ELECTRONIC SERVICING

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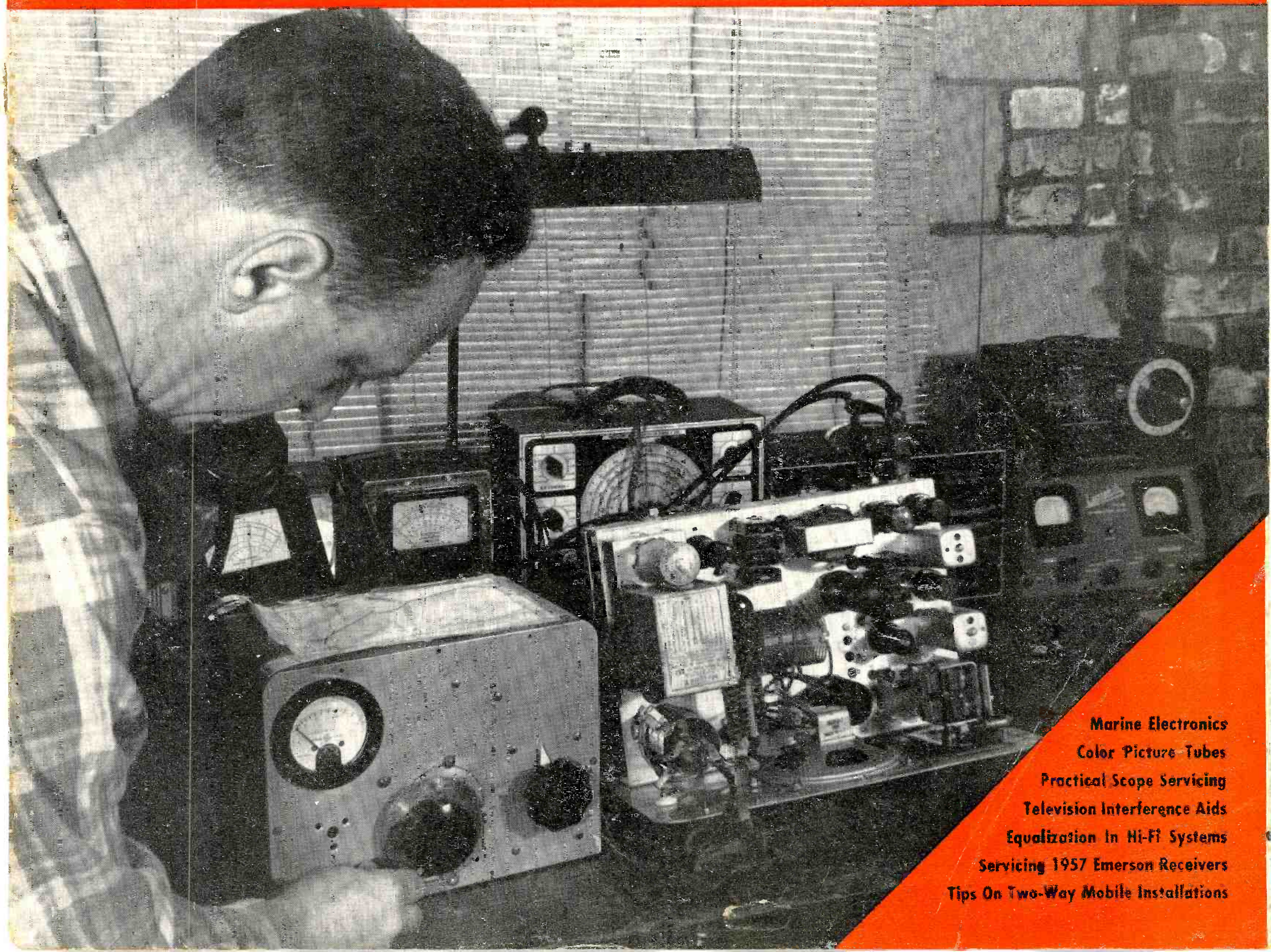

Marine Electronics
Color Picture Tubes
Practical Scope Servicing
Television Interference Aids
Equalization In Hi-Fi Systems
Servicing 1957 Emerson Receivers
Tips On Two-Way Mobile Installations

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FEATURE ARTICLES

CIRCUIT AND SERVICE FORUM

DEPARTMENTS

THIS MONTH'S FRONT COVER

Typical scene in shop devoted to marine radio maintenance and repair. (Elbert Robberson)

COWAN PUBLISHING CORP., 300 West 43rd Street, New York 36, N.Y.

Ad Libs

by S. R. COWAN

Color TV

It is common knowledge that RCA has invested hundreds of millions in promoting color TV. Their loss in 1956 is reported at nearly $7 million, despite the fact that color set sales reached an all-time high and, as one person put it, "color at last broke the sales-reistance barrier."

Now RCA announces that color set list prices on 3 of the 10 models will be increased $45 to $50 but the price of the table model remains unchanged at $495.00. Some experts claim that it costs more than that to make the sets and that reason alone deters many other set makers from getting on the color-TV bandwagon. We believe that *all* TV sets, monochrome and color, are now priced too low and would sell just as easily at higher (and more profitable) prices.

In our opinion, color TV can and will be the average serviceman's salvation and prime money-making source in due time. Unfortunately, too many servicemen have not expressed enthusiasm for color TV when queried about it by potential new set buyers. This is negative thinking. Color TV is here to stay and in time may replace monochrome entirely. Remember the adage: "If you can't lick 'em, join 'em." It's time to get behind color TV if you intend to stay in the servicing business. And remember, March 25-30 is National TV Serviceman's Week. This public relations program which benefits all servicemen was originally sponsored by RCA.

The 1957 Electronics Parts Show

Are you desirous of attending the special Sound Demonstration Area (where commercial sound and Hi-Fi

equipment will be shown) at the 1957 Show to be held at Chicago May 20-23rd? If so, you will be sent a badge of admission if you purchase from at least six different exhibitors at least six of the following classes of products: tuners, amplifiers, speakers, speaker enclosures, phonograph turntables, record changers, wire or tape recorders, cartridges, discs, wire, tape, phonograph needles. Registration forms will be sent to you if you write to Mr. K. C. Prince, 11 South La Salle Street, Room 1500, Chicago 3, Illinois.

Servicemen Conventions

Thirty years ago manufacturers of radio tubes, parts, accessories and test equipment recognized the fact that servicemen and jobbers were vital to their business. Consequently each year, for 5 years, these manufacturers ran a convention (or parts show) with all jobbers and servicemen being invited to attend. Then, certain jobbers convinced manufacturers that it was their group which "controlled" the replacement parts markets, and not servicemen; and based on that theory jobbers won places on the Show Corp committees and as a result they arranged it so that servicemen were no longer eligible for admission to the conventions.

Thus, in effect, what started to be shows by manufacturers for servicemen became shows for jobbers. That's fine! But today we know that over 90% of the nation's professional servicemen decide for themselves what brands of replacement they will buy and use. Jobbers seldom influence any servicemen's purchases nowadays. In fact, our files are loaded with letters from servicemen who complain that most jobbers' count-

[*Continued on page 6*]

Tips on Two Way Mobile Installations

by Lewis M. Owens

The installation of 2-way communication equipment on autos and trucks requires workmanlike techniques.

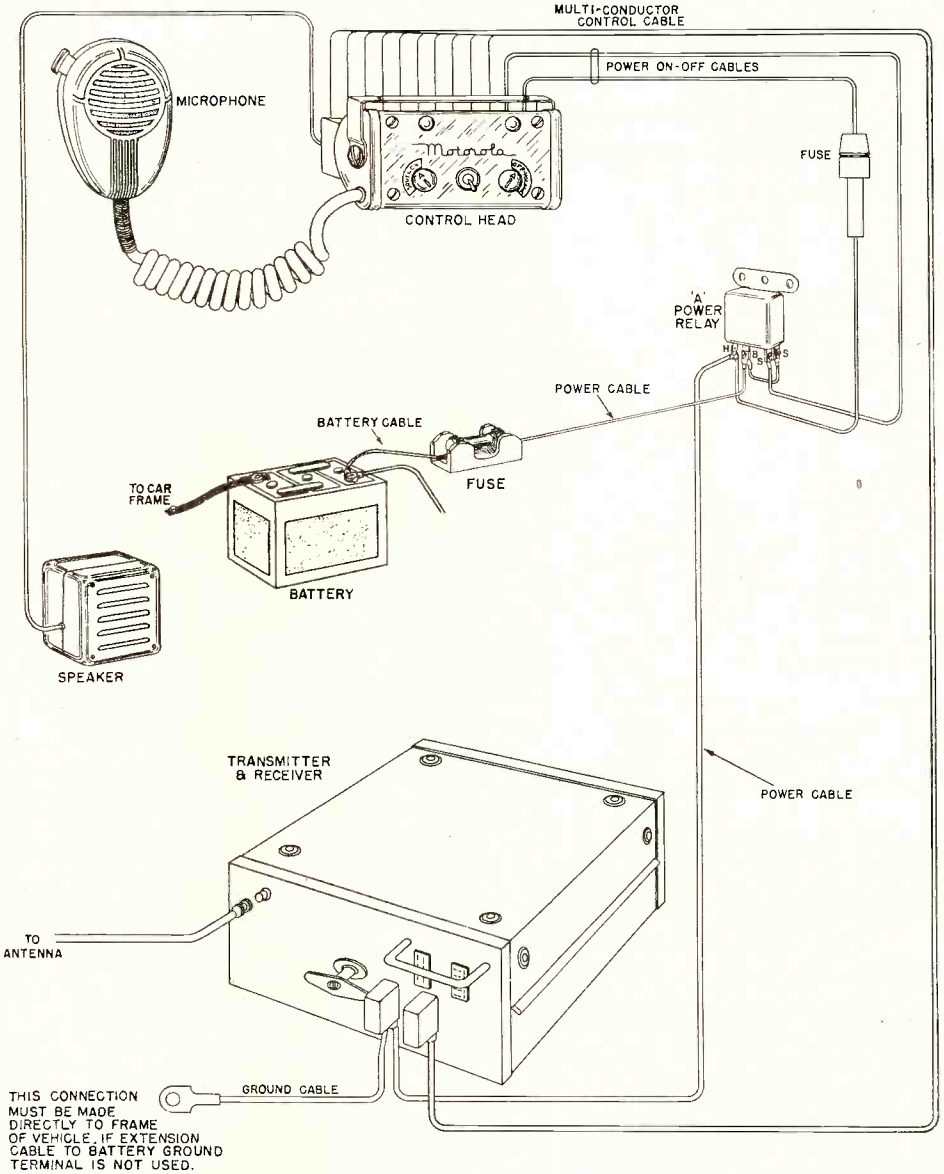


Fig. 1—Typical interconnection arrangement on 2-way installation. (Motorola cabling detail T41G series mobile station)

THE service a two way mobile radio unit gives over a period of time will depend, to a large extent, upon the installation. Taking the attitude that you will be the technician to maintain the equipment, will probably result in a better than average installation and reduce future maintenance. Methods of installation will differ with the type of vehicle, the technician etc., but the following pointers should help to produce a good installation.

A definite plan on the mounting location of the various parts, fuse block "A" power relay, microphone, speaker, control head and antenna, should be made prior to the start of installation. This will save considerable time, and some future trouble will be eliminated. The unit should have adequate removal clearance from the housing. The controls and microphone should be mounted at locations convenient to the vehicle operator but must not interfere with operation of the vehicle. The basic interconnections are shown in *Fig. 1.*

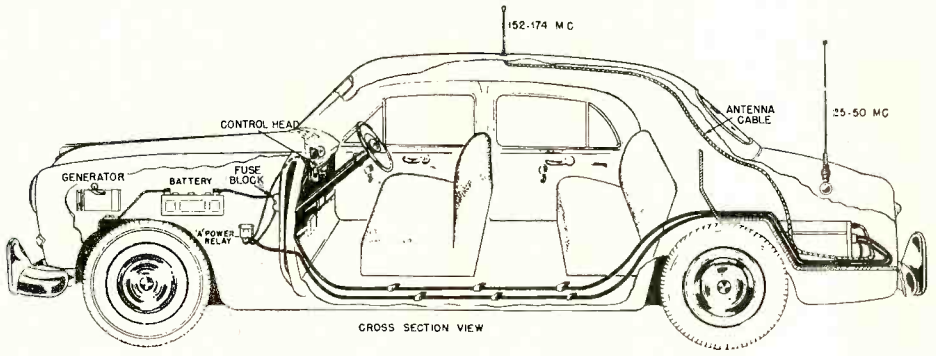


Fig. 2—Outline drawing showing installation details in automobile.

Automobile Installation Unit Mounted in Trunk

Installations in automobiles are usually the easiest. The unit is mounted in the trunk (be careful not to pierce the gas tank or line when drilling the mounting holes for the unit housing) with the power and control cables routed through the forward trunk wall, underneath the rear seat and under the floor mat along the side of the center drive shaft well. An outline of this arrangement is shown in *Fig. 2.* The spring support bar on the front of the rear seat can be bent with heavy pliers if necessary to keep the cables from being "pinched."

The control cable will be less conspicuous if brought up under the dash behind the heater cardboard duct to the control head, which is usually mounted at about the center of the under side of the dash. The microphone is usually mounted on the dash. It is a good idea to give some consideration to the vehicle operator on microphone placement. If lefthanded the operator might prefer the microphone installed to the left of the steering wheel, where there is usually ample room.

The speaker is usually mounted underneath the dash on the firewall. If the vehicle is to be used in a noisy area, the speaker might better be mounted on the steering column (with a special clamp) or on the dash. Recently one manufacturer has announced a speaker with built-in transistor audio amplifier for use with their equipment. It has a power output of 5 watts at 6 volts and 15 watts when used with a 12 volt source. This is very helpful when a vehicle is used in a noisy location or if the operator is some distance from the vehicle and is called.

The power cable can go through the firewall, high enough from the floor so that water won't enter the vehicle around the cable. Rubber tape or a rubber grommet should be used where the cable goes through the firewall. The "A" power relay is usually mounted on the engine side of the firewall and the fuse block assembly on the fender panel. The battery cable should go directly to the battery and a good clean connection made. The cables on the engine side of the firewall should be positioned so they will not come in contact with the engine as damage may result from the heat. Some cables or parts of cables may have to be repositioned to reduce ignition

noise. The ground cable should be connected to the grounded side of the battery or to the engine if possible. If the cable isn't long enough for this, make a good clean and tight connection to the vehicle frame.

Antenna Installation

The antenna is mounted in the center on top of the vehicle if this unit operates in the high (152-162 *mc*) band. The antenna mounting hole can be made with a lip saw and the transmission line fished from the trunk with a fish tape or similar device. It sometimes is easier to remove the trim from one of the rear windows and fish the transmission line first to the window and then on to the antenna mounting location. A good ground connection is essential at the mounting location. For an antenna used with a unit operating in the low band (30-50 *mc*) the antenna is mounted at the upper left corner of the trunk lid, between it and the left corner of the rear window. This is usually a strong part of the vehicle body and as high as possible to mount an antenna of this length.

Front Mount Type

The front mount type unit has built-in speaker and controls. This unit, if mounted in an automobile, is most convenient when mounted on the center drive shaft well. Mounting brackets or braces made of angle iron sometimes make for a better installation in some vehicles. This location probably will not be accessible in a trunk, and the unit will have to be mounted further from the driver. The microphone is often mounted on the unit, but may be mounted closer to the driver or the operator whichever the case may be for con-

[*Continued on page 52*]

AD LIBS

[*from page 3*]

ermen know so little about components that they are a hindrance rather than help . . . and that so many owners of jobber firms themselves have lost contact with the servicemen's needs and preferences that they don't even try to stock the items that are most wanted, aside from "bread-and-butter" parts. (I can prove this: Last month in Florida not one of five jobbers I called upon had in stock a 22½ V. miniature battery needed as a replacement for a Regency Transistor Radio —one of the most commonly used in radios of its type).

The point we're driving at is this: Servicemen are today an even more vital part of most manufacturers' business than ever before—the replacement dollar volume annually being equal to or even higher than original equipment sales volume at present. So, in our opinion, it is time for manufacturers to again reassess their working relation to servicemen per se. Conventions to be held in key cities by manufacturers for servicemen, excluding jobbers entirely, would do both the manufacturers and their servicemen customers more good than any other arrangement. We'll cover this idea more fully in next issue . . . but, what do servicemen feel about the idea? Write!

Manufacturers should bear in mind this fact: printed circuits, and the like products of ever - increasing automation-designed-circuitry; and the expanded practice of factory-captive-service, could easily, in time, result in parts jobbers losing all contact with professional servicemen as the latter would be forced to buy most of their replacement components from set distributors.

British Columbia Licenses Servicemen

Even when things are "normal" it is impossible to publish a serviceman's magazine that pleases all subscribers because there are so many factions and regional problems that those in our position frequently seems to be "straddling both sides of the fence."

For example, at one time we opposed *all servicemen* license plans. Then, when we found conditions untenable in some areas, we reversed our stand believing that only by means of localized legal controls could the best interests of both servicemen and the set-owning public be served.

Recently British Columbia's Government brought all TV and Electronics technicians in that province under certification "in order to prevent partly-trained technicians from setting themselves up in business." We'd be interested in hearing from our northwest colleagues. Do they like this new law or has it some short-comings?

An Anniversary Name Change

Just 18 years ago this month Radio Service Dealer Magazine was launched. Subsequently, with the advent of television the title was changed to Radio-Television Service Dealer. In May, 1956, the title became Service Dealer and Electronic Servicing. Now the title is being changed again in keeping with the editorial content and type of work now being done by our subscribers. Electronic Servicing is our name—and will be—for 18 or more years to come, God willing. As in previous years, our policy will continue to be one dedicated to the furtherance of servicemen in the electronics industries. ■■

Equalization in Hi Fi Systems

by LAWRENCE FIELDING

Equalization of frequency response in phono amplifiers is considered in this revealing article. Different types of equalization, their circuitry and how they are used in Hi Fi systems are discussed.

PART 1

Frequency	RIAA (db)	Old RCA (db)	Old AES (db)	Old Columbia (db)
30	+18.6	—	+22.5	+14.0
50	17.0	+24.0	18.0	13.3
70	15.3	20.0	15.0	12.5
100	13.1	16.5	12.0	11.0
200	8.2	9.5	6.5	8.0
300	5.5	6.0	4.5	5.5
400	3.8	3.5	3.0	4.0
500	2.7	2.5	2.0	3.0
600	1.8	1.5	1.5	2.0
700	1.2	1.0	1.0	1.5
800	.7	.5	.5	1.0
900	.2	.2	.2	.5
1,000	0	0	0	0
2,000	—2.6	—2.5	—2.2	—3.0
3,000	4.8	4.5	4.0	5.5
4,000	6.6	6.5	5.5	7.8
5,000	8.2	8.0	6.7	9.5
6,000	9.6	9.5	8.0	11.0
7,000	10.8	11.0	9.0	12.5
8,000	11.9	11.5	10.0	13.5
9,000	12.9	12.0	11.0	14.5
10,000	13.7	12.5	12.0	15.5
11,000	14.5	—	13.0	16.3
12,000	15.3	—	13.5	17.0
13,000	16.0	—	14.0	17.3
14,000	16.6	—	15.0	17.5
15,000	17.2	—	15.5	—

Fig. 1—Table of most popular equalization responses.

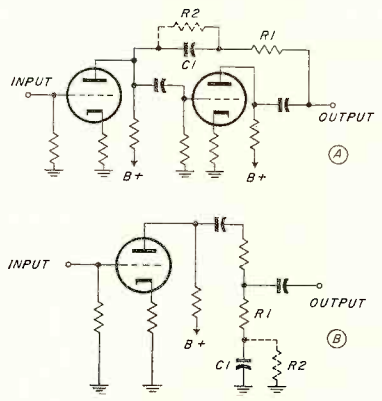


Fig. 2—Two popular methods of achieving bass boost in phono amplifiers.

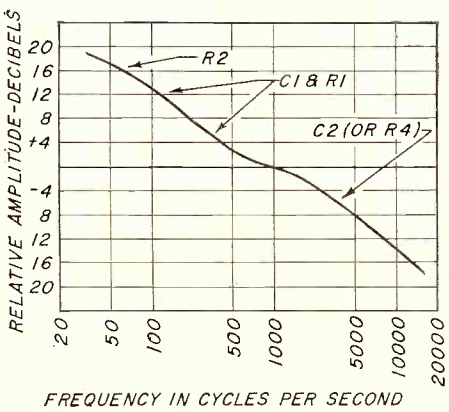


Fig. 3—Equalization characteristics of phono amplifier showing which parts control shape of the curve.

In an early installment of this series (September, 1956) we discussed, in some detail, the equalization (or, actually, the departure from flat response) required for phonograph reproduction in high fidelity systems. In this installment, we shall take up more specific types of equalization, how they are used in the overall circuitry, and what test and repair procedures should be undertaken in connection with these circuits. Actually, any tonal compensation which results in more faithful (or more apparently faithful) reproduction of sound may be classified as a form of equalization. However, since we have already examined tone controls and loudness controls in previous issues, we shall concern ourselves presently with the following additional forms of equalization:

1. Record playback equalization
2. Tape playback equalization
3. Presence control equalization
4. Record scratch filters
5. FM De-emphasis characteristics
6. Loudspeaker padding
7. Turntable rumble filters

Record Playback Equalization

You may recall that in the early days of recording, there were about as many playback response characteristics as there were record companies. A table of the response characteristics of some of the most popularly used techniques is listed in *Fig. 1*. It is interesting to note that except for the extreme ends of the frequency spectrum, the various degrees of boost and deemphasis between the curves shown do not differ from each other by more than a few decibels, at worst. Still, even these small differences at mid frequencies and the relatively larger differences at the low and high ends of the audible spectrum are audible to a discerning audiophile who possesses a good high fidelity set-up. Much of the fine, early equipment produced before 1954 did not, of course, include the new, now standard, RIAA playback curve setting. It is a simple matter to modify one of the other existing playback settings to take care of this difficulty and bring your customer's equipment up-to-date. There are basically two ways of achieving low-frequency boost in phono preamplifiers. These are illustrated in *Figs. 2a* and *2b*. The first method involves inverse feedback between two stages, in which the capacitor *C1* decreases the amount of feedback (or, in other words, increases the gain) as lower frequencies are approached. Resistor *R1* determines the total amount of feedback at higher frequencies and *R2* (present in some cases) determines at what frequency the boost levels off to flat response. (See *Fig. 3* for a breakdown of functions of the different components). In *Fig. 2b*, a voltage divided type of circuit is used, where the percentage of signal developed across the *R2-C1* combination increases at low frequencies because the impedance of *C1* becomes greater. The gain at mid and high frequencies is controlled by the ratio of *R1* to *R2*.

Converting AES to RIAA

Since most older systems had an equalization setting called AES (Audio Engineering Society proposed playback curve of 1948-9) and since very few recording companies actually adopted this curve for any length of time, this would be a good setting to convert over to RIAA, the new standard. This is simply done by replacing *C1* (in either *Fig. 2a* or *2b*) with a value equal to 4/5 of the present value. (A .01 μf value of *C1* would now become .008 μf, for example.) *R1* need not be altered. *R2*, whether present or not, should be replaced by a resistor whose value is equal to the reactance of *C1* at 100 cycles. (The formula for capacitive reactance is $X_c = \frac{1}{2} \pi fC$ where f is 100 and *C* is the value in *farads* of *C1*). Thus, if the new value of *C1* is .008 μf, the value of *R2* to be paralleled across it would be 200K.

Changing the De-emphasis from AES to RIAA

Three methods of achieving high-frequency de-emphasis are normally employed in preamplifiers, as illustrated in *Figs. 4a, 4b* and *4c*. The method of *Fig. 4c* is nothing more than external loading of certain types of magnetic cartridges to reduce high frequency output in accordance with a prescribed curve The manufacturer of the particular cartridge will be able to furnish you with data as to what value should be assigned to *R4* to produce proper roll-off in accordance with the new RIAA recording characteristic. For GE variable reluctance cartridges, this value is 6.8K. In *Figs. 4a* and *4b* the amount of de-emphasis is controlled by capacitor *C2*. Again, starting from the AES setting, which will become extinct, it will be necessary to *increase* the value of *C2* by approximately 1/3 more, but in this instance, no hard and fast rule can be given, because of vast differences in

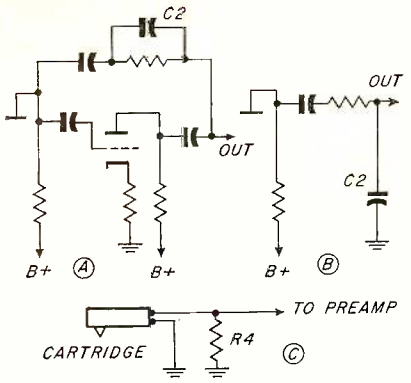


Fig. 4—Achieving treble roll-off in phono preamplifier.

circuitry between different units at this point. It is a simple matter to check response with your test record, however, and adjust the value of *C2* slightly, making it larger if insufficient treble de-emphasis occurs and smaller in the reverse case. It would be a good idea to suggest this modification to all your customers who do not now have a setting for RIAA playback on their preamplifiers. They should be more than pleased to go along with this idea for many of them are turning in perfectly enginered preamplifiers for newer versions because of this minor obsolescence.

Tape Playback Equalization

The magnetic playback-head of a tape recorder is in many respects similar to a magnetic playback cartridge. Since both operate on magnetic principles both are basically *velocity* sensitive. It follows, then, that the recording characteristic of a tape head should be about like the straight line of *Fig. 5*. Actually,

[*Continued on page 56*]

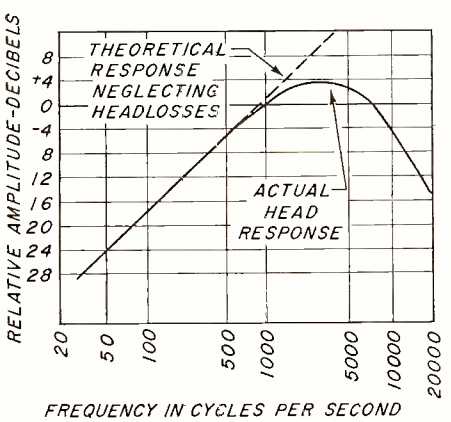
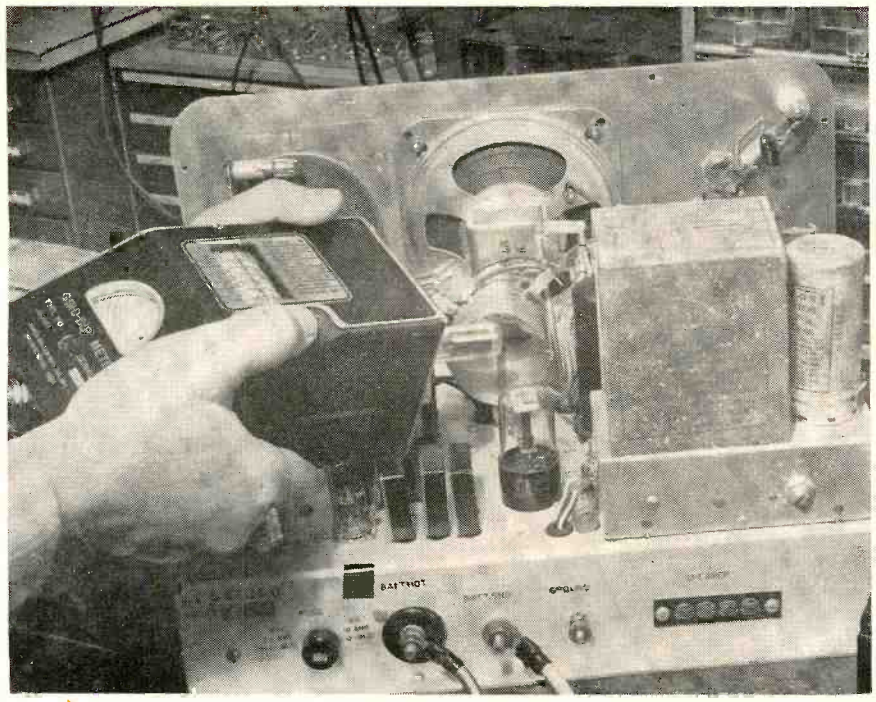
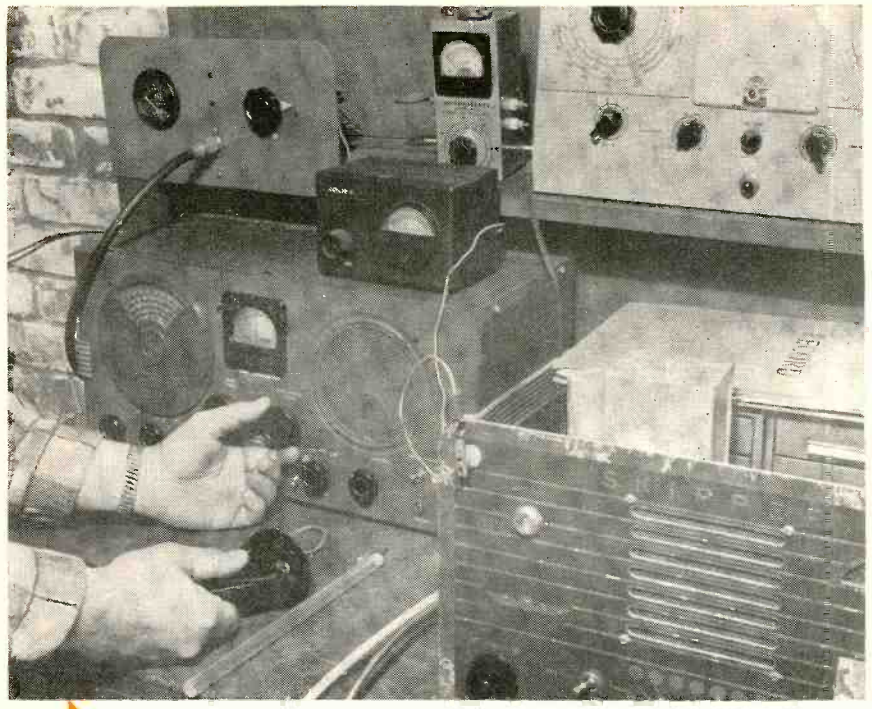


Fig. 5—Typical response of unequalized tape playback head.



Transmitter circuits can be pre-resonated with a grid-dip meter.



Rough check on harmonic output using receiver and "S" meter.

Marine Electronics

Part 9

by ELBERT ROBBERSON

Valuable time-saving suggestions are provided in this installment on final-tuning the transmitter

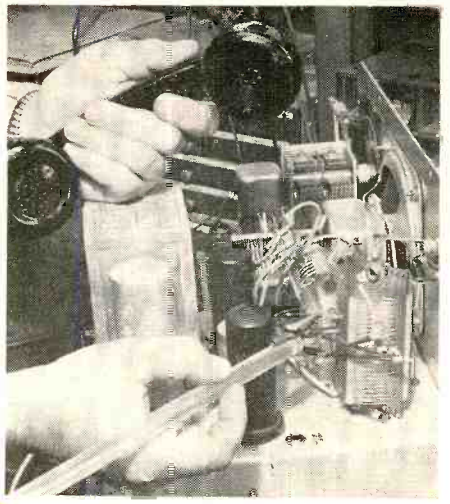
FINAL tuning of a marine radiotelephone must be performed by FCC-licensed personnel, and for good reason. Not only is this operation very important for satisfactory operation of the equipment, but also, it must be performed so as to insure that radiation from the transmitter is legal and cannot interfere with other services.

There are several methods of going about the job, in addition to a few time-saving kinks. Accordingly, although some details of the various procedures involved have been mentioned from time-to-time in preceding installments, the subject is important enough to be reviewed and tied together before leaving the topic of radiotelephone installations.

The crux of successful radiotelephone tuning is familiarity with the equipment. For this reason it is important that first of all, any new equipment be given a complete bench check in the shop so that any possible deficiencies may be corrected where facilities are readily at hand, and also, so that when placing the equipment in service you will know what to expect. Shop equipment required for preliminary-test purposes includes a direct-current power source; voltmeter and ammeter in the primary circuit to measure input power; a dummy antenna or calibrated *rf* load for measuring output; a voltmeter and milliammeter of suitable range for measuring plate-input power; a means of measuring *rf* frequencies; a modulation meter or oscilloscope for checking modulation; as well as a field-strength, or other meter, which will measure harmonic output.

The first shop operation is to place the equipment on the bench and install all of the operating crystals. Then apply input power and make sure the primary-current drain is proper. Then, with a milliammeter of the proper range inserted in the *rf* power-amplifier plate circuit, begin tuning the transmitter. During the first stages of tuning, overload can naturally be expected as the plate circuit of the amplifier will be off-resonance until proper adjustments have been made. On low-power equipment this overload is not dangerous. However, on transmitters of high power, or those employing high voltage where there is no power-reduction feature for tuning, a slight modification to the method of putting a milliammeter directly in the plate or cathode circuit gives satisfactory tuning indications; and, at the same time, protects amplifier tubes from possible damage.

Instead of plugging in a milliammeter, wire a high-wattage wire-wound resistor of about 500-ohms across the plug which goes into the meter jack. Then, connect the shop voltmeter across this resistor. Voltage drop through the resistor prevents off-resonance plate current from reaching a dangerous value, while at the same time, permits the stage to operate sufficiently well for resonating purposes. The indication de-



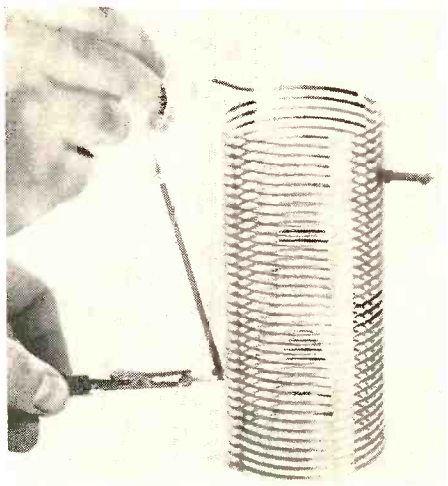
Tool made of alligator clip facilitates handling of coil clips.

sired is the lowest voltage reading across this resistor. Once this adjustment has been made, the regular milliammeter may be plugged into the jack, and final tuning completed.

Another method of preventing possible overload damage, while tuning high-power stages, is first to bring circuits as close as possible to resonance by using a grid-dip meter coupled to the tuning coils before applying power.

After tuning an *rf* amplifier it is always wise to make sure, by the use of an absorption type wave meter, that output is on the desired fundamental frequency and not on a harmonic.

I have found cases where crystals were damaged in transit or became dirty and shifted off frequency enough to fall outside the legal frequency tolerances. For this reason, it is also a good idea



Insulated alligator clip pressed into service for emergencies.

to check frequency of operation on each channel.

Transmitter defects are most easily spotted at this point by connecting the transmitter antenna circuit to the dummy load and determining if the power output is normal. At the same time, modulation and over-modulation checks should be made. If the transmitter is not of recent vintage, and does not have FCC certification that its harmonic output is below the legal level, the second-harmonic output should also be measured. This is accomplished by using a field-strength meter, or as an approximation, a communications receiver with an accurate "S" meter, backed up by a signal generator having an accurate output calibration.

Although everyone is inclined to feel that receiver tuning is so simple as to require no special attention, the tuning job on the boat, where time costs more money and facilities are more limited than ashore, will be greatly simplified if the receiver is preliminarily tuned up in the shop. Then, only slight adjustments of the antenna stage will be required after installation. The importance of a shop-tuning job is greatest when one of the older radiotelephones, having non-crystal-controlled receiving channels, is encountered. These old equipments tuned the receiver oscillators by trimmer condensers. Even in heavy-traffic areas, such sets are very difficult to tune aboard a boat, relying upon signals on the air, and more than one of the phones tuned in this fashion has ended up with receiving channels adjusted to the wrong frequencies. And, even with crystal-controlled receivers, input circuits can accidentally be tuned, without preliminary shop alignment, to image frequencies, rather than to the communication channels.

Transmitter-antenna tuning is ordinarily thought to be possible only with the equipment finally installed on the boat. However, if antennas of uniform characteristics are routinely used, it is entirely feasible to make the preliminary antenna-tuning adjustments on the transmitter while the equipment is in the shop, thus reducing the antenna-tuning operation aboard the boat to a mere process of touching up the previously made shop adjustments.

Most commercial antennas, such as

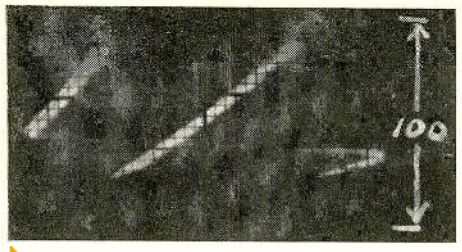
are used on powerboat installations, have the effect of a capacitance and a resistance in series. With a setup outdoors to simulate a boat installation, the characteristics of these antennas may be measured closely enough to help greatly in the tuning of the radiotelephone. A simple means of doing this with non-loaded antennas is to erect the antenna over a ground plane of wire or wire screen, or place it close by a water pipe; then, measure the capacitance between antenna and ground with a capacitance checker or bridge. The value thus found will be close to the capacitance that the antenna will normally have on board a boat. Now, with the variable capacitor in the shop dummy antenna (or *rf* load) calibrated and set to the above-found value of capacitance, it should be possible on the bench to adjust the antenna-tuning circuit of the radiotelephone fairly close to the adjustments which will be proper on the boat.

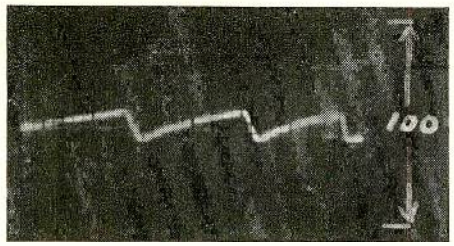
A somewhat different procedure is used with loaded antennas which have coils built into their structure. Set the antenna up as described, and connect one of your radiotelephones between it and ground. Do not apply power to the radiotelephone. Then, using a grid-dip oscillator set to the marine frequencies and coupled to the radiotelephone antenna coil, the equipment loading coil can be adjusted for resonance of the antenna circuit, which will be indicated by a dip in the oscillator grid current.

If only one model radiotelephone is installed, make a record of the amount of inductance required for loading circuit resonance on the different channels; and subsequent similar phones can then have their antenna circuits preadjusted to the same values.

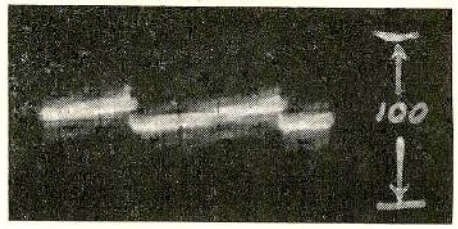
However, if several different models of equipment are handled, a slight elaboration on this system is used. After the trial equipment has been resonated by the grid-dip meter for the different channels, disconnect the radiotelephone from the antenna and ground, and set it up on the bench. Connect the shop dummy antenna, and determine the capacitor setting required to resonate the output circuit with the inductance settings which were found in the outside antenna experiment. Then, the

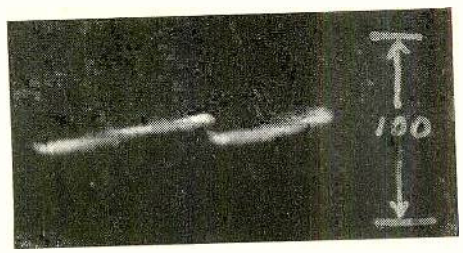
[*Continued on page 37*]





(Left) Scope pattern of sampling signal to afc tube in Motorola TS 418 which had an inductive filter condenser. (Right) Normal signal when condenser was replaced.





(Left) a low capacity and inductive filter gave this wave form at the plate return of the vertical output transformer. (Right) Normal wave form, See *Figs. 8, 9.*

Practical Scope Servicing

by Allan F. Kinckiner

A properly used oscilloscope can be an extremely useful tool in servicing. This is the second installment of an article dealing with the use of the scope in tracking down defective capacitors. ....

PART 2

In the previous installment, case histories were described in which the oscilloscope was used to quickly and effectively locate defective capacitors. The following are additional cases where the scope was used in a similar manner.

Motorola 292—Poor Horizontal Lock In

In Motorolas, of which the 292 is the prototype, the resistors feeding the sampling voltage to the horizontal *afc* tube were found burned and decreased in value. See *Fig. 6.* They were replaced as was the .001 μf condenser, but the hold was still critical. The sampling pulse is taken from the cathode of the damper tube where the deflection pulse is present. A small condenser bypasses the damper tube (cathode to plate) and the plate is fed from the set B plus. A filter, capacitor, *C95A,* also connects to the plate returning to the 130 volt B+ source. The ripple across the filter showed too high at the horizontal frequency but not at the lower *ac* ripple frequency. Apparently the condenser was inductive and was not bypassing the higher frequencies present in the line. Further proof was the lack of hum in the audio. Hum would have been present if the filter had been merely low or open, since the condenser also acts as a filter for the audio output stage. At least one other manufacturer mentions inductive filters and suggests adding a .05 μf capacitor across its filters if other than non-inductive units are used as replacements.

Zenith "F" Series—Poor Horizontal Linearity

Adjusting the horizontal linearity coil to improve linearity revealed a 120 cycle ripple on the raster's right edge. This was traced to ripple in the B plus line feeding the horizontal deflection circuit and was due to the open filter condenser shown in *Fig. 7.* The normal ripple at this point is about 30 volts *pp.* With an open filter it scoped over 100 volts.

Admiral 21M1—Horizontal Bending

Figure 8 is a partial schematic of the circuit involved. The scope revealed an open filter at the vertical output transformer return. The high ripple at this point was coupled into the *agc* voltage line which was dressed near the filter terminals. In this case the open filter which is in the vertical circuit had no adverse effect on vertical deflection. In contrast, note conditions in the following cases of vertical deflection troubles.

Vertical Deflection Circuit

Defective capacitors in the vertical circuit affect the vertical deflection of the raster. Failures may result in poor linearity, lack of full height or vertical distortion. Several vertical defects encountered due to filter condenser failure, are described in the following paragraphs.

Admiral 24D1—Vertical Breathing

The raster would slowly reach full size vertically, then shrink about one inch at the top and bottom. After a few minutes it would again reach full size. The condition kept repeating very slowly. The raster seemed to be breathing vertically. In *Fig. 9,* the scope traces were normal up to the plate of the 6S4, where the trace changed amplitude in time with the raster shrinking. Shifting the scope to the return end of the primary of the vertical output transformer revealed a larger than normal pulse at all times, and when the raster shrank this pulse became even larger. The fault was in the condenser *C407.* The normal and defective waveforms and peak to peak voltages are also shown. Incidentally, the *dc* voltage readings were not changing as might be expected, so the trouble was apparently due to changing plate loading.

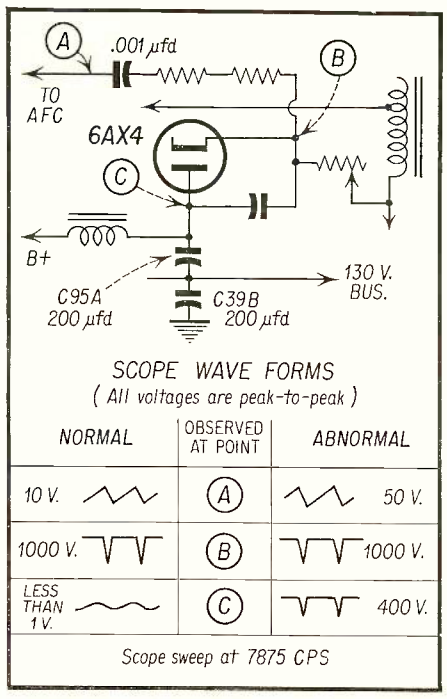


Fig. 6—Scope patterns observed in Motorola with *afc* trouble.

Du Mont RA 113—Poor Vertical Linearity

The raster was compressed at top and bottom and expanded in the center. The

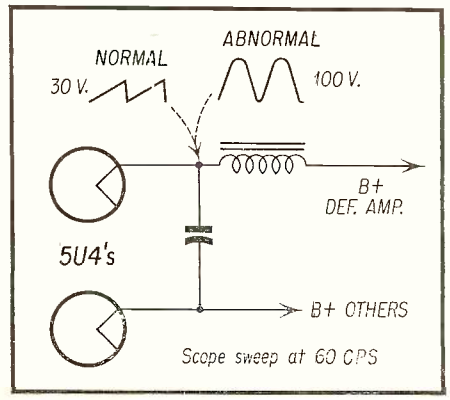


Fig. 7—Open filter condenser produces high ripple voltage.

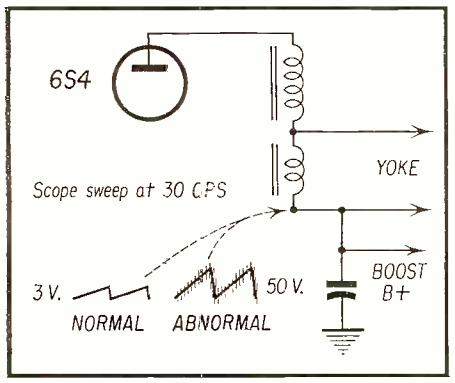


Fig. 8—An open filter in this case caused horizontal bending.

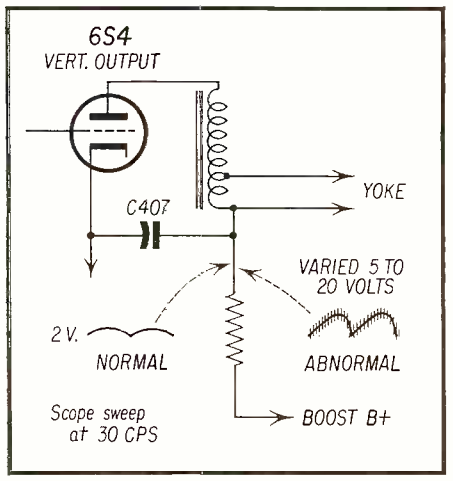


Fig. 9—Defective C407 caused vertical "breathing" in Admiral.

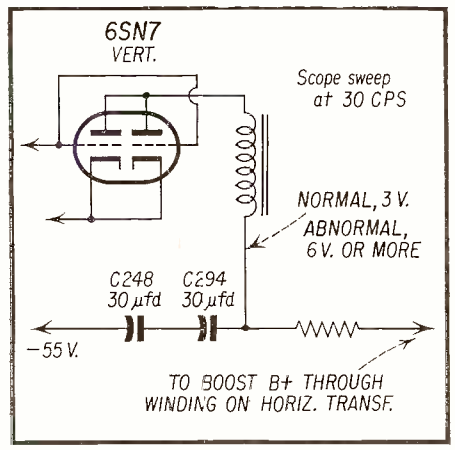


Fig. 10—Open C294 in DuMont caused poor vertical linearity.

set also exhibited more than normal blooming when the brightness control was advanced. Scope tracing of vertical circuit revealed hum at the plate return of vertical output transformer, due to an open capacitor, *C294, Fig. 10.* Replacing the concenser also cleared up the blooming condition, which was caused by the vertical sawtooth fed back through the boost decoupling resistor

[*Continued on page* 53]

Color Picture Tubes

by SAMUEL L. MARSHALL

The two basic groups of color picture tubes are the three-gun simultaneous display type and the single-gun sequential display type. The manner in which color pictures are made with these tubes in discussed

PART 1

From a forthcoming book entitled "Fundamentals of Color Television" by Samuel L. Marshall & Robert T. Dargan

THIS is the first of a series of three articles dealing with color TV tubes. In this first article we establish a basis of comparison of fundamental types, namely the 3-gun types which are simultaneous display devices, and the 1-gun types which are sequential display devices. In the second and third installments various tubes together with their associated control requirement will be described in detail.

Electron gun operation of color and monochrome (black and white) picture tubes are basically the same. Any essential difference between them arise from the fact that (1), three color signals must be processed as separate and distinct beams in a color tube as compared to a single beam in a monochrome tube, and (2), three separate and distinct colors, red, green and blue, must be displayed in a color tube as compared to the single color, white, which is displayed in a monochrome tube. Many systems for processing the three color beams in their progress from the picture tube cathode (or cathodes) to the phosphor screen are presently under development. Two basic types will now be discussed.

Basic Electron Guns

To begin with, let us briefly review the operation of two basic electron guns used in monochrome picture tubes, the magnetically focused, and the electrostatically focused types. These are shown in *Figs. 1* and 2. In the magnetically focused gun shown in *Fig. 1,* the negative *dc* bias between grid No. 1 and cathode provides control of brightness. Incoming video signals are applied between grid and cathode. Grid No. 2, commonly referred to as the screen grid provides initial acceleration to the beam, and produces a constriction of the beam diameter (focusing) at the first crossover area.

As the beam progresses through the tube it enters the influence of the H.V. anode field where it is given a high acceleration. As a result of this acceleration, enough energy is imparted to the beam to cause the phosphor screen to light up at the point of impact.

Passing through the field set up by focus magnet, or coil, the beam is constricted (focused) again so that it reaches the phosphor screen as a fine pinpoint of light. Permanent magnets or electromagnets may be used for this purpose.

Normally, the beam would strike the center of the phosphor screen. However, vertical and horizontal sawtooth currents flowing through the vertical and horizontal deflection coils deflect the beam at the deflection plane, causing scanning of the screen from top to bottom and from left to right.

In addition to the electron particles emitted from the cathode, negatively charged ion particles, which are much heavier than electrons may also bombard the phosphor screen. This bombardment produces a brown spot on a small center area of the screen. This effect may be neutralized by bent and slashed gun design together with external ion traps which deflect and prevent the heavier negative ions from reaching the phosphor screen, or by coating the phosphor screen with a thin film of aluminum. In the latter case, the film is thin enough to allow the electrons to penetrate, but effectively prevents the ions from passing through to the phosphor screen.

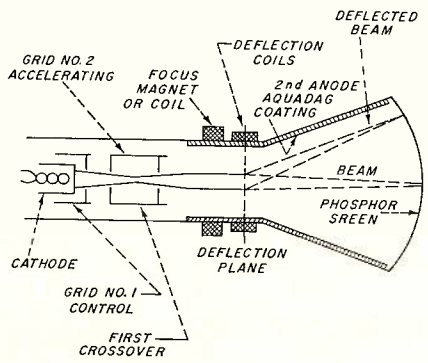


Fig. 1—Magnetically focused and deflected monochrome picture tube.

A simplified gun diagram of an electrostatically focused tube is shown in *Fig. 2.* Here we observe that an additional grid (Grid No. 3) follows Grid No. 2. By connecting this focus grid to a variable source of B+ it is found that variation of the B+ voltage provides effective focusing action without affecting the brightness. In some tubes the focus potential is approximately one-fifth the anode potential. In other tubes much lower potentials are employed in the range of zero to a few hundred volts.

Beam centering in magnetically focused tubes may be conveniently effected by a mechanical adjustment of the focus coil or magnet. Inasmuch as focus coils or magnets are not used with electrostatically focused tubes, it becomes necessary to employ an external beam centering magnet to provide means of centering the beam on the screen. Such a device is generally located directly behind the deflection coils.

Color Picture Tubes: 3-Gun Type

We are now ready to consider how a picture tube must be constructed to provide color reception. Since color TV is a 3-color system the picture tube must provide a 3-color display. This means that the phosphor screen must contain some satisfactory geometrical arrangement of individual red, green and blue phosphors. In practice each set of phosphors provides a display in one color. The phosphor elements are so close to each other that at normal viewing distance the eye cannot resolve them as separate displays; instead it sees the three displays as a single image, the color of which is the addition of all three colors.

So much for displays. Now, directing our attention to the color signal, we find that a standard color transmission represents three color signals occurring at the same instant. As such, the system is said to be *instantaneous.*

In a receiver, the picture tube and its associated circuits is designed to reproduce all three color signals at the same instant when an instantaneous viewing system is used, and sequentially when a sequential viewing system is used. When viewing an instantaneous system, an observer sees the composite effect of all

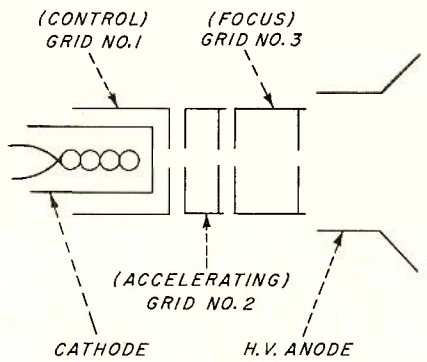


Fig. 2—Electrostatically focused picture tube electron gun.

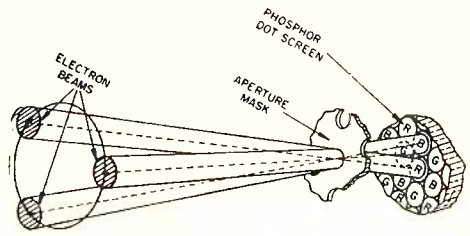


Fig. 3—The three electron beams converge at the holes in the aperture mask and pass through to strike their proper phosphor dots.

three color displays as they are reproduced at the same instant.

A color tube in an instantaneous system employs three separate electron guns, each gun controlling the reproduction of one, and only one of the three colors. Such a tube is called a 3-gun tube.

The most familiar type of 3-gun tube is the so-called "aperture-mask" or "shadow-mask" tube. The reason for this designation is illustrated in *Fig. 3* which shows how three electron beams converge on one of the openings in a metal plate located in front of the phosphor screen (hence the term, aperture or shadow-mask) and fall on three different colored phosphor dots, red, green and blue. Each color beam falls on its own corresponding color phosphor.

In this case the three beams represent red, green and blue video signals, and the color display consists of red, green and blue phosphor dots arranged in triangular trios as shown. The system is instantaneous, and in the resulting display all three colors blend into one as viewed by an observer at a reasonable distance.

Figure 4 illustrates a somewhat simplified cross-section of this tube. Actually the guns are positioned 120° apart with the blue gun on top and the red and green guns below. Here we see red, green and blue video signals entering their respective guns. These guns are of the electrostatic focus type illustrated in *Fig. 2*, and are provided with a slight tilt as an aid in converging the beams at the center aperture of the mask.

One of the devices made available

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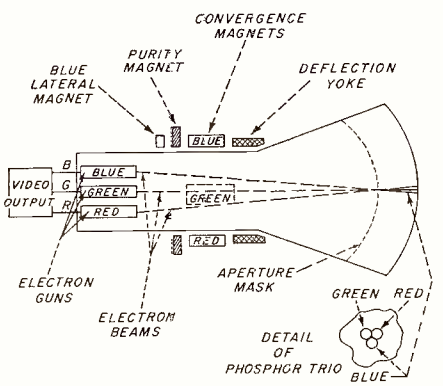
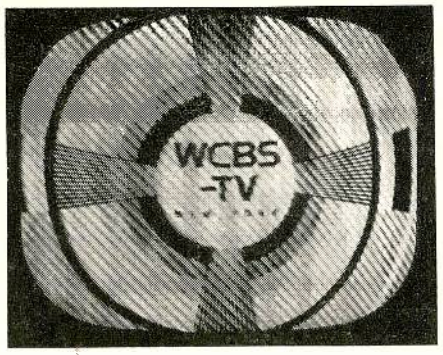
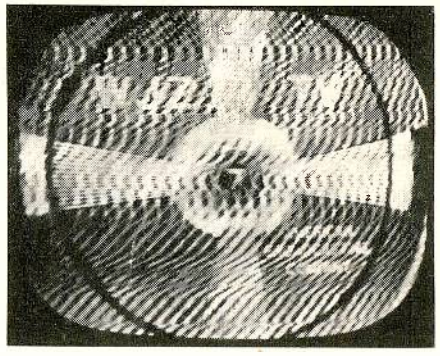
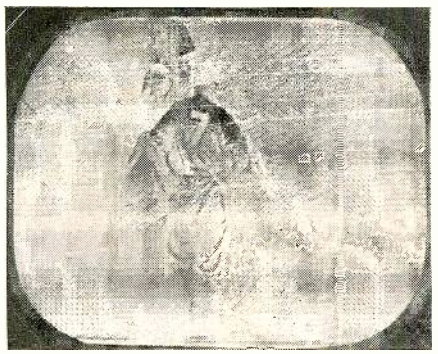


Fig. 4—The three-gun aperture mask type of color picture tube.







The photographs above illustrate various types of interference. From left to right they are: (1) Interference caused by FM station; (2) Crosshatching caused by harmonic of a nearby radio station; (3) Interference caused by a harmonic of an *rf* device such as an industrial heater, radio transmitter, or receiver oscillator; (4) Interference from another TV or FM receiver so strong that it has turned the picture into a negative.

Television Interference Aids

A discussion of the causes and suggested remedies for television interference caused by various types of transmitters. The information presented was prepared by the Washington TVI Committee.

The Washington Television Interference Committee, WTVIC, is a volunteer group engaged in studying the causes and cures of TV interference from other transmitters in the communications spectrum, and acquainting the servicing fraternity and all others concerned, with their findings. They work in close cooperation with RETMA and other national organzations. The following information is from a pamphlet put out by the WTVIC and the editors wish to thank the committee for making it available to us. We wish in particular to thank Col. Van Deusen, the committee coordinator, and Mr. Harold R. Richman, associate advisor, for their cooperation.

Cross modulation as discussed herein is the interference caused by the mixing or heterodyning of an undesired signal with the desired station signal. The result may be the presence of the two signals in the audio or video response. Two signals introduced in a non-linear circuit will mix and cross modulate. The non-linear condition may be brought about by the overloading of one or more circuits by a strong signal.

This difficulty usually occurs in one of two places in the receiver:
(1) the *rf* input or tuner circuits, and
(2) the *if* circuits. Any extremely strong signal, even though it is entirely out of the television channels, can produce this condition if allowed to reach one of these two circuits.

Obviously any measures which will prevent the undesired signal from reaching *rf* or *if* circuits where cross modulation may occur will cure this type of interference.

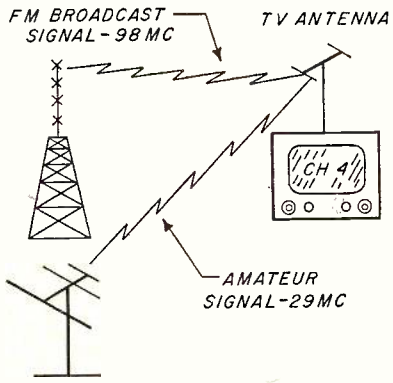


Fig. 1—Cross modulation due to two strong interfering signals.

Sources of Undesired Signals

TV receivers may be subjected to interference from a great many signal sources such as—

1. Strong signals from nearby radio stations, including FM broadcast, amateur, police, taxi, government, airways and military services.
2. Radiation from local oscillator of nearby TV and FM broadcast receivers.
3. Diathermy, industrial heaters, etc.
4. Image interference (This situation exists when a strong signal occurs at the oscillator frequency plus or minus the *if*).

In television receivers this interference will affect either the audio or the picture, and possibly both.

Audio — Distortion of the desired signal.
— Reception of the unwanted audio signal along with the desired audio.

Picture — Distorted, non-linear and unstable.
— Presence of interference pattern.

Why Does This Happen?

Cross modulation occurring in the *rf* circuits may be due to two strong signals reaching the grid of an *rf* stage with sufficient voltage to cause the tube to operate in a non-linear manner. Mixing of the two signals takes place with the tube acting as a converter or mixer. From here on the interference is incurable. Once the cross modulation has occurred it is impossible to separate the desired from the undesired signal. The only solution is to prevent an undesired signal from reaching the grid. *Fig. 1* illustrates a common condition which may give rise to this cross modulation.

Cross modulation occurring in the *if* stages of a receiver is also usually due to a strong signal reaching the grid of one of the *if* stages causing it to operate over a non-linear range, or to draw grid current, become non-linear and function as an invertor or mixer. Again, once having occurred, there is no way to separate the desired from the undesired signal.

The undesired signal finds its way to the grid or grids of either *rf* or *if* stages because it is not opposed by sufficient rejection circuits. This may mean inadequate *rf* tuned circuits ahead of the *rf* stage, or insufficient shielding of the *rf* and the *if* stages, or both. An undesired signal may be thousands of times stronger than the desired signal because its source is closer to the re-

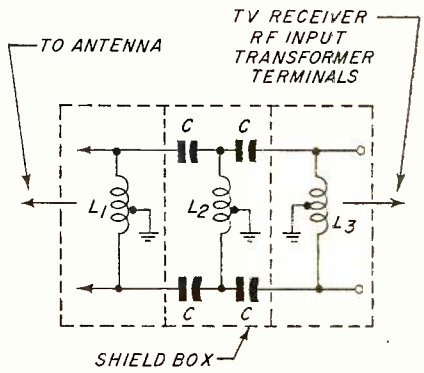


Fig. 2—Typical high pass filter for reducing cross modulation.

Test Equipment

KNIGHT TRANSISTOR AND DIODE CHECKER KIT

by Richard Kerwin
Project Engineer
Allied Radio Corp.

With the ever increasing use of the transistor in home radios, hearing aids, and various "transistorized equivalents" of common circuits, the need has arisen for a quick and simple way to check transistors. The experimenter is further hampered by the lack or unavailability of published data, and the frequent need for matched pairs of transistors for use in audio and metering circuits. The need for such a device is obvious. Any service shop which desires to earn its share of the profits from the sales and service of the increasingly popular transistor radio, must sooner or later have such a device. The checker to be described, though simple, may be used for many purposes other than merely obtaining a good or bad rating for a transistor.

Principle of Operation

In order to understand the operation of this checker, it is only necessary to visualize the transistor as a variable, two-terminal resistance. This resistance is controlled by a third element requiring only small amounts of power relative to the power consumed or controllable by the main two elements. The main two elements in this circuit are emitter and collector. The controlling element is the base. Polarities are shown in *Fig. 2* because they differ for PNP and NPN transistors. The current flow through the transistor is controlled by the emitter to base voltage. The base, however, is not perfectly isolated from the main two elements as is the control grid in a vacuum tube. Therefore, if the base were left unconnected, or floating, we would still have a definite emitter to base voltage caused by leakage currents in the semi-conducting material. This bias, as we may call it, will differ for different types of transistors and will differ even for transistors of the same type number. In this respect the transistor is similar to a vacuum tube, since it can not be completely cut off by self bias.

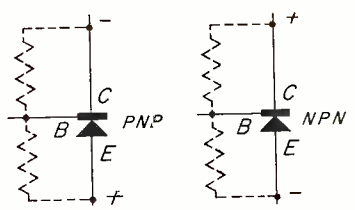


Fig. 2—Inherent leakage resistance between terminals of transistor.

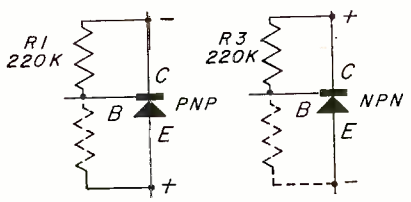


Fig. 3—Equivalent circuit when leakage-gain switch is depressed.

In this checker we have a transistor in a common emitter amplifying circuit. The meter and the calibration control form the collector load impedance. With the switch in the normal or open position the base assumes its own bias and a certain current will flow. When the switch is operated a resistance is connected to the base circuit, changing the bias and causing more current to flow. *Fig. 3* illustrates the circuit under these conditions.

The current flow through the base resistor is very small compared to the collector current flow and will in itself add little to the meter reading. This second condition is called gain.

The ratio of leakage current to gain current may be considered as a figure of merit for a transistor. In general, if the leakage is less than the gain the transistor will amplify. The closer these two become, the lower is the available current amplification.

If both leakage and gain currents are high, it is an indication of a rather low impedance transistor. Conversely, if both of these currents are low we have a high impedance transistor. All of the above may be considered true for both PNP and NPN type transistors. Two separate sockets are supplied because of the different element polarities in these two types.

Testing Surface-Barrier Units

Almost all of the currently available junction and point contact transistors have collector ratings of 20 volts or more. Although the battery used in this unit delivers 22½ volts, it is not likely that more than 15 volts will be applied to the transistor in the gain position. No difficulty has been encountered in this respect. If, however, surface-barrier type units with a maximum collector voltage of 6 volts are to be checked, a 6 volt battery may be used in place of the battery shown. In any case, before testing any transistor, reference should be made to a table of characteristics to determine whether the PNP or NPN socket should be used. Reversed polarities may damage the transistor by heating.

Transistor current gain test

After reference is made to a table of characteristics, the transistor is placed in the proper socket. The spring-return, leakage-gain switch is operated and the calibration control adjusted for full scale deflection. The unit is now calibrated for this individual transistor. This reading (full scale or 1) is the gain measurement. The switch is released and a second reading taken. This reading is the leakage measurement. The ratio of the two is a relative figure of merit. If the leakage equals the gain the transistor under test is bad and will not amplify. Sometimes it is found that a transistor with a small figure of merit will perform in an operating circuit better than one with a large figure of merit. This is probably due to the fact that the better performing unit presents a better impedance match to the operating circuit. If the calibration control must be set low (representing a greater shunt to the meter) to achieve full scale reading, it is an indication of a low impedance unit. The opposite is true if the control must be set high. Once in a great while, we will find a transistor which will not reach full scale reading in the gain position. All measurements are then made relative to half scale deflection.

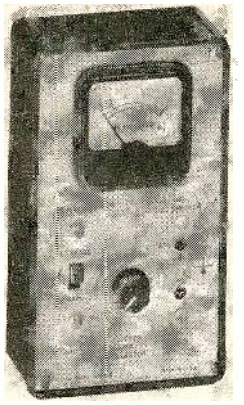


Fig. 1—Photo of the Knight Transistor and Diode Checker unit.

Other Tests

In addition to this check for the merit of a transistor, a number of other tests may be made with the unit. These include transistor matching, transistor noise measurements, crystal diode checking, and the checking of selenium and similar rectifiers. ■■

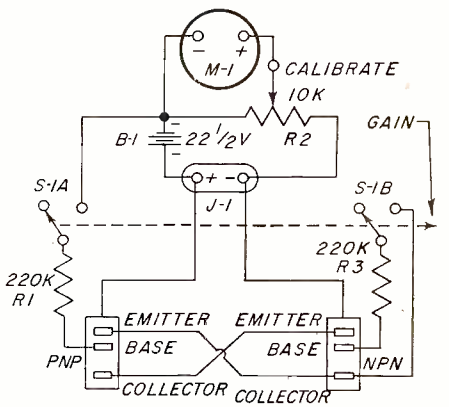


Fig. 4—Schematic diagram of the Transistor and Diode Checker.

ceiver. To eliminate undesired signal some means of adding rejection circuits, shielding or both are necessary.

Measures For Prevention of Cross Modulation Effects

The following measures may be taken to reduce or eliminate cross modulation and its effects:

1. An appropriate filter may be used at the antenna input or in the power line, or both. *Fig. 2* shows a high pass filter for use at the antenna input, while *Fig. 3* gives the details of a power line filter. These filters are available commercially or they may be easily constructed.
2. Adequate shielding. In a very heavy *rf* field caused by a strong signal the *rf* energy can reach critical stages without being conducted along wires leading to the receiver. Direct pickup of this type is particularly likely to occur in unshielded coils, especially when located above the chassis. Shielding components above and below the chassis from this type of pickup can often be accomplished simply by judicious use of ordinary screen or other suitable, easy to handle, shielding material. Sometimes it is easiest to shield the entire inside of the television cabinet, rather than to individually shield suspected points of pickup. One precaution is necessary in this latter case. All leads going through this shielding must be suitably filtered in order for the shielding to be fully effective, and the shield must be properly grounded.

   A metal pan installed inside the cabinet on the chassis shelf, and properly grounded, will help.
3. A shielded transmission line (coaxial cable) from the antenna to the input of the receiver may be used. The impedance of this line must be matched to the antenna and to the receiver for best results.
4. Reorientation of antenna: When the desired signal is strong and the receiver is operating with *agc,* its sensitivity to other signals is reduced.
5. A special antenna system in weak signal areas will give a more favorable desired to undesired signal ratio.

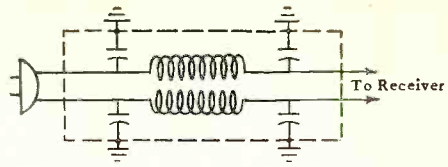


Fig. 3—Power Line Filter

How to Identify This Type of Cross Modulation

There are several methods for determining if observed interference is due to internal cross modulation or is due to other causes. (1) Install trial high pass filter. If the interference disappears the difficulty is probably cross modulation from an interfering signal whose frequency is below approximately 45 *mc*. (2) Remove the *rf* amplifier tube from its socket. If the interference disappears it is either cross modulation in the *rf* stage or an undesired signal directly on the television channel. If the interference persists with the *rf* tube removed, the interference is due to pickup and cross modulation in a later stage, probably an *if* stage. A check on several nearby receivers will usually indicate whether the interference is directly on the TV channel. Make certain the interference is not direct pickup by the audio amplifier.

Pickup similar to audio rectification can occur in the video amplifier which has a much greater pass band and for that reason is more susceptible than an audio amplifier.

Image Interference

Severe interference may result from inadequate image rejection in the TV receiver. In this case the mixing effect occurs in the regular mixer stage, but is caused by a signal equal in frequency to the normally received channel plus or minus twice the receiver *if*.

A sharper tuned trap or stub must be used to eliminate the undesired signal without attenuating the desired signal.

Nearby *fm* broadcast signals are the most common causes of image interference affecting the lower TV channels. The best check is to use a tunable filter designed to cover the *fm* band (88-108 *mc*). ■■

THE ANSWERMAN

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

BY ELECTRONIC SERVICING TECHNICAL STAFF

Mr. Answerman:

I have a problem that you might be able to help with. The receiver I have exhibits a wiggle on the left horizontal wedge of a test pattern. On a picture the wiggle extends in a couple of inches running about the full side of the picture. It seems the horizontal deflection lines are bent a slight amount. Everything I can think of has been checked including tubes and condensers. I sure would like to clear it up. The set is a G.E. Model 20C150.

J. C.
Chicago, Ill.

From the description of the difficulty it sounds as though the horizontal deflection coil trimmer condenser is out of adjustment. This condenser, shown in *Fig. 1* as *C465,* is located on the main assembly support bracket at the left side and just a little forward of the yoke.The purpose of the condenser is to eliminate just such conditions, namely wiggle in the horizontal lines. The trimmer permits correcting for any unbalance that might arise in construction between the different halves of the horizontal deflection coils. For each yoke a proper fixed condenser, *C460,* has been selected. This condenser may have a value anywhere from 39 to 68 *uuf* and has a rating of 2000 volts. Trimmer *C465,* being adjustable from 1 to 12 *uuf,* permits adjusting with *C460* for any unbalanced condition that may exist between the two sections. When the horizontal deflection coils are balanced cross talk due to the vertical deflection coils is prevented, and conditions such as this waviness are prevented.

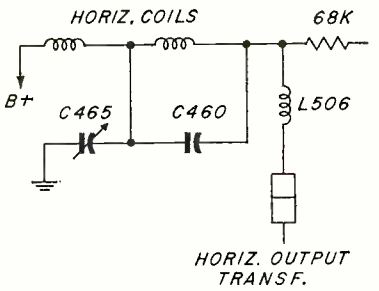


Fig. 1 — Partial schematic GE 20C150.

Dear Sir:

I ran into one of the new Motorola receivers with the remote tuning and noticed something that I could not understand. When the receiver was caused to change channels, either remotely or from the front panel push button, a small "plop" or "popping" sound was heard from the speaker. The receiver incorporates sound muting so that normally when channels are changed nothing should be heard from the speaker. Examination of the contacts indicated that they were in good shape and not the cause of the trouble. The audio tubes were checked by substitution and thus found to be normal.

N. M.
Philadelphia, Pa.

One component which should be checked in trying to correct for the trouble is *C316,* a .01 *uf* capacitor shown in *Fig. 2.* A small amount of leakage in this condenser could easily bring about this difficulty. The sudden stopping of the current flow in the grid circuit due to the leakage of this condenser will give rise to a voltage pulse which is amplified by the audio output tube and heard as a "pop" from the speaker. Condenser *C316* most probably is the cause and should be checked and replaced. The leakage may only be small and not affecting the reproduction, but still may be significant enough to cause this trouble.

Dear Sir:

I have a receiver in which there is a buzz that is much the same as an intercarrier buzz. All tubes have been checked, as well as the alignment and the balance of the FM detector. Have you any idea of what can occur in TV receivers that might be causing this condition which sounds so much like intercarrier buzz but evidently is not.

T. R.
El Paso, Texas

The grounding loops extending from the yoke housing to the outer aquadag coating should be inspected to determine that sufficient ground contact is being made at this point. If the connection is poor, the high voltage circuit will not have sufficient capacitance for filtering. A poor ground connection at this point is often a source of radiation of video pulses that may be picked up in the speaker lead or some other lead such as an audio coupling circuit or volume control lead. Thus a buzz is reproduced in the speaker. Liquid aquadag is available at many electronic distributors for correction of just such troubles. ■■

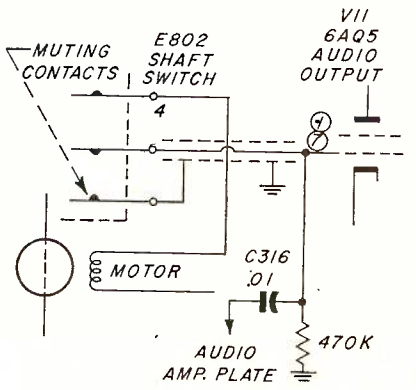


Fig. 2—Motorola muting circuit.

MARINE RADIO

[*from page* 13]

dummy-antenna capacitor value approximates that of the antenna, and this setting can be used for pre-tuning other equipments to be used with the same type of antenna.

It has been possible in many instances, to take a radiotelephone which has been completely adjusted on the bench in this fashion, and put it on a boat with hardly any subsequent adjustments being required. Thus, this small amount of preliminary work is very well worth the time.

Aboard the boat, unless a radiotelephone transmitter has an antenna *rf*-meter incorporated in its structure, the standard method of tuning is to insert an *rf* ammeter in the antenna lead-in. However, this introduces a difficulty since removing the meter and its associated wiring may alter tuning. For this reason, an indicating system which does not alter the inductance or capacitance of the antenna circuit is preferable. An *rf* milliammeter may be coupled to the antenna lead inductively through a loop, to give a tuning indication without materially changing the antenna-circuit tuning. An *rf* field-strength indicator, similar to those which have been previously suggested, will also do the same job. These indications, in conjunction with the *rf* plate-current reading, will show when desired operating points have been reached, and then the equipment can be safely buttoned up without fear of detuning.

Part of the difficulty in tuning many radiotelephone transmitters is the simple mechanical problem of handling the clip leads on the coil. An insulated holder for the clips can be made from modified alligator clips attached to a piece of polystyrene rod or in an emergency, held by their own insulated handles. This will greatly facilitate running clips up and down the coil to find the proper point.

Sometimes, output on one channel may be slightly below that which is expected. Before bothering to unscrew the clip lead and move it one way or another, the proper direction of movement can be determined by using a large slug of ferrite which can be held

[*Continued on page* 51]

trade

Manufacturers' sales of transistors in 1956 were nearly four times as great as they had been a year earlier, the Radio-Electronics-Television Manufacturers Association announced recently releasing a Marketing Data Department compilation. A similar increase in transistor sales had been recorded by RETMA for the calendar year 1955, indicative of the continued rise in application of the semi-conductor device.

December 1956 sales of transistors totaled 1,608,000 units valued at $4,691,000 compared with December 1955 sales of 479,968 transistors valued at $1,232,622, RETMA reported.

After February 15 RETMA will be in its new building 1721 De Sales St., N.W. Wash. 6, D. C.

• • •

The I.R.E. show will be held from March 18 through March 21 at the New York Coliseum. This year's national convention program places heavy emphasis on the theme "something new"—840 exhibits of new apparatus, 275 papers reporting new developments, and a new exhibit location. The Radio Engineering Show has been expanded substantially and moved to a larger, more conveniently located quarters, the recently opened New York Coliseum in midtown Manhattan. Coupled with this "greatest show on earth" will be an outstanding four-day program of technical papers, highlighted by two special symposia on Tuesday evening, March 19: one dealing with the timely topic of a national system of air traffic control, and the other with microminiaturization—the ultimate technique.

• • •

The first closed circuit television tour of a major financial institution was just concluded by Blonder-Tongue Laboratories, Inc., Westfield, N. J. More than 300 shareholders attending the annual stockholders meeting of the Bankers Trust Company at 16 Wall Street, New York City, witnessed the TV tour that covered four major departments from bookkeeping on the eighth floor down to the vaults, two stories beneath the street.

• • •

Retail sales of radio receivers in 1956, excluding auto sets, was firmly established as being the highest in the history of radio, the RETMA Marketing Data Department reported to RETMA members. More than 8.3 million receivers were sold to consumers through these outlets.

Though a decline was recorded in the number of television sets sold through retail outlets during the year, TV sales in 1956 were reported to be one of the three best years in television history.

During the calendar year 1956, retail sales of TV receivers amounted to 6,804,783 compared with 7,421,084 sets sold during the calendar year 1955. Radio set sales during the year, excluding auto sets, totaled 8,332,077 compared with 6,863,676 radios sold through retail outlets during the year 1955, RETMA reported.

In addition to the radios sold through retail outlets, RETMA reported that 5,057,409 automobile radios were produced during the year 1956. These figures compare with the total of 6,863,676 auto sets made during 1955. Since the bulk of car radios produced are sold direct to the automobile manufacturers for installation in new cars, they are not included in RETMA's count of retail radio sales.

• • •

Telerama, a service industry sponsored weekend at the Ritz Carlton Hotel, Atlantic City, April 12, 13, 14, is rapidly assuming large proportions. Sponsored by the Council of Radio & Television Service Associations of Philadelphia and the Delaware Valley, considerable interest in the program has been evoked among many of 228 service associations contacted throughout the country.

The entire 3-day weekend at the Ritz Carlton is being afforded at the complete cost of $20. per person, which includes ocean-view room with private bath, meals, floor and fashion shows, the banquet and registration, if reservations are made before March 15th. Reservations can be made by writing to Electronic Service Industry Telerama, 628 Lewis Tower, Phila. 2, Pa.

• • •

An underlying feeling of optimism in the growth and future of high fidelity in both the consumer and commercial fields was reported here recently by Lawrence LeKashman, vice-president in charge of sales for the David Bogen Co., Inc. and Presto Recording Corp., affiliates of Unitronics Corporation.

Mr. LeKashman voiced his optimistic predictions following his return from a two-week visit to the trade.

flashes

The American Television & Radio Co. has recently formulated a sales plan which should be of considerable interest to servicemen. This merchandising plan is believed to be the first in television history with a direct approach from factory to serviceman for the sale and service of TV sets. A certain number of qualified technicians will be granted the ATR franchise. The number will of course depend on the population of the city. It is estimated that there will be one certified ATR TV Technician for each 25,000 population. This may be modified, of course, depending on the degree of TV set saturation, square mile area, and other factors.

• • •

Ken Kleidon, national color TV manager for Hycon Electronics, will present a continuous showing of his demonstration on color television servicing at the Sterling Radio Jamboree in Houston, Texas. He will be assisted by W. R. Hays, Southwestern representative, at the Jamboree which is being held this Sunday afternoon.

Approximately 1600 people are expected to attend the Jamboree sponsored by the Sterling Radio Distributing Co. Kleidon will demonstrate the techniques of operating the color bar/dot generator and the wide-band test colorscope.

• • •

As part of Cornell-Dubilier's long-range program of being helpful to both servicemen and jobbers, a "Questions and Answers" session was held recently in Union City, New Jersey. Host was Nidisco of Jersey City, New Jersey, with branches in Hackensack, Richfield and Trenton.

• • •

A series of Silicon Diodes and Medium Power Rectifiers covering the current range from 100 milliamperes to 3 amperes will be introduced at the I.R.E. show, New York City, by the United States Dynamics Corporation, Boston, Mass., manufacturers of solid state devices, it was announced recently by Dr. Walter E. Strimling, President.

A product of the Semiconductor Products Division, the new diodes and rectifiers now complete the series of current ranges from 100 milliamperes to 35 amperes which are covered by U. S. Dynamics silicon devices. All units are stud mounted and hermetically sealed.

Duotone is launching a consumer advertising campaign in Holiday magazine.

"Every service man," said Steve Nester, president of the Duotone Company, Inc., "will welcome the news that Duotone is continuing to expose millions of new people to the Duotone story because it means that every time you make a service call the national recognition of the Duotone name and quality will make people realize that you carry the finest and deal in the best."

• • •

The Government Service Department of the RCA Service Co., Inc. has been reorganized to provide expanded service to each branch of the Armed Forces, P. B. Reed, Vice-President, Government Service Department, announced recently.

"The reorganization was carried out," Mr. Reed said, "to facilitate and coordinate our various services to the Army, Navy and Air Force. The new responsibilities are necessary because of the expanding scope and diversification of the Government Service Department."

• • •

Manufacturers sold more picture tubes during 1956 than in any previous television-year, the RETMA Marketing Data Department reported to RETMA members. The number of such tubes sold last year exceeded the sales figures for 1955, which had been established as a record year.

Cumulative picture tube sales for the calendar year 1955 had totaled 10,874,234 units valued at $209,007,518. Receiving tube sales in the calendar year 1955 had totaled 479,802,000 units valued at $358,110,000. This compares with the following RETMA chart which shows cathode ray and receiving tubes sales in December and the cumulative 12-months of 1956:

• • •

Key officials of the National Electronics Distributors Association and Eastern states TV service leaders opened industry conversations at the Hotel Roosevelt, New York, recently.

The occasion was described, largely, as being an electronic industry discussion for the exchange of ideas and improvement of industry relations for mutual benefit. It represented the culmination of months of individual conferences between parts distributors and Service leaders in an effort to seek common areas of effort and, ultimately, the resolution of common problems.

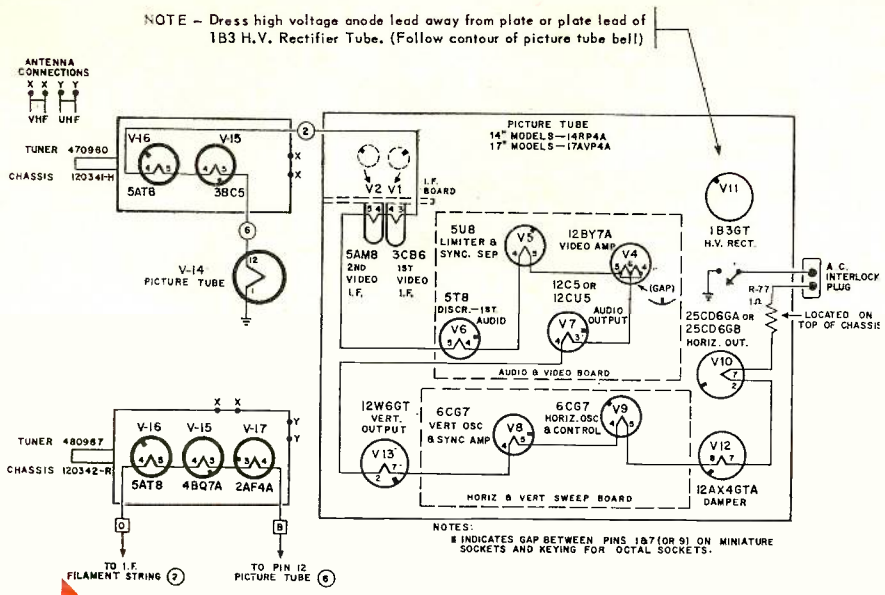


Fig. 1—Tube location diagram showing sequence in series filament wiring.

THE late 1957 TV line of Emerson Radio and Phonograph Corporation consists of four basic chassis and forty models, approximately twenty of which are UHF-VHF receivers. The portables alone amount to twelve models including 8½", 14" and 17" picture tube sizes. The two other basic chassis (excluding color) are incorporated in the Deluxe sets (twenty models) and Eldorado sets (six models).

The purpose of this article is to familiarize the dealer and independent service man with the Emerson line from a servicing and circuit design standpoint. Rather than discuss all circuitry in general, only those circuits which are unique with Emerson or not easily understood from the circuit schematic will be explained.

General Servicing Features

The following are features true of all Emerson TV sets in the late 1957 line. Servicing features which are applicable to only one type of chassis are treated in the section dealing specifically with that chassis.

1—All receiving tubes can be easily replaced simply by removing the masonite back on all sets except the 8½" portable (1232, 1233, 1270, 1271), but chassis removal of the 8½" portable is very quick.

2—Slo Blow type fuses are accessible from the top of the chassis. These fuses fit into a special holder, requiring no unsoldering. This type of holder prevents a fuse much larger in current capacity from being substituted in error.

3—Two or three (depending on model) etched circuit boards are used, allowing for the replacement of many components without having to remove the chassis from the cabinet. (Except 8½" portable models 1232, 1233, 1270, 1271).

4—Tuner oscillator adjustments are readily available without having to remove the chassis from the cabinet.

5—Horizontal oscillator and phase coils can be adjusted in the customer's home without removing the chassis from the cabinet and without any equipment.

6—The replacement of the horizontal output transformer can be made without having to remove the chassis from the cabinet on all models except portables. The portable chassis however, can be removed quickly and simply.

7—Vertical size and linearity controls are accessible without removing the masonite back.

8—Safety glass or lens is removable easily and quickly on all models for cleaning of glass or picture tube without having to remove the chassis from the cabinet.

Portable and Port-O-Rama Models

Port-O-Rama models are portables which can be used in five different ways: TV, radio, phono, with personal listening attachments, and from a car or boat battery supply by means of an external

SERVICING 1957

The first of this two part discussion of servicing new Emerson TV receivers provides general servicing information and delves

PART 1

accessory inverter. Portable models differ from the Port-O-Rama series in that they do not incorporate a radio or external sound jack. They do however, incorporate a phono jack and phono-TV switch. Aluminum chassis and aluminum cabinets are used on all current 14" and 17" portables to reduce weight to a minimum. Since the Port-O-Rama models incorporate both a phono input jack and an external sound jack (to audio output tranformer), they can also be used with an externally mounted 12" speaker (3.2 ohm voice coil) to provide musical entertainment for a relatively large group.

Operation of Portable Sets in a Car or Boat

Since the power consumption of portable or Port-O-Rama models is relatively low, it becomes practical to operate these sets from a rechargeable battery source such as commonly used in automobiles, boats, rural farm areas, etc. An inverter is required to convert the available low D.C. battery voltage (usually 6 or 12V) to 115V 60 cycle A.C. The inverter must be large enough to handle the power requirements of the set, stable in voltage and frequency output, and have low radiation from the vibrator. Inverters which are not large enough to handle the load will cause poor operation of the TV set such as low brightness, insufficient size, and an ignition type of interference. Inverters are available with an input plug which fits into a cigarette lighter receptacle or with terminations, which fit directly on the battery terminals. Remote inverter "on-off" switches are also available which permit the inverter to be turned "off" or "on" at the same location as the TV set.

8½" Port-O-Rama models 1232, 1233, 1270 and 1271 consume approximately 100 watts which requires an inverter

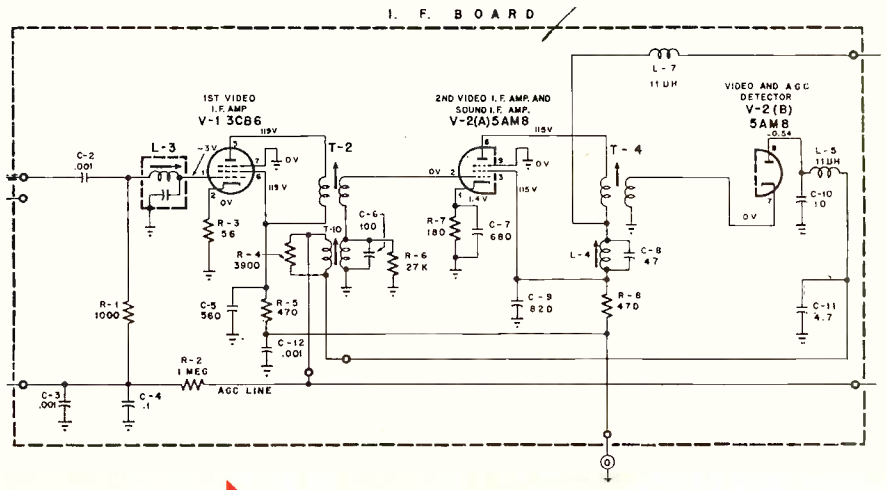


Fig. 2—Emerson Sound Reflex Circuit.

EMERSON RECEIVERS

into such aspects as control locations, along with low voltage, sound reflex, picture stability and agc circuit analyses.

by HAROLD BERNSTEIN

Service Manager, Emerson Radio & Phonograph Corp.

rated at 100 watts continuous operation. 14″ and 17″ models (1254, 1255, 1258, 1259, 1264, 1265, 1268, and 1269) consume approximately 110 watts, which requires an inverter rated at 125 watts continuous operation.

Certain states may have laws forbidding the installation of a TV receiver in an automobile, whether in view of the driver or not, so check before such an installation is attempted.

Serviceability of Portable TV Sets

On the 14″ and 17″ portables, all tubes are accessible for replacement simply by removing the masonite back. The picture tube is removable from the front of the set without having to disturb the chassis.

On the 8½″ portables the chassis must be removed for tube replacement, but only four screws hold the chassis in place, and two screws secure the front mask and safety lens assembly. The chassis, complete with picture tube, is removable from the front of the set. The chassis consists of a vertical and horizontal section, and by removing a few screws, the vertical section can be tilted so that all components can be easily reached for replacement or testing.

14″ and 17″ portable and Port-O-Rama models use the ruggedized 600 milliamp tubes (controlled warm up heater filaments) which are connected in series. This arrangement eliminates the need for a filament transformer which reduces the over-all weight of the set for greater portability. Analysis of defective tubes over the past few years shows that the vast majority of tube failures are due to causes other than open filaments (low emission, shorts, gas, etc.); therefore the location of a defective tube will be the same as for a set with parallel connected filaments. If an open filament in one tube should occur, then none of the tubes in the series string would receive filament power, and therefore, this type of tube defect (regardless of the tube, except the 1B3) would always result in no picture, no sound, and no raster.

To assist the service man in locating defective tubes a tube location diagram as shown in *Fig. 1* is attached to every receiver of this type. By removing a tube in the center of the string (V-7) continuity may be checked from socket pin 3 to chassis and from socket pin 4 to *R-77*. This would quickly isolate the trouble to one of six or seven tubes rather than fourteen. It would be a good idea to place a jumper wire across *R-77* since this could have opened due to a filament to cathode short in such tubes as V-5, V-4, V-8, etc. (all of which have the cathode connected to chassis).

The 14″ and 17″ portables use a 25CD6GA,GB as the horiontal sweep amplifier tube. To make selection of replacement 25CD6GA,GB tubes less critical with regard to Barkhausen effect and/or snivets, an ion trap magnet is secured to the top portion of this tube. Adjustment of this magnet by rotating it around the tube will in most cases eliminate this interference. A 25DN6 is used as the horizontal sweep amplifier in UHF-VHF models which, along with its ion trap, effectively eliminates Barkhausen and snivets which tend to be more pronounced on the UHF channels.

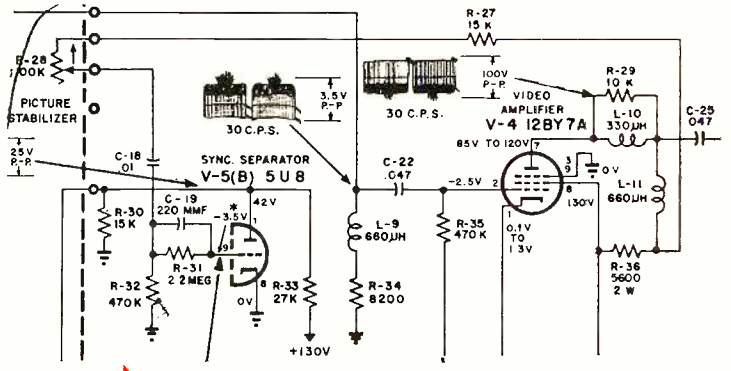


Fig. 3—Emerson Picture Stabilizer control.

Low Voltage Power Supply

The 14″ and 17″ portables and Port-O-Rama sets use a single selenium rectifier in the power supply. This type of circuit has the advantages of very light weight (which is so desirable in portables), low power consumption (which means low operating costs), and operation on *ac* or *dc* power. High efficiency sweep circuits are used to adequately scan the 90° deflection picture tubes used and provide the necessary high voltage. As indicated previously, these sets consume approximately 110 watts of power from a 115 volt line, which is quite low for television receivers of high sensitivity and 90° deflection.

Sound Reflex Circuit

To eliminate a sound *if* tube and still provide adequate sound sensitivity, many manufacturers take the 4.5 *mc* intercarrier sound *if* beat from the plate of the video amplifier where overload due to too much contrast or a weak tube may cause 60 cycle audio buzz. Emerson has reduced this possibility by using the sound reflex circuit shown in *Fig. 2*. The plate and grid circuits of V-2 are tuned to two sets of frequencies. T-2 and T-4 are tuned to the video *if* (40 *mc* range) while T-10 and L-4 are tuned to the intercarrier sound frequency of 4.5 *mc*. The 4.5 *mc* intercarrier audio beat is picked up from the video detector and fed back to the grid of V-2 where it is amplified along with the regular 40 *mc* video *if* signals. These two frequencies are far enough apart so that very little interaction takes place. With this type of circuit, the setting of the contrast control or the condition of the video output tube cannot affect the sound.

Picture Stabilizer Control

The picture stabilizer control circuit is shown in *Fig. 3*. The purpose of this control is to provide additional sync stability in electrically noisy or weak signal areas. To understand how this circuit operates, you must first know how noise effects picture stability. Noise pulses which are of greater amplitude and in the same polarity as sync pulses could either prematurely trigger the vertical or horizontal oscillator or upset the operation of the sync separator tube. The relatively long time constant in the vertical integrator network however protects the vertical circuit, while the use of an automatic frequency control system protects the horizontal circuit from being prematurely triggered by random noise. In actual operation, we find that these noise pulses actually upset the operation of the sync separator by causing *C-19* to charge up to a high negative value (peak of the noise pulse). If the amplitude of the noise pulse is great enough, *C-19* discharging through *R-31* could cause the grid bias of V-5B (sync separator tube) to go well beyond cut off. If this condition occurs just prior to vertical sync time, there would be no vertical sync pulses in the plate circuit of the sync separator and therefore the vertical oscillator would momentarily cause loss of vertical sync. If the noise is continuous as well as severe, the horizontal sync may pull out in areas.

By adjusting the picture stabilizer control in a counter clockwise direction, resistance is added in series with the noise charging circuit (*C-19* and the grid of the sync separator). This increases the charging time constant of *C-19* and prevents noise pulses (usually of short duration) from materially

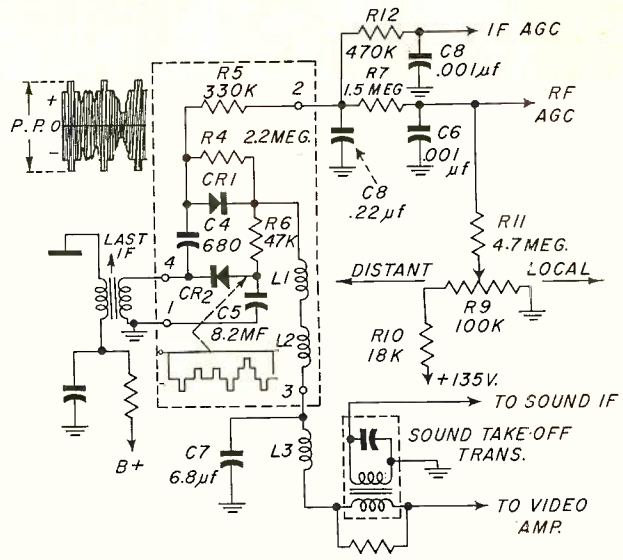


Fig. 4—Video detector, *if* agc and tuner delay agc circuitry of the Emerson TV receiver.

changing the grid bias of the sync separator tube.

Video Detector and AGC

The *agc* system, by the nature of the tuner delay and doubler circuit, is designed to adjust the gain of the receiver for optimum performance in both very weak and strong signal areas. This is accomplished by using the undelayed output of the *agc* doubler circuit for *if agc* and the delayed output for the *rf agc*.

Fig. 4 shows the circuit used to perform these functions. All components shown within the dotted rectangle are housed in an aluminum container, similar to an *if* transformer. The top of this container is removable, permitting the replacement or trouble shooting of the *agc* and detector crystals (*CR-1, CR-2*).

The circuit operation is as follows: The negative half of the *rf* modulation envelope is demodulated by the crystal diode, *CR-2*, and then fed to the video amplifier (12BY7) through the *rf* filter network *L-1*, *L-2*, *C-7*, *L-3*, and the sound take-off transformer. The negative modulation envelope (composite video signal) appears across capacitor *C-5* and is therefore also applied through resistor *R-6* to the cathode of the *agc* detector diode *CR-1*. At the same instant that the negative video signal is applied to the cathode of *CR-1*, a positive *rf* signal (with the identical video component) is applied to the plate through capacitor *C-4*. The instantaneous voltage across *CR-1* is therefore equal to twice the peak to peak value of the detected video signal (*agc* doubling) and therefore when *CR-1* conducts, it charges *C-4* up to this value. The time constants in this circuit are such that the *if* and *rf agc* voltage is proportional to the strength of the incoming signal and not to any random noise that may be picked up. The full doubled *agc* voltage is filtered by *R-12* and *C-8*, and is applied to the grid of the first *if* amplifier tube (V-1).

To keep the *rf agc* voltage clamped to a low negative value over a wide range of fringe to moderate strength signals, a local-distant potentiometer (*R-9*) is used to manually set the amount of positive delay voltage applied to the *rf agc* line. This keeps the line at the grid contact potential of the tuner *rf* tube (about –0.7V) until the incoming signal is strong enough to develop a voltage higher than the amount of applied positive delay voltage set by *R-9*. At this point the *rf agc* will be able to go more negative depending on the strength of the incoming *rf* signal. By keeping the *rf* bias at –0.7 volts over a wide range of weak signals, optimium gain and signal to noise ratio is obtained. In very strong signal areas where maximum *agc* voltage is required to eliminate tuner overload (excessive contrast, audio buzz, vertical jitter, etc.) the local-distant control (*R-9*) should be set to its local (minimum positive delay voltage) position. Since no tuner delay voltage is applied, the *rf agc* voltage developed will be at a maximum.

[*Continued next month*]

THE WORK BENCH

Unusual Service Problems And Their Solutions

by PAUL GOLDBERG
Service Manager

This month's installment is devoted to series filament problems. Studying the particular receiver schematic before starting to service these receivers is of primary importance. There are currently three types of series string tubes. These are the 600 *ma.*, 450 *ma.*, and the 300 *ma.* heater types. The 450 *ma.* and 300 *ma.* are mostly types which have been used in parallel circuits, but have been redesigned to include controlled heater warm-up time. The designation of these tubes is changed by adding the letter A or B after the type number. However, the 600 *ma.* types have relatively new designations such as the 3CB6, 5BK7 etc.

The disadvantages of series circuits are slowly being overcome by manufacturers. Formerly the heater to cathode voltage rating of most tubes was limited to ±90 volts. This caused many premature failure of tubes in certain applications, since heater to cathode shorts would cause hum in sound and picture. Current series string tubes are being manufactured with a ±200 volt heater to cathode voltage rating which should keep these shorts to a minimum.

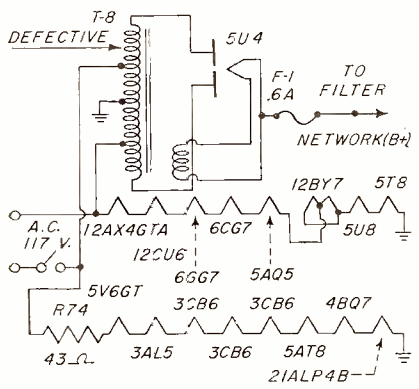


Fig. 1—Partial schematic of Emerson Chassis 120292-V.

Many servicemen overlook the cold resistance advantage of series circuits. The cold resistance of a 6SN7-GTB, for example, is about 2 ohms. Thus in a parallel circuit, the instantaneous cold current is about 3.1 amperes or about 5 times the normal current. Now in a series circuit string with a total filament resistance of 20 ohms and a filament dropping resistor, for example, of 50 ohms, the maximum cold current that could appear across the string is about 1.67 amperes. This lower cold current is an important factor in prolonging the tube's life.

Emerson Chassis-120292-V

The receiver was turned on and it was observed that some tube filaments were lit brightly while others were either not lit or lit very dimly. The 5U4 was not lit at all. Noting this, the 5U4 was pulled out of the socket and instantly all the other tubes lit up to what seemed to be the proper amount. The diagram (*Fig. 1*) was now consulted. This receiver uses an auto-transformer set up. A special separate winding for the 5U4 filament voltage had been added. Each string of tubes is fed from a separate tap on the transformer. You will observe that one tap to ground is in parallel with one string of tubes while the other tap to ground is in parallel with the other string. In this manner the 117 volt line voltage is divided properly with each string of tubes. Plate voltage for the 5U4 is supplied from the ends of the auto-transformer.

Knowing these facts the 5U4 was replaced. But again its filament did not light while some lit too brightly and others did not light at all. And again, when the 5U4 was removed both strings lit up properly. *F-1,* the B+ fuse, was next removed as a check on the loading effect of the receivers circuitry. However, this had no effect. We deduced therefore that the auto-transformer *T-8,* was defective and that the 5U4 loaded the auto-transformer down to such a degree that the taps on the auto-transformer fed low voltages to each string of tubes. *T-8* was removed and a new auto-transformer was installed. The receiver then functioned properly.

Admiral-17Z3D

The receiver was turned on and it was seen that none of the tube filaments were lit. The *ac* plug was removed and the diagram was consulted. After studying the diagram (*Fig. 2*) a check was made from the filament side of resistor *R501* to ground. The meter read infinite on the 1000 ohm scale. The total filament resistance for this receiver is about 25 ohms. The tube filaments were then resistance checked individually. The 6CG7, V401, was found to be open. A new 6CG7 was then installed. The *ac* plug was plugged in again and the receiver was turned on. Again no tube filaments lit. The 6CG7 was pulled out of the socket again in order to recheck its filaments. As soon as this was done all filaments lit up correctly. The new 6CG7 filaments were checked and found to be good. As

[*Continued on page* 53]

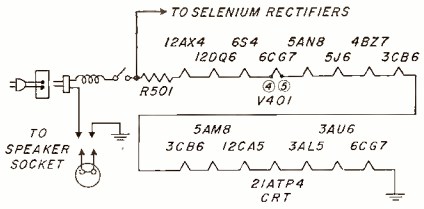


Fig. 2—Admiral series filament.

Audio Equipment

BOGEN LX60 P.A. AMPLIFIER

by ALLAN M. FERRES

THE most common problem in temporary P.A. installations is to be able to provide the necessary output power and flexibility with equipment small and light enough to be portable. In the more elaborate permanent installations, it is often difficult to furnish the necessary flexibility unless custom-built equipment is used. This is undesirable due to the increase in cost and the delays involved in obtaining the special equipment needed.

To meet the need for an amplifier which combines portability, high power and flexibility, the Bogen Company has recently marketed a 29½-pound, 60-watt amplifier with a 4-channel mixer. Their "Flex-Pak" LX60, illustrated in *Fig. 1* was designed to provide the facilities needed for most temporary and permanent commercial installations. *Figure 2* is a block diagram of the LX60, which includes several unusual features.

Four input channels

Facilities are provided for mixing four high-impedance microphones. Any of these inputs can be changed to accommodate a 50, 200, or 500 ohm microphone by removing a plug and inserting a matching transformer, furnished as an accessory item. Plugging in the transformer automatically makes the necessary circuit changes and no rewiring is required. High-pass filters can be connected into microphone inputs two and three by means of switches on the front panel. These filters are similar to dialogue equalizers used in sound recording to attenuate execessive low frequency response caused by room acoustics or noise and serve to improve the intelligibility of speech. A selector switch is provided for mixer input number one so that it can be used for either a microphone, magnetic, ceramic or crystal phono cartridge, or a radio tuner or tape recorder. An equalizer preamplifier is included for the phono cartridges.

Provisions are made for plugging in a two- or a four-position remote mixer so that the gain of the various input channels can be controlled at a distance from the amplifier. The installation of the remote control unit requires only three or five unshielded conductors which carry low-current *dc* between the amplifier and the remote point.

Fig. 1—Bogen "Flex-Pak" LX60.

Tone control

The output of the mixer is fed to a stage of voltage amplification which feeds a Baxandall type of tone control stage. The low frequency response is continuously variable between plus and minus 15 *db* at 60 *cps*, and the high frequency response between plus 10 and minus 15 *db* at 10,000 *cps*. With the tone control knobs set to their center positions, the response of the amplifier is flat within 1.5 *db* between 20 and 20,000 *cps*.

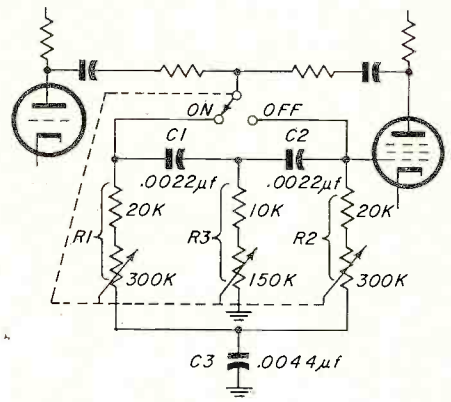


Fig. 3—Schematic of parallel T anti-feedback filter circuit.

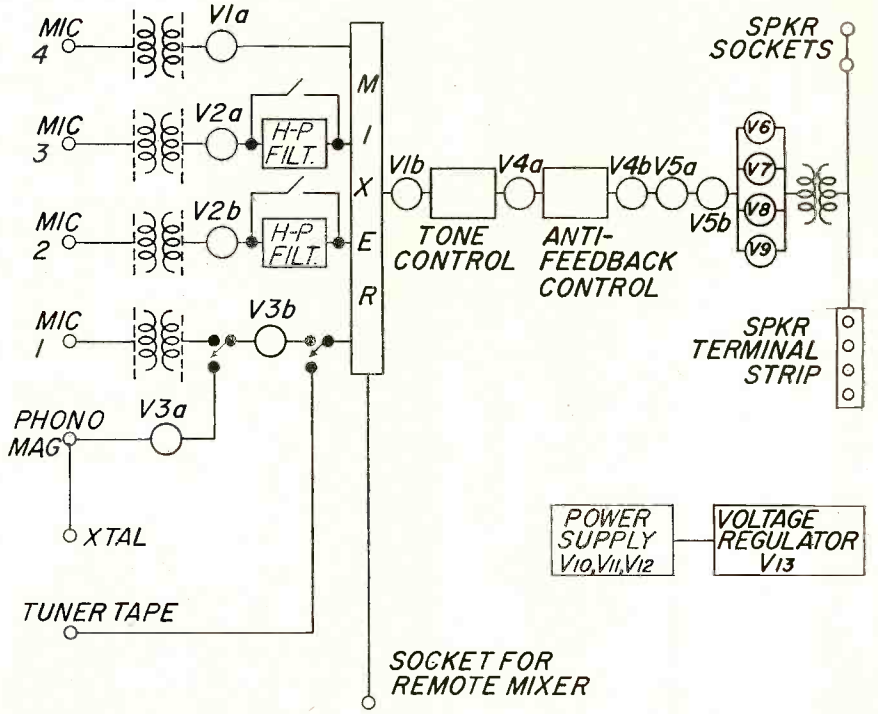


Fig. 2—Block diagram of Bogen LX60 P.A. amplifier.

Anti-feedback control

The tone control stage is followed by an anti-feedback control stage. This control adjusts a narrow-band variable frequency rejection filter which reduces acoustic feedback between 250 and 3500 *cps*. The anti-feedback filter is a parallel T type, shown in *Fig. 3*. The rejection frequency is controlled by adjusting the values of the filter resistors. The sharpness of the filter is increased by providing negative feedback around the filter, so that the filter has little effect on the overall frequency response of the amplifier except at the desired frequency, where the gain of the amplifier is greatly reduced.

To use the filter, the gain control of the selected channel is advanced just to the point where feedback or "howl" occurs. The anti-feedback control is turned on and the control is slowly rotated throughout its range until the "howl" is eliminated. The channel gain control can then be advanced further, up to a point just below which feedback again occurs. If acoustic feedback is not encountered at the normal operating level of the amplifier, the anti-feedback control should be turned off. This filter will permit the use of considerably higher sound level than would ordinarily be possible in installations where acoustic feedback is a problem.

Output stage and power supply

The anti-feedback control stage is followed by one more stage of voltage am-

[*Continued on page* 54]

Mfr: General Electric **Chassis No.** "K" line

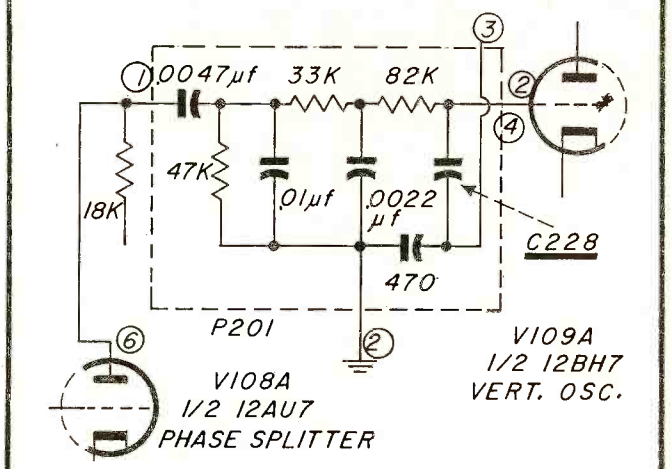
Card No. GEK-7

Section Affected: Pix

Symptoms: No vertical sync. Horizontal sync normal.

Cause: Defective condenser. Condenser *C228* (.001 μf) has developed leakage.

What to do:
Replace: Vertical plate *P201*.



Mfr: General Electric **Chassis No.** "K" line

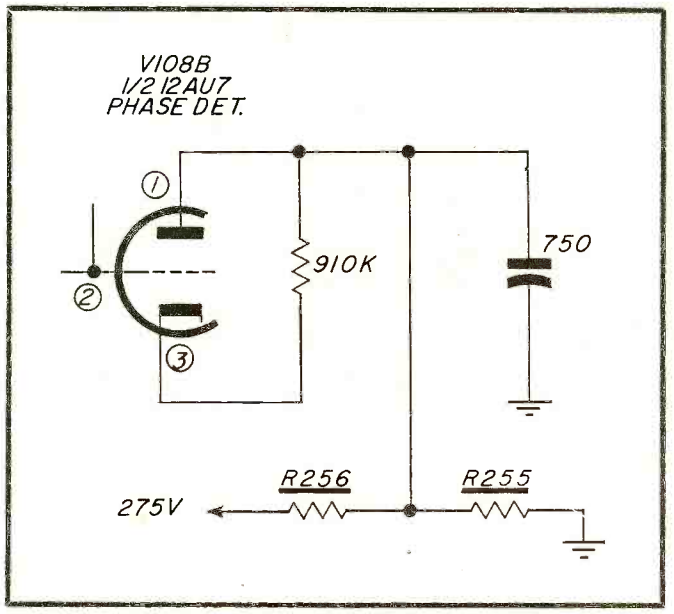
Card No. GEK-8

Section Affected: Pix

Symptoms: Weak or no horizontal sync.

Cause: Defective resistor in the horizontal phase detector circuit.

What to do:
Check: *R255* (220K) and *R256* (10M).



Mfr: General Electric **Chassis No.** "K" line

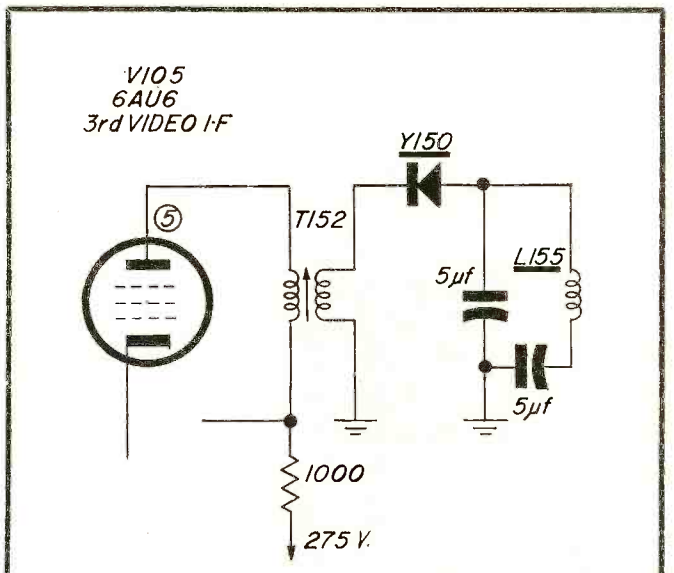
Card No. GEK-9

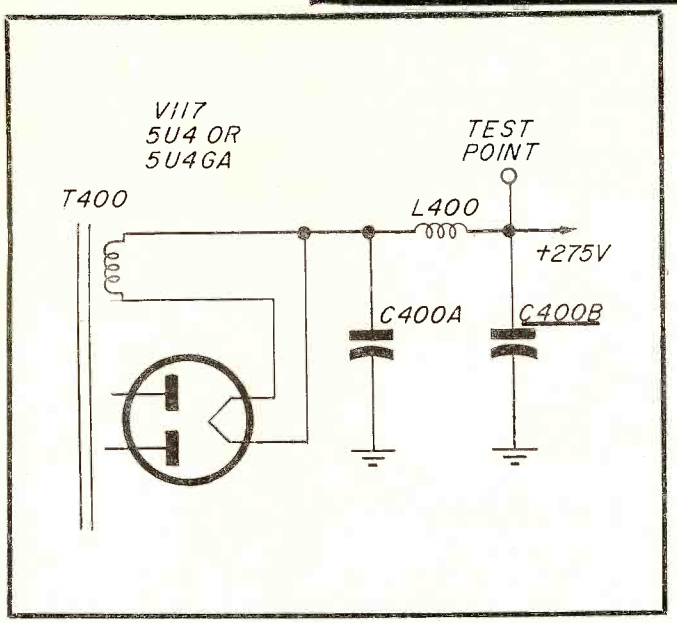
Section Affected: Pix and sound

Symptoms: No picture, no sound.

Cause: Open video detector crystal (*Y150*) or *L155*.

What to do:
Check: *Y150* (1N64).
L155, peaking coil.





Mfr: General Electric **Chassis No.** "K" line

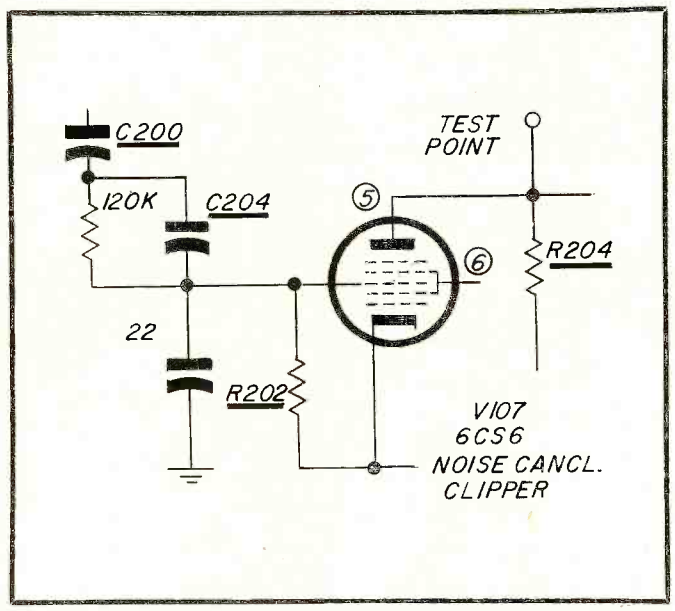
Card No. GEK-10

Section Affected: Pix

Symptoms: Poor horizontal linearity, bright vertical bars and narrow width.

Cause: Open condenser.

What to do:
Replace: *C400B* (80 μf).



Mfr: General Electric **Chassis No.** "K" line

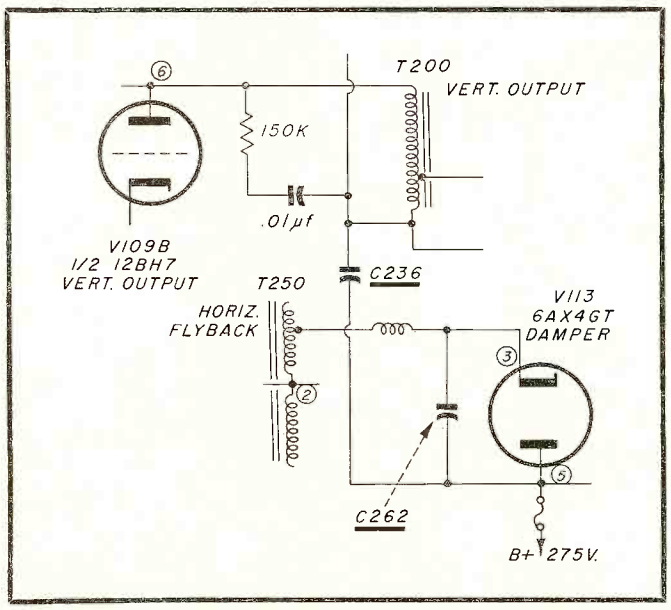
Card No. GEK-11

Section Affected: Pix

Symptoms: Poor horizontal and vertical sync.

Cause: Defective component.

What to do:
Check: *C200* (.005 μf), *C204* (470 $\mu\mu f$), *R204* (220K), *R202* (1.2 meg).



Mfr: General Electric **Chassis No.** "K" line

Card No. GEK-12

Section Affected: Pix

Symptoms: Inadequate picture width and/or poor horizontal linearity.

Cause: Defective component.

What to do:
Check: *C262* (120 $\mu\mu f$, 5KV) and *C236* (20 μf, 450 V).

Mfr: Motorola **Chassis No.** TS-533

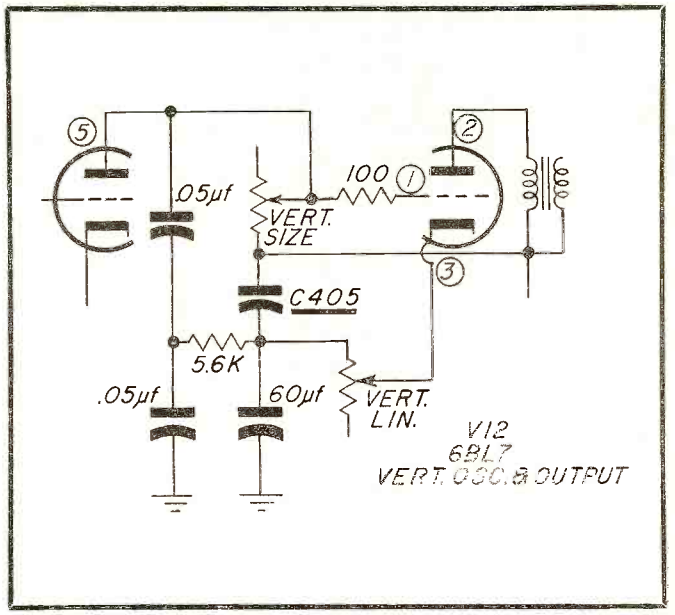
Card No: MO-533-1

Section Affected: Pix

Symptoms: Insufficient boost voltage.

Cause: Defective capacitor.

What to do:
Replace: *C405* (20 *μf*).



Mfr: Motorola **Chassis No.** TS-533

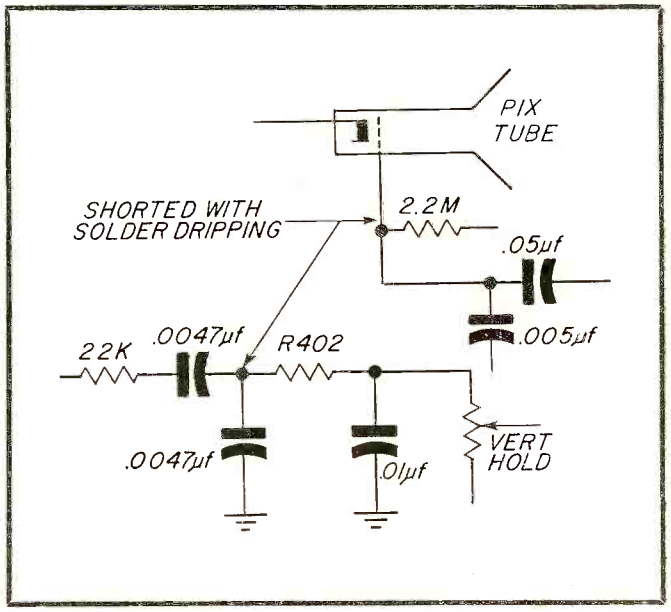
Card No: MO-533-2

Section Affected: Pix

Symptoms: Vertical collapse with increase of brightness control.

Cause: Low resistance short from CR tube grid to vertical integration network.

What to do:
Check: For solder dripping between CR tube grid lead and *R402* (10K) in vertical integrator. These terminals are adjacent on a terminal strip.



Mfr: Motorola **Chassis No.** TS-533

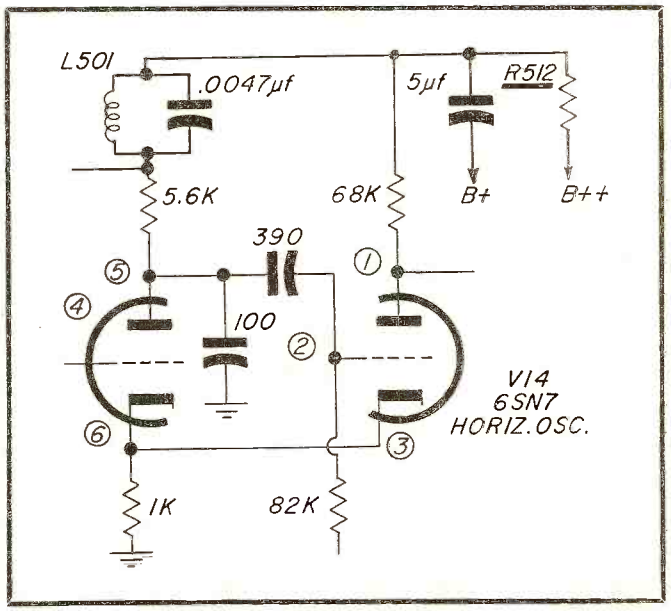
Card No. MO-533-3

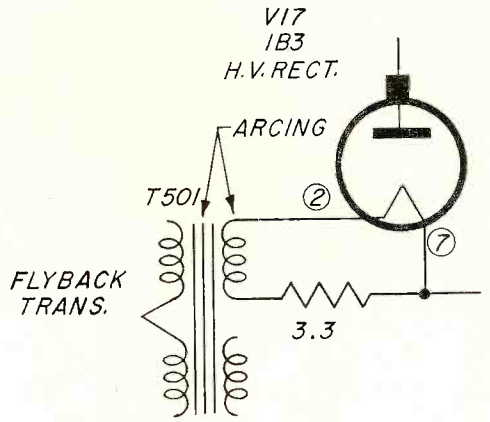
Section Affected: Pix and sync

Symptoms: Pulling and tearing at low contrast settings.

Cause: Resistor increased in value.

What to do:
Replace: *R512* (4.7K)





Mfr: Motorola **Chassis No.** TS-533

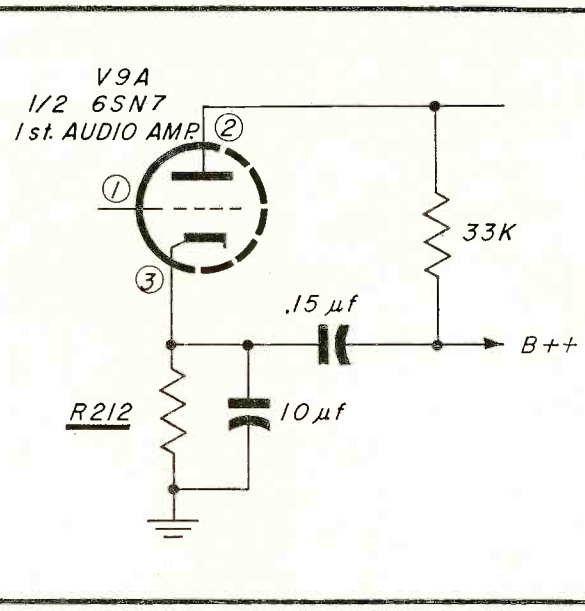
Card No: MO-533-4

Section Affected: Raster

Symptoms: No high voltage

Cause: Arcing in filament loop around high voltage transformer core.

What to do:
Replace: Filament loop with Teflon insulated wire Motorola part number 30K 738698. Also, 1B3.



Mfr: Motorola **Chassis No.** TS-533

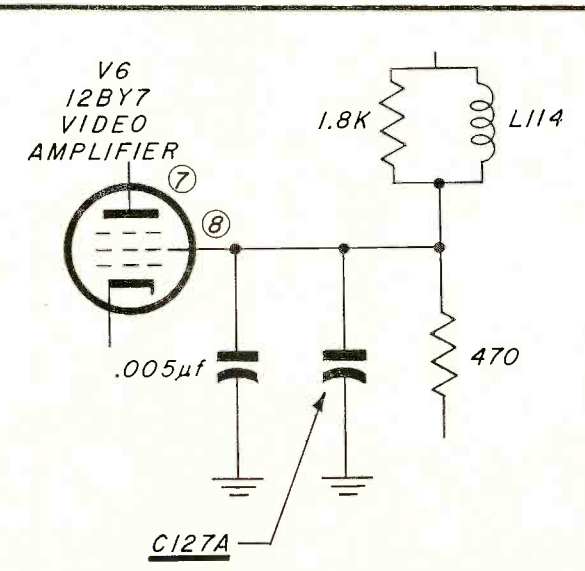
Card No: MO-533-5

Section Affected: Sound and pix

Symptoms: Weak picture at full contrast. No picture or sound at reduced contrast. Low B plus (147V). *AGC* voltage with no signal and contrast at maximum is –120 volts at the plate of the *agc* tube, **V13.**

Cause: Defective resistor.

What to do:
Replace: *R212* (1.2K, 5%).



Mfr: Motorola **Chassis No.** TS-533

Card No: MO-533-6

Section Affected: Sound and raster

Symptoms: No sound, no raster.

Cause: Shorted condenser

What to do:
Replace: *C127A* (10 *μf*, 200V) with 10 *μf*, 400 V.

Note: Production change beginning with chassis coding C-04.

CONTACT

This section of ELECTRONIC SERVICING serves as liaison office between 1) Manufacturers of Electronic devices who seek qualified service firms capable of acting as their branch service depots, and 2) Technically qualified, financially sound Service Firms or Independent Radio-TV Servicemen who seek to be appointed as Factory-Trained Branch Service Agencies for Electronic Equipments Manufacturers in the areas where they are situated.

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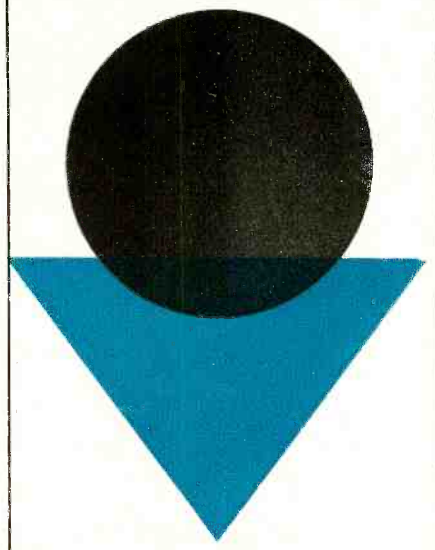

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RIDER SPEAKS

JOHN F. RIDER

WE RECEIVED a letter in which we are reminded that everyone who reads this page doesn't necessarily agree with the ideas that we present. This is not strange. We knew that this would be so at the time we wrote the copy for the first issue. If people don't have a difference of opinion it would be a very dull world. Some of the bite is taken out of the letter by the comment that the correspondent agreed with some of the thoughts we had.

A point at issue is our suggestion that when a service shop operator feels that he doesn't have the resources to finance a diversification program that he combine forces with another service station operator, or perhaps more than one. Our correspondent feels that any such move results in a loss of independence on the part of the people who have merged.

This may or may not be so depending upon the conditions surrounding the combination of effort and the resources. There are many establishments in America which are run as partnerships and they are being conducted very successfully. The mere fact that two people pool their funds, their skills and their equipment doesn't necessarily mean that one of the men must become subservient to the other. Naturally, there must be an understanding between the men wherein each contributes his abilities and time to the success of the venture. We agree that on occasion personalities may clash and a partnership turns out unsuccessfully. But there are altogether too many businesses run as partnerships wherein the partners see the same target and each does his share to the best of his capabilities to make the business prosper.

We also acknowledge that in some cases the temperament of an individual is such that he desires to make every decision and wishes at all times to go his own way and do as he pleases. Such a man might find it very difficult to join forces with a friend, or someone else who is engaged in a similar type of enterprise and have harmony reign. In this event the man just carries on by himself. After all, we just made the suggestion. Whether or not men presently engaged in television servicing remain as individuals or combine efforts is, of course, up to each one. In seeking a solution to a problem we feel that it is necessary to explore every possible avenue. Some thoughts may be more valuable than others. Some may be more practical than others. If an idea is picked up by only a small minority it is still worth while, especially when it does not harm the majority.

While on the subject of reader's letters, it might be well to emphasize that the opinions expressed on this page have never been intended to represent the opinions of the publisher of this magazine—these are strictly our own opinions. We are on very friendly terms with the publisher, but we never discuss the material which will be dealt with by this writer. We mention this so that any reader who disagrees with what we say should realize that difference of opinion is between us and not between that person and the publisher.

Admittedly, both the publisher and ourselves have one objective. Both of us would like to see a stable and successful servicing industry. It is only

natural that thinking independently, the two of us might, on occasion, have conflicting thoughts. Fortunately, this doesn't occur too often. Anyway, we want it known that if there is any bone to pick with anything we say, it should be our bones rather than that of the publisher.

Now, for another subject. Examining the differences in some of the horizontal publications (that is, those circulated among service technicians, experimenters, radio amateurs and hobbyists) we note the definite push on the part of industry for technicians. Apparently, industry has come to the realization that many duties heretofore within the province of the graduate engineer are within the capabilities of the skilled technician. In other words, *the technician without a college degree of any kind is being offered tremendous opportunities in industry.* That such should occur is not strange when one witnesses the expansion programs being implemented by many electronic equipment manufacturers. There's hardly an area in any well populated part of the country where land is not being dug up for the foundations of new industrial plants. Many bear names well known in the electronic world, and some are relative newcomers to the electronic equipment manufacturing field.

At the same time we can't help wondering about the absence of effort on the part of all who are concerned with the activities of the radio and television servicing industry to maintain the roster of men active in this field. Seemingly, the only people who are making any effort to attract men into the servicing area are schools. Even here, one wonders how long it will be before the emphasis will be placed on gaining men for the industrial electronics field rather than for home electronic servicing. The industrial electronic equipment manufacturers producing non-home electronic devices are making an aggressive bid for technician manpower. They are offering many inducements. On the other hand, very little incentive, if any, is being offered the youth of the land to become active in servicing the public's electronic possessions—to learn servicing of home electronic equipment as a career. *Something should be done about it!* ■■

MARINE RADIO

[*from page 37*]

in the field of the coil. If the introduction of this ferrite slug raises output, it is obvious that somewhat more antenna inductance is required, so the clip can be moved to provide a little more coil. If introducing the ferrite to the field reduces output, it is likewise obvious that slightly less inductance is required and the number of turns can be reduced by adjusting the clip lead.

Sailboat installations are bothered particularly by the varying influence of movable rigging. Some radiotelephones have antenna-trimmer controls (which may be called "boosters," or other such catch terms). From one tack of sailing to another this trimmer can be used to optimize transmitter output. However, the majority of radiotelephones do not have such a provision, with the result that on sailboats, or other vessels having considerable movable top hamper, up-and-down operation is obtained—with the "down" sometimes to a serious level.

When such a situation is encountered, although it may add somewhat to the expense of the installation, it is wise to provide an external antenna-tuning arrangement to compensate for the variations. The tuning element required is a variable inductance, and unfortunately, the proper kind of component is not readily available in the commercial market.

However, the surplus bins offer relief in the form of the many roller-contact coils which were used in military transmitters. One of these can be mounted in a suitable equipment box or on a panel to make up part of the antenna-tuning inductance. Unless the transmitter has an output-current indicator of some kind, it will be necessary to add one, either in the form of an ammeter of suitable range, or a shunted flashlight or dial lamp, to indicate antenna resonance. When installing external coils, do not enclose them in tight-fitting metal boxes, since this would introduce loss due to reduction of coil "Q." In a few cases, such external tuners have restored the confidence of sailboat radiotelephone owners who had been dissatisfied with the operation of equipment installed just as it came from the factory. ■■

2-WAY MOBILE INSTALLATION

[*from page 5*]

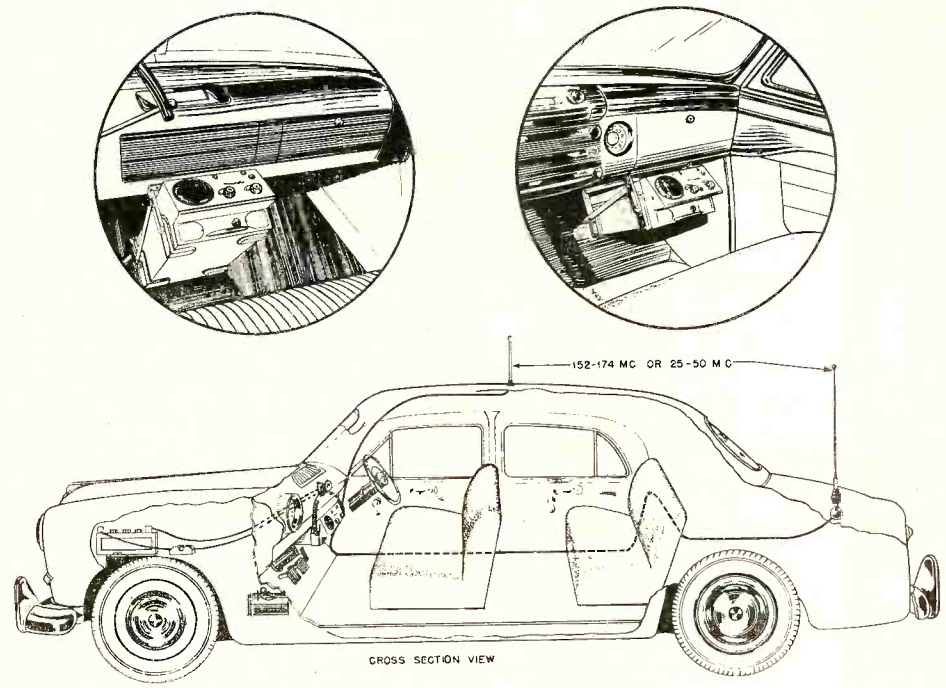

Fig. 3—Installation details of front mount unit.

venience if desired. The power cable goes through the fire-wall, using rubber tape or a grommet. *Fig. 3* illustrates this type of installation.

Truck Installations

Thus far, we have been concerned primarily with installations in automobiles. The truck installation is usually more difficult and consumes more time. The unit may be mounted behind the seat, underneath the seat and in some cases on top of the cab or in the rear of the truck using a weather proof housing. The cables are routed partly or completely on the exterior, using flexible conduit, and terminating on the engine side of the firewall. Any excess opening is filled to prevent water from entering. The conduit may be fastened along the route with conduit straps or heavy wire.

Battery charging equipment requirements vary with the unit drain, cycle of transmitter use, speed of the vehicle, etc. For 30 watt units or less, the vehicle's standard battery charging equipment is usually sufficient. Units requiring 60 amperes or more when transmitting sometimes require larger battery charging equipment, such as heavy duty generators or alternators. Alternator systems are preferred since they can charge at a 25 ampere rate when the engine is idling and they have a long and comparatively trouble free life.

Noise reduction in some vehicles can become quite a problem. Noise will usually be eliminated (assuming the receiver is tuned to the frequency to be received) by installing a suppressor in the distributor center lead and a capacitor between the generator armature terminal and ground. If this does not eliminate the noise, bypass capacitors can be tried at various points in the electrical system and additional bonding straps installed between motor block and frame, exhaust pipe and frame and fenders to frame. There is no sure cure for noise in all vehicles. The cure for one installation may not suffice for another.

Battery voltage measured at the unit should be at least 5.8 or 11.6 volts for 6 and 12 volt systems respectively. It may be necessary to rotate the vibrator 180 degrees and reverse dynamotor output leads before mobile unit will operate. The receiver and transmitter should be adjusted to the antenna as suggested in the manufacturer's instruction manual. Meter readings should be

observed and adjustments made where necessary for proper operation. Frequency, modulation and final stage power input measurements on the transmitter should now be made and adjustments made where necessary. The installation is not complete without these measurements and adjustments. As a final word, the installation should be made with the thought of giving *optimum* service, rather than just satisfactory service. ■■

SCOPE SERVICING [*from page* 14]

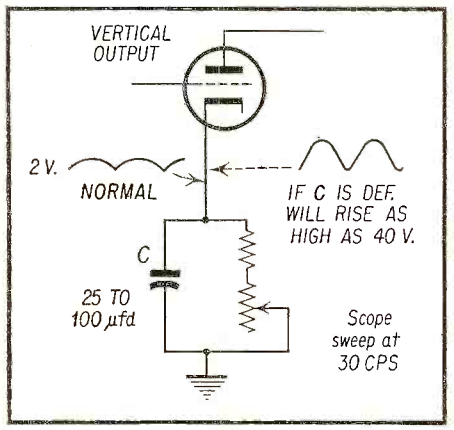

Fig. 11 — Wave forms encountered when defective bypass condenser causes compression of raster.

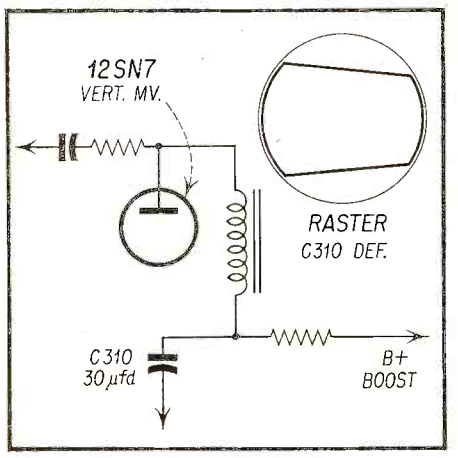

Fig. 12—Keystone distortion of raster caused by defective C310.

and the small winding on the horizontal output transformer.

Poor Vertical Linearity

Many receivers exhibited compression of the raster at the bottom, due to low capacity or an open filter across the cathode bias resistor of the vertical amplifier. *Fig. 11* shows the normal and abnormal waveforms and voltages at this point.

GE 12C107—Irregular Raster*

This set was first suspected of having a short in the vertical section of the yoke. A yoke substitution indicated that such was not the case. Once again a defective condenser in the vertical output transformer plate return (*Fig. 12*) was found to be the cause. While the position of the condenser in this set was identical to that found defective in the Du Mont, the effect was different, as noted. The reason for this difference is probably due to the vertical output circuitry. In the Du Mont the output tube is a straight amplifier while in the GE the output tube is also a section of the vertical multivibrator. ■■

*Ed Note—This last case seems to be very unusual in view of the "Keystone" effect. We invite comments from our readers.

THE WORKBENCH

[*from page* 43]

soon as the 6CG7 was replaced the other tube filaments died out. A check of the 6CG7, V401 socket was next in order. The receiver was dismantled so as to view the underside of the V401 socket which was on a printed circuit board. The socket's filament pins, #4 and #5, were observed as V401 was pulled out and pushed into the socket. It was noted to our amazement that a blob of solder lay loose between pins #4 and #5 and also that pins #5 had a bad solder connection. When the tube was pulled out of the socket, the solder blob shorted the filament pins which allowed all other tubes to light. Moreover when V401 was placed into the socket the solder blob unshorted, but the connection to pin #5 opened up, thus preventing any tube filaments from lighting. The socket was then cleaned and resoldered and the receiver functioned properly. ■■

AUDIO EQUIPMENT

[*from page* 44]

tion, directly coupled to a split-load phase inverter. Four type 6AV5GA tubes, with 550 volts on their plates, are used in push-pull parallel as the power output stage. The amplifier is rated at 60 watts output with less than 2% harmonic distortion and a peak power output of 90 watts.

Both a terminal strip and sockets are provided for connection to the speakers. Load impedances of 4, 8 and 16 ohms can be accommodated as well as 25- and 70-volt speaker lines.

The power supply uses three 5Y3GT's in parallel. A voltage regulator, using a 6CM7, furnishes the *dc* supply voltage for the screens of the 6AV5GAs and the pre-amplifier tube plates.

The overall size of the amplifier is only 5⅜" high, 13" deep and 16¼" wide and weighs 29½ pounds, convenient for portable work. A wall bracket, a locking cover to protect the controls against unauthoriezd tampering and rack mounting hardware are available for use in permanent installations. The mechanical construction is such that all tubes and parts are easily available for servicing. ■ ■

COLOR PICTURE TUBES

[*from page* 17]

for adjusting the three beams is a purity coil or magnet which provides motion of all three beam centers in a lateral direction. Proper adjustment of the purity coil insures correct initial alignment of the beams so that they fall properly on their respective phosphors. In this manner uniform response of the primary colors is obtained over the entire screen area.

Proper beam convergence is further aided by adjustable magnets located directly behind the deflction yoke; one magnet being provided for each beam. These magnets provide radial adjustment of the beams they control, that is, motion of the beam from the neck of the tube towards the center axis. Additional control of the blue beam in a lateral or horizontal direction is effected with a Blue Lateral Magnet, thereby providing complete static alignment of the three beams, static alignment referring to the means of correcting the beams for production gun assembly errors.

In addition to static convergence, dynamic deflection of the beams results in convergence errors at the extremities of the tube because of the geometric conformation of the shadow mask and phosphor screen. How these errors arise and how they are corrected will be dealt with subsequently under the heading of "Dynamic Convergence."

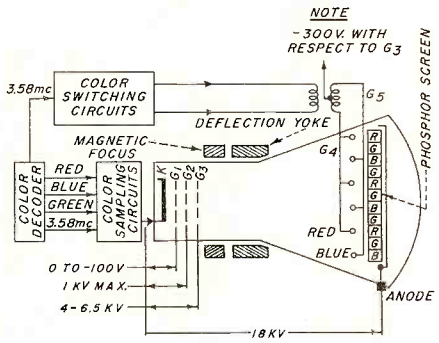

Fig. 5—Basic system involved in sequential color processing. (Chromatron Type PDF 22-4)

Color Picture Tubes: 1-Gun Type

As previously mentioned, the system just described is essentially instantaneous. Also, available is a 1-gun which processes the three video signals sequentially. In this tube (*Fig. 5*) the color signals are injected into the gun one at a time so that the red, green and blue signals occur in a certain time sequence. Since all three color signals are fed into the same gun each corresponding beam must be directed onto its respective phosphor by means of a switching device located internally within the tube.

Notice that the tube uses a high voltage (4 to 6.5 KV) accelerating grid (G3), and magnetic focus. Leaving the influence of the deflection yoke the beam is directed toward G4 and G5 which are alternate grids connected in parallel. Directly ahead of this wire

grid assembly is an aluminized phosphor screen backed up by a metal plate at 18 KV. This screen is made up of horizontal strips of phosphors arranged in the phosphor sequence r, g, b, g, r, g, b, g, etc.

A color switching sine wave voltage at 3.58 *mc* is derived from the color switching circuits and is inductively fed into G4 and G5 through T1. When the voltage between G4 and G5 passes through zero the beam falls on the green phosphors. As the potential between G4 and G5 varies between positive and negative values the beam is switched alternately from the red phosphors to the blue phosphors and back again to the red phosphors at a 3.58 *mc* rate.

During this time the red, green and blue signals are switched in the color sampling circuits in exact synchronism with the color switching circuit action. Thus the red, green and blue beams fall only on their own respective phosphors. Observe that a 3-color display is provided. Also, even though the system is sequential, the rapidity of the display action is such that the observer sees the additive effect of the three color phosphors being switched vertically at a 3.58 *mc* rate as the deflected beam is swept both horizontally and vertically.

This system makes use of high frequency switching power at approximately 30 watts. For this reason switching could give rise to *rf* radiation if the components are not properly shielded.

In addition to the above, vertical resolution is relatively coarse in saturated blues and red because of larger spacing between them as compared to the green. A further consideration is the fact that color balance (production of white) is no longer adjustable by the receiver controls and becomes the responsibility of the manufacturer of the tube. Finally, because of sine wave switching (which is not the most efficient, although it appears to be the most practical) the beam traverses non-luminous areas located between phosphors for certain portions of the cycle, resulting in a loss of available light output.

On the credit side of single gun sequential processing, notice that in this system no purity or convergence correction is required. In addition, the fact

that the shadow mask is replaced by a grid wire structure for beam switching allows for a greater utilization of the available beam current.

In an aperture mask tube only about 25% of the electron beam current can be utilized for useful light output, the rest being lost in the metal area surrounding the apertures.

Another advantage of this tube is its single gun structure. This allows for standard deflection and focus components as well as economy of manufacturing cost. These advantages, coupled with the absence of purity and convergence complications, are strong factors in favor of this type of color tube.

[*Continued next month*]

EQUALIZATION IN HI-FI

[*from page 9*]

the response is more like the curved, solid line in the graph, because at high frequencies, losses take place, particularly as the length of a single cycle on the tape approaches the length of the gap in the magnetic head. Therefore, the desired playback characteristic should be the exact inverse of the tape head characteristic, or as shown in *Fig. 6*. You will note the resemblance between this curve and the recording playback curves shown in an earlier article. With the exception that the high end has no roll-off or de-emphasis, the boost portion follows the same rate of slope. However, the boost begins at a much higher frequency, about 1600 cycles, compared to 500 cycles for the RIAA characteristic.

Direct Tape Head Playback

An increasingly popular source of program material in hi fi is the prerecorded tape. Many companies (some already in the recording field) are turning to this method of home music reproduction. Most people play these tapes on complete tape recorders (that is, recorders capable of making tape recordings and of playing back recorded tapes) but an ever growing number are not so interested in making tapes as they are in playing back professional quality tapes gathered together much as one would assemble a record collection. These people have a choice of purchasing a relatively inexpensive tape-deck and an expensive preamplifier or a complete tape recorder. Now, you can give them a third choice: the purchase of a tape deck only and the simple conversion of their phono-preamplifier to accommodate tapes directly through the existing system. Since, as we have seen, the basic playback curves are similar between the two devices, the modification can be accomplished with little difficulty. This time, let us use the seldom-used but usually available LP playback setting of the equalizer switch. The configuration will once again be one of those shown in *Figs. 2a* and *2b* for the bass boost end and like *Figs. 4a, 4b* or *4c* for the high end. First remove all treble de-emphasis components (*C2* or *R-4* of *Fig. 4*). Next, replace *C-1* with a capacitor having exactly one-third the previous value. Thus, if *C-1* in the LP playback circuit is now .01 mfd, substitute a capacitor of .0033 *μf*. Remove *R-2* (of *Figs. 2a* or *2b*). Remove any loading resistors across the input jack which may have been wired in to accommodate specific phono cartridges. Tape heads should work into "open circuit" or high impedance inputs for best results. Now your customer has a tape-phonograph for well under $100 including your time and the purchase of a tape playback deck.

[*Continued next month*]

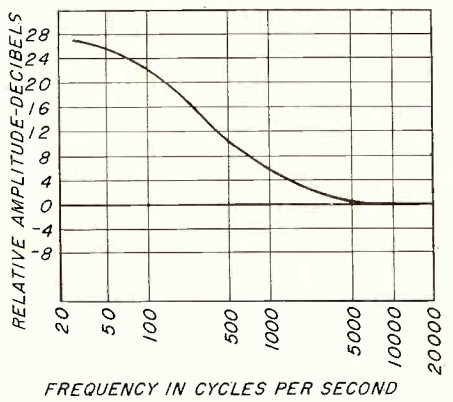

Fig. 6—Response for tape preamplifier. Note similarity to phone playback curve of Fig. 2.

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