replace *R270, 47K* and/or *C266, .1mf.*





Mfr: GE **Chassis No.** 14T016-7-8

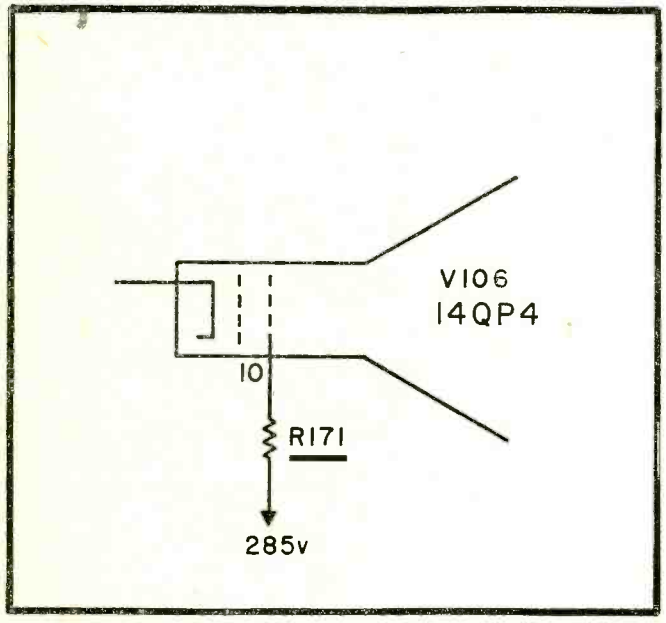
Card No: 14T016-4

Section Affected: Raster

Symptoms: Brightness control partially inoperative.

Cause: Leaky video coupling condenser.

What To Do:
Replace *C162*.



Mfr: GE **Chassis No.** 14T016-7-8

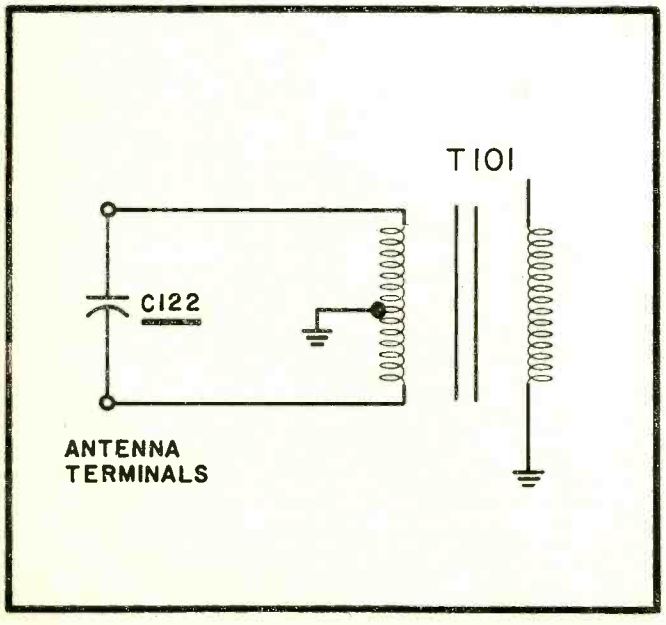
Card No: 14T016-5

Section Affected: Raster

Symptoms: Low brightness

Cause: Reduced voltage at first anode of the picture tube due to increased value of *R171*.

What To Do:
Replace *R171, 100K*.



Mfr: GE **Chassis No.** 14T016-7-8

Card No. 14T016-6

Section Affected: Video

Symptoms: Low gain on high *VHF* channels.

Reason For Change: Circuit improvement.

What To Do:
Add *C122, 2 mmf* ceramic condenser across antenna terminals.

Mfr. Emerson

Chassis No. 120306
120307
120325
120326

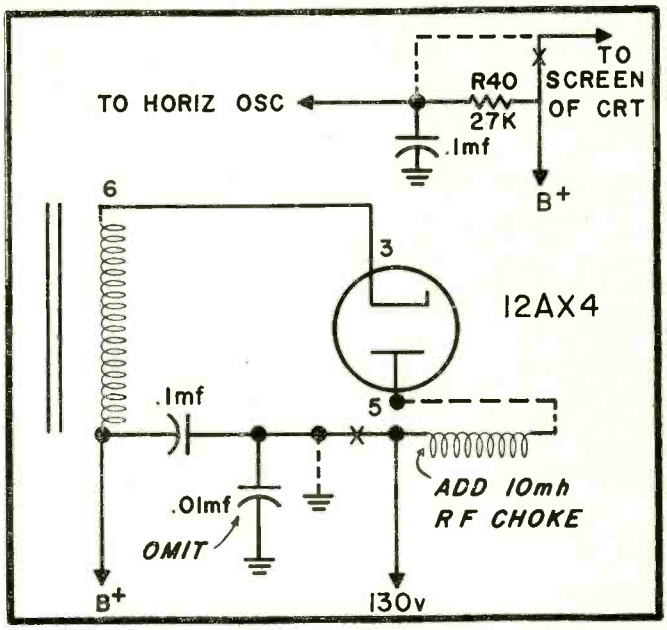
Card No: EM-120306-1

Section Affected: Sync

Symptoms: Horizontal instability in ultra fringe areas.

Reason For Change: To further improve horizontal sync in ultra fringe areas.
Note: Chassis already incorporating this change are coded (A).

What To Do:
1. Add a *10 uh rf* choke (EM PT #708021) in series with lead to pin 5 of the 12AX4 socket (keep choke close to socket).
2. Remove a *.01 mf* condenser from pin 5 of the 12AX4 to chassis.
3. Move C.R.T. first anode to filtered boost (junction *C28, R40*).
4. Disconnect pigtail of *.1 mf* condenser from pin 5 of the 12AX4 and connect to chassis.



Mfr. Emerson

Chassis No. 120306
120307
120325
120326

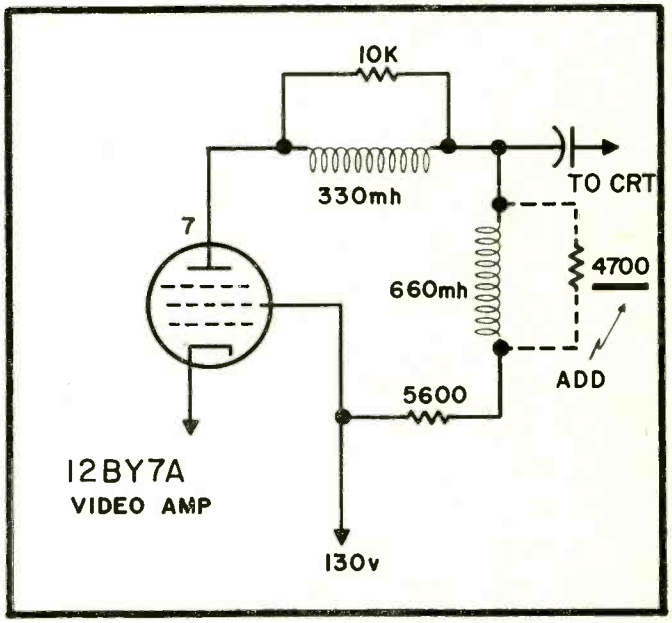
Card No: EM-120306-2

Section Affected: Video

Symptoms: Video ringing on some channels (close spaced ghost) which varies with fine tuning.

Reason For Change: To reduce video peaking.
Note: Chassis incorporating this change are coded (D).

What To Do:
Add a 4700 ohm ½ watt resistor across the video plate shunt peaking coil.



Mfr: Emerson

Chassis No. 120306
120307
120325
120326

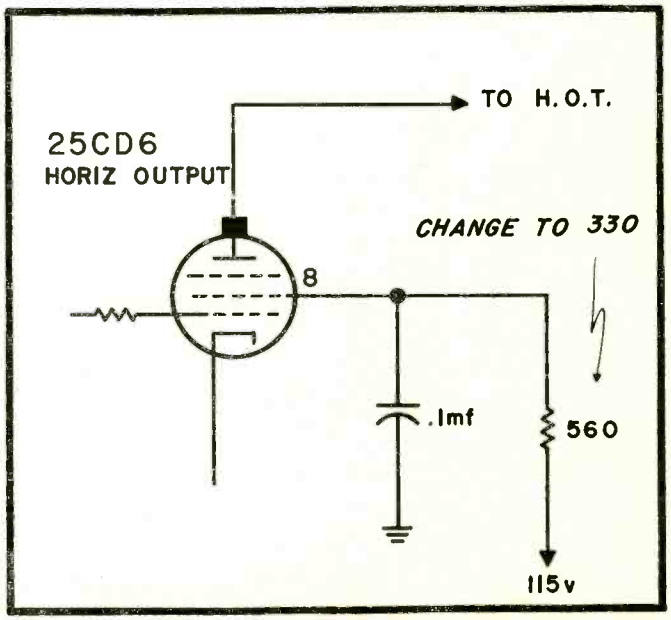
Card No: EM-120306-3

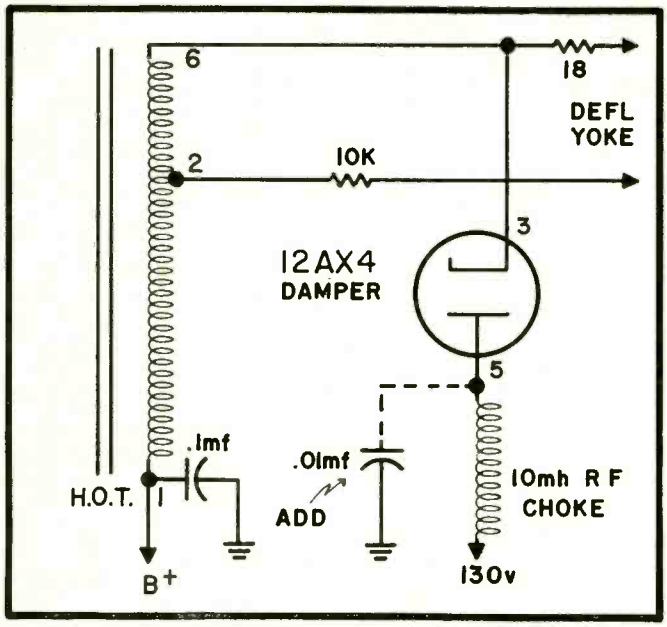
Section Affected: Raster

Symptoms: Insufficient width at low line voltages.

Reason For Change: To increase width.

What To Do:
Change the 560 ohm horizontal screen resistor to 330 ohm 1 watt.





Mfr: Emerson **Chassis No.** 120306
120307
120325
120326

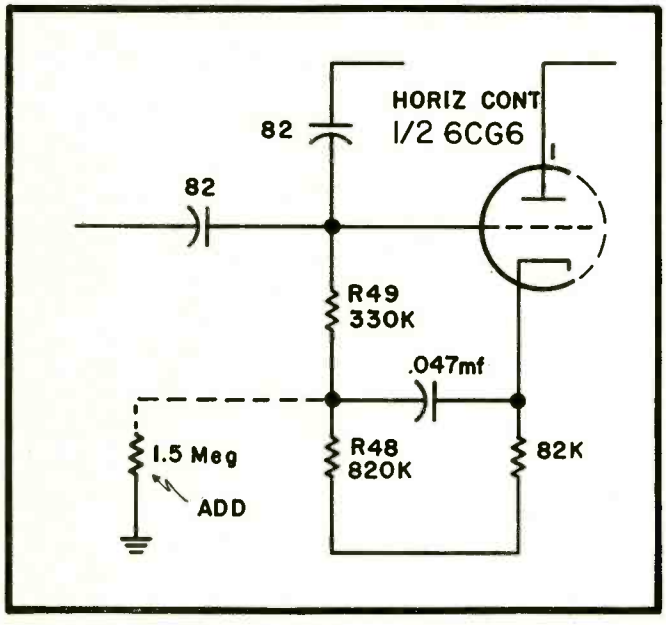
Card No: EM-120306-4

Section Affected: Sound

Symptoms: Whistle in audio.

Reason For Change: To reduce horizontal pick up in audio.
Note: Chassis already incorporating this change are coded (C).

What To Do:
Add a *.01mf* 600V condenser from pin 5 of the 12AX4 damper tube socket to chassis.



Mfr: Emerson **Chassis No.** 120306

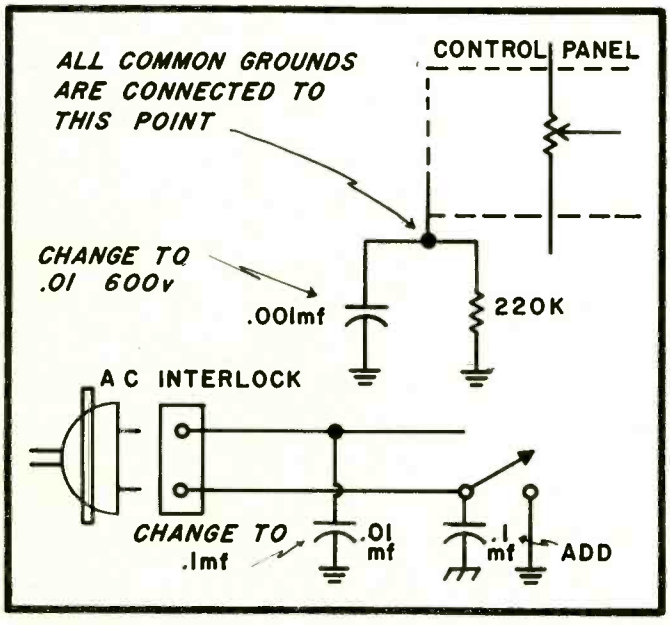
Card No: Em-120306-5

Section Affected: Horizontal

Symptoms: Squedging (Christmas Tree) between channels.

Reason For Change: To make free running frequency of horizontal oscillator more stable.
Note: Chassis already incorporating this change are coded (B).

What To Do:
Add a 1.5 meg resistor to the etched circuit board from the junction of *R48-R49* to the chassis.



Mfr: Emerson **Chassis No.** 120306
120307
120325
120326

Card No: EM-120306-6

Section Affected: *AC* input

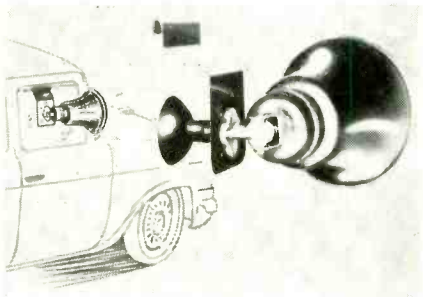
Symptoms: Possible interference to *am* radios.

Reason For Change: To minimize line radiation of horizontal sweep frequency and harmonics.
Note: Chassis already incorporating this change are coded (E).

What To Do:
1. Change *C63* from *1000 mmf* to *.01 mf* 600V.
2. Change *C53, ac* line by-pass condenser from *.01 mf* to *.1 mf* 600V.
3. Add another *.1 mf* 600V condenser from the other side of the *ac* line to chassis.

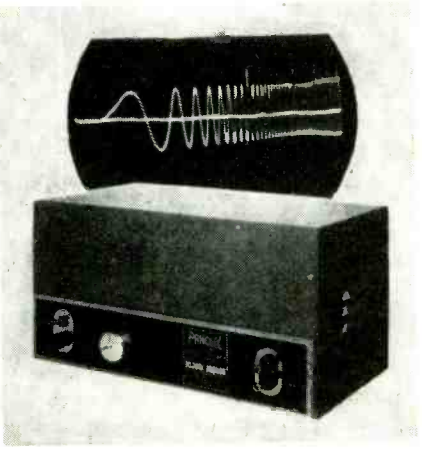
AUTO PA SPEAKER

Quickly enabling any car or truck to become a mobile sound vehicle, the new WM-1 Car Window Speaker Support, announced by Atlas Sound Corp., 1451—39 St., Brooklyn 18, N.Y., safely attaches to any automotive window by means of its rubberized, cork-lined channel. This channel slips over the window glass top and locks tightly against the window glass slot when the window is raised shut. No tools are needed for the installation, which does no damage to the vehicle's paint finish, window glass or window adjustment mechanism. The WM-1 Speaker Support is constructed of sheet steel and finished in grey enamel; and comes complete with all hardware for attaching speaker.



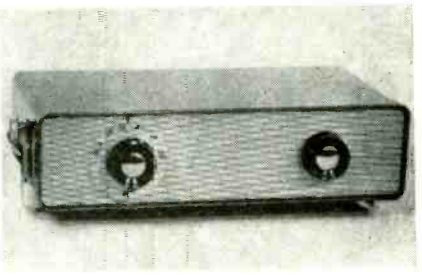
AUDIO SWEEP GENERATOR

Pacific Transducer Corp., 11836 W. Pico Boulevard, Los Angeles 64, California, announces a new Audio Sweep Frequency Generator to determine quickly the behavior of audio and other alternating electrical apparatus with respect to frequency and associated phenomena. The complex signal is produced by scanning photoelectrically a synchronously rotating disc. The signal, as it comes from the Generator, scans from 80 c.p.s. to 20,000 c.p.s. The sweep frequency is covered by 20 signal pulses per second. The signal is flat over the specified range within 1 db. Frequency markers occur at 2, 5, 10, 14, 18 and 20 Kc. A base line is provided for determining relative amplitudes. The output is 4 volts, open circuit, internal impedance, 290 ohms. This Generator will operate with any oscilloscope.



MARINE TUNER

Many boats equipped with radio-telephone equipment do not have facilities for broadcast reception. Kaar Engineering Corp. of Palo Alto, California has just introduced its new model R 909 B.C. Tuner, designated as the "Neptuner." Designed to work with any marine radio-telephone unit, the Neptuner will provide broadcast entertainment and background music for the boat owner, while still maintaining monitor service on the marine frequencies. It can be mounted in any convenient position, adjacent to or remote from the radio-telephone. It uses the radio-telephone loud speaker and amplifier. Full information on this interesting new piece of marine gear can be obtained by writing to 2995 Middlefield Road, Palo Alto, California.



SPEAKER BAFFLE

A combination speaker baffle and light is marketed by Lavell of St. Louis. The unit is anodized, unpainted and available with an eight foot pole. It is recommended for use in patios, alongside swimming pools, motels and drive-in restaurants.

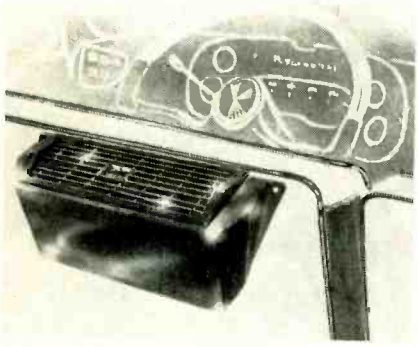
MIKE OUTLET

A new microphone receptacle floor outlet unit has been marketed by the Lowell Manufacturing Co. of 3030 Laclede Station Rd., St. Louis, Mo. It is completely flush with the floor when not in use. The cover cap is hinged and cannot be separated and lost. The entire unit is designed to mount on a standard 4″ by 4″ electrical box. For further information write the manufacturer.

[*Continued on page 34*]

CAR SPEAKER

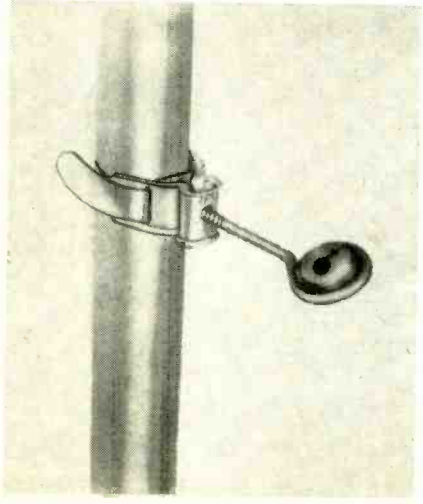
Empire Electronics of 22022 Woodward Avenue, Ferndale, Michigan has marketed a new type of rear seat speaker called "Car-Fi." By mounting the baffle on the back of the front seat the unit may be used in convertibles and station wagons. It is located well above the knee level of the back seat and will not interfere with entering or leaving the vehicle.



STANDOFF INS.

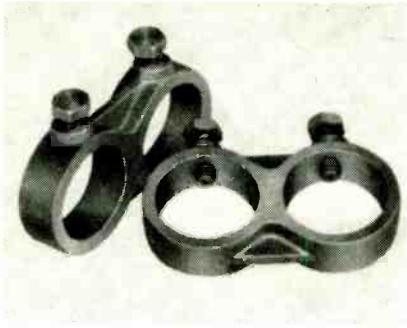
JFD Electronics Corp. has announced the development of a new universal strap standoff that accommodates any No. 8 or No. 9 standard wood screw eyes.

The advantages of the IMP design are reflected in the smaller inventory necessary to stock the new standoff line, as well as the savings resulting from a 50% reduction in storage space and handling over present types. With the IMP, serviceman stocks only his regular wood screw standoffs and the new buckle and strap. No special thread non-universal screw eyes need be stocked which add to the store's inventory investment and slow turnover.



MAST GRIPPERS

Helix Mast Grippers, new light weight clamps used for antenna installations, are now being marketed by the Helix Rotor Company, manufacturers of the Helix Mechanical Rotator. Used in pairs these grippers instantly convert any 1¼" tubing into a slidable trombone mast. With them, one man can easily raise, lower, or turn an antenna, while having control of the mast and antenna at all times. Their use adds extra strength to the mid-section of tall installations. Hand orientation of the antenna from ground level is possible by leaving one lock screw of upper mast gripper loose. Information is available from Helix Rotor Company, Marlin, Texas.

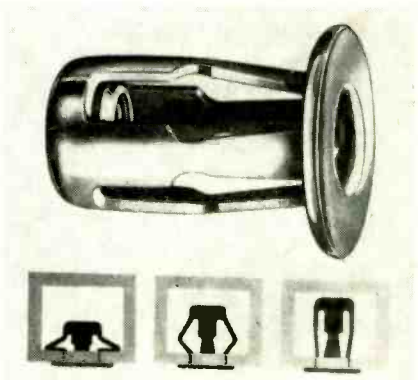


FURNITURE SPRAY

Four push-button, aerosol-type, satin-finish stains, that permit the user to spray on a matching touch-up color on wood furniture that has been scratched, nicked, burned, water-marked or defaced, have been developed by the Press-N-Spray division of the Saco Chemical Corp., 527 Lexington Ave., New York, N.Y. The four colors available for touch-up include brown and cordovan mahagony, walnut and blonde. These touch-up finishes, which dry instantly, do not bubble or affect previous surfaces. They blend beautifully, completely covering any marks while maintaining the patina of the wood. After one quick spray over the defective area, the imperfections will disappear as the touch-up blends with the original finish to provide a smooth, satin-like surface.

BLIND FASTENER

A blind fastener about one-half the length of the shortest hollow wall anchor previously available has been developed by the Molly Corporation, Reading, Pa. Called the Jack Nut, it was designed to fill the need for a fastener to hold fixtures securely in hollow construction with narrow expansion areas. Workable in space as small as ⅜", Jack Nuts can be used in hollow-core flush doors, plywood or wallboard over narrow furring strips, in mobile homes, automobiles and countless other places where larger anchors will not work and wood or sheet metal screws will not hold. Jack Nuts are self-adjusting to grip any kind of material. They are available in two lengths: short for thicknesses from 0" to 3/16" and long for 0" to ⅜". They are easy to install with any U.S. standard 6-32, 10-24 or ¼"-20 screw. Once installed, they remain in place permitting fixtures to be removed and replaced.



DIRECTION FINDER

Apelco announces the Model DFR-12, a precision direction finder with 3-tunable ranges and crystal controlled fixed channels. These fixed channels facilitate intership and shore station "homing" operation, also permit DFR-12 to be used as an excellent communications receiver in conjunction with a radiotelephone transmitter. The three tunable ranges extend from 150 to 5000 kcs and encompass BEACON, STANDARD BROADCAST and MARINE frequencies. The eight crystal controlled channels cover approximately 2000 to 5000 *kcs*. Nulls are obtained aurally by loudspeaker or earphones. A tuning meter provides simultaneous visual indication. Other features leading to improved accuracy include Bearing Width Control and Beat Frequency Oscillator. The unit also has a positive "sense" provision. DFR-12 features an automatic volume system which prevents overloading on the

[*Continued on page 37*]

PORTABLE AUTO RADIO

A unique development in automotive radio design and use--an all-transistor radio which can be slipped out of the 1958 Oldsmobile and Pontiac panels and used as a portable radio, is offered as optional equipment on the 1958 model cars. The compact portable has been named the "Trans-Portable" by Oldsmobile, the "Sportable," by Pontiac.

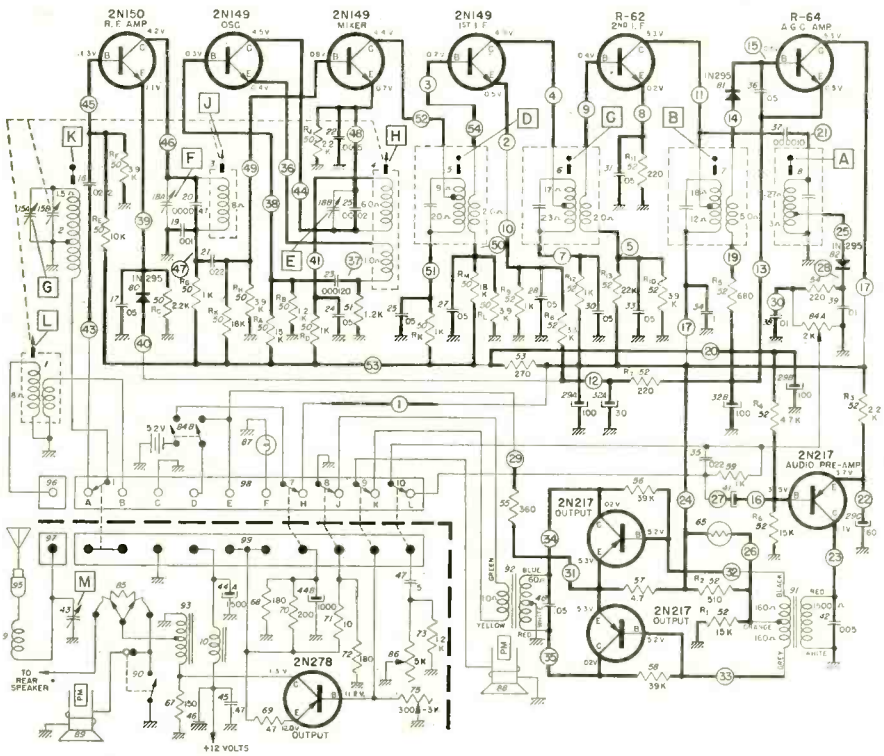
Small mercury batteries power the portables when used outside the car. In the automobile, the radio automatically plugs into the car's electrical system when slipped into its place in the instrument panel. In the car it also utilizes the car's loud speaker, extra transistor audio system, and the car's antenna.

Used as a portable, the unit has its own speaker, power supply and loop antenna. The portable case is 6½ inches long, 4½ inches wide and 2 inches deep and is made of durable high impact plastic. It has a chrome face and carrying handle. The portables weigh less than three pounds and can easily be carried in a man's overcoat pocket or in a large handbag.

The portable can be removed from the panel by releasing the catch, which is accessible by reaching inside the glove compartment. If the glove compartment is locked, the radio cannot be released from the instrument panel.

Use of transistors eliminates any warm-up time and the radio starts playing as soon as it is turned on. Nine transistors in the small radio provide outstanding performance for a unit of its size. A high power transistor in

the car portion of the radio adds the extra power needed for use in the automobile. Transistors being much more rugged than vacuum tubes, the new radio should offer much longer trouble-free operation. The mercury portable batteries offer about 160 hours of playing time at a cost of less than two cents per playing hour. ■ ■



Schematic of the Delco portable auto radio used in the Pontiac and Olds.

TV WALL INSTALLATIONS

General Electric television engineers have voiced a word of caution for those planning to use a television set in a wall installation. Prompted by the increasing popularity of "built-in" furniture and appliances, G. E. prefaced the cautionary note by urging those contemplating such an installation to seek professional advice before undertaking the task. In so doing, they said, the possibility of a heat or fire hazard due to lack of essential air circulation may be avoided.

All General Electric TV receivers, as well as those made by most manufacturers, are approved by the Underwriters Laboratory. This approval, however, is given on the basis of the complete receiver with the chassis enclosed in its own cabinet.

The TV cabinet is designed by the manufacturer so as to permit adequate air circulation throughout the interior of the set when operating in an open area. This provides the necessary cooling action and is absolutely vital for safe operation and long life.

G. E. engineers point out that some people may assume the cabinet provided with the set can be built directly into a partition with no additional safety measures. This, however, is not true. Even if the TV set were to be placed flush against a wall, sufficient air circulation might be cut off so as to impair operation of the set or create a heat menace.

Actually, a built-in television receiver, when properly installed, should be enclosed in a separate enclosure with a minimum of two inches of air

[*Continued on page* 43]

ANSWERMAN

[*from page 12*]

properly controlled. In this particular case, on the basis that the picture is normal for three or four seconds it can safely be assumed that the video *if* and amplifiers are capable of functioning normally.

Generally, problems resulting in the *agc* circuits are due to component failures such as resistors that have changed in value. In this instance, it is felt that the trouble is in the plate circuit of the *agc* tube and a resistance check should be made to determine if there are any defective resistors. However, a more desirable test would be that of the condensers as most probably filter condenser *C182* (0.47 *uf*) has shorted. ■■

AUTO RADIO

[*from page 11*]

If a bind exists in the tuner:

1. Recheck for 12 volts on battery or 16 volts on the eliminator.
2. Solenoid bottoms; adjust treadle solenoid as far back as possible and power solenoid so body is flush with plunger guide pin.
3. Inspect for bind at treadle pivots. Be sure pivots and levers are properly lubricated. Use Beacon grease or equivalent.

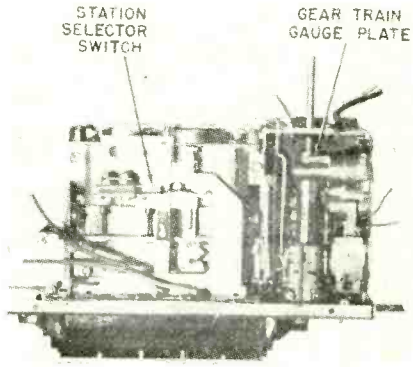


Fig. 6—View of receiver showing gear train gauge plate.

Tuner machine gunning may be due to:

1. Defective gear governor train. Replacement of the unit is necessary.
2. Improper gear train adjustment. To adjust, loosen the gear train mounting screws (see *Fig. 6*) and adjust for a clearance of .0006 to .068 inches between gear train housing and rack.

[*Continued on page 46*]

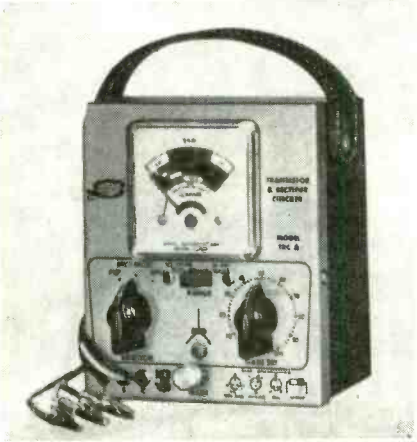
NEW PRODUCTS

[*From page 34*]

strongest local signals yet retains fullest response to weak signals. Extremely rugged construction and moisture-resistant treatment for the entire assembly contribute materially to long operating life. Power supplies are separate units, can be supplied for 12 or 32 volt DC or 115 volt AC. The DFR-12R is also available with remote loop mounting assemblies. For additional information write to Applied Electronics Co. Inc., 213 E. Grand Ave., South San Francisco, Calif.

TRANSISTOR TESTER

Service Instruments Corporation of 171 Official Road, Addison, Illinois, has announced a new, improved transistor checker which also tests crystal diodes and selenium rectifiers. The new tester provides a complete check on power transistors. It tests or opens, shorts, current gain and leakage on all transistors and forward to reverse currents on crystal diodes and rectifiers. Further information is available by writing to the firm.

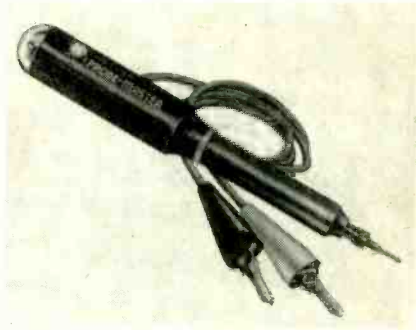


[*Continued on page 38*]

TEST PROBE

A new and versatile all-purpose probe with a built-in capacitive network and a neon type checker has been introduced by Kingston Electronic Corp. of Medfield, Mass. Called the Kingston Probe-Master, this new instrument, because of its capacitive network, makes it possible to (1) bypass stages; (2) check open condensers; (3) couple signals from one stage to another in any circuit which self-generates a signal; and (4) to isolate a defective stage without outside signal-generating equipment. The instrument also eliminates time-consuming condenser substitution.

Attractively packaged, with complete step-by-step instruction for use, these instruments are available from electronic parts distributors.



WORK BENCH

A combination work bench and desk is made for those common repair, test, and light assembly jobs that require both paper work and mechanical operations. Under its metal edged, masonite top are two shallow drawers—a narrow one for paper and a wide drawer, subdivided into 24 compartments, for parts and small tools. Two extra-large file drawers below accommodate blue prints, circuit drawings, instruction manuals, etc., and two open storage shelves provide space for bulky fixtures, test equipment and extra supplies. Drawers may be inserted from the back to reverse the kneehole position. The 54" x 25" desk top is 36 inches high. Legs are fitted with adjustable glides for easy leveling. Write the Neubauer Mfg. Co., 521 Lowry Ave. N.E., Minneapolis 18, Minn. for further data. ■■

ASSOCIATION NEWS

Associated Radio and Television Servicemen, Illinois (ARTS)

We received a letter from H. J. Wolfson Chairman of the Illinois chapter disagreeing with the August "Ad Lib" on licensing. We are publishing this letter in part.

The ARTS, Illinois Service Association is on "record," and has been on record for five years as opposed to licensing in any shape or form.

If the best case that can be made for licensing depends on the disreputable character described in the editorial then it seems that restrictive legislation is needed in every line of commercial effort, because characters like that infest our commercial fabric from top to bottom.

Further, I doubt that licensing would be of much help, as it appears from the story that this character was wending his merry way in crime from 1946 onward, and if all the laws on the books did not put him in clink for five or ten years, because of his previous misdeeds, the service licensing law, had he passed it, would not have stopped him one wit.

As far as keeping undesirable characters like this one out of peoples homes, all that is needed is proper enforcement of laws already on the books by the thousands. All that is needed is enforcement of what is there.

Radio Television Guild of L. I. (RTG)

The movement by service dealers toward a reasonable charge for services has picked up additional momentum with dealers in Queens now raising their rate to $5.00.

Sal Francione of France's Radio & Refrigeration on Jamaica Avenue, who is now charging a $5.00 fee, has found excellent customer acceptance of his increase. At the time Francione raised his rate, he discovered that the customer that left his accounts was the individual who would have complained regardless of any rate.

Dealers by charging $5.00 are at last recognizing the cost of their overhead and a reasonable amount for themselves. The dealers who have been ostriches and maintain $2.00 and $3.00 service charges, have not recognized the value of their own labors. In Nassau County, the movement has been under way for about eight months and more dealers are charging appropriately for their services.

At the September 23rd Executive Meeting, the Radio and Television Guild's Attorney, was empowered to investigate the possibility and benefit of group insurance covering the RTG of LI membership.

Television Electronics Service Association of St. Louis (TESA)

Almost everyone who has opposed licensing of TV technicians has used the argument that a license law would harass and hamstring business; it would subject small shop owners to regulation. Some of the men opposing a law that would require the examining and bonding of technicians, stated that they were hard-headed individualists who loved their independence and detested regimentation.

Robert Sickels, Editor of the Hoosier Test Probe; official publication of the Indianapolis Television Technicians Association (Indiana has a strict license law for watch repair men in operation for over 10 years) wrote an article on the subject. The following are some excerpts from the article.

There must be a limit to freedom somewhere. It begins precisely where the misuse of freedom brings harm to others.

In the public interest, this TV service industry badly needs standards of ethical practice. It further needs the enforcement of these standards, under the law, if need be, with suitable means to punish flagrant offenders. A good licensing bill, drafted in the PUBLIC interest, can do this job.

Opponents of licensing claim that there are already enough laws on the books to deal with this problem, that the public is protected . . . and yet . . . whenever a house-holder gets gyped, his only recourse is to bring civil action, which is costly. ■■

TRADE LITERATURE

Allied Radio Corporation, Chicago, announces the release of a new, 64-page *Electronics Data Handbook* that consists of a carefully selected collection of the most-often needed formulas and data used in radio and industrial electronics. Formulas include those needed for basic circuit analysis, transmission line calculations, determination of vacuum tube characteristics, resonance calculations, meter calculations, etc. Included are up-to-date EIA and Military specifications for resistors and capacitors, coil winding data, wire gauge data, metric relationships, tables for directly interchangeable radio and TV picture tubes, interchangeable batteries, decimal equivalents of fractions, pilot lamps, logarithms, trigonometric functions, etc. A three-page explanation on the use of logarithms precedes the logarithm tables. Additional data covers Attenuator Networks; Minimum Loss Pads, Mixers; Decibels vs. Voltage; Current and Power Ratios; and complete details on using the EIA 80.7-volt system of speaker hookup. The book is available from *Allied Radio Corporation, 100 N. Western Avenue, Chicago 80, Illinois,* and is priced at 35¢ postpaid. *Stock number is 37 K 398.*

• • •

The General Electric Company has announced a new, revised replacement guide for electronic service technicians for using germanium rectifiers to replace selenium rectifiers in television sets. The revised replacement guide lists all American-made television sets built since 1953 in which selenium rectifiers may be conveniently replaced by G.E. germanium rectifiers. The guide lists the manufacturer's name, the manufacturer's model number, the chassis number, the selenium rectifier part number and the new General Electric snap-in replacement germanium rectifier.

In addition, wiring and mounting instructions for the germanium rectifiers are included.

The new revised General Electric Germanium TV Rectifier Replacement Guide may be obtained at any G.E. authorized Tube and Transistor Distributor or by writing to General Electric Company, Semiconductor Products Department, Syracuse, N. Y.

● ● ●

Centralab, a division of Globe Union Inc., announces the availability of their *Pocket Control Guide No. 6.* This handy control cross reference guide is published semi-annually to make the latest and most up-to-date replacement control information available to everyone. Hundreds of new listings are in this 3¾" x 8½", 121 page guide which will fit neatly into your pocket or repair kit. Priced at 20 cents it will be available at all Centralab distributors or by writing direct to Centralab, a Division of Globe Union Inc., 900 E. Keefe Avenue, Milwaukee 1, Wisconsin.

● ● ●

The introduction of volume nine in an *Audio Amplifier Series* was announced by Howard W. Sams & Co., Inc., 2201 East 46th Street, Indianapolis, Indiana.

This very popular series presents complete photo coverage, Standard Notation Schematic, Parts List, Voltage and Resistance Measurements, and Servicing information for each piece of equipment.

Volume Nine contains data on fifteen amplifiers, three preamplifiers, twelve tuners and five custom radios. All of this equipment was produced during 1956.

● ● ●

A new twelve page P.E.C. (Packaged Electronic Circuit) Guide containing schematics and specifications on all 96 types of Centralab P.E.C.'s sold through electronic parts distributors is announced by Centralab, A Division of Globe-Union Inc. The P.E.C. Guide contains a complete cross-reference section which lists the manufacture part number of all the packaged circuits used by 130 radio and TV manufacturers since 1949, and the corresponding Centralab replacement. There is also a section containing the proper test procedure for checking all listed packaged circuits.

P.E.C. Guide No. 4 is available from Centralab distributors or by writing direct to Centralab, A Division of

Globe-Union Inc., 900 E. Keefe Avenue, Milwaukee 1, Wisconsin.

• • •

A 1957-58 RCA Victor Television Servicing Information manual has been announced by Supreme Publications. This new manual presents all service information needed to repair any of the recent RCA TV sets. The manual is priced at $1.50 and may be ordered from Supreme Publications, 1760 Balsam Road, Highland Park, Illinois.

• • •

Electronic Instrument Co. has just released its 6-page catalog describing the EICO line of high fidelity equipment in both kit and factory-wired form.

The catalog contains full specifications and features on the complete high fidelity amplifier and preamplifier line as well as speaker systems. For a free copy write to EICO Inc., 33-00 Northern Blvd., Long Island.

• • •

Stereophonic Sound by N. H. Crowhurst (list price $2.25, John F. Rider Pub.) is an assessment of the exciting new medium. The book provides all the information the hi-fi fan needs to add this new dimension to his listening pleasure.

Though primarily written for hi-fi enthusiasts interested in obtaining the most realistic results in home audio reproduction, Stereophonic Sound will be welcomed by anyone concerned with sound reproduction. ■■

WALL TV

[*from page* 35]

space between the TV cabinet and the enclosure at bottom and rear and three inches between the enclosure and the top of the set. Adequate grill openings should be provided in front and at top and bottom of the receiver. This enclosure should be constructed of an approved galvanized material similar to the standard terminal or junction box or other approved fireproof material. The TV within the box should be supported by metal braces and the 110 volt power supply, installed by an electrician, should be within the enclosure.

Adequate provision for removing the set for servicing or replacing with one of different size should, of course, be considered. ■■

TEST INSTRUMENTS

[*from page* 7]

ic voltmeter permits accurate measurement of *ac* voltages below two volts. A transistorized *if* oscillator circuit provides crystal controlled *if* frequencies between 280 *kc* and 13 *mc*. A 455 *kc* crystal is included to assure precise alignment of the last *if* and discriminator stages. Additional crystals can be added as required.

In addition, this unit can be used to measure A+ and B+ in both receivers and transmitters, grid and plate current in the transmitter, relative field strength of radiated signals, transmitter power output and receiver quieting sensitivity. A transistorized *rf* Peaking Generator, available as an optional accessory, provides crystal controlled *rf* output for *rf* peaking of 25-54, 144-174, 450-470 and 890-960 *mc* receivers. Any one of eight internal crystals (also available as optional accessories) can be selected by means of a front panel control.

The Motorola Model TU546 Portable Test Set is powered by four 1½ volt size "D" batteries. ■■

TRADE FLASHES

[*from page 16*]

may be individually removed and replaced for quick, easy maintenance or modernization. All chassis and units are made of aluminum for superior electrical conductivity, strength and corrosion resistance. All table and console models feature select wood cabinetry and woofer and tweeter *Hi-Fi* speakers.

● ● ●

Packard-Bell is introducing a portable 17-inch TV set with a pre-formed fiber glass cabinet. Packard-Bell's new model, the 17VT-3, is the result of more than two years of research and development. With high tensile strength, the resin-bonded, pre-formed fiber glass used in the Packard-Bell cabinet brings to portable television new and unsual qualities of lightness, durability and attractiveness. The colors are fade proof and penetrate the entire thickness of the cabinet. Users cannot receive an electric shock from this fiber glass cabinet as it is a non-conductor of electricity.

● ● ●

Saturation advertising of the big-profit outdoor antenna markets has been launched by Channel Master Corp., a manufacturer of TV antennas and accessories. The featured product of the new national campaign is the powerful TV fringe area T-W antenna, which was introduced last year via the industry's very first national consumer campaign. A free "Antenna Check-up Kit" offer is again prominently displayed in all new ads. This offer has demonstrated its ability to pull in live leads for dealers by the tens of thousands. Based on experience, more than 50% of the leads are converted into actual sales. To blanket the rural and smaller city trading areas, which comprise the bulk of the fringe area markets, large-space ads are appearing in Farm Journal, Progressive Farmer and Family Weekly.

● ● ●

A new promotion designed to build consumer confidence in local radio TV service dealers and the profession of servicemen, was announced by the Westinghouse electronic tube division. Key to the program is a pamphlet, "This is the Story of a TV Set," which is given free to all dealers as part of a "Build Consumer Confidence" kit. A dealer window display and streamers are also included in the kit. "The objective of the program is to bring some of the little known facts of servicing to the consumer," Mr. Lane pointed out. "Consumers are not aware of the 'buy' they get in modern servicing because they fail to understand basic costs that go into servicing. Our program is designed to bring this story to the consumer."

● ● ●

Sales of TV sets in September reached the highest level recorded since last December and only slightly under sales of last September, the second highest sales month during 1956, the Electronic Industries Association announced. Radio sales at retail, excluding auto sets, continued spectacularly and were exceeded only by the December 1956 sales for this near-two-year period. Television sales totaled 705,247 in September compared with 510,097 sold in August and 763,908 receivers sold during September 1956. Cumulative television sales totaled 4,452,081 during the first nine months of this year compared with 4,603,626 sets sold during the corresponding period last year, EIA reported. ■■

TRANSISTORS

[*from page 5*]

that the drawn crystal is either *p*-type or *n*-type depending on the type of impurity originally present in the melt. During the pulling process, the type of impurity in the melt may be changed from *n* to *p* or *p* to *n*. This is done by adding sufficient impurity metal of opposite charge so that the original charge is neutralized. Following this an additional amount of the same impurity is added to effect the desired amount of impurity. Thus, if a melt is originally *n*-type, by adding a *p*-type metal the melt will become *p*-type. Similarly a *p*-type melt can be changed into an *n*-type by adding sufficient *n*-type impurity to the melt.

This principle is utilized in making a grown junction transistor. Let us consider first the manufacture of an *n-p-n* type. In this process the single crystal seed is dipped into a doped *n*-type melt of germanium, or silicon, then rotated and withdrawn at a controlled rate. At a certain point in this cycle the crystal will have a shape such

to *C2* in *Fig. 2*. Inductance *L104* is the *rf* choke which, in combination with *C118* and *C128*, prevents *rf* from reaching *R109* and other parts outside the tuner. In practice, two fine tuning (variable resistor) controls may be used. (The simplified schematic, *Fig. 2*, shows only one variable resistor.) Resistor *R109* is the fine tuning control located on the receiver control panel and wired to the tuner. A remote fine tuning control may be wire connected to pin 7 of the remote socket. When used, the remote fine tuning control is in parallel with *R109* and therefore interaction occurs between the two controls. In other words, the setting of one fine tuning control affects the tuning of the other. For proper fine tuning of the remote fine tuning control, the receiver control should be in approximately mid-position. Similarly, the correct setting for the remote fine tuning control is mid-position when adjusting the fine tuning control at the receiver.

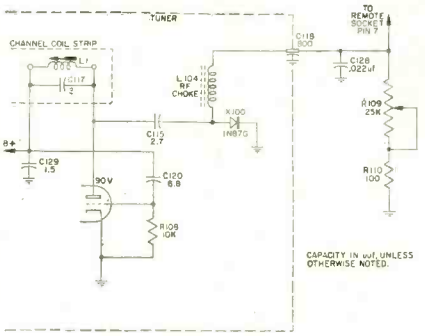


Fig. 3—Schematic of the fine tuner circuit interconections.

The oscillator half of the mixer-oscillator tube (5S8) is shown in *Fig. 3*. Inductance *L1* is the oscillator coil and part of a turret strip and a different oscillator coil is switched in when the channel is changed. Capacitor *C117* forms part of the oscillator resonant circuit. *C115* (corresponding to *C2* in *Fig. 2*), in series with the crystal diode, is effectively connected across the oscillator coil. The cathode of the crystal diode is grounded, *C115* is connected to one end of the oscillator coil; the other end of the coil is at *rf* ground potential. As discussed previously, the effective capacity of *C115* is determined by the current flow through the crystal diode. This current flow is controlled by the loading effect of the fine tuning controls and thus, fine tuning of the oscillator is accomplished electrically. ■■

Advertisers' Index

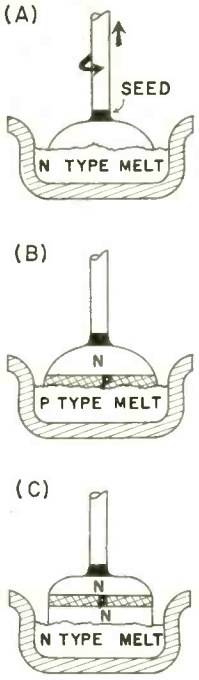


Fig. 7—Doping procedure during initial steps of production of n-p-n junction transistor. Crystal is then diced as shown in Fig. 8.

as that shown in *Fig. 7A*. Now, let us add a pellet of *p*-type material with just enough impurity content to make the melt have a given *p*-type resistivity. Under these conditions the pulled portion of the crystal will be *p*-type as shown in *Fig. 7B*. At a certain time corresponding to the desired thickness of *p*-type crystal formed, if an *n*-type pellet is added to the melt, the pulled crystal will become *n*-type again. This is shown in *Fig. 7C*. There is now formed a single crystal with a *p*-layer sandwiched between two *n*-type layers. The thickness of the *p*-layer is controlled by the time during which the melt is allowed to remain in a *p*-type condition. During this process accurate temperature control is maintained. This temperature control is of extreme importance. The end result is a crystal of the type shown in *Fig. 8A*. This crystal is first sawed along the dotted section shown in the figure. We now have an *n-p-n* crystal disc as shown in *Fig. 8B*. This crystal is then sawed horizontally and vertically producing hundreds of individual *n-p-n* units of the shape shown in *Fig. 8C*. Leads are then attached to these units as shown in *Fig. 8D*.

In *Figs. 9A* and *9B* we show how alloy junction and grown junction transistors are mounted. In both cases the center lead connects to the base.

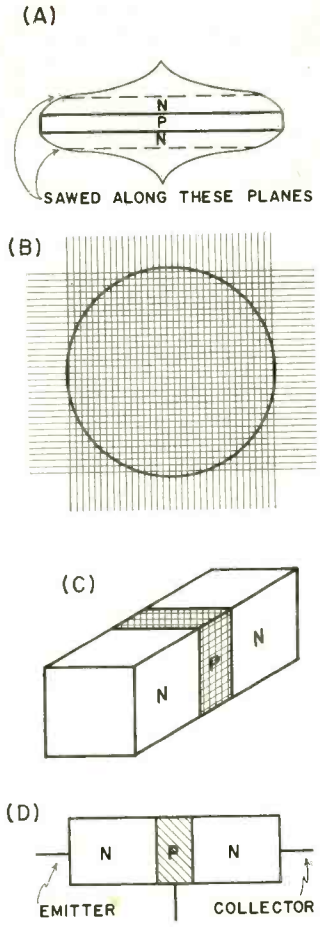


Fig. 8—Crystal is diced by sawing as indicated in "A" and "B." Hundreds of grown junction transistors are produced from a single slice.

The lead nearest the base lead connects to the emitter. The lead farther removed from the base lead connects to the collector.

Grown transistors are superior to alloy junction transistors for high frequency applications. Of course it must be understood that where the frequency requirements are not so rigorous, as in audio applications, alloy junction transistors provide satisfactory service. In the next installment we will describe other types of transistors, the manner in which they are made and their characteristics.

[*To be continued*]

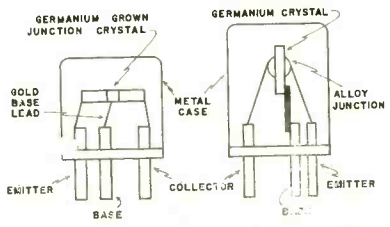


Fig. 9—Complete transistor in mounting. Emitter is closer to base.

AUTO RADIO

[*from page* 44]

If the tuner blows fuses, the cause may be:

1. Sticking solenoids. If evident, replace.
2. Clutch adjusted too tight. Readjust clutch.

Should radio blow fuses:

1. Check for a shorted transistor.
2. If transistor is o.k. check for short in the radio "A" supply circuit.

To test the transistor for short between the emitter and collector (most common short) it is necessary to:

1. Unsolder base and emitter leads from the circuit. (See *Fig. 7*)

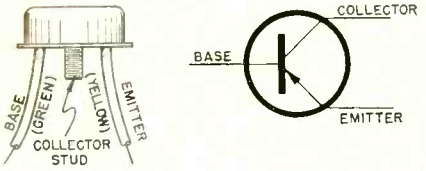


Fig. 7—Color coding used on the transistor terminal connections.

2. Set ohmmeter on R x 1 scale (caution: do not use a higher scale).
3. Place negative meter lead on collector and positive lead on the emitter.
4. If reading is zero, the transistor is shorted. ■ ■

FINE TUNING

[*from page* 8]

period of time, the current through the crystal diode increases; the crystal diode acts as a lower series resistance and reduces oscillator frequency. The reverse condition exists when *R2* is increased in resistance, causing a longer *R2-C2* time constant.

The *rf* choke prevents the radiation of the oscillator signal through the wiring by presenting a high impedance to its passage.

Practical Circuit Operation

Up to this point, reference has been made to an equivalent circuit and a simplified schematic. Consider now the EFT circuit used in the 470VO43HO3 tuner in the Westinghouse V-2371-29 chassis. A portion of the tuner schematic is shown in *Fig. 3*.

The crystal diode, *X100*, is a 1N87G. Condenser *C115* corresponds

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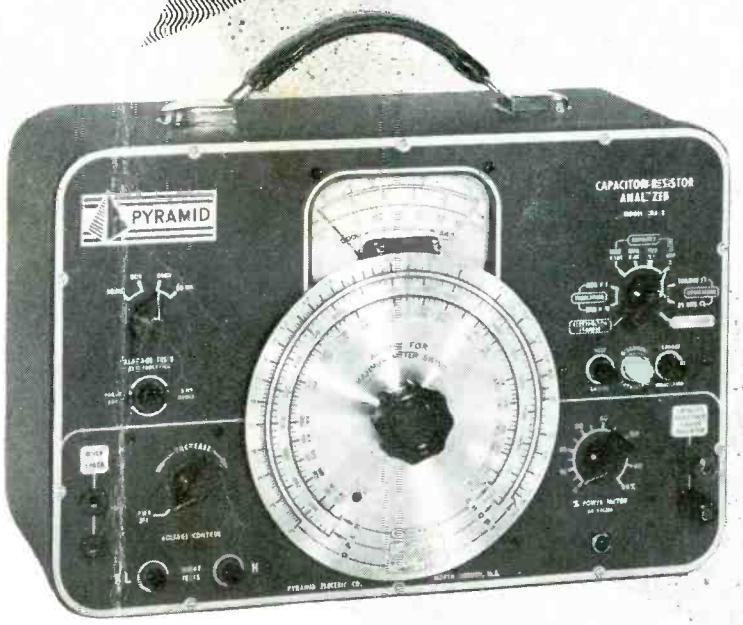

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