

ELECTRONIC SERVICING

OCTOBER
1957 • 50c



Echo Sounders in Marine Electronics



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Echo Sounders in Marine Electronics

1957 Admiral TV

Elimination of Color TVI

Power Output Stages in Hi-Fi



AR-22



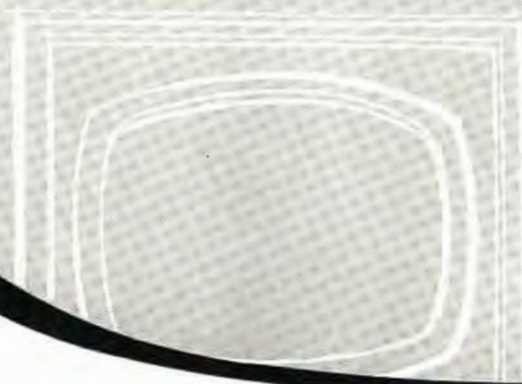
TR-2



TR-4

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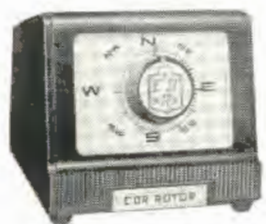
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THIS MONTH'S FRONT COVER

Photographs from top to bottom: Moving Chart Recorder, Bendix "Fish Magnifier," Echograph depth finder, and the "Fisherman" rotating lamp indicator. Courtesy of Raytheon, White Studios, R C A and Ross Labs. respectively.

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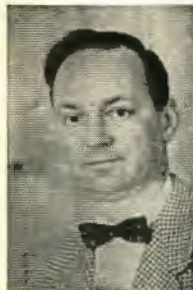


Echo Sounders in Marine Electronics

by Elbert Robberson

Part 1

A treatment of the basic principles of operation of the Echo Sounder, Transducer, Oscillators and Fathometers.



Elbert
Robberson

ECHO sounders have been in existence for years, but their widespread use on small boats has come only recently. There are many boatmen who now consider this instrument the most important device aboard. First, the echo sounder gives continuous, accurate indications of the depth of the water under the boat. Irregularities can be spotted immediately. This is useful, not only for keeping the boat off the beach or rocks and shoals, but also for navigation, through the identification of ridges, valleys, and underwater contour lines. The instrument is also valuable in dredging, pipe laying, channel clearing and sub-surface charting. An interesting new-found use has brought about a new era in the acceptance of this electronic device. A suitable echo sounder will spot fish underwater, show the size of a school, give an indication of the kind of fish and even tell how deep to set the nets for dragging the fish in. As an example, the manager of one fishing-boat fleet states that after installing echo sounders, fleet catches jumped up more than 25 per cent. In some areas

there wouldn't be any profitable fishing, were it not for the ability to find the elusive quarry. Accordingly, the sales and service of echo sounders can be an important function of the marine-electronics shop.

Basic Principles

Principles of echo sounding were known more than fifty-years ago. However, the devices used were bulky and inefficient, and would not be suitable for today's small boat. These early instruments clearly show the basic principles which are used today. On one of these instruments, an explosive charge was set off against a steel plate placed in the bottom of the hull, and at the same time a clock or timing mechanism, calibrated in fathoms, was set in motion. The return of the echo from the bottom was picked up in a microphone-like listening device which, through a relay, stopped the motion of the clock timer. The depth of water underneath the vessel could then be read from the timing dial. Another device used a metal "projector," in contact with the water at the bottom of the vessel, which was struck with a hammer to send out a pulse of sound energy to the bottom. Later, electromagnet oscillators were used to provide the sound energy. The listening devices, or "hydrophones," were various, but most of them were applications of the simple principles of a microphone and amplifier which actuated a timing mechanism, or to which an operator listened with earphones. Some early sounders



A cutaway view showing typical installation of a fathometer.

were completely manual in operation—the operator sending a sound pulse to the bottom by pressing a telegraph key, and at the same time, starting a stop watch. Upon return of the echo, which was heard in a headset, the operator stopped the watch and could figure the water depth from the fact that sound travels through salt water on the average of 4800 ft. per second.

All of these sonic sounders suffered from the fact that underwater noises from the ocean, the vessel and the propellers, were in approximately the same frequency range as the intentionally transmitted sound pulse. These noises, therefore, could seriously interfere with operation of the sounding device. To avoid this interference, the frequency of operation was moved into the ultrasonic range around 20 to 50-kilocycles. To generate this energy, some equipments used a low-frequency radiotelegraph transmitter.

Transducers

Because ordinary electromagnetic oscillators, or transducers, would not operate at frequencies this high, two different forms of transducers, or projectors and receivers, were employed. One operated through piezo electricity and consisted of a sandwich of quartz crystals mounted between steel plates, and was flooded with oil for insulation and improved sound propagation. The other type of transducer used magnetostrictive principles and consisted of laminations, or tubes of nickel, polarized

[Continued on page 48]

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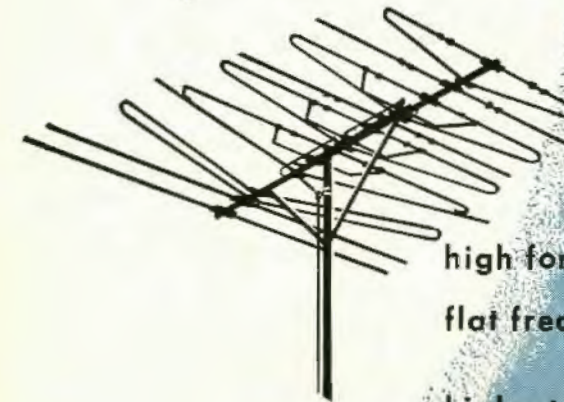
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Eliminating Color TVI

Part I

A brief review of basic color circuitry is presented to provide a foundation for the solution of interference problems.

by The Washington Television Interference Committee (WTVIC)

We have had the privilege of presenting the work of the Washington Television Interference Committee (WTVIC) to our readership once before (March 1957). We are again indebted to them for this series of articles relating to TVI in color TV reception. Both the committee and this publication are grateful to the following individuals and agencies for making available portions of the material presented herein: Clint Walter, Field Service Administrator, RCA Service Company, Camden, N. J.; John Kimball, Philco Corporation, Philadelphia, Pa.; Westinghouse Electric Corporation, Metuchen, New Jersey; Peter LaBarbera, Admiral Distributors, Washington, D. C.; and Granville Klink, WTOP-TV, Washington, D. C.

MANUFACTURERS of color television receivers make available to their service agencies, together with routine service bulletins, excellent up-to-date

detailed information on color receiver fundamentals and circuitry. However, to introduce an initial study of color TVI a review of basic color television receiver circuitry and operation such as might now be encountered is desirable. This material is composite in nature and does not reflect the current receiver design of any particular manufacturer. In the block diagram (Fig. 1) the individual circuits of the color receiver are grouped, according to function, in eight sections, and show the paths followed by the signal components, and auxiliary circuits required for the reproduction of a color broadcast. The heading of each section relates to the predominant function of its section.

Since the operation of a color tele-

vision receiver is essentially the same as that of a black and white receiver except for these additional circuits, it is susceptible to many interference problems usually associated with a black and white receiver.

Tuner Unit

The tuner unit of a color television receiver is very similar to its counterpart in the monochrome receiver. The selected video and sound signals are amplified in the *rf* amplifier and then coupled to the mixer. The video signal includes video, sync pulses, equalizing pulses, blanking pulses and color sub-carrier. In the mixer stage, these signals are combined with an *rf* signal

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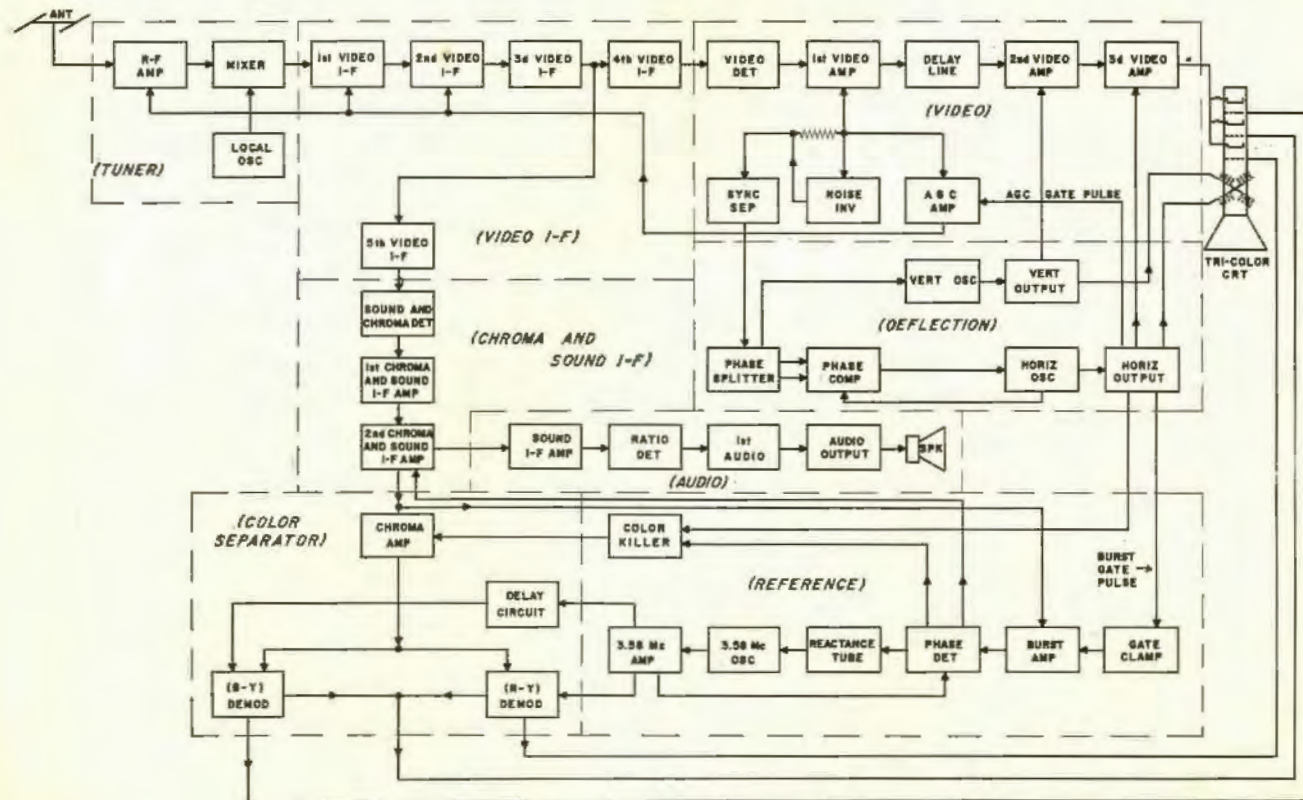


Fig. 1—Complete block diagram of a typical present day color TV receiver.

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1957 Admiral TV by Frank Hedrick

A discussion of the circuitry of 1957 Admiral receivers with emphasis on principles of circuit operation.

AMONG the features of Admiral's 1957 line of portable TV receivers, is the incorporation of a recent development in improved FM sound detection. This development was realized with the introduction of the 6DT6 and 3DT6 pentode tubes. Both tubes are identical except for filament current ratings; the 3DT6 being specifically designed for use in 600 milliamperere series string filament circuits. The significant difference between these tubes and other pentode tubes is mainly the construction and placement of the suppressor grid with respect to the other elements. This placement and construction permits the suppressor grid to be made to function much like a control grid because of its considerable control upon electron flow from cathode to plate. This article will discuss the unique operation of the FM detector (commonly called the Locked Oscillator—Quadrature Grid detector) along with other important features.

FM Detector Operation

The signal input to the 3DT6 is taken from the last sound *if* stage and coupled to the control grid as shown in Fig. 1. The detected output signal in the plate circuit is coupled directly to the volume control of the sound output stage. To fully understand the operation of the circuit, two modes of operation must be considered. One mode occurs at low signal levels (Locked Oscillator) and the other at high signal levels (Quadrature Grid). At low signal levels, the mode is so named because the circuit will oscillate, rather weakly, at a frequency determined by the tuned circuits in the control grid (T201) and suppressor grid (C206, L202, and R211).

As we know, an amplifier will oscillate provided sufficient energy of the proper phase is returned from the output to the input circuits. This is the condition that exists with the 3DT6 under weak signal conditions. The en-

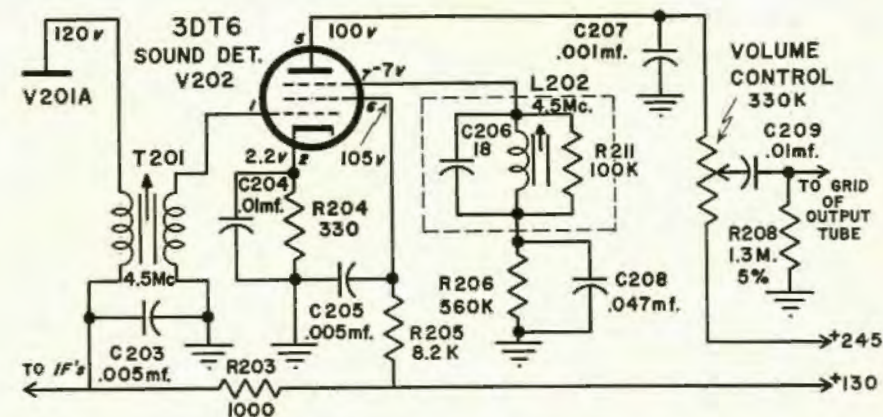


Fig. 1—Partial schematic illustrating FM detector section. Improved operation is obtained by use of "Locked Oscillator-Quadrature Grid" detector.

ergy is returned (feedback) from the suppressor grid to the control grid. The signal at the suppressor grid is induced by space charge coupling which is sometimes referred to as "negative capacitance." There is also a positive capacitance existing between the suppressor grid and control grid (interelectrode capacitance). These two capacitances, coupled with an approximate gain of three, between control grid and suppressor grid, cause sufficient energy of proper phase to be returned to the control grid and cause oscillation. The interelectrode capacitance between these two grids is sufficiently high to sustain oscillation.

When a weak signal is applied to the control grid of the oscillating circuit, the oscillator will become "locked in" with the applied signal. As the incoming *fm* signal deviates about its center frequency, the oscillating detector will also deviate about the same mean frequency. However, if the applied signal becomes extremely weak, the oscillator will become unlocked resulting in loss of detection. Locking will occur only over a limited range of weak signal strength.

The signal at the suppressor grid differs in phase with the *fm* signal (no deviation) applied to the control grid

by 90 degrees. Now, as the *fm* signal and the oscillating detector deviate, the amount of phase difference between the applied *fm* signal and the signal at the suppressor grid will vary depending upon the amount and direction of the applied signal deviation from the mean frequency. The combined action of the deviated *fm* signal applied to the control grid, and the phase varying signal on the suppressor grid varies the plate current in accordance with the frequency modulation, since the suppressor grid also has control over plate current.

The other mode of operation occurs when a strong FM signal is applied to the control grid. With this condition, the oscillation is overridden by the higher signal and the tube functions as a Quadrature Grid detector. Limiting action is accomplished due to the high input signal on the control grid driving the tube from plate current cut-off to plate current saturation. Thus, the current flow toward the plate will be essentially that of a square wave and limiting action is produced.

To obtain frequency discrimination, the square wave pulses of current produced by the control grid transfers energy to the suppressor grid in the

[Continued on page 42]



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- Rectifiers
- Filters

Ad Libs

by S. R. COWAN

ON Labor Day, while cruising on my small boat, a storm came up so we put in to a sheltered harbor to ride it out. While thus sitting idle, I noticed the electronics gear aboard and started to ponder on what I, and what the average small boat owner, might have invested in such equipment, and what this represents in terms of dollar income to the average marine radio dealer and service firm.

To begin with, last spring I ordered the boatyard to install a radio ground-plate. I paid \$75 for the service but believe that it was worthwhile because it is a very tedious although not difficult job. Actually the labor was only about 3 hours so I know the dealer didn't lose any money on me.

My RCA Golden Sentry ship-to-shore radio cost \$295 plus \$60 for crystals. Not having an FCC ticket, I had to pay \$60 for the installation. I also bought a \$100 antenna direct from another manufacturer. Next was the Raytheon fathometer which cost me \$149.50. Then I spotted the American Television & Radio Co. Inverter which sells for \$50, if my memory isn't too bad. Next I noticed the Heath Fuel Vapor Detector which sells for \$36 in kit form and then I remembered the Heathkit Battery Eliminator which I use as a battery charger and which sells for \$31.50. I then noticed the Hallicrafters All-Band radio receiver which I keep aboard during the summer. Finally I remembered the Bendix Portable Gas Generator that was stowed in the bilge compartment for emergency power. This cost \$179.00.

Adding it all up I realized that I had over \$1557.00 invested in needed electronics equipment on my small boat. I intend getting a radio direction finder that will cost about \$250.00 and a radar unit at about \$750.00 in kit form.

In terms of selling and servicing, most items on the boat allow the dealer at least 25% gross profit so there was upwards of \$340 made on sales plus a percentage of the \$60 labor fee. As I did most of the installing, I saved quite a bit, but most boat owners have

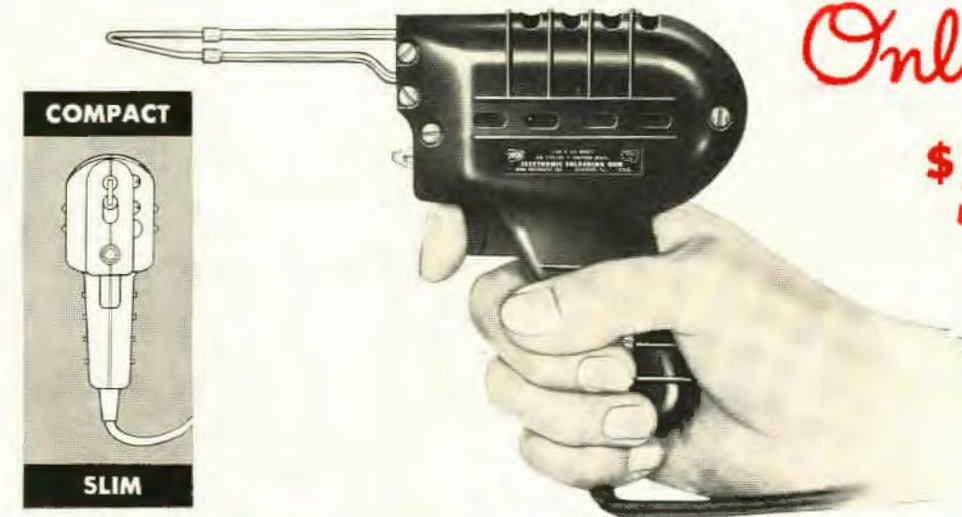
[Continued on page 47]

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Power Output Stages in Hi-Fi

By Lawrence Fielding

A treatment of the circuitry, adjustment and troubleshooting methods for modern Hi-Fi power amplifiers.

BY FAR the most interesting circuit in a high fidelity amplifier is the power-output section containing a pair (or more) of power amplifier tubes. These are operated in push-pull and feed audio power to the output transformer which in turn couples power to the loudspeaker. More has been written about the design and operation of this stage than any other single circuit in the audio field. Controversy still rages concerning the relative merits of triode versus pentode operation, not to mention the middle-of-the-road "Ultralinear" (a cross between a triode and pentode) circuit. The purpose at hand, however, is not to re-hash the theory and mathematics of output stage design (which most servicemen have read and re-read at one time or another) but rather to present an up-to-date summary of circuits which are commonly found in hi-fi gear today. We shall also examine all the critical parameters of these circuits and try to equip the hi-fi service technician with enough data to properly care for ailing output circuits.

Output Tubes

A power tube is fundamentally no different in theory from a voltage amplifying tube. Grids are still grids, cathodes still emit electrons when heated and plates still attract them when B plus is applied. The great difference lies in the physical construction of the tube. The plate construction is much more rugged than in the voltage amplifying counterpart and is built to dissipate power without overheating. Certain tubes which are designed for class AB₂ or class B operation have control grids heavy enough to allow substantial grid current flow during part of the cycle without self-destruction. In line with the above, the first

precaution to observe in dealing with these tubes is that *they run hot!* Most power output tubes run much hotter than rectifiers in the equivalent envelope size. Unfortunately, they don't look as hot, and the first instinct is to grab them much as one would take hold of a 6SN7. Suffice it to say that the bulb temperature of some output tubes is high enough to melt solder and you certainly wouldn't think of grabbing the business end of a soldering iron, no matter how cool it looks. Table I lists some of the more popular tube types found in amplifiers, together with some pertinent data concerning each type. One of the first things a hi fi serviceman should do is get full data sheets on these tube types and any others he may run across. Usually, the key to servicing these stages (barring simple tube replacement) lies in *dc* voltage checks and more *dc* voltage checks. What's more, a 5% or 10% accurate *v_{tum}*, while adequate for most

voltage measurements, is not good enough here. Most power output stages are designed to squeeze that last watt out of the tubes, and voltages are set at or very near maximum ratings. A maximum rating of 400 volts on the plates of a pair of output tubes means just that. Exceeding that voltage by as little as 20 volts can often spell disaster. The same is true of bias conditions, both fixed and self-bias.

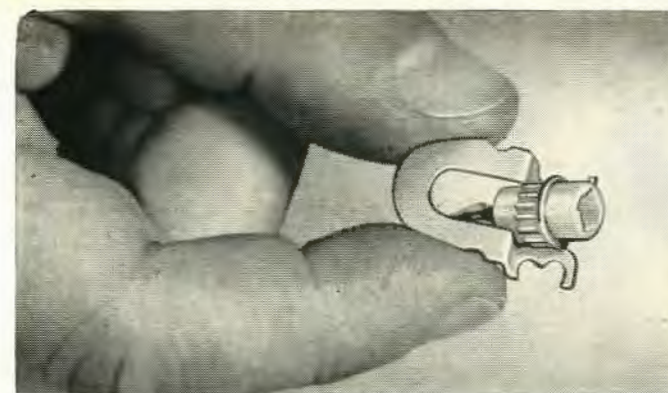
A Simple Output Circuit

An almost classical output circuit, in one form or another, consists of a pair of 6V6 pentode tubes operating in push-pull, with self-bias. Practical use of this circuit is made by the David Bogen Company in their popular Model DB110, whose tone control circuits we discussed in an earlier issue. The schematic of this particular output circuit is shown in Fig. 1. The out-of-

[Continued on page 51]

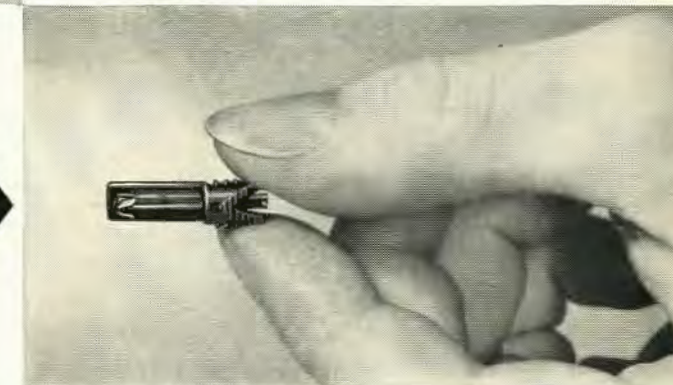
TABLE I

Tube Type	Envelope	Manufacturer	Typical Power For Push-Pull Pentode Operation	Notes
807	4-pin with plate cap	RCA, GE, etc.	Up to 50 watts (15 as triodes)	Seldom used due to envelope
1614	Octal glass or metal	RCA	Up to 50 watts	Popular
5881	Octal glass	Tung-Sol	About 30 watts	Popular
6550	Octal glass	Tung-Sol	Can push 100!	For the big basic amps.
6CM6	Noval mini.	RCA, Sylvania	10 to 12 watts	In all-in-one pre-amp-amps.
6L6	Octal glass or metal	RCA, most others	Up to 50 watts	Similar to 1614
6V6	Octal glass	All	10 to 14 watts	In small compact amps.
12BA4	Noval mini.	GE, etc.	About 20 watts	Limited use due to 12 volt filaments
EL-34/6CA7	Octal glass	European	Up to 100 watts	Readily available here
EL-37	Octal glass	Mullard (British)	Up to 30 watts	Only one source of supply
EL-34/6BQ5	Noval mini.	European	Up to 20 watts	Very popular



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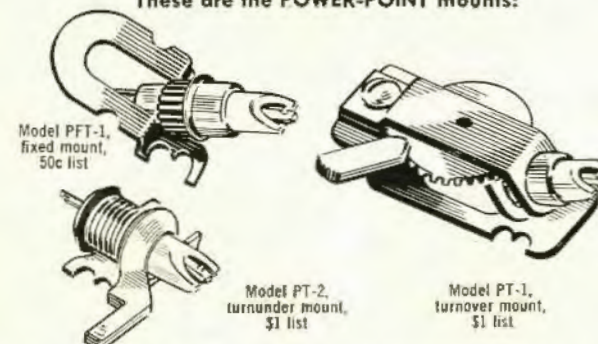
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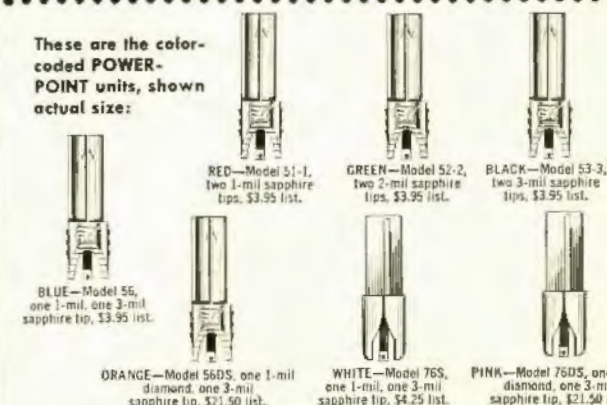
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Elgin's new TRC dynamic microphone offers faithful audio reproduction in the 80-8500 cps range, yet lists from \$11.50. It is designed for use with tape recorders... yet has the versatility to perform ideally at meetings and assemblies, wherever p.a. systems are used. The TRC is less than five inches long, weighs only nine ounces, has a polished, chromeplated case. It is omnidirectional and picks up voices within a radius of ten feet under average conditions.

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ELECTRONICS DIVISION

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COLOR TVI

[from page 8]

from the local oscillator, thereby converting the video and sound *rf* signals to *if* signals. The relationship between the incoming signals and the local oscillator signal is such that the frequency differences are always the same; that is, the corresponding intermediate frequencies are the same for all channels. In the receiver under discussion, the video *if* carrier frequency is 45.75 *mc* and the sound *if* carrier frequency is 41.25 *mc*. The mixer output is designed to cover all signals within this frequency range as well as 1.25 *mc* above the video carrier and slightly below the sound carrier. These signals are applied to the video *if* section.

With regard to interference, most manufacturers incorporate design features to minimize radiation of undesired signals from the receiver, and to reject undesired external signals, providing two-way protection against interference. For example, the receivers of one manufacturer utilize a shielded antenna input network consisting of:

1. An antenna matching transformer (designed for 300 ohm input).
2. Two fixed-tuned parallel resonant traps in the IF frequency range.
3. A high pass filter.
4. A tunable FM trap.

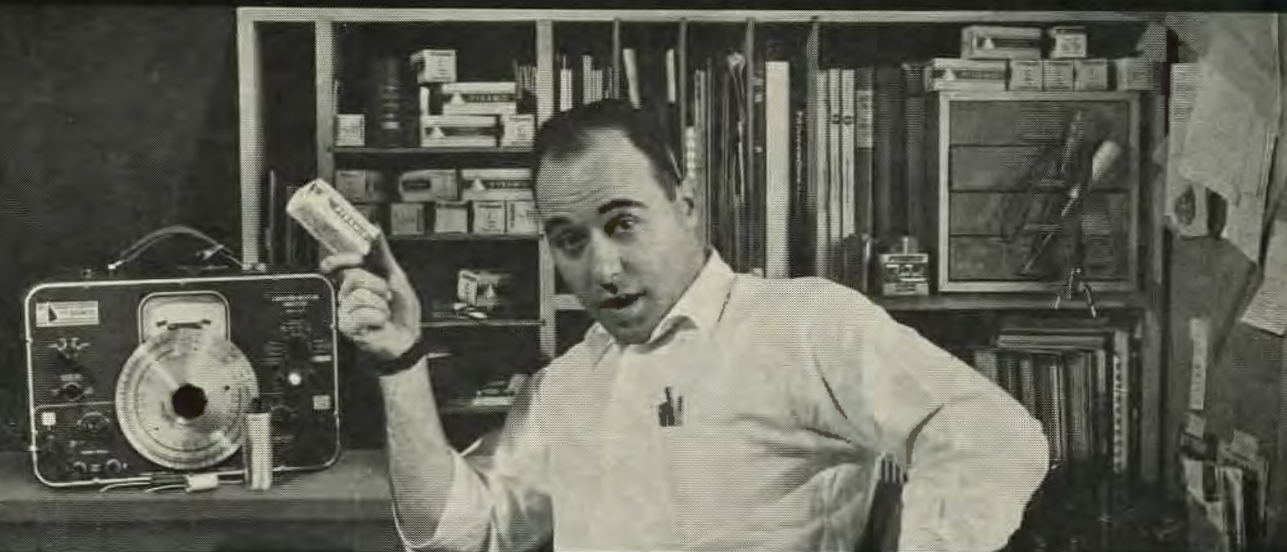
Video I.F. Section

This section contains five *if* stages which are stagger tuned to provide the bandwidth required to amplify the full range of frequencies received. The output signal from the third *if* stage (video, sync pulses, equalizing pulses, blanking pulses, color sub-carrier and sound) is applied to both the fourth and fifth *if* stages. The output of the fourth video *if* stage is applied to the video section. The output of the fifth video *if* stage is applied to the chroma and sound *if* section. The overall frequency response of this section is such as to amplify the video signals much more than the sound signals. Rejection traps for signals produced by adjacent channel transmissions are used extensively throughout this section.

Adequate shielding is provided to prevent radiation from the second detector circuits, and to prevent unwanted

[Continued on page 41]

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BEST BUILT



YET

That's our claim—backed up by a solid majority of independent set makers who use them. Built to one standard of quality—Blue Chip Quality—Magic Mirror Aluminized Picture Tubes mirror twice the light to create a picture twice as bright. Tell your supplier you'd rather have Tung-Sol!

Blue Chip Quality

TUNG-SOL[®]
Magic Mirror Aluminized
PICTURE TUBES

TRADE

The successful operation of a complete "forward scatter" communications link in frequencies above 2,000 megacycles has been established by the Research and Development Division of Allen B. DuMont Laboratories, Inc. According to DuMont engineers, the path length of the new DuMont link is 124 miles, and transmission and reception are at 2180 megacycles. The increased problems of the crowded radio spectrum make communications in these low microwave frequencies of particular importance in both military and commercial communications, it was pointed out. Furthermore, more information can be transmitted in these higher frequencies within a relatively smaller segment of the spectrum.

Westinghouse has scheduled a record advertising campaign this fall to introduce its 1958 line of television receivers, it was announced. Emphasizing the Westinghouse feature of automatic electronic tuning, the campaign will run to December 9, on network television, in Life and Saturday Evening Post, in Sunday supplements—This Week, Parade and Family Weekly—and in farm publications, all backed by strong local advertising support.

Jackson, Mississippi's television station WJTV, channel 12, began programming under full power allowed by the Federal Communications Commission. Increased power will give its viewing audience improved reception in fringe areas and clearer picture quality throughout the entire coverage area.

A completely new premium promotion will help V-M dealers sell popular-priced stereo-play tape recorders. The promotion features a deluxe boxed set of five stereophonic tapes recorded especially for V-M. The complete package, valued by V-M at \$40, may be offered free of additional charge to purchasers of tape recorders in October and through the Christmas season.

Amperex Electronic Corporation has announced its decision to manufacture special-purpose, premium-type, miniature electron tubes at the company's Hicksville, L. I., N. Y. plant. Such tubes have thus far been manufactured for Amperex by Philips of the Netherlands, imported to the U. S. under the Amperex name, and applications-researched for the American electronics industry by the Amperex engineering teams. The extremely favorable reception of these tubes by American manufacturers of military and commercial electronic equipment has now prompted the

FLASHES

Amperex board of directors to authorize the procurement and installation of the necessary facilities for going into domestic production.

Production of radio and TV receivers in July dropped somewhat from the June level but increased over July output of last year, the Electronic Industries Association (formerly RETMA) reported today. Cumulative output of TV sets declined from the first seven months of 1956 while radio production increased by more than one-half million receivers compared with the like 1956 period. While retail sales of TV receivers in July increased substantially over the number sold in June, radio set sales lagged compared with June but were reported over the number sold in July of last year. Sales of receiving and TV picture tubes decreased from June. Receiving tube sales were reported to be over July a year ago while TV picture tube sales dropped somewhat from the July 1956 level. Factory sales of transistors in July declined from the June level—an all-time high for the semiconductor device—but more than doubled the number sold in July 1956, announced today. Cumulative sales during the first seven months of this year continued to exceed substantially the number sold during the corresponding period of last year.

A Good-Will Business Builder Program was announced recently to independent service dealers by officials of Raytheon's Tube Sales Staff. This new program has been specially created to assist independent service dealers in stimulating service business and assuring repeat service calls. Provided in the program is a collection of personal and useful promotion items available at low cost and supplied with each service dealer's personal imprint. Along with the knowledge and skill offered by service dealers to their customers, distribution of these items and helps assure repeat calls. Complete information regarding this program is available from the RAYTHEON Good-Will Builders Supply Station, P. O. Box 30, Milford, Connecticut.

As a result of the growing interest in hi-fi, Americans will spend more than a billion dollars next year to enjoy recorded music in the home, James M. Toney, Vice President and General Manager, RCA Victor Radio and "Victrola" Division, predicted. "By 1958 the fantastic growth of high fidelity will have helped to boost the home-music industry's sales by 200 per cent over a period of five years, while spending for all recreation was rising by only about 17 per cent," Mr. Toney said.

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THE ANSWERMAN

BY ELECTRONIC SERVICING TECHNICAL STAFF

Answerman:

An increasing number of transistor portable radios are being brought in to my shop for repairs. So far I have been lucky in servicing them. During the process of working on these transistor radios I became curious about one aspect, and that is the accuracy of the voltage measurements to be expected in these receivers and of the meters used in the measurements. Just how close should these voltages be to the prescribed values? Is a special voltmeter necessary to work on this type of circuit?

B. M.
Philadelphia, Pa.

In servicing transistor radios, the measurement of *dc* voltages is just as useful and important as in the servicing of vacuum tube radios. However, the major difference is in the magnitude of these measured voltages. The *dc* voltages in circuits using transistors are usually on the order of less than 9 volts although transistor circuits will be encountered where as high as 26 volts are employed. Bias voltages between the base and the emitter of a transistor

are on the order of 0.05 to 0.2 volts. In some receivers the operation of a transistor with 0.1 volt between the base and the emitter will cause improper reproduction if the transistor requires 0.2 volts. This illustrates some of the voltage values and possible tolerances encountered in servicing transistor radios. The sensitivity of the voltmeter movement is also important in the measurement of these voltages and should be at least 20,000 ohms per volt or better. It is also necessary for the low voltage scale to have a range that will permit reading voltages with an accuracy of plus or minus 0.03 volts or better. Such meters are available although not all meters reading in these ranges will provide this kind of accuracy.

As has been mentioned this bias voltage on a transistor, frequently termed "Forward-Bias," is quite important and is analogous, in a way, to the grid bias of a vacuum tube. However, there is an important difference that should be noted. With no forward bias between the emitter and the base there will be a current flow in the circuit of the collector. As the forward bias is increased collector current increases as can be noted in Fig. 1. Normal operation of many transistors calls for a voltage of between 0.1 and 0.2 volts between these elements. This is one of the important voltage measurements in servicing of transistor radios.

In repairing transistor circuits, voltage measurements are much to be preferred over resistance measurements wherever possible. This is because the voltage inserted by the

ohmmeter battery will often provide an incorrect indication and can cause permanent damage to the transistor. When making resistance measurements the safest method is to remove the transistor from the circuit, or, if this is not easily possible, to disconnect one end of the component being measured.

Dear Mr. Answerman:

In a Motorola TS-533 TV receiver, the picture is very snowy on all channels. The antenna checked good. This is the original complaint on the receiver. The tuner has been cleaned and appears to be normal as well as the other stages in the receiver. Can you suggest the cause of this trouble?

W. E. D.
Chicago, Ill.

The symptoms are typical of trouble in the agc system. This difficulty is probably due to the 8.2 megohm resistor, R129, which couples a small portion of positive voltage into the agc system. Resistor R129, shown in Fig. 2, has probably increased in resistance or opened so that little or no positive delay voltage is being applied to the agc line. The resultant negative agc voltage biases the r-f and i-f amplifier tubes so that normal gain is not achieved and a snowy picture results.

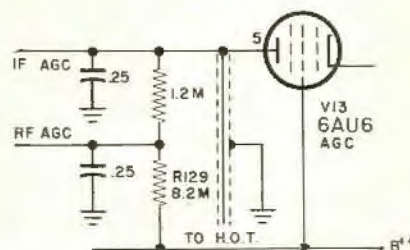


Fig. 2—Partial schematic of Motorola TS-533 showing the agc circuit.

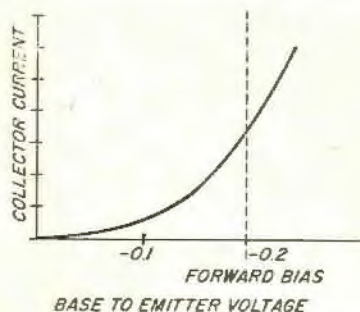
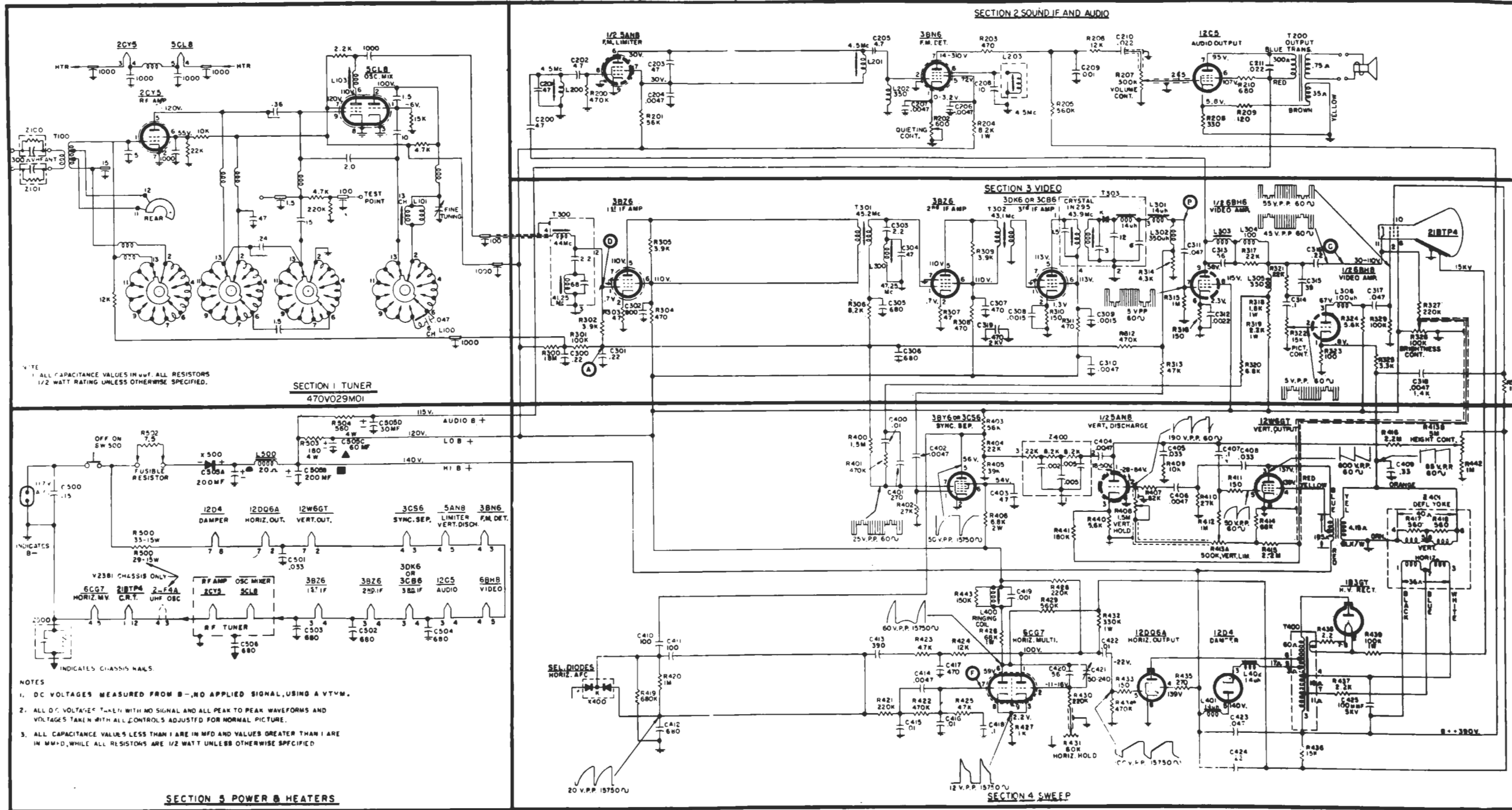
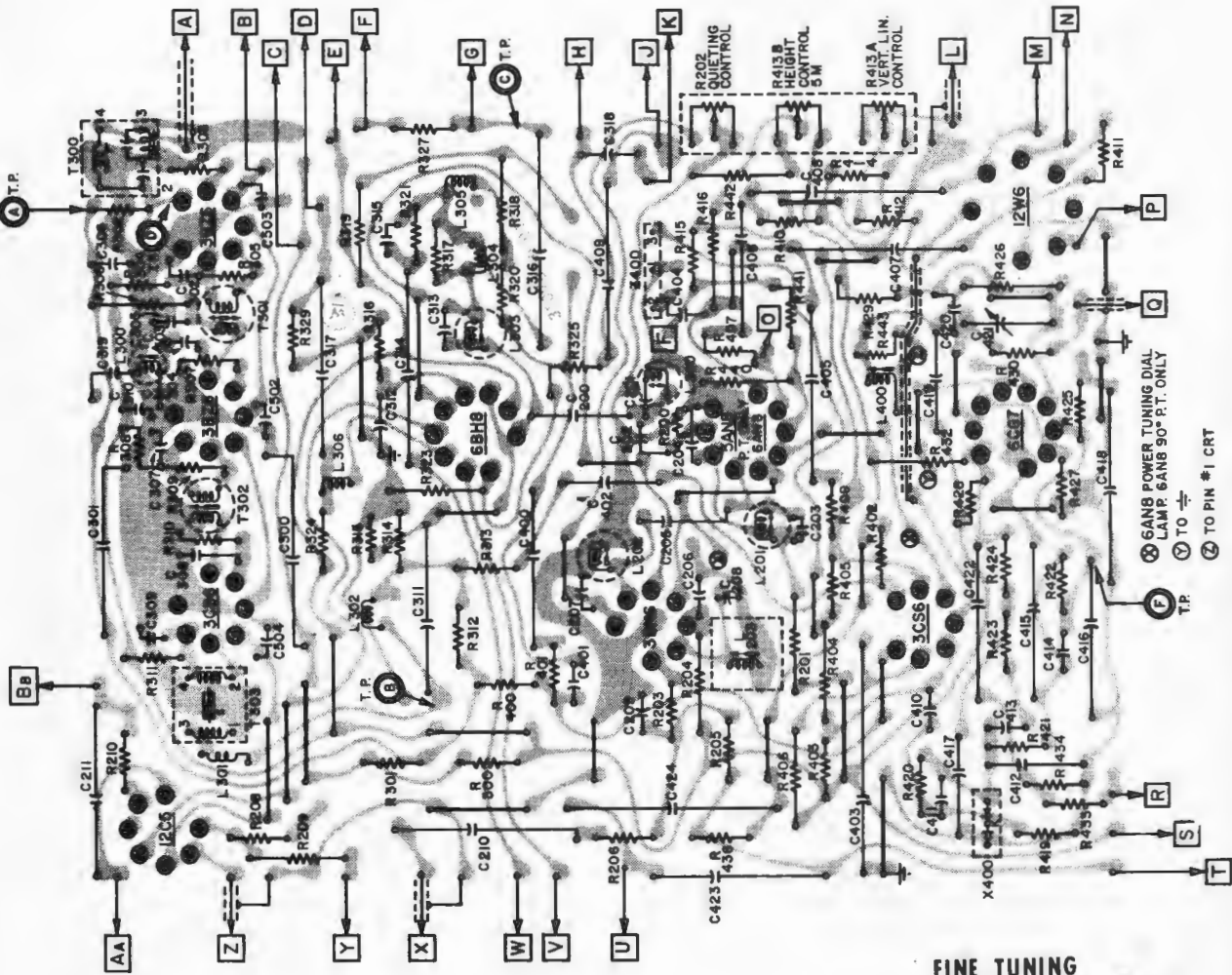


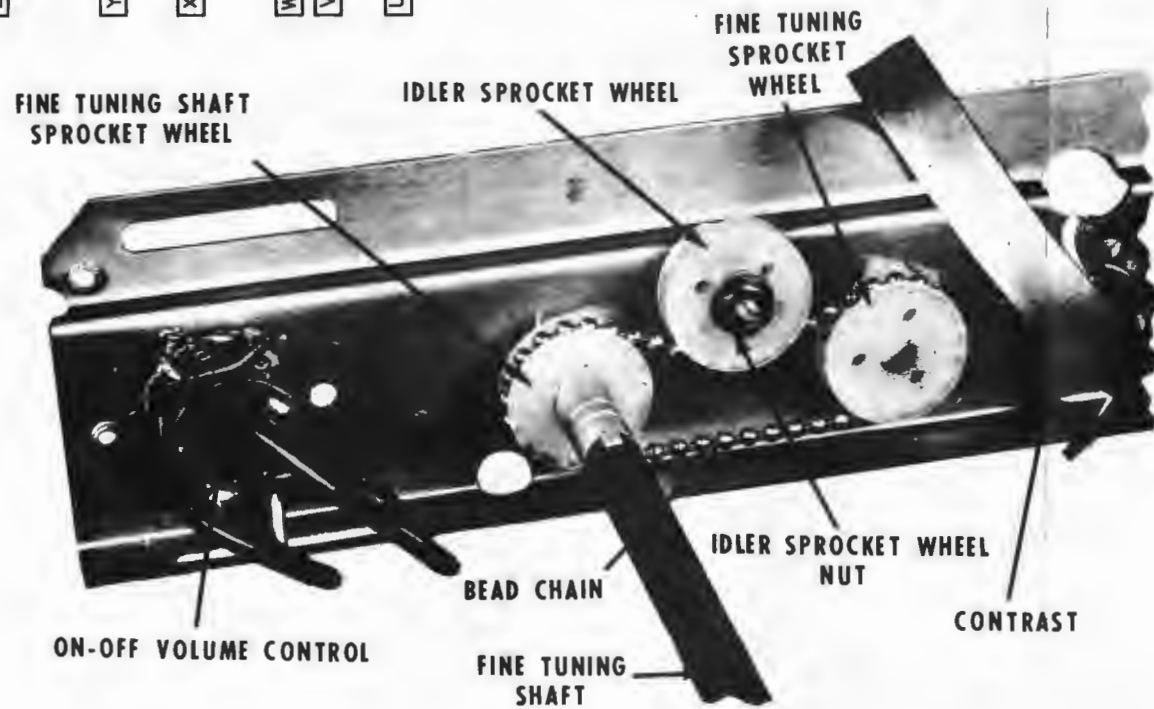
Fig. 1—Collector current increases as the forward bias is increased.



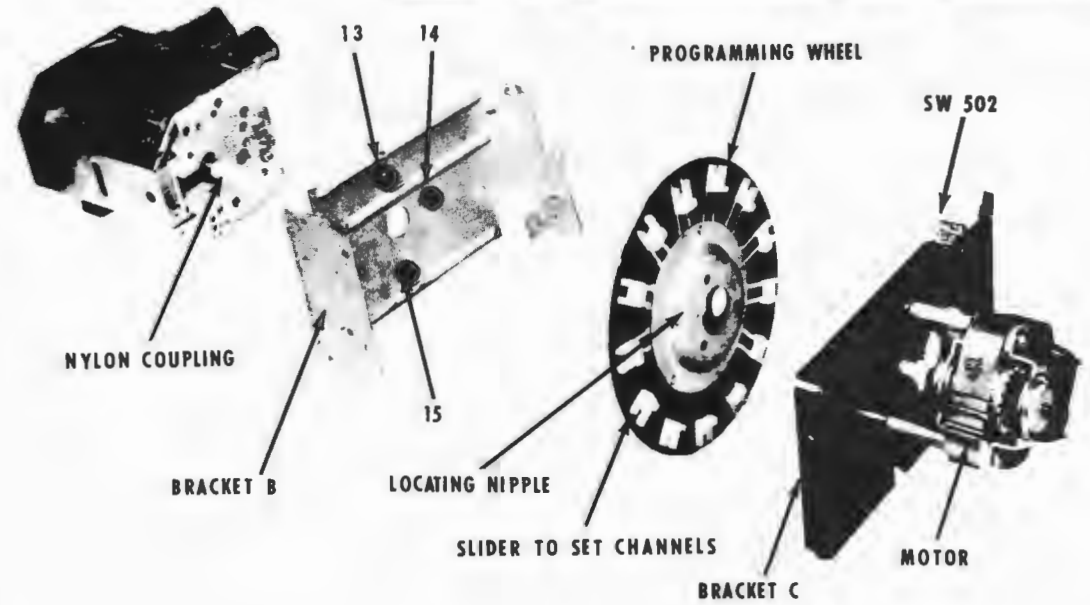
Chassis, V-2371 & V-2381, Schematic Diagram



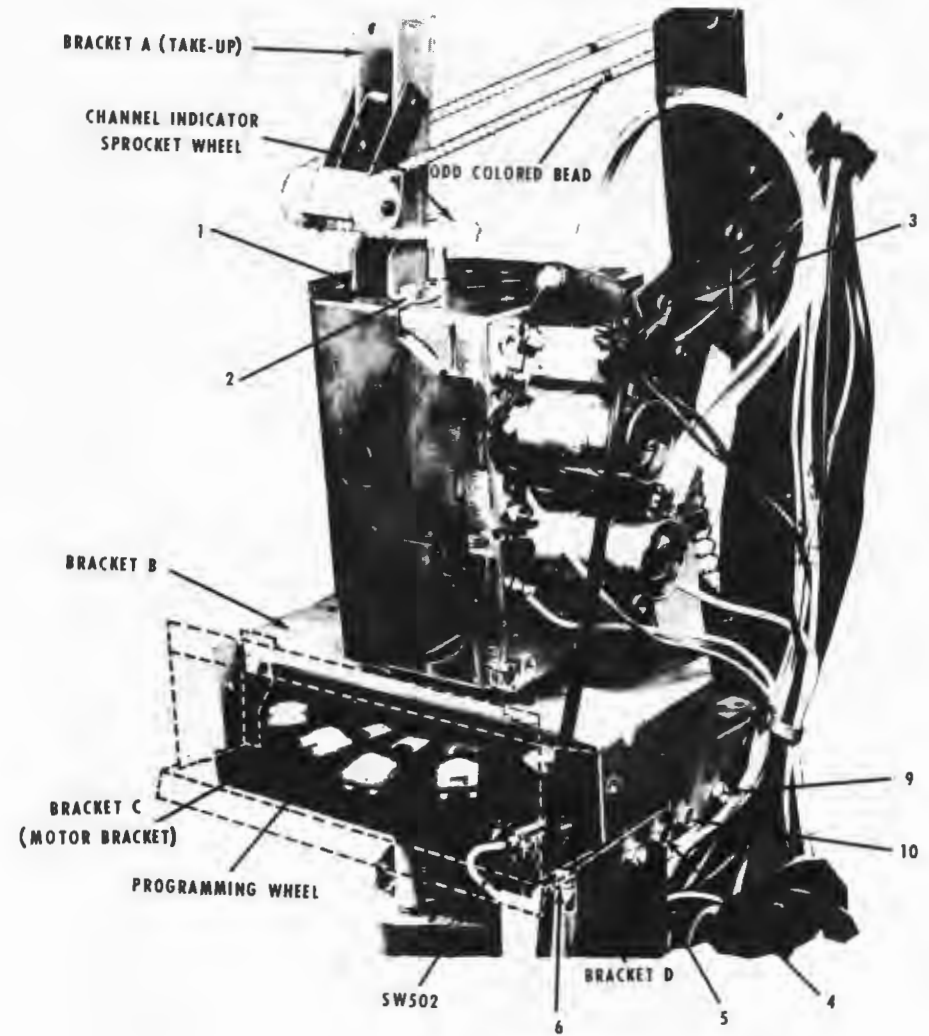
Bottom View of Printed Board Showing Top Components as Schematic Symbols



Control Bracket, Manual Tuning Chassis, Rear View

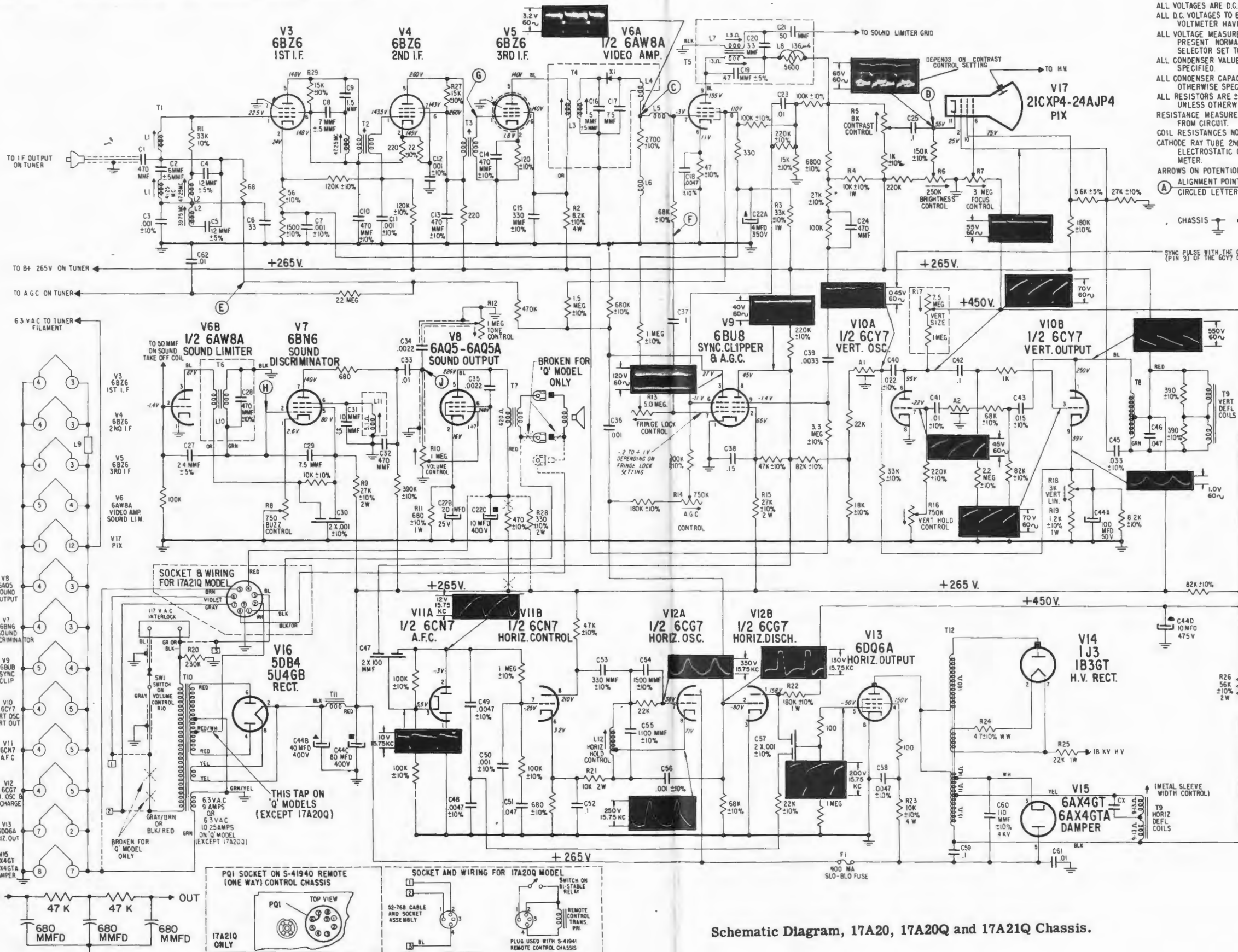


Tuner and Motor Assembly, Exploded View



Tuner and Motor Assembly

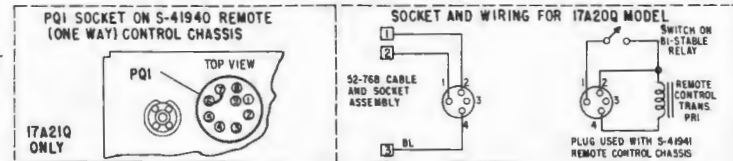
NOTES
 ALL VOLTAGES MEASURED FROM CHASSIS TO POINTS INDICATED
 ALL D.C. VOLTAGES ARE D.C. UNLESS OTHERWISE SPECIFIED
 ALL D.C. VOLTAGES TO BE MEASURED WITH A VACUUM TUBE VOLTMETER HAVING 11 MEGOHM INPUT RESISTANCE.
 ALL VOLTAGE MEASUREMENTS TO BE MADE WITH NO SIGNAL PRESENT NORMAL SETTING OF CONTROLS AND CHANNEL SELECTOR SET TO 2 UNLESS OTHERWISE SPECIFIED
 ALL CONDENSER VALUES IN MICROFARADS UNLESS OTHERWISE SPECIFIED
 ALL CONDENSER CAPACITY TOLERANCE $\pm 20\%$ UNLESS OTHERWISE SPECIFIED
 ALL RESISTORS ARE $\pm 20\%$ TOLERANCE, CARBON, 1/2 WATT UNLESS OTHERWISE SPECIFIED
 RESISTANCE MEASUREMENTS SHOWN WITH COILS DISCONNECTED FROM CIRCUIT
 COIL RESISTANCES NOT GIVEN ARE UNDER ONE OHM
 CATHODE RAY TUBE 2ND ANODE VOLTAGE TO BE MEASURED WITH ELECTROSTATIC OR 20K MIN. OHM PER VOLT HIGH VOLTAGE METER
 ARROWS ON POTENTIOMETERS INDICATE CLOCKWISE ROTATION
 ALIGNMENT POINTS
 CIRCLED LETTERS INDICATE ALIGNMENT AND TEST POINTS



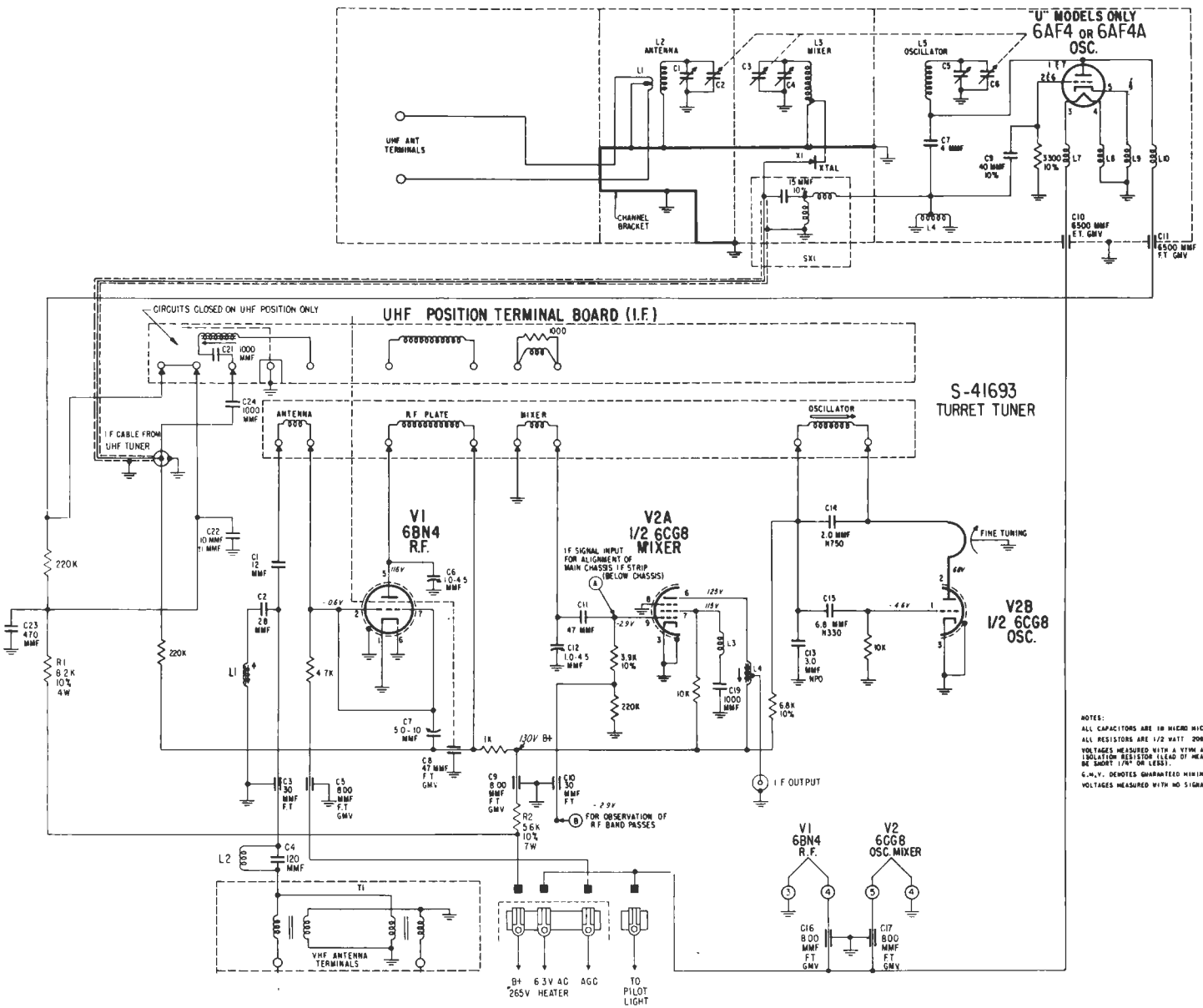
TEST POINTS
 C- DETECTOR OUTPUT
 D- VIDEO OUTPUT
 E- 1st A.G.C.
 F- TO BE GROUNDED FOR I.F. ALIGNMENT
 G- 3RD I.F. GRID
 H- SOUND 6B6G GRID
 J- SOUND OUTPUT

Schematic Diagram, 17A20, 17A20Q and 17A21Q Chassis.

EQUIVALENT CIRCUIT FOR 87-5 INTEGRATOR

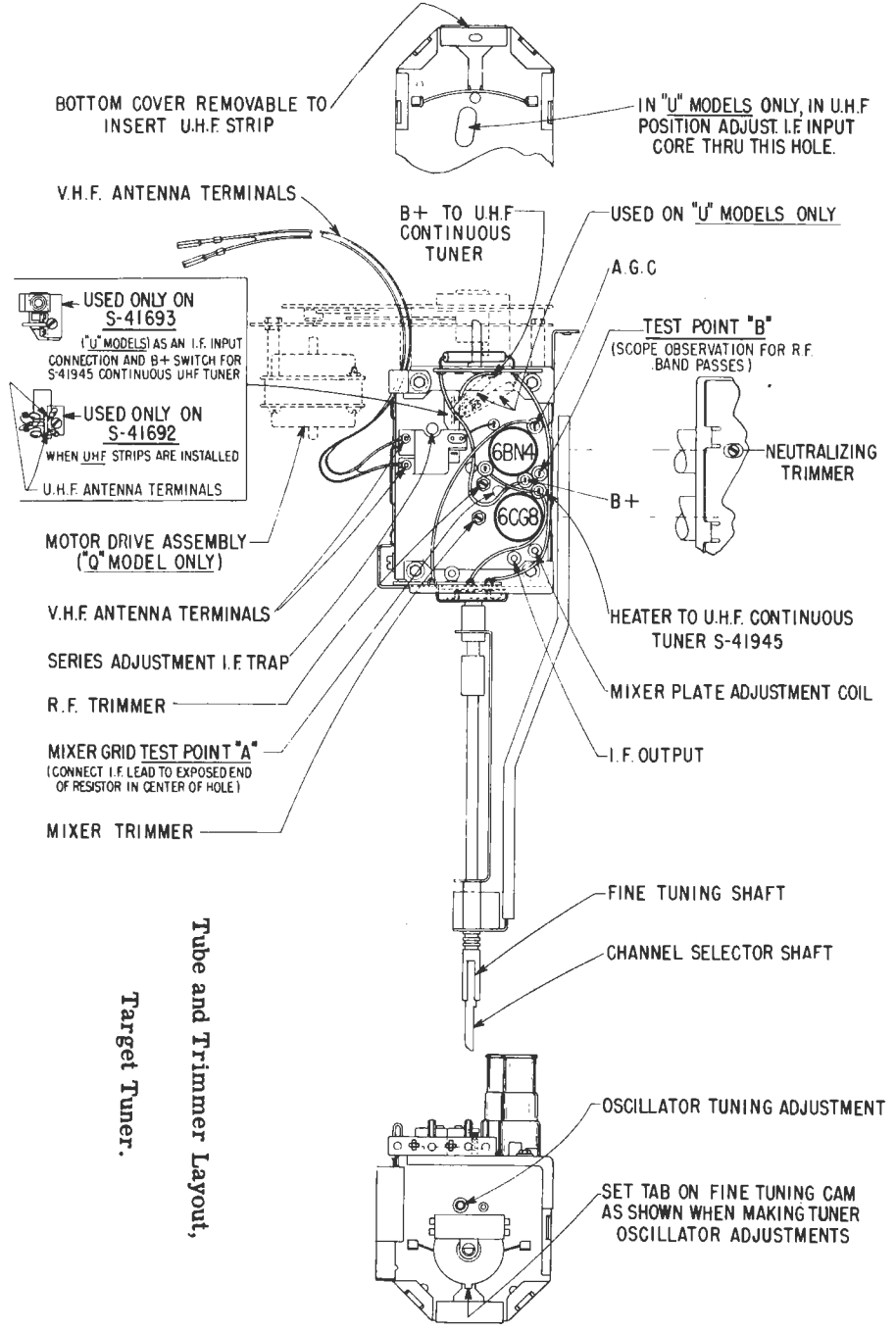


13 Position Target Tuner used in the 17A20 Chassis.

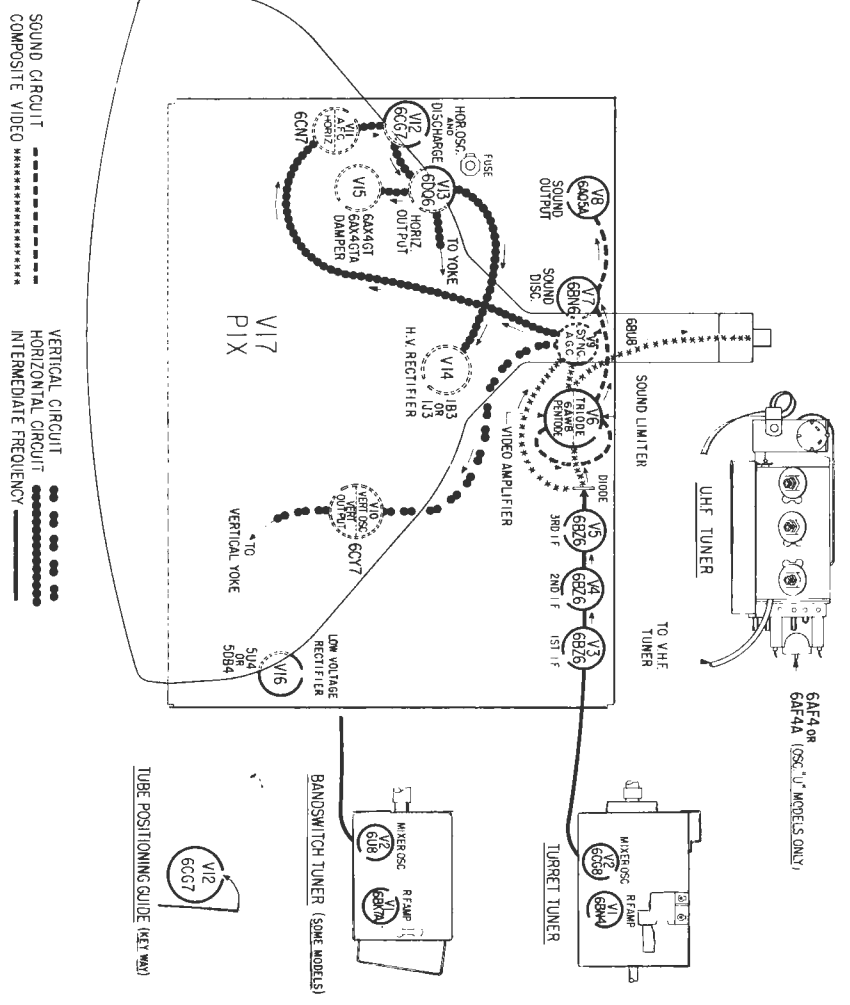


S-41945
UHF
CONTINUOUS
TUNER

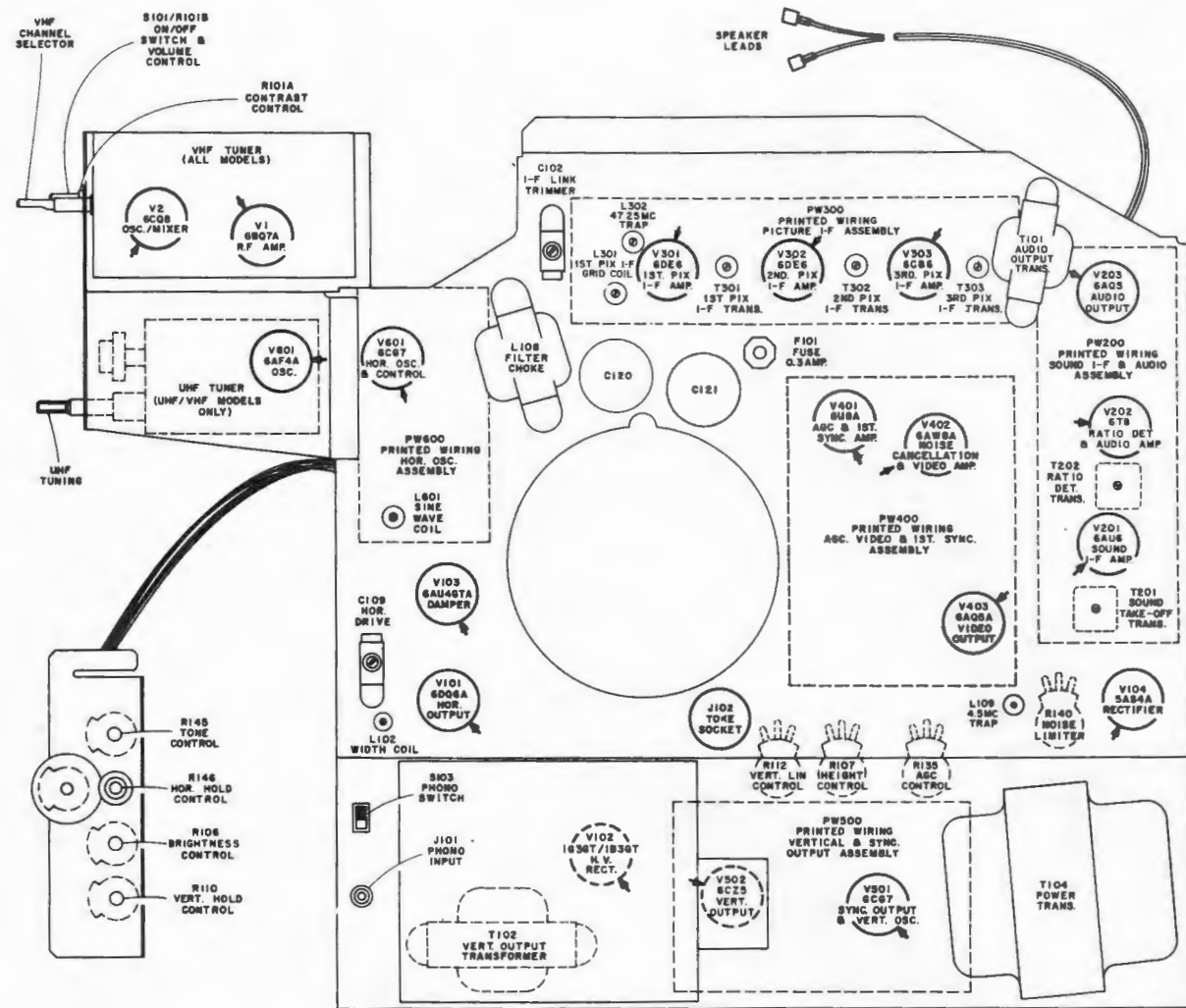
NOTES:
ALL CAPACITORS ARE IN MICRO MICROFARADS.
ALL RESISTORS ARE 1/2 WATT, 20% UNLESS OTHERWISE SPECIFIED.
VOLTAGES MEASURED WITH A VTVM HED A 100 OHM 1/2 WATT ISOLATION RESISTOR (LEAD OF MEASURING END OF RESISTOR MUST BE SHORTED TO GND).
G.M.V. DENOTES GUARANTEED MINIMUM VALUE.
VOLTAGES MEASURED WITH NO SIGNAL OR CHANNEL ON.



Tube and Trimmer Layout,
Target Tuner.

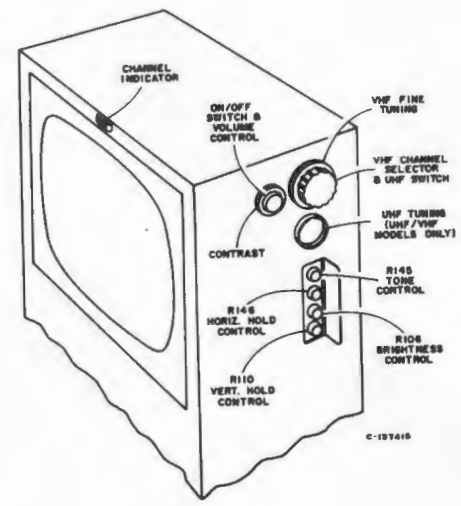


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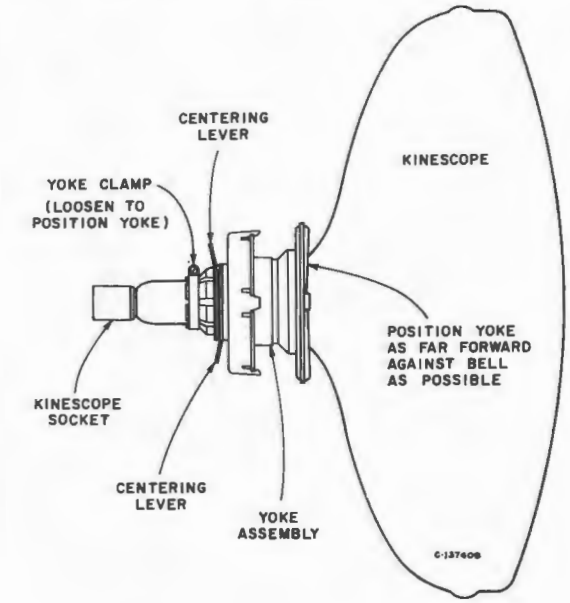


↑ DENOTES KEYWAY (OPEN PIN LOCATION FOR MINIATURE TUBES)

CHASSIS REAR VIEW



Operating Controls—Consoles



Yoke and Magnet Adjustments

USE 1/2 WATT 5% COMPOSITION RESISTORS

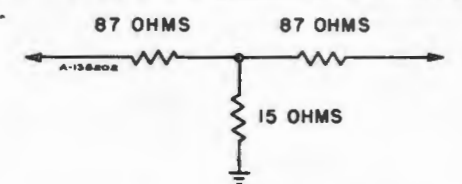


Figure 10—Sound Attenuation Pad

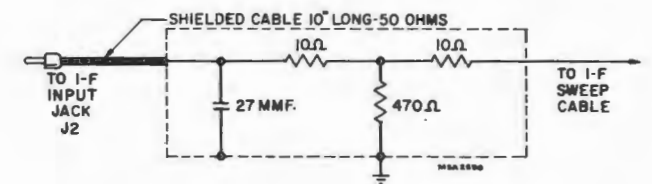
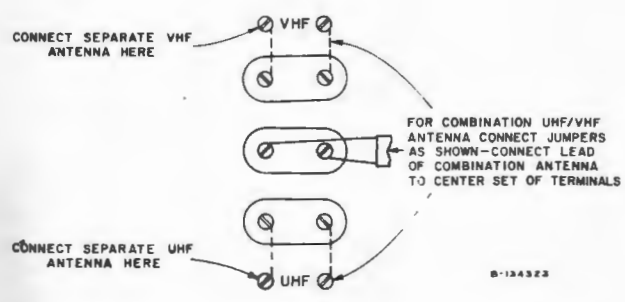
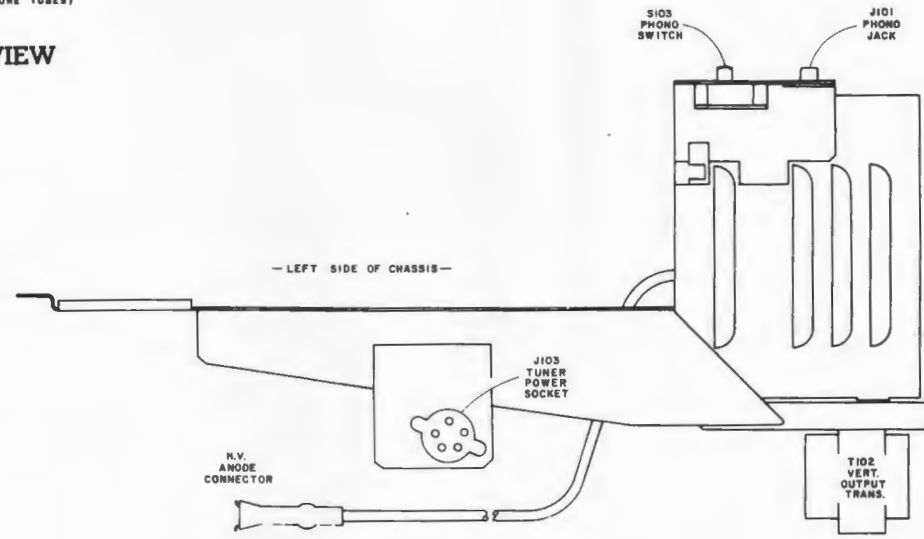


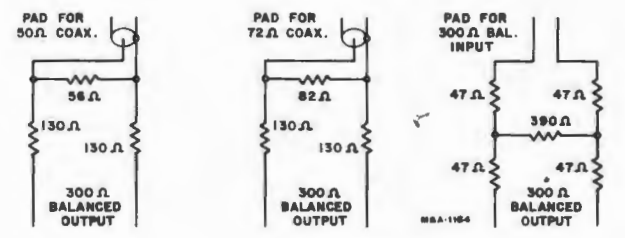
Figure 11—Tuner I-F Input Head



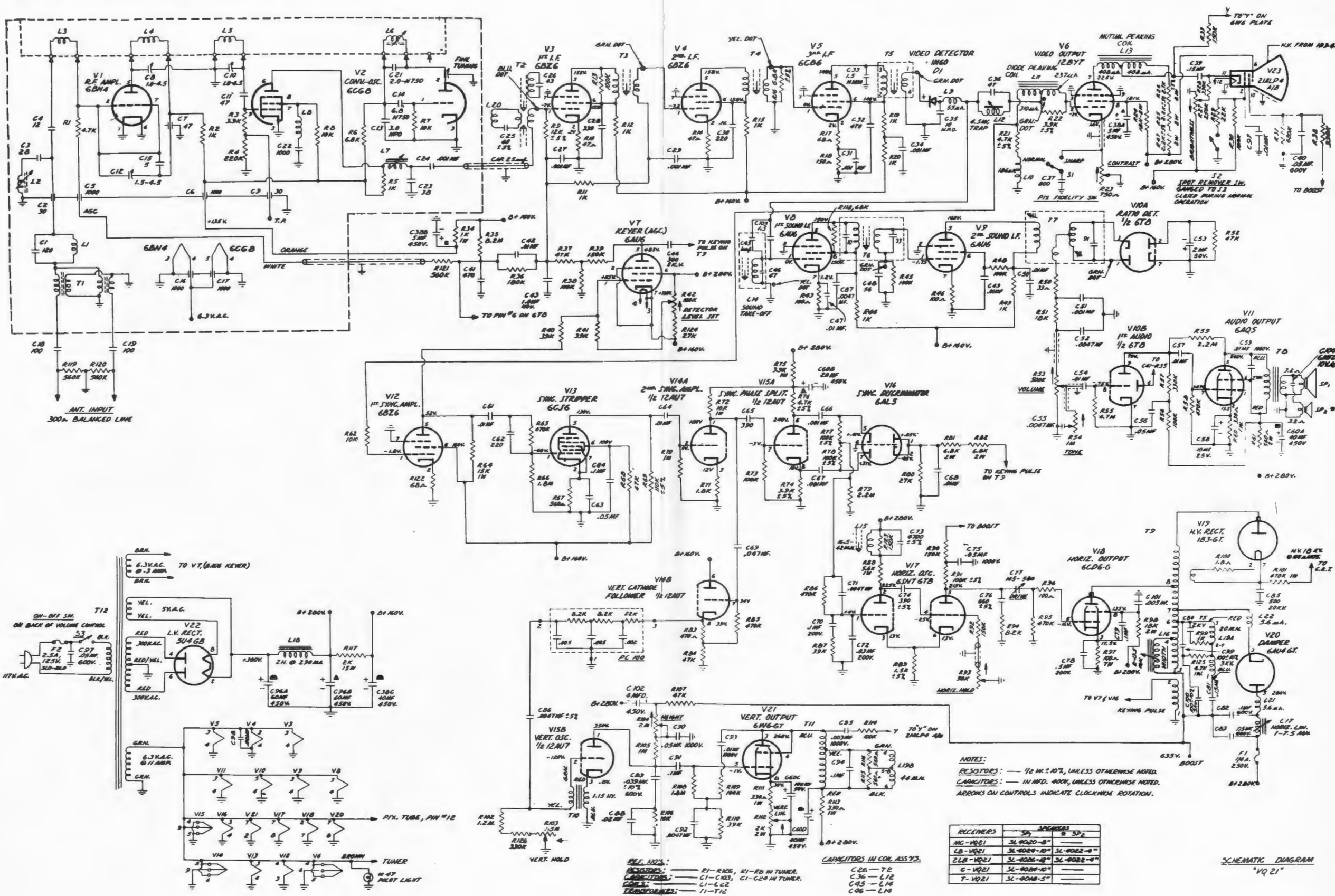
Combination UHF/VHF Antenna Matching



Chassis Rear View

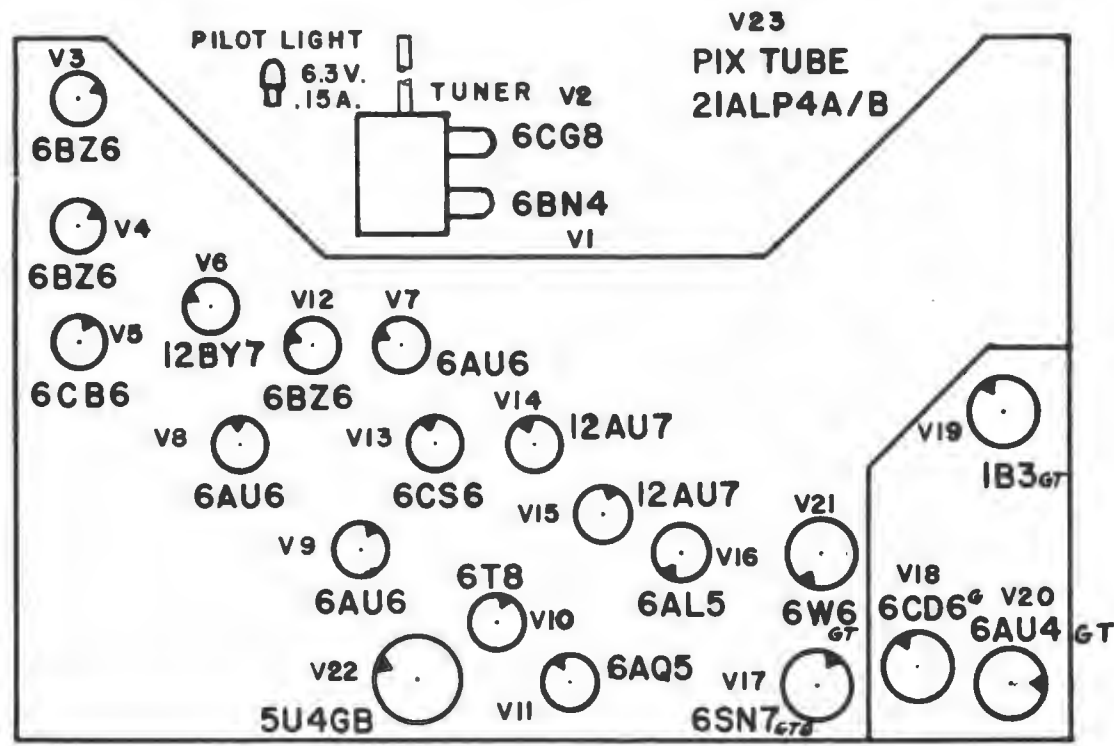


Sweep Attenuator Pads



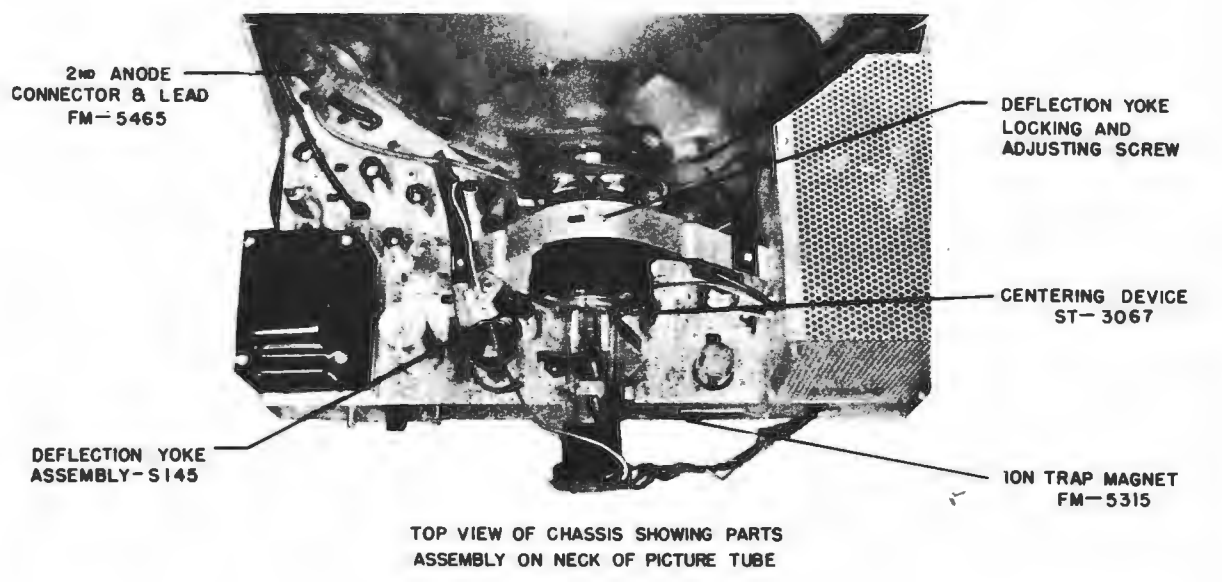
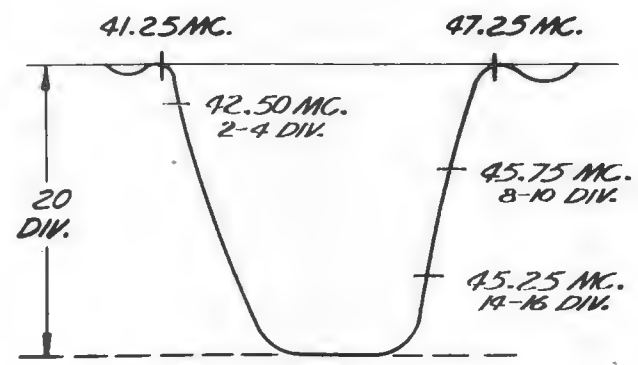
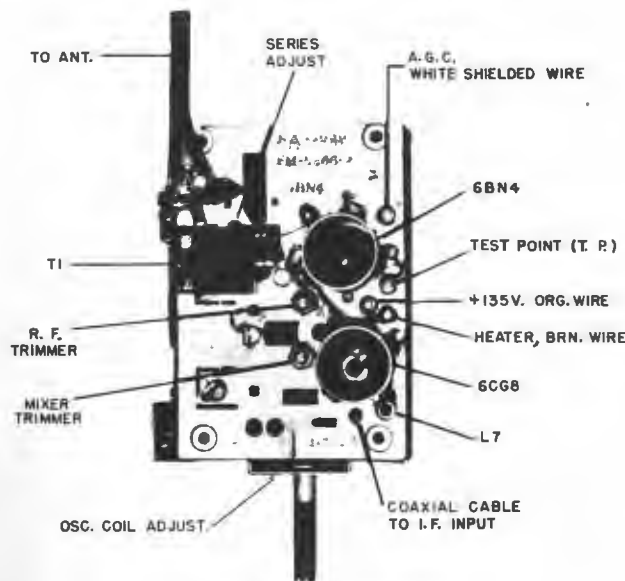
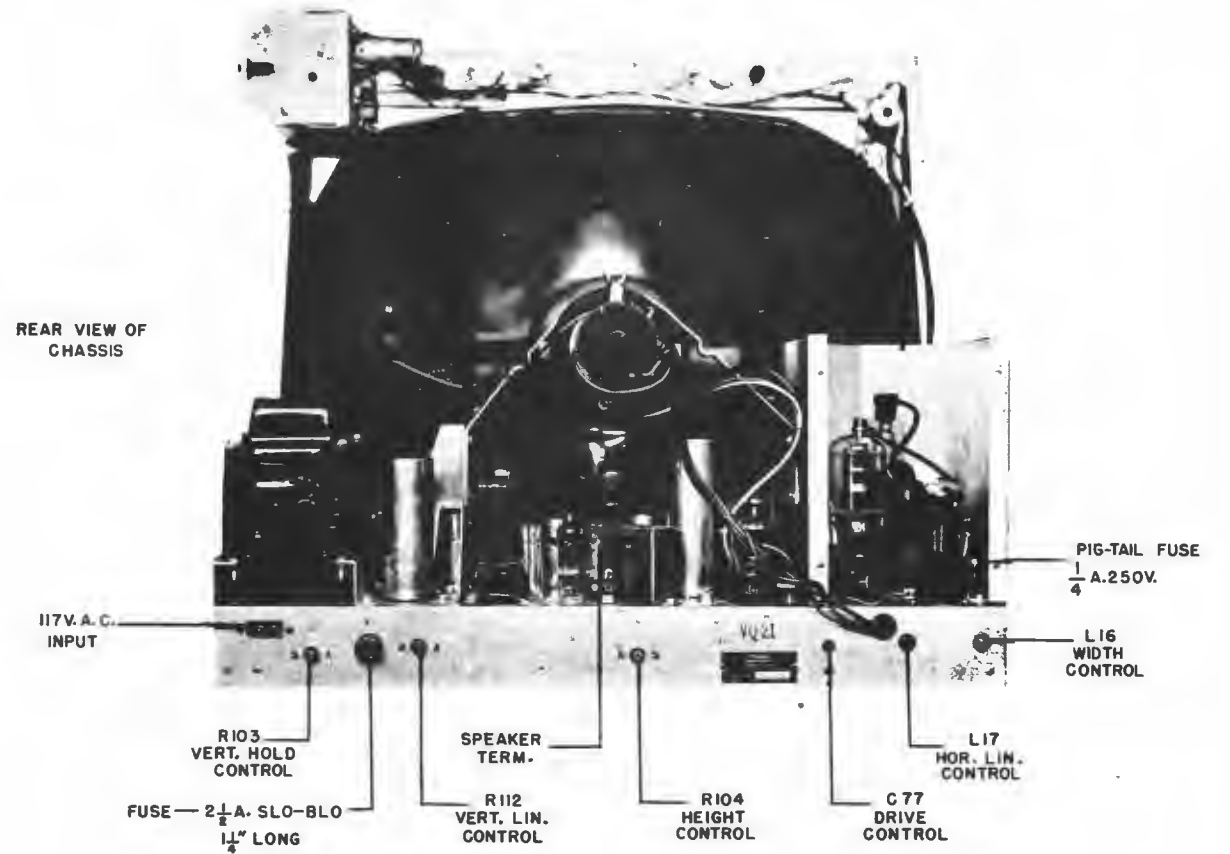
SCHEMATIC DIAGRAM
"VQ 21"

ANDREA VQ 21 SERIES



SYMBOL A SHOWS SOCKET PINS OR KEY POSITION FOR CORRECT TUBE INSERTION

TUBE LOCATIONS TELEVISION VQ21 CHASSIS



Mfr: Philco Chassis No. TV-440

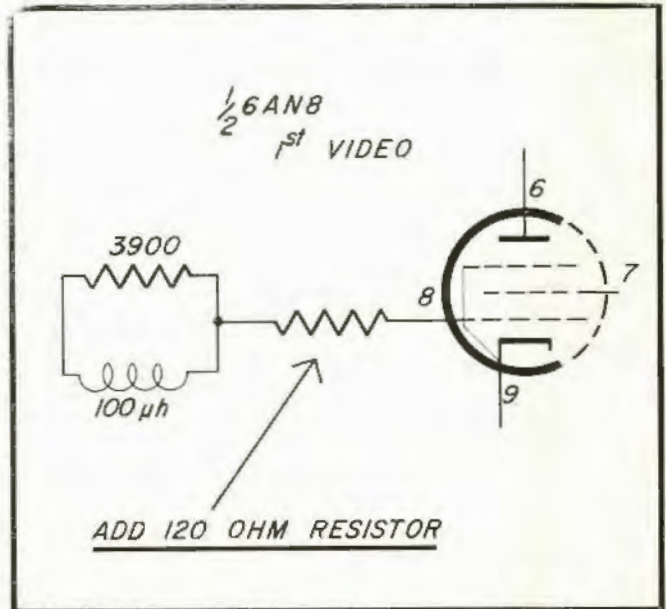
Card No: PH-TV-440-1

Section Affected: Picture.

Symptoms: Oscillations in video.

Reason For Change: Grid circuit needs added resistance (Prod. change—run 6)

What To Do:
Add a 120 ohm resistor in series with grid of the 1st Video Amplifier.



Mfr: Philco Chassis No. TV-440

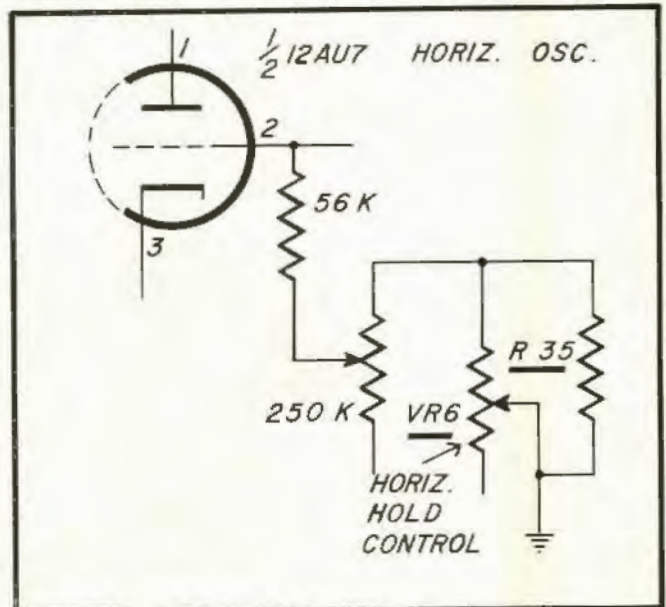
Card No: PH-TV-440-2

Section Affected: Sync.

Symptoms: Weak horizontal hold action.

Reason For Change: Horizontal hold control value is too large. (Prod. change—run 4)

What To Do:
Change horizontal hold control VR6 from 50K to 30K. Also, remove resistor R-35 (82K).



Mfr: Philco Chassis No. TV-440

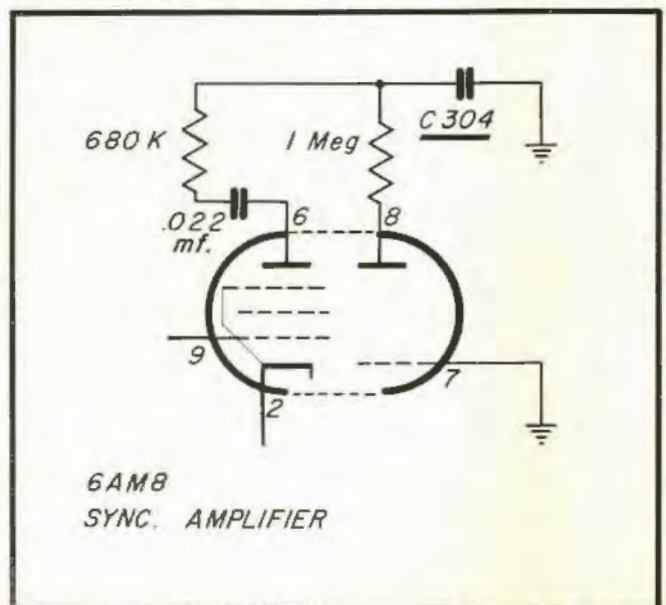
Card No: PH-TV-440-3

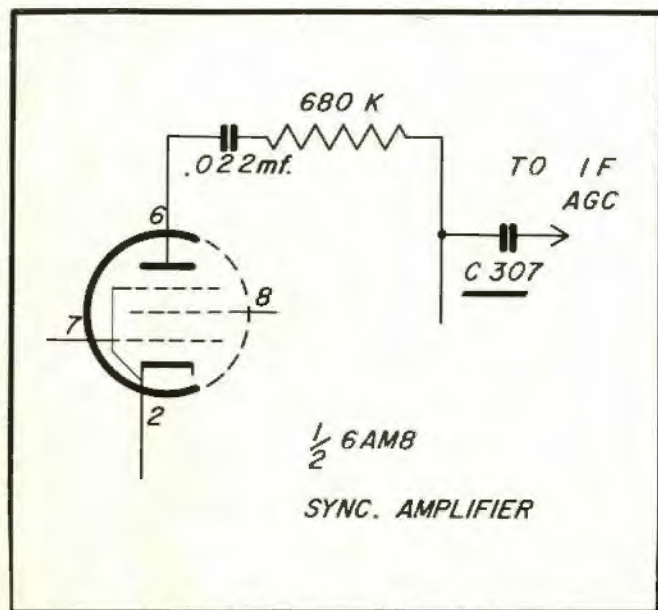
Section Affected: Sync.

Symptoms: Poor sync under varying age conditions.

Reason For Change: Condenser from plate circuit to ground is too small.

What To Do:
Change C304 from .1 mfd to .15 mfd.





Mfr: Philco Chassis No. TV-440

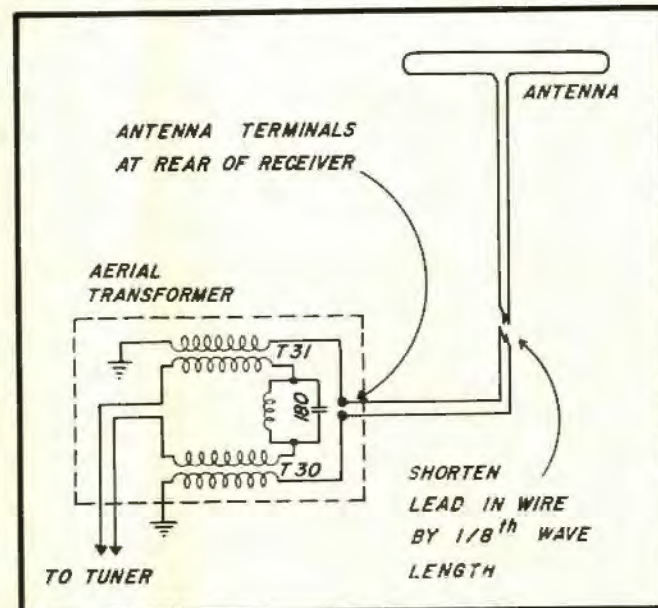
Card No: PH-TV-440-4

Section Affected: Sync.

Symptoms: Poor sync under varying agc conditions.

Reason For Change: Capacitor in agc circuit is too large. (Prod. change—run 3)

What To Do: Change capacitor C307 from .01 mfd to .006 mfd.



Mfr: Philco Chassis No. TV-440

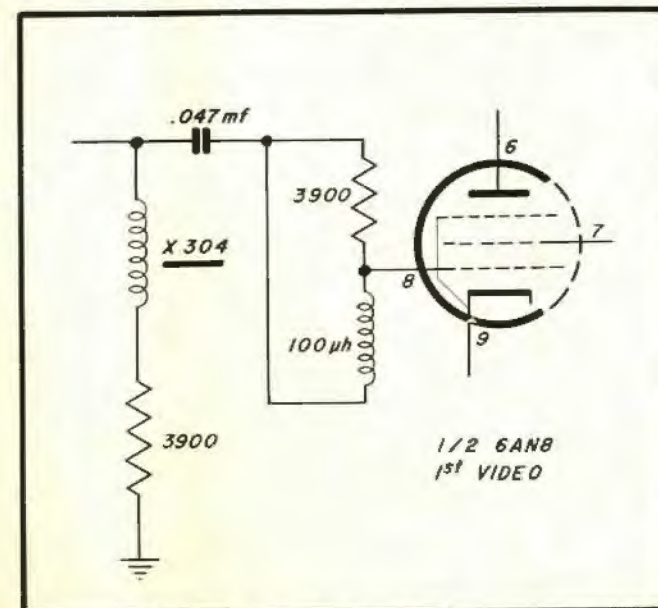
Card No: PH-TV-440-5

Section Affected: Picture.

Symptoms: Smear.

Cause: Tuner—Antenna mis-match.

What To Do: Shorten lead in wire from antenna to the set by 1/8 wave length of the particular channel being received.



Mfr: Philco Chassis No. TV-440

Card No: PH-TV-440-6

Section Affected: Picture.

Symptoms: Oscillations in video.

Reason For Change: Choke coil X304 is too small. (Prod change—run-6)

What To Do: Change coil X304 from 150 mh to 250 mh.

Mfr: Emerson Chassis No. 120331H 120332R

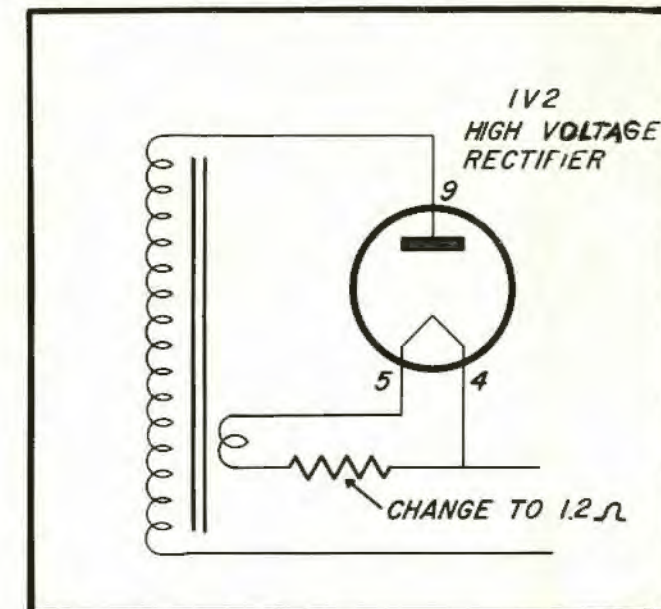
Card No: EM-120331H-1

Section Affected: Raster.

Symptoms: Picture blooms as brightness is increased.

Reason For Change: To increase filament heat in Hi-Voltage Rectifier. (Check Hi-Voltage rectifier 1V2)

What To Do: Change hi-voltage rectifier filament dropping resistor from 1.5 ohms to 1.2 ohms.



Mfr: Emerson Chassis No. 120331H 120332R

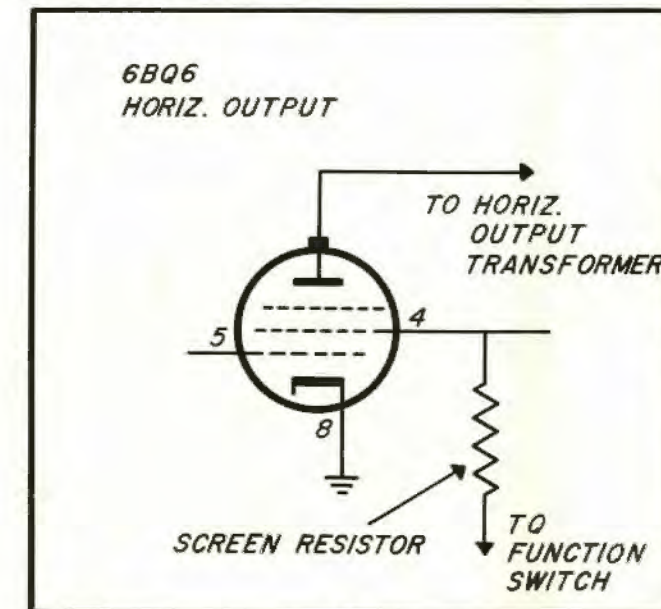
Card No: EM-120331H-2

Section Affected: Horizontal Sweep.

Symptoms: Narrow picture.

Reason For Change: To increase width.

What To Do: Change screen resistor of horizontal output tube from 1000 ohms to 100 ohms.



Mfr: Emerson Chassis No. 120331H 120332R

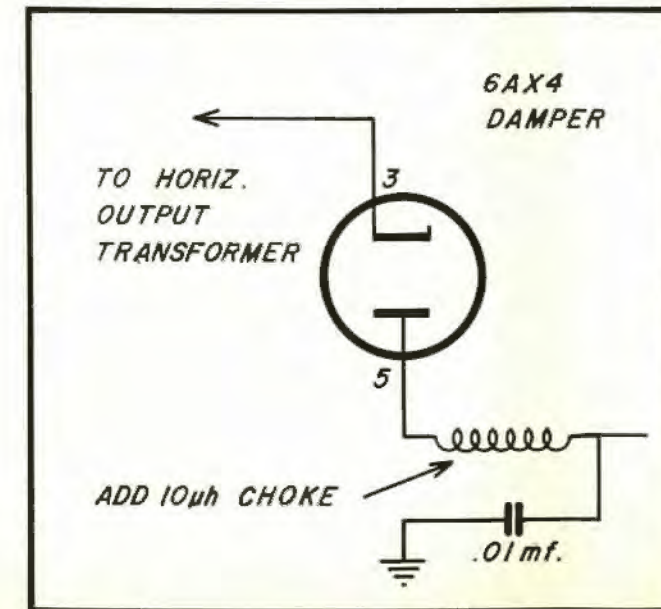
Card No: EM-120331H-3

Section Affected: Sync.

Symptoms: Unstable sync on weak signals.

Reason For Change: To improve vertical and horizontal sync action.

What To Do: Add a 10uh RF choke in series with the plate (pin 5) of the horizontal damping tube, 6AX4. Note: Keep the lead from pin 3 to the H.O.T. as short as possible and close to the chassis.



1957 ADMIRAL TV

[from page 10]

same manner as previously mentioned in the locked oscillator mode (space charge coupling). Voltage developed at the suppressor grid by this action, also influences plate current flow. When a signal at center frequency (4.5 megacycles) is applied to the control grid, the resulting developed voltage at the suppressor grid will be 90 degrees out-of-phase with the control grid voltage, just as in the locked oscillator mode. Thus, the plate current pulses are half the width of the pulses produced by the control grid as shown in Fig. 2. Now, when the incoming frequency deviates about the center frequency (above and below), the phase difference between the voltages at the control grid and suppressor grid changes to less than 90 degrees and more than 90 degrees respectively. The high Q tuned circuit in the suppressor grid circuit maintains a constant voltage phase at this grid. The resulting plate current pulses then become less or more than half the width of the pulses produced by the control grid. The average plate current then becomes lower or higher, respectively, from its value at center frequency in accordance with the *if* signal variation from center frequency. As a result of the plate current changes in either mode, audio voltages are produced across the volume control (R207). This control, and capacitor C207, also comprise the de-emphasis network. Rejection of *am* signal variations is accomplished by the capacitor C204, and resistor R204 in the cathode circuit.

Power Distribution

Another feature of Admiral's portable TV receivers is the method of

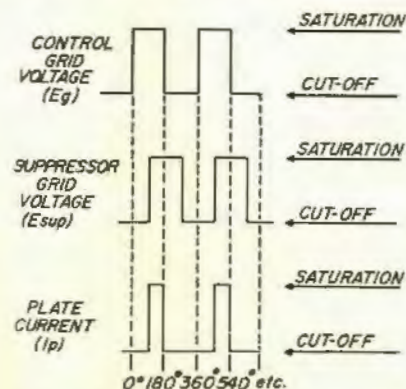


Fig. 2—Relationship of electrode potentials in the detector.

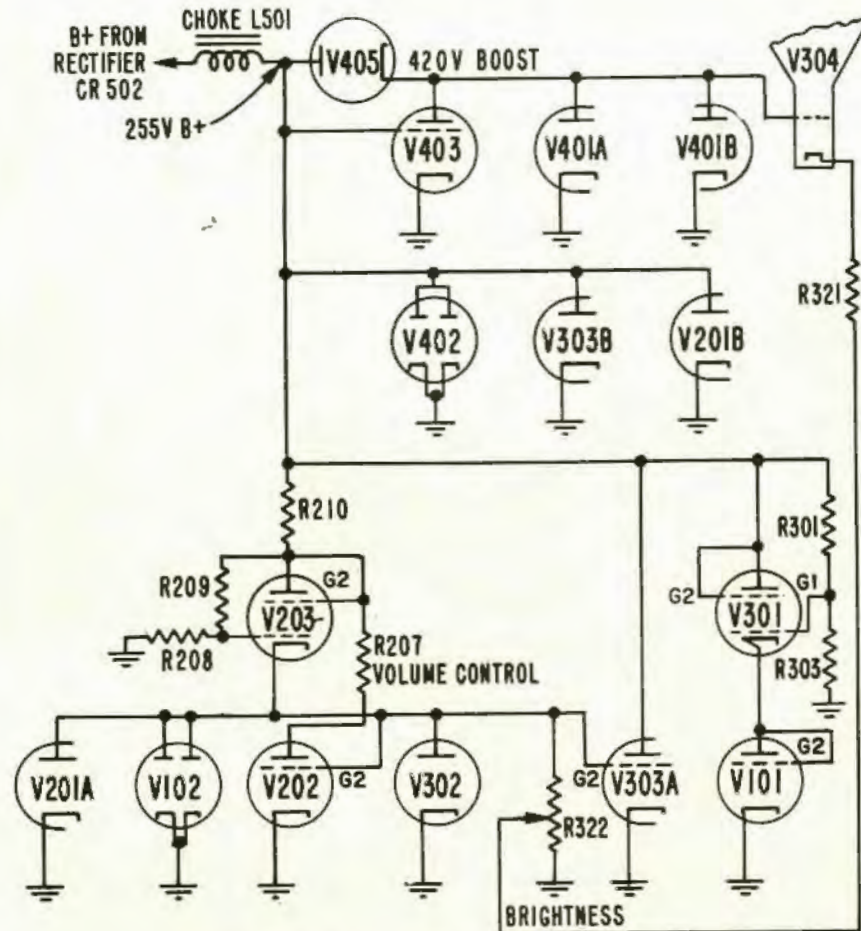


Fig. 3—Block diagram showing B plus distribution.

supplying B plus voltages to the tubes. A simplified B plus distribution diagram of the 14YP3D chassis is shown in Fig. 3. The B plus power supply consists of two 300 milliamperere selenium rectifiers operating as half wave voltage doublers coupling to a π type filter network consisting of two 100 *mf* capacitors and an iron core filter choke. The 255 volts of B plus is distributed as shown in Fig. 3. The cathode of the damper tube supplies approximately 420 volts (boost voltage) to the horizontal output stage, vertical oscillator and output, and first anode of the picture tube.

The sound output tube operates as a voltage dropping tube for supplying B plus to other tubes operated from this voltage source. The cathode of the sound output tube has a potential of approximately 130 volts positive with respect to chassis ground. In addition to amplifying the *if* signals, the first *if* amplifier tube functions as a voltage dropping tube supplying B plus voltage to the *vhf* amplifier.

Video Circuit

To provide a maximum amount of contrast range without the possibility of overload, the control grid of the video amplifier tube has a fixed negative voltage applied. This small negative voltage is applied through a divider network from the negative drive voltage appearing at the control grid of the horizontal output tube. (Fig. 4) ■ ■

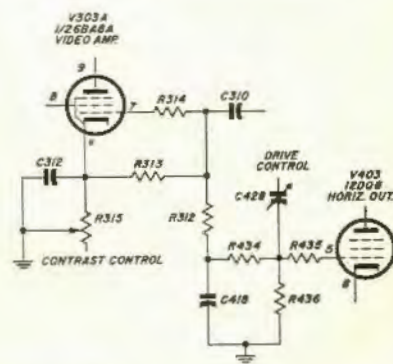


Fig. 4—Horizontal drive provides bias for video amplifier.

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Select the control you want — ½-watt composition-element, regular, tapped or dual; 2-watt wire-wound; 3-watt wire-wound; or 4-watt wire-wound. Then choose from any one of the 13 shaft types. There's one for every need.

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ASSOCIATION NEWS

National Association of Television and Electronic Service Associations (NATESA)

After almost two years of investigation, meetings and planning, NATESA is now able to offer each member of each local affiliate a chance to participate in the NATESA National Advertising

and Publicity Program.

The program calls for ads in several of the top magazines, newspaper ads on local level, radio and TV "spots" on a national level, listing in the "yellow pages" of the phone directory, "Operator 25" service and use of direct mail pieces.

Individual members of local affiliates

are you satisfied with your present job?

are you satisfied with your present income?

If you are, you're a lucky man . . . and very unusual

if not . . . send for me

Successful Electronics Training

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Please rush "Successful Electronics Training" without obligation.

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will be "franchised" to participate and window valances, truck decals, letter-heads, bill-heads, mailing pieces, etc. will be available at cost. The cost will be extremely low because of being able to use mass purchasing power of these advertising materials.

The Cody Advertising Agency of Chicago has been selected to handle the program and are already preparing ad copy, etc. Such an ambitious program may be thought to cost a hundred dollars a month, but that is not the case. The yearly cost of this program, because of its overall size is unbelievably low, and it can be purchased by individual members for a few cents a day over a period of several months. This will enable the one man operator to get advertising, publicity and a public relations program at the same cost per item that large corporations are able to buy.

The plan will also relieve the shop owner of planning and scheduling his program. It will give him the benefit of the use of top artists, copy writers and public relations men, something hardly a man in the TV business today could afford. In fact, it is doubtful if any local association could afford such talent to plan an advertising program. Now NATESA offers it to its members at a yearly cost comparable to what some shop owners pay for a telephone directory ad for one month.

Small business owners find it extremely difficult to purchase insurance to protect themselves and their employees at a reasonable figure. Group plans are not available unless the business has 25 or more employees. As a result most TV shops do not carry coverage.

Now NATESA offers to its members a plan based on a 500 employee rate but available even to a one man shop at that same low rate. Under the plan the owner and employees may be covered for any type accident 24 hours a day, loss of time from work; loss of eyes, limbs or part thereof, loss of life, cost of hospitalization, surgical fees and doctors calls to the home.

For complete details and applications, write to NATESA, 5908 So. Troy St., Chicago 29, Illinois. This is another advantage of TESA membership, because this plan is available only to NATESA members.

Appointment of Len Gross as executive secretary, advertising and public relations counsel for the San Francisco Television Service Guild was announced this week by Ned Gramlich,

president of the Guild. Gross is a partner in Gross and Roberts, San Francisco advertising and public relations firm.

In addition to his executive secretary duties, his first assignment will be development of an advertising and promotion program to educate the general public concerning the Guild and its members.

The Guild, a non-profit trade association, was organized in 1955 to improve standards of television service and has as its guiding principle "servicing the public with honesty, dependability and fairness."

Minnesota TV Service Engineers

A Radio-TV Apprenticeship Standards Guide, believed to be the first of its kind, has been published jointly by the Minnesota Television Service Engineers, Inc. and Tung-Sol Electric Inc. Initial distribution was made at the recent Texas Electronics Association Clinic and Fair at Fort Worth. According to John W. Hemak, secretary of MTSE who compiled the manual, its purpose is "to establish a foundation for the eventual recognition of electronic service as a professional activity".

The guide was printed by Tung-Sol through the efforts of Robert M. Andrews, Tung-Sol's manager of electronic and semiconductor products advertising. Mr. Andrews made it plain that the manual is just the "opening gun" in Tung-Sol's 1958 campaign to raise the dignity of the radio-TV service field to the professional status "it rightfully deserves." Copies of the manual are free to all jobbers, dealers and associations. They may be obtained through local Tung-Sol jobbers or by writing: TTLB, Special Services Department, P. O. Box 1321, Indianapolis, Ind.

COLOR TVI

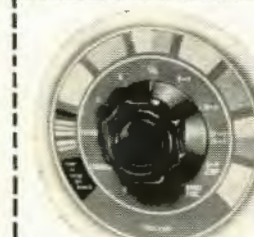
[from page 41]

phase delay circuit determines the phase difference between them. A negative pulse from the horizontal output circuit is amplified and shaped in the gate clamp and applied to the burst amplifier. Also applied to the burst amplifier is a signal containing color information and burst from the second chroma and sound if amplifier. Since the burst is positioned on the back porch of the horizontal sync pulse at the transmitter, the gate pulse from



NEW!

Simpson
COLOR BAR GENERATOR
MODEL 430



SINGLE MASTER CONTROL has all outputs pictured in color. Shows what you should see on TV screen.



HINGED SIDE PANEL opens for fine adjustments and maintenance. Allows use from shelf or bench.

PROVIDES TRUE 100% SATURATED NTSC SIGNAL—Here's the new color bar generator you've heard so much about. It's literally packed with features to save you time, to do more jobs, to operate simply. And what's more, Model 430 will service any color-TV receiver—past, present, or future. You'll find it to be the finest, most complete instrument of its type.

IMPORTANT SPECIFICATIONS

Exceptional Range of Outputs—Y; chroma; color bar (8 bars simultaneously—color phase accuracy, $\pm 5^\circ$); R-Y; B-Y; R-Y and B-Y simultaneously; I; Q; I and Q simultaneously; G-Y at 90° (demodulator color phase accuracy, $\pm 3^\circ$); sync and burst; horizontal sync; high level 3.58 megacycle output; high level modulated RF output; positive or negative video output. 4.5 Megacycle (crystal controlled) marker for proper tuning.

Chroma Level Switch—0 db for checking older style receivers and some current models; -6 db for video check of newer receivers using vestigial IF alignment; -15 db for checking color sync lock under weak signal conditions. Variable chroma control position for other chroma levels.

Color Bar Display Pattern—Left to right: red, yellow, green, cyan, white, magenta, blue, black.

Model 430, complete with Operator's Manual and Leads **\$395.00**

See your Electronic Distributor, or write

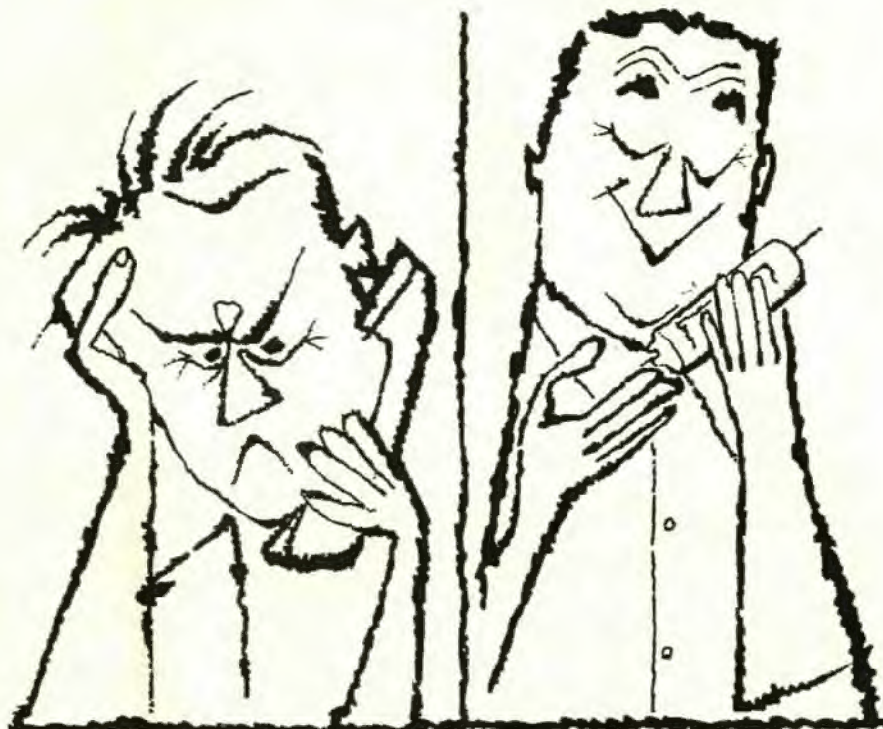
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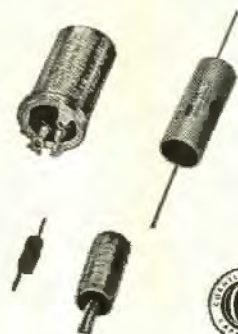
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*CALL BACKS ARE COSTLY. Cornell-Dubilier are specialists in ELECTROLYTICS for replacement service. The familiar C-D Trademark has been the mark of outstandingly superior quality for over 47 years. Every style, size, rating and characteristic of electrolytic capacitor is produced in C-D's own network of plants. From the tiny "finger-nail" size "ELECTOMITE" to the compact "BLUE BEAVER" to the long-life "UP" C-D ELECTROLYTICS have earned their great popularity because they are consistently MADE BETTER TO LAST. Say C-D when you buy ELECTROLYTICS—be particular. Write for Catalog 200D-3E to Dept. ST-97, Cornell-Dubilier Electric Corp., South Plainfield, New Jersey.

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STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946 (Title 39, United States Code, Section 233) SHOWING THE OWNERSHIP, MANAGEMENT, AND CIRCULATION OF ELECTRONIC SERVICING, published monthly at New York, N. Y. for October 1, 1957.

1. The names and addresses of the publisher, editor and business manager are: Publisher, Sanford R. Cowan, 6 Embassy Court, Great Neck, N. Y. Editor, Samuel L. Marshall, 262 Sullivan Place, Brooklyn 25, N. Y.; Managing Editor: None; Business Manager, David Saltman, 1878 Harrison Ave., New York 53, N. Y.

2. The owner is: (if owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given.) COWAN PUBLISHING CORP., 300 West 43rd St., New York 36, N. Y.; Sanford R. Cowan, 6 Embassy Court, Great Neck, N. Y.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and beliefs as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

(Signed) David Saltman, Business Manager

Sworn to and subscribed before me, this 20th day of September, 1957.

WILLIAM M. FORGIONE, Notary Public
(commission expires March 30, 1959)

the gate clamp and the burst arrive at the burst amplifier at the same time. Hence, the burst positions itself on top of the gate pulse while the color information remains at the same level. The burst amplifier is biased such that only the burst appears in its plate circuit. The 3.58 mc burst signal, which is the phase reference standard, is applied to the phase detector. A portion of the signal from the 3.58 mc amplifier also is applied to the phase detector.

If the phase of the 3.58 mc signal from the amplifier is not correct, a dc voltage appears at the reactance tube grid. This tube is a part of the frequency-determining portion of the 3.58 mc oscillator. When a dc voltage is applied to the reactance tube, the tube appears either more or less capacitive to the oscillator, thereby changing its frequency. As soon as the output signal from the 3.58 mc oscillator is of the correct phase, there is no output from the phase detector. By this means the output signal of the reference oscillator maintains correct phase.

A portion of the voltage developed in one half of the phase detector is applied to the second chroma and sound if amplifier for automatic chroma control. A portion of this same voltage is applied to the color-killer stage. The color-killer stage is so connected to the chroma amplifier that the chroma amplifier is cut off when the color-killer stage conducts. A positive pulse from the horizontal output transformer causes the color-killer stage to conduct except when burst signals are being received. When a burst is received, a negative voltage from the phase detector causes the color-killer to be cut off, thereby permitting the chroma amplifier to function. In this manner the color-killer stage deactivates the chroma channel when the color television receiver is receiving black and white programs, thus eliminating possible noise pickup into the color circuits during black and white program, which could appear on the screen as colored confetti.

Adequate shielding and by-passing is employed to minimize radiation of the 3.58 mc oscillator signal, and to prevent external rf signals from affecting receiver operation.

Deflection Section

Sync signals from the sync separator, in the video section, are applied to the

phase splitter from which positive vertical sync pulses and both positive and negative horizontal sync pulses are obtained. The horizontal sync pulses are fed to a balanced phase comparer. A portion of the signal from the horizontal oscillator is also applied to the phase comparer. If the horizontal oscillator is not at the correct frequency, a control voltage is applied from the phase comparer to the horizontal oscillator, which adjusts the oscillator frequency, thereby maintaining frequency stability.

The output of the oscillator is amplified in the horizontal output stage, and applied through the horizontal output transformer to the horizontal deflection coils. These provide the magnetic field for the horizontal deflection of the electron beams. The horizontal output transformer also provides pulses for the *agc* gate, the color-killer gate, the burst gate and horizontal retrace suppression.

The vertical sync pulses are applied from the phase splitter, through an integrator network, to the vertical oscillator where they synchronize the vertical sweep with the transmitted signal. The vertical output tube amplifies the oscillator output and applies the signal to the vertical deflection coils, which provide the magnetic field for the vertical deflection of the electron beams.

A shield may be placed around the deflection yoke to prevent the earth's magnetic field or other extraneous fields from causing beam distortion and minimize any radiation from the yoke.

This brief review of the operation of color circuitry will serve as an important background for the material on eliminating interference which will be presented in the following installments.

[To be continued]

AD LIBS

(From page 12)

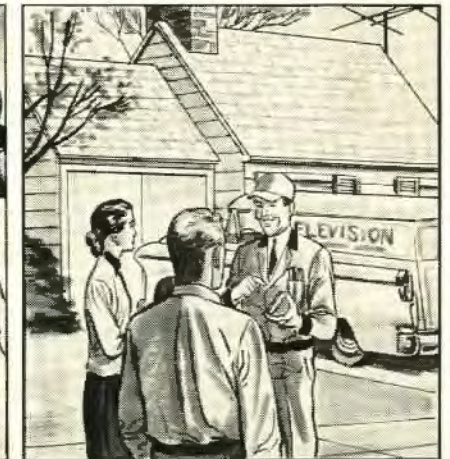
this work done for them by their local service dealers or marine radio agencies.

Today, several million of the small boats afloat are equipped with little, if any, radio gear and in the main those that do have some electronics gear aboard only have a direction finder or a ship-to-shore radio. Thus the sales potential is considerable. If your service shop is near a boat basin or waterway, are you going to try to expand your marine radio sales next year? It's worth thinking about now because the 1958 boating season is much closer than you think. ■ ■

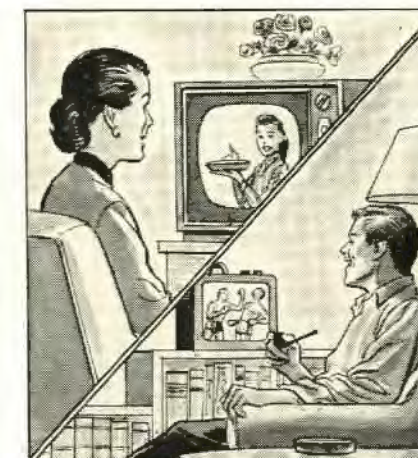
The Case of The Serviceman WHO SAVED A MARRIAGE!



Smith wanted to watch the fights; Mrs. Smith insisted on "This Is Your Wife". Fights they got, since a second set was within their means but there was only one antenna and no multi-set coupler they tried had worked satisfactorily.

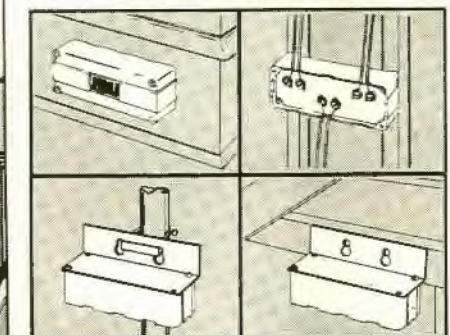


"You won't need another antenna with this 'NEW' Jerrold Multi-set COUPLER", said the TV Serviceman. "Its special design allows for equal distribution of the signal with exceptionally low loss and without smearing or ghosting"

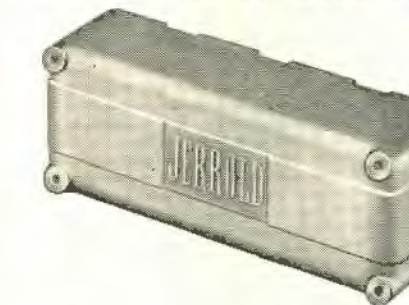


The Jerrold multi-set coupler took only minutes to install... now, both the Smiths watch their favorite TV shows.

UNIVERSAL MOUNTING



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- Outdoors, on the antenna mast or on the side of the house.



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MF-4—up to 4 sets—all areas... list 5.75

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ECHO SOUNDERS

[from page 6]

by adjacent permanent magnets or through *dc* current in a winding around the nickel elements. When ultrasonic energy was applied through the coils to the nickel elements, energetic oscillation took place. Both of these forms of transducers were two-way devices and similar units could be used for transmitting as well as receiving. With an appropriate switching system, one unit could be made to serve both functions.

Because they were built to sound tremendous depths, and also for use in military applications to detect objects at great distance, the transducers were large and heavy, and required a great deal of power. Modern transducers still use the principles of these early units, but are more compact; and Rochelle salts or ceramics have taken the place of quartz crystals in the piezo-electric varieties.

Fathometer Operation

The first practical commercial sounder in the U.S. was the *Fathometer*.

This was a forerunner of most small-boat equipments used today, and many of its principles are still employed.

The heart of the Fathometer is a constant-speed motor which drives a rotating arm on the end of which is a neon light. Around the arc described by the rotating light is a scale calibrated either in feet, fathoms, or both. At the zero point, the arm operates a contactor, keying the system so the sonic pulse is launched. Receipt of the echo causes the lamp to flash, indicating the depth in feet or fathoms on the scale alongside. With the arm rotating at one-revolution per second, a maximum depth of 2400-feet could be accommodated since the pulse travels at the rate of 4800 feet per second, and the pulse would travel 2400 feet down and 2400 feet up. Revolving at 6 2/3 rps, a total depth of sixty fathoms, or 360-feet would be shown, etc.

Instead of a contactor on the rotating arm to key the driver, some equipments use a permanent magnet attached to the rotating arm to induce a voltage pulse in a small stationary pickup coil, which keys the transmitting circuit.

The simplest form of driver, or generator of the high-power pulse, is an arrangement to discharge a capacitor through the load resistance of the transducer. Methods of accomplishing this

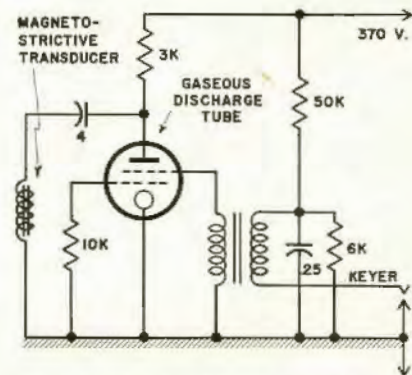


Fig. 1—Simple driver circuit for a magnetostrictive transducer.

are shown in Fig. 1. In the first example, when the keyer contacts close, the charge stored in the .25 mf capacitor is discharged through the primary of the driver transformer. The resultant pulse in the secondary is applied to the discharge-tube grid, causing the tube to ionize and conduct, passing a sharp momentary flow of current from the 4-mfd. capacitor through the transducer.

In the second example (Fig. 2), closing of the keyer contacts puts a

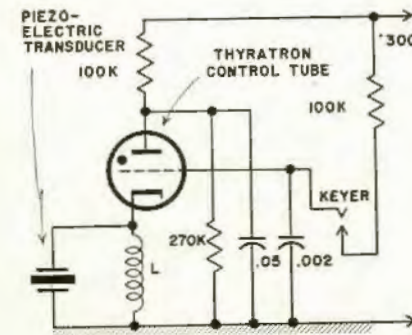


Fig. 2—Thyratron driver circuit feeding a crystal transducer.

positive charge on the grid of the control tube. This drives it into conduction, and allows the discharge of the .05- mf capacitor through the cathode inductor "L" which, with the crystal in shunt, forms a "ringing" circuit.

With each of these drivers, the transducer is shock excited. The momentary burst of current from the capacitor is analogous to the gunpowder blast or hammer blow of the old types.

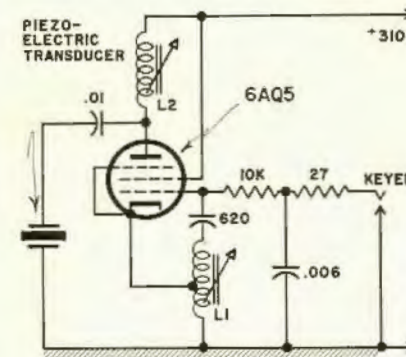


Fig. 3—Triggered oscillator circuit driving a quartz transducer.

Another arrangement is shown in Fig. 3, where a keying pulse triggers an oscillator tube, the output being applied to the transducer through the .01 mf capacitor. The net result is that the transducer rings for a short period, sending a sonic pulse to the bottom where it is reflected back. Reflections will also occur from any intervening objects. On some equipments, the return pulses are picked up in a separate transducer; while in others, one transducer is coupled both to the driver and to the receiver. The receiver may be a straight-through RC or LC-coupled amplifier, or it may be a super-heterodyne designed somewhat upon radio receiver lines. In either case, the receiver output is applied through a slip-ring arrangement to the rotating neon tube on the indicator arm. A receiver-sensitivity control is used to

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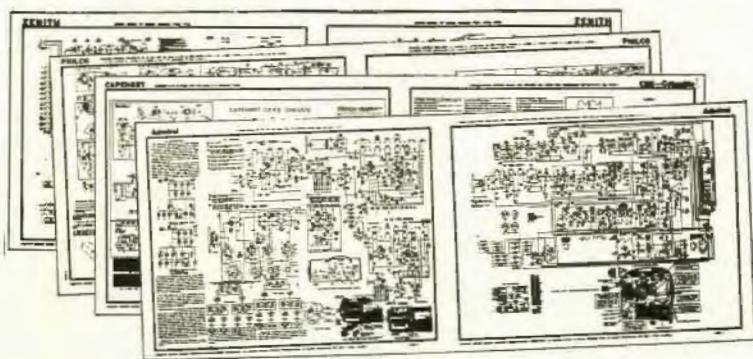
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maintain echo signals at the proper level.

Power for the various circuits is obtained from a vibrator power supply operated by the boat's batteries.

Another form of indicator is the recorder, which inscribed on a moving piece of chart paper the depths which the boat traverses, thus generating a contour map of the bottom. One form of recorder simply replaced the neon bulb at the end of the moving arm with an electrical stylus, over which a specially prepared sheet of paper travels. Upon receipt of the echo pulse, the stylus "burns" a mark on the paper. As the paper is automatically slowly drawn along, marks corresponding to the depths are scribed.

A more common form of recorder uses a stylus on a vertical belt which traverses the paper from top to bottom. Travel of the belt is timed exactly as is the rotating arm in the visual indicator types. In another form of recorder, a drum with a spiral of wire around it rotates under the paper, on top of which rests a printer bar. Rotation of the wire spiral is timed, as is the rotating arm of an indicator, and at the time of receipt of the echo pulse, an arc occurs between the spiral and the printer bar, at a distance down the graph paper corresponding to the distance to the bottom.

Visual indicators are also built, which use an oscilloscope tube presentation. On these, the trace moves down the center of the tube, from top to bottom, and is expanded horizontally upon the receipt of echoes. A linear scale down the face of the tube indicates depths.

Indicators and recorders are also made which will expand a chosen section of the water, underneath the boat, to give a magnified image of this section, permitting closer identification of fish or other underwater objects.

Another type of sounder gives depth indications on a meter. Instead of having a rotating element for timing, a multivibrator and RC circuit operates twelve times a second. A flip-flop thyatron circuit keys the transmitter oscillator and allows current to flow at rising rate into the meter. As this current builds up, the meter needle rises. If no echo is returned within one-twelfth of a second, the meter will just read full-scale. If an echo is received within the one-twelfth period, it operates a thyatron which cuts off the current-integrating circuit, and allows the meter to pass only a portion

of the full-scale current, that portion then being a measure of the time of return of the echo. The meter is designed to have instantaneous pickup and a slow return, and at full scale, there will be a slight twelve-cycle vibration. If a sounding is missed, the meter will tend to flip up scale. Presence of large objects, such as schools of fish under the boat, will cause the meter to drop back momentarily to a depth indication corresponding to the depth of the fish. The signal locks in on the first echo returned from any appreciable mass.

In the various echo sounders available, ultrasonic frequencies ranging from about 14 to 200-kilocycles are commonly used. The choice of frequency is governed by the primary use for which the sounder is designed. The higher the ultrasonic frequency, the smaller the size of the target which may be detected. For example, fair-sized fish can be seen best at frequencies from about 30-kilocycles up. Smaller fish and objects are most clearly defined at the highest frequencies. On the other hand, the attenuation of the ultrasonic waves in the water increases with frequency, so that the higher the frequency, the shorter the practical useful range. Thus, a unit desired for long range should have a low-operating frequency.

The resolution of the ultrasonic beam depends upon the ratio of the transducer diameter to the sonic wavelength. The beam is sharpest when the trans-

ducer is large in comparison to the wavelength. Naturally, a sharp beam gives maximum return for a given amount of power when the transducer is aimed directly at an object. This feature would give best range and best resolution with a stable platform. However, on a boat subject to considerable motion, as is the case in most small boats, a somewhat broader beam or smaller transducer size-to-wavelength ratio is desirable, so that as the boat rolls or the bottom slopes, the return will not be lost.

Not yet available, but in the development stage is a scanning-type small-boat sounder with a movable transducer, which can be trained forward or to the sides of the boat's course, as well as straight down. This feature, together with an oscilloscope presentation, similar to the radar type-B scope form, will give a picture of objects below, ahead, and to the sides of the vessel. An example of the use of this instrument would be the navigation of a narrow channel, or the finding of a school of fish and encircling it with a net. In experimental models of this type, it has been possible, actually, to determine how many fish are in the net by the ultrasonic return.

These, then, are the basic principles underlying the operation of the common forms of echo sounders used on small boats today. The next installment will deal with the installation, adjustment, and service of these units.

[To be continued]

POWER OUTPUT IN HI-FI

[from page 14]

phase signals are coupled from the driver stage to the respective grids of the output tubes through capacitors C1 and C2. Note the high value of these capacitors (.1 mf) for good low frequency response and low phase shift at bass frequencies. The dc grid return is provided by R1 and R2, each a 220K resistor. Self bias is accomplished by means of R3 and C3. The total current through R3 is about 67 ma and consists of screen grid current for both tubes, plate current for both tubes and, in this special case, a few milliamperes of "stiffening" bleeder current through R4 back to the 325 volt supply. Thus, the bias from grid to cathode is about 22 volts, with grid negative (at ground potential) with respect to the positive cathode. Resistor R4 (which actually

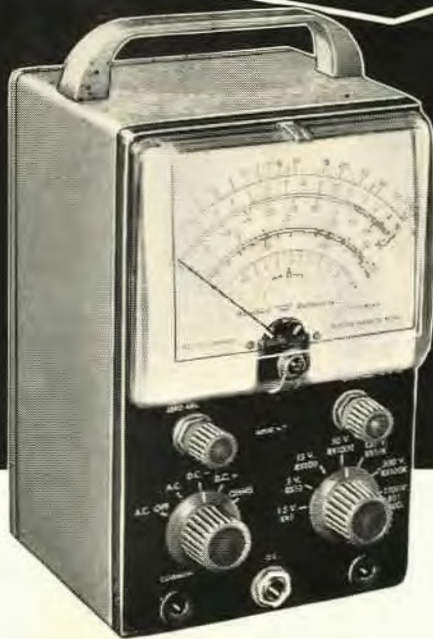
consists of 2-100K resistors in parallel) acts somewhat in the nature of a screen voltage regulating device. With increasing control grid audio signal, the tube parameters are arranged so that normally the screen grids would tend to draw more current. This current would cause additional voltage drop in the B supply filter resistors (not shown) which would result in a lowered screen voltage. Such a condition would cause premature distortion before full power output is obtained. Since the bleeder current through R4 helps set the final operating screen voltage and since this current is more than 50% of the total current flowing in the supply filter resistors, the percentage of change of screen voltage due to increased screen current is thereby reduced. In higher

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powered amplifiers, much more elaborate forms of screen regulation are employed and we shall examine one such type presently.

Condensers C4 and C5 are rather unusual in circuits of this type. They are included simply because the output transformer primary is wound in two sections and, in this design, the winding capacities of the two sections are not equal. If external compensation such as C4 and C5 were not employed, high frequency distortion and, in extreme cases, instability might result because of imperfect balance between the two tubes of the push-pull circuit.

The plates are connected to the primary of the output transformer and derive their voltage from its center tap, which is returned to 380 volts dc. It is of interest to note that the actual plate voltage is only 365 volts. The primary winding of the output transformer, although represented schematically as a pure inductance actually has quite a bit of resistance, enough to cause a voltage drop of 15 volts in this case. This point is stressed because very often an attempt is made to measure plate voltage at the primary center tap instead of at the actual plates and the results can be misleading.

Tell-tale Measurements

A very common complaint with output stages, is the repeated failure of one or both output tubes after a short period of use. A check of tube pin voltages may spot a voltage that is actually beyond the maximum ratings. It is desirable to have schematic dia-

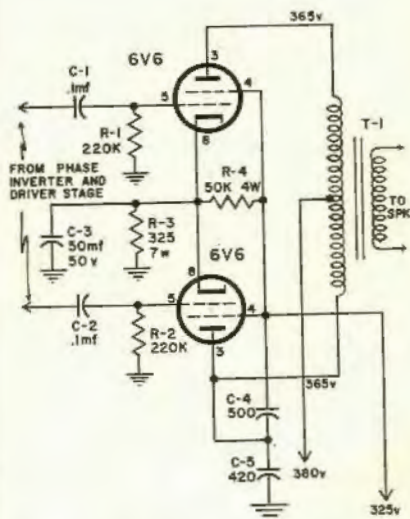


Fig. 1—The push pull output circuit employed in the Bogen DB 110.

grams with voltage charts of every amplifier you service. In the absence of such data, reference to the tube manual or data sheets can serve a useful purpose. Incidentally, plate voltage is defined in the data sheets as voltage between plate and cathode, not necessarily between plate and ground. Thus, in the case of the circuit of Fig. 1, the actual plate voltage is 365 minus 22 (cathode voltage) or 343 volts. Similarly, screen grid voltage would be 325 less 22 or 303 volts. Exceeding maximum voltage ratings of output tubes, while usually responsible for reduced tube life, is not the major cause of tube failure in these circuits. It is quite possible to operate tubes with plate and screen voltages within maximum ratings, voltage-wise, but with excessive plate and/or screen power dissipation. It is this excessive power dissipation which frequently causes tube failure.

Measuring Plate and Screen Dissipations

Plate and screen power dissipation measurements are made under two conditions:

1. With no signal applied to the amplifier (quiescent condition).
2. With full power being drawn by the loudspeaker (or, better still, a dummy load).

Disconnect each plate lead, in turn, and insert a milliammeter in series between the plate pin and the disconnected lead. The positive meter terminal goes to the lead and the negative to the plate. Read the plate current and multiply it by the plate voltage (that is, the plate to cathode voltage). The result is the plate dissipation. Do not assume that measurement of one tube gives the answer for both. A condition in one tube may cause it to draw more current than its mate, thus severely upsetting good balance and ultimately destroying the tube. Repeat the above measurement with full power applied to a load. This time, however, subtract 1/2 the power output from the answer, because although the product of current and voltage is still the actual power applied to the plate, not all of that power is dissipated in the plate itself—some of it is extracted into the load. In neither case should the answer be greater than the maximum plate dissipation of the tube as given in the tube data sheets. You will generally find that a tube

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that is within safe plate dissipation limits under quiescent (no signal) conditions, will also be safe under full power output conditions.

Just the reverse is true of screen dissipation. Although the screen dissipation may be within safe limits under quiescent conditions it may not be so under a full signal. Screen dissipation is measured in much the same way as plate dissipation. That is, disconnect the B supply from each screen in turn and hook in a milliammeter in series, recording screen current and voltage for each condition. Aside from gassy or inferior tubes, there are only two causes for excessive plate dissipation. One of these is improper operating voltages (screen or plate) due to high line voltage or deterioration or change of supply filter resistor values. The other is improper tube bias. Improper bias may be due to change of value of the cathode resistor or a leaky by-pass capacitor in the cathode circuit. Of course, with fixed bias arrangements, the causes of improper bias are many and we shall now examine this type of arrangement.

Fixed Bias Circuits

A partial schematic of the Fairchild Model 275 65 watt output circuit, (shown in Fig. 2) illustrates the use of fixed bias. The output tubes are a pair of rugged 6550's and signal wise, the picture is not unlike that of the previous circuit, except for one minor difference. The screens are returned to tap points on the output transformer primary. This sets the operating point of the tube somewhere between a true triode and a pentode and is popularly known as ultra-linear operation. The bias supply and its related adjustments are of particular interest at the moment.

A selenium rectifier, SR-1, is fed from a tap on the power transformer secondary which results in a negative rectified but unfiltered voltage of about 95 volts *dc*. After suitable filtering by means of C4, R6, and C5, -54 volts remain and are applied across bleeder network R7 and R8. Potentiometer, R9, is adjusted to tap off exactly -46V *dc* for application to the two control grids through an isolating resistor, R9. Whenever any servicing of this supply has been completed, always make certain 46 negative volts are available at the grid pins before installing the output tubes. If, for any

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reason, this bias should fail, immediate destruction of the output tubes will take place. Further adjustment refinements are provided by R4. Incorporation of this control acknowledges the fact that perfectly matched tubes are difficult to obtain. Even though equal bias is applied to each grid, unequal currents may flow in the two tubes. Adjusting this control for absolute minimum hum in the loudspeaker with the driver tube (12AV7) removed is an indication that equal currents are flowing in both halves of the primary of the output transformer. Thus, one grid may be -47 volts while the other is -45 volts. The other adjustment is for dynamic signal balance and is accomplished by means of R5. It insures equal audio drive to both grids and again, the test is for minimum hum in the loudspeaker. In general, fixed bias is used with tubes whose change of plate current with large signal swing would cause great shifts in bias if cathode bias were employed. Again, the aim is for maximum power output without distortion, or, full utilization of the power capabilities of the tubes involved.

In part two of this discussion we will continue the examination of output circuits, with emphasis on screen regulating supplies, output transformer testing, and negative feedback.

[To be continued]

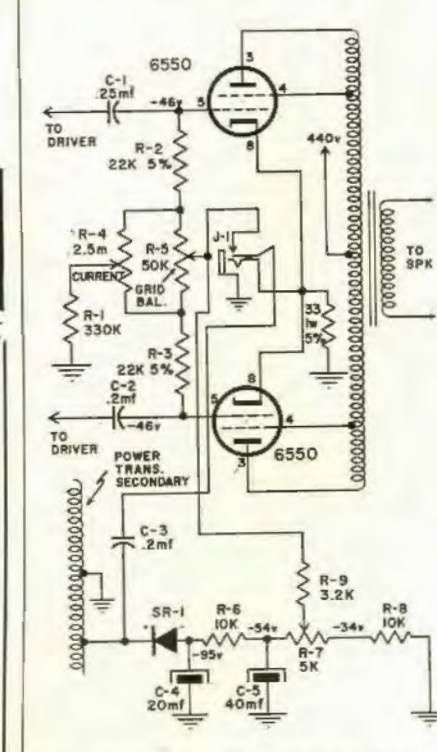


Fig. 2—Circuit demonstrating the application of adjustable bias.

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