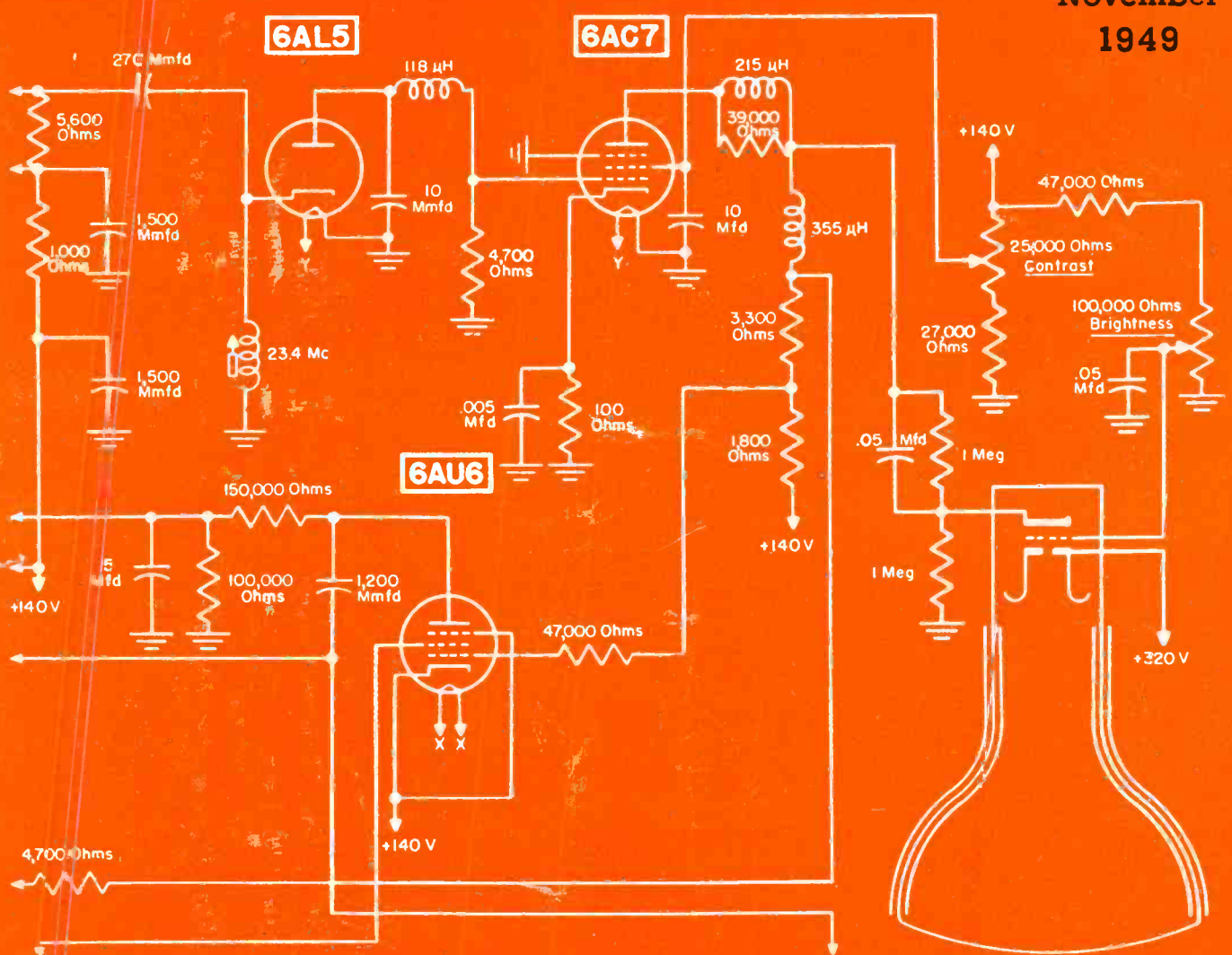
RADIO · TELEVISION · ELECTRONIC

SERVICE

November
1949



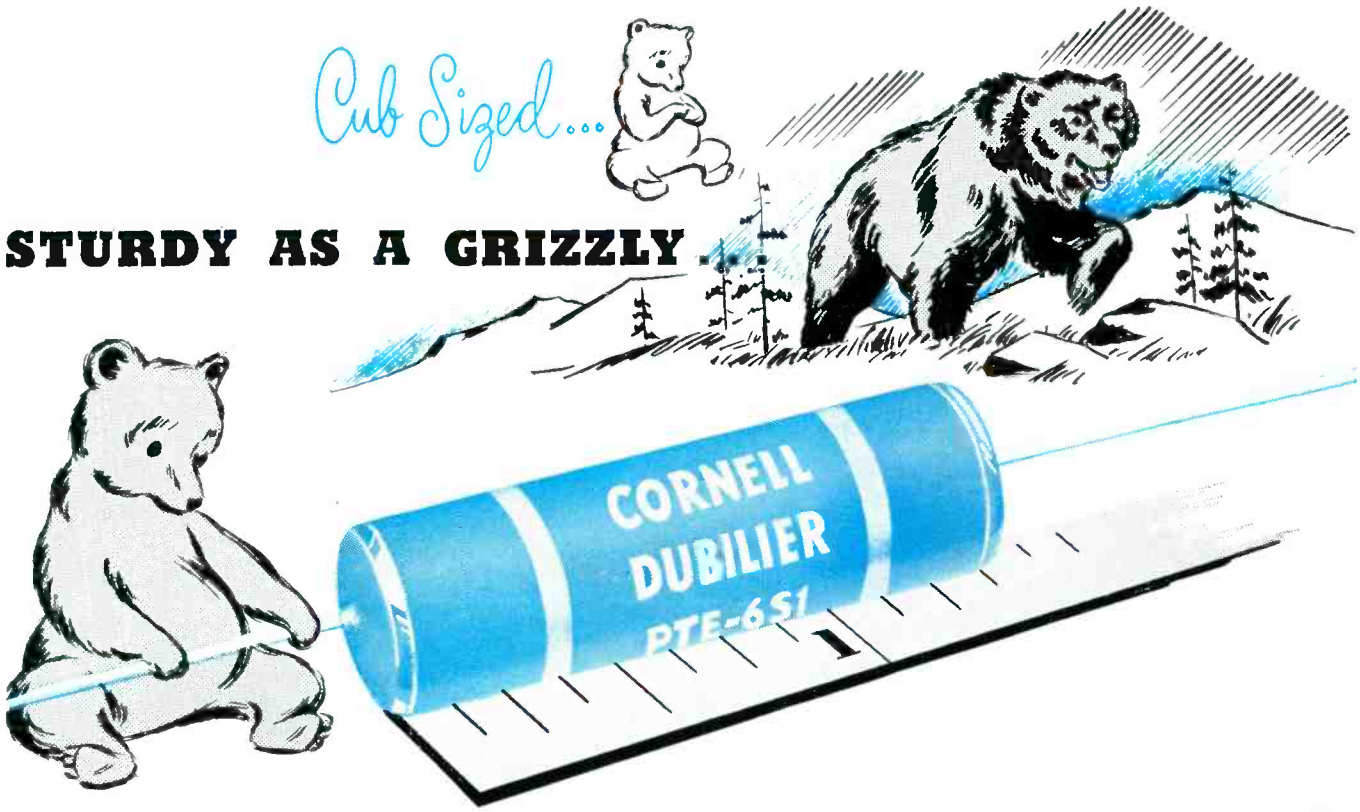
Keyed agc circuit developed for the 630 TV chassis.

[See page 2]

THE TECHNICAL JOURNAL OF THE RADIO TRADE

Cub Sized...

STURDY AS A GRIZZLY...



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the new plastic paper tubulars

One sure thing about these C-D "BLUE CUBS"—you can install them and forget about them. No shock, no vibration is too much for these pint-sized "giants"; they're fortified with solid mold construction and "cushioning" features. They take temperatures from —70°F to +212°F in their stride. Capacity remains constant within 5% under most severe conditions of temperature and humidity. Get acquainted with these job-insuring "BLUE CUBS" now.

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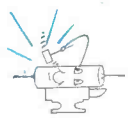
LEADWELD terminals: The only tubular with leads welded to section. Welding eliminates possibility of opens and intermittents.



STYRICAST molded: The only tubular cast in plastic after Vikane impregnation. No heat or pressure to injure unit. Rockhard coating for permanent eye-appeal and durability.

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AUTO VIBRATORS · TV and FM ANTENNAS
POWER CONVERTERS
1910 1949

For further details on this and other units in C-D's complete line of quality capacitors see your jobber or write for catalog. Cornell-Dubilier Electric Corp., Dept. S119, South Plainfield, N. J. Other plants in New Bedford, Worcester and Brookline, Mass.; Indianapolis, Ind.; Providence, R. I. and subsidiary, The Radiart Corp., Cleveland, Ohio.

* T. M. Reg. U. S. Pat. Off.

See yellow pages of your Classified Telephone Directory for nearest C-D authorized distributor.

In Radio and Television Tube Sales

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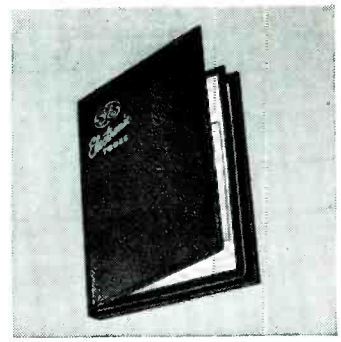
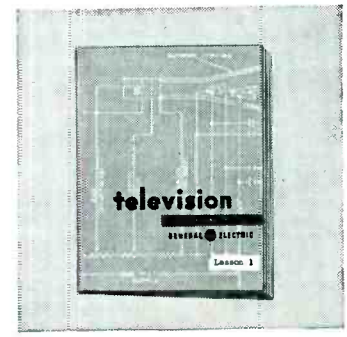


The G-E Pocket Office turns your job-time into more dollars by making cards, forms, and records available in convenient form.

TECHNI-TALK—G. E.'s down-to-earth service magazine edited by practical men for practical men—assists you in building repair business.

G. E.'s new shop garments—smart, serviceable—are a big hit with tube dealers and repairmen everywhere.



The General Electric TV-service course helps you profit from television's great new market for tubes, parts, and service.

and now... THE HANDY G-E TUBE PULLER!

Latest of a series of helps that speed your work, increase your sales, and upgrade your profits, the new G-E tube puller cuts time on the job materially. Now you'll find it quick and easy to remove tubes without the risk of burns, shock, or cuts from fractured glass.

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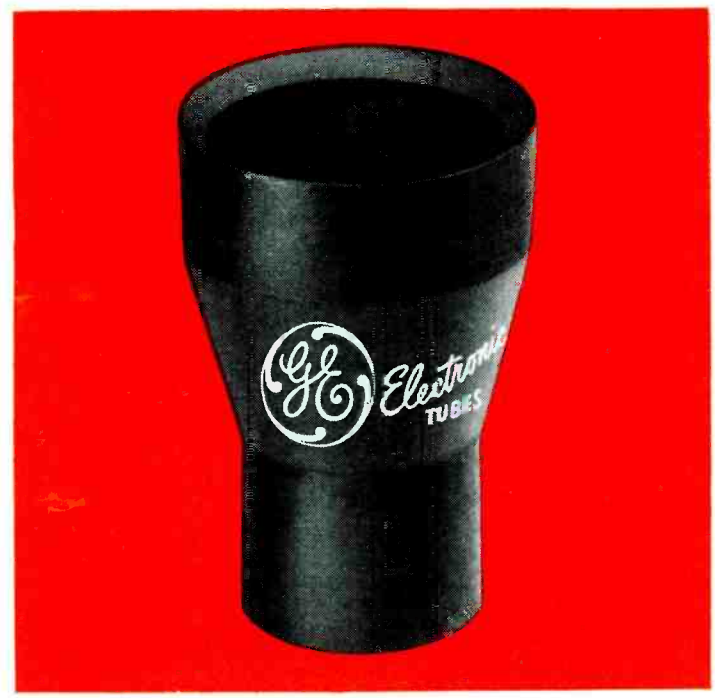

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181-HA7

Vol. 18, No. 11

RADIO · TELEVISION · ELECTRONIC
SERVICE

November, 1949

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F. WALEN
Assistant Editor

ALFRED A. GHIRARDI
Advisory Editor

ABC

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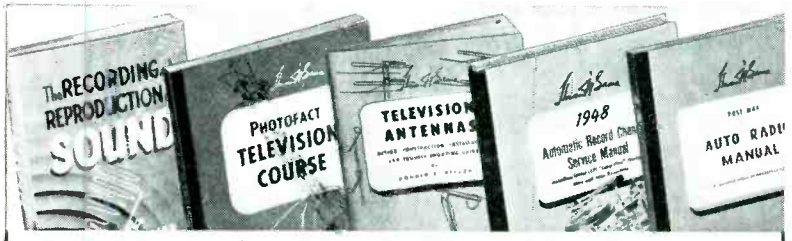

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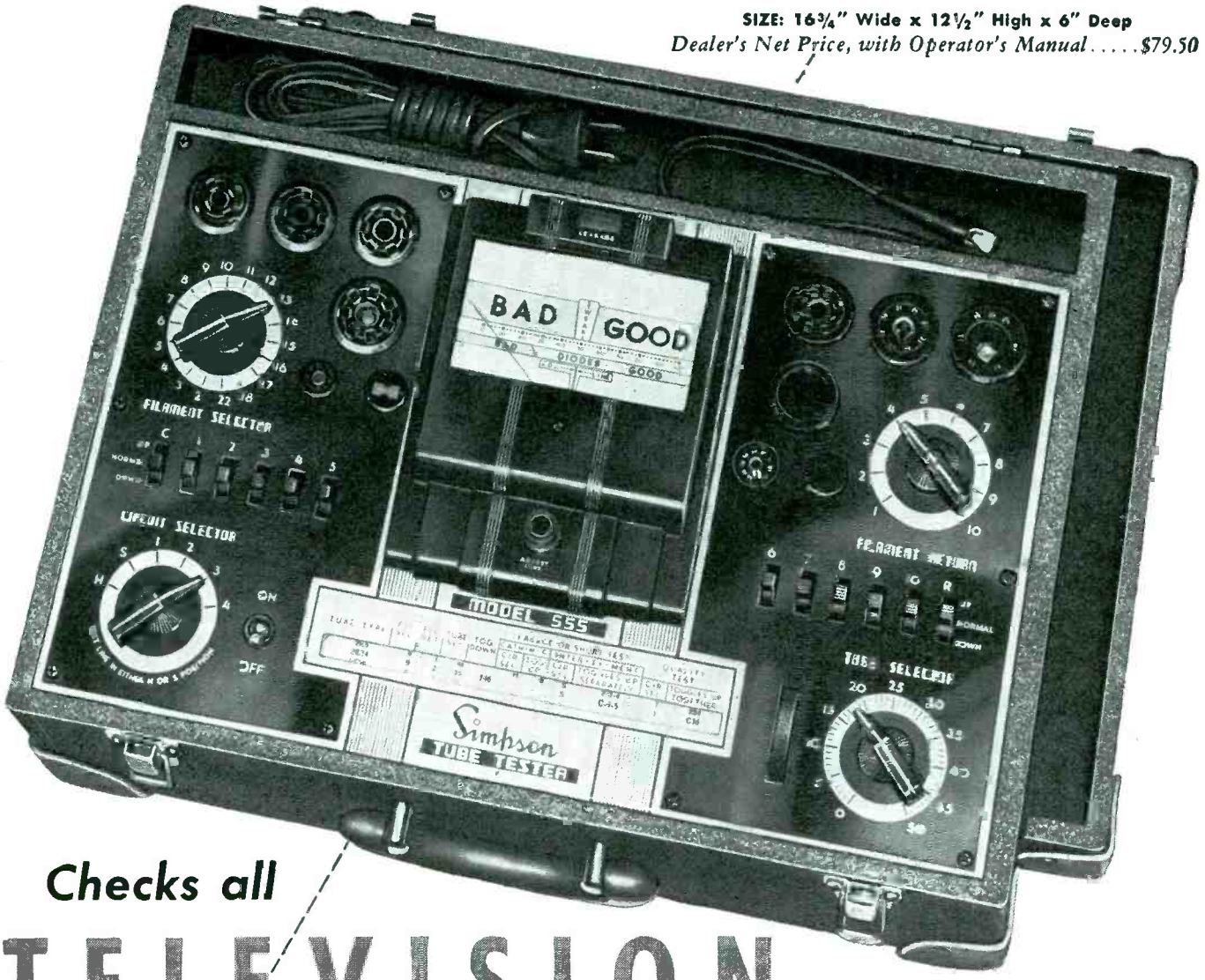

Checks all TELEVISION and Radio types

*SIMPSON 555 Tube Tester

- *Basic RMA recommended circuit. Tests any tube regardless of base connections or internal connections of elements.*
- *Simpson designed 3-position lever operated toggle switches with molded rotor carrying silver plated contacts, self-cleaning through wiping action.*
- *Sockets for all receiving tubes on the market.*
- *Provision for future tube developments.*
- *No adapters or special sockets required.*
- *Properly fused, provides for line adjustment from 100 to 130 volts; smooth vernier control.*
- *Beautiful modern panel of shining, silver and black anodized enduring aluminum.*
- *Large illuminated meter for easy readings.*
- *Unique jewel-like molded lucite housing encloses Neon bulb indicating shorts and inter-element leakages.*
- *Line adjustment control below dial opening. Easy to operate.*
- *Case of sturdy plywood with heavy fabricoid covering, slip hinges.*
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1949 IS T-V YEAR

See the 555 at your parts jobber or write for descriptive literature.

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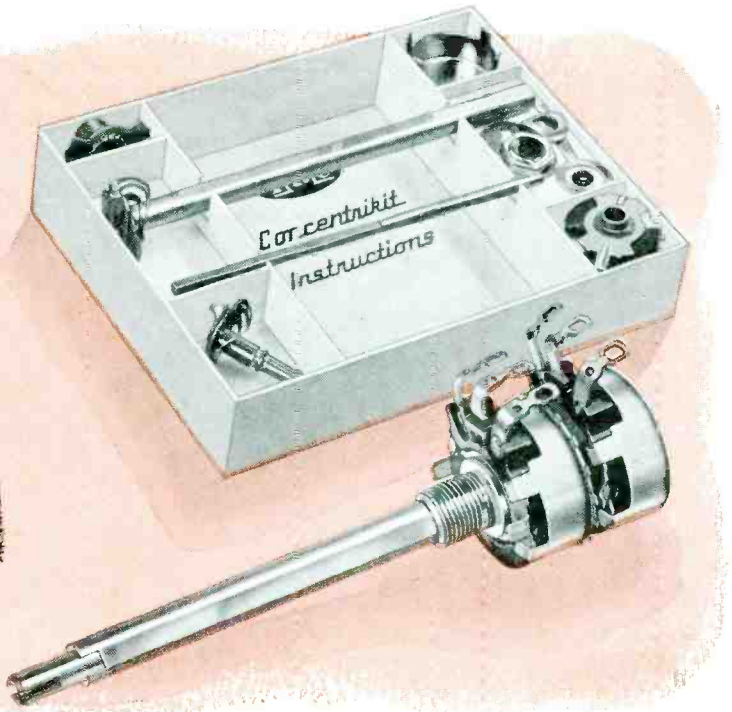
Concentric Dual Worries Out the Window!

Amazing New IRC Concentrikit Replaces 90% of All Concentric Dual Controls



With Original IRC Base-Element Assemblies

Here is the for-sure answer to your concentric dual problems. The new IRC CONCENTRIKIT is a set of specially designed parts with which you can assemble a great variety of concentric dual controls. With CONCENTRIKIT on the job you entirely eliminate long searches and waits for exact duplicates. Instead, you quickly and easily assemble the exact concentric dual replacement you need . . . saving time and inventory investment.

USED WITH NEW IRC BASE-ELEMENT

Each CONCENTRIKIT contains 11 IRC universal parts. These combined with a wide selection of Shaft Ends and Base-Elements—purchased separately—afford a full range of concentric duals. Thus you save by buying only what you need. IRC Base-Elements are a revolutionary advance in concentric dual replacement. Each unit is a complete blue molded base with element, terminals and collector ring installed—no loose parts.

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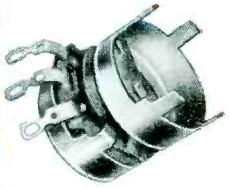
YOU MUST SEE CONCENTRIKIT

See CONCENTRIKIT *now*, at your IRC Distributor! Take advantage of the most sensational control development that ever hit the industry. It's a money-maker!



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IRC INTERNATIONAL RESISTANCE CO.

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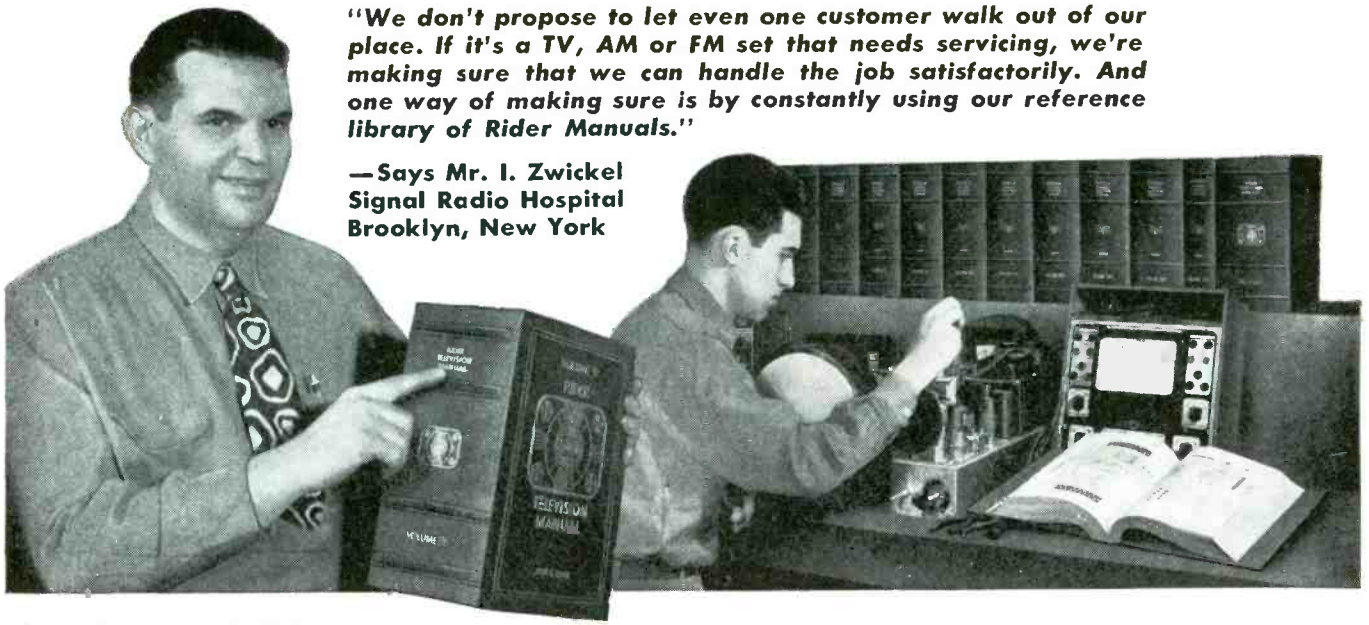
"TV+FM+AM... We're making sure that we get all of this business . . ."



"We don't propose to let even one customer walk out of our place. If it's a TV, AM or FM set that needs servicing, we're making sure that we can handle the job satisfactorily. And one way of making sure is by constantly using our reference library of Rider Manuals."

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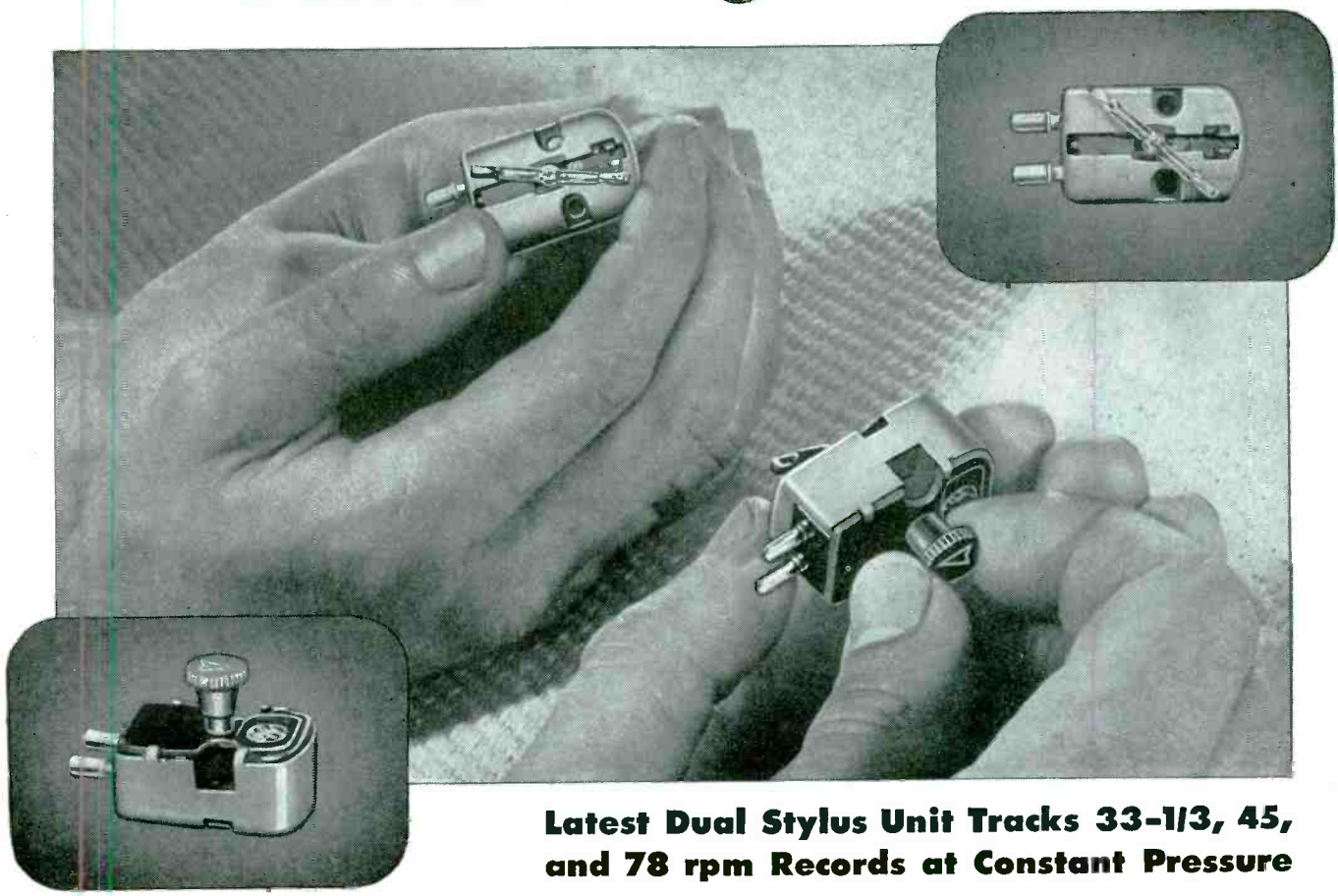
NOTE: The Mallory Radio Service Encyclopedia, 6th Edition, makes reference to only one source of radio receiver schematics—Rider Manuals.
NOTE: The C-D Capacitor Manual for Radio Servicing, 1948 Edition No. 4, makes reference to only one source of receiver schematics—Rider Manuals.

NEW G-E *Triple-Play* CARTRIDGE PLAYS ALL 3 SPEEDS



Latest Dual Stylus Unit Tracks 33-1/3, 45, and 78 rpm Records at Constant Pressure

Costs 25% less than Pickups it Replaces

A new General Electric "Triple Play" Cartridge that tracks any commercial record is now available to manufacturers, distributors, and dealers.

Simplicity is the key feature of this notable electronic advancement. Once installed in a tone arm, the cartridge will play all types of popular narrow groove and standard groove records *without replacement or even a change in position!*

ONLY ONE PRESSURE

The new cartridge retains the unsurpassed frequency response characteristics of the famous G-E Variable Reluctance unit and in addition, tracks the three types of records at 6 to 8 grams. Thus the pressure is constant regardless of the stylus you're using. The special design of the "Triple Play" permits precise adjustment of tone arm pressure. Weight changing and pressure compromise problems are eliminated. High compliance and low moving mass reduce record wear to a minimum.

TWO STYLI IN ONE CARTRIDGE

A single twist of a built-in knob turns either end of a dual stylus to playing position. A 1-mil stylus, mounted at one end, plays 33⅓ and 45 rpm records, and a 3-mil stylus, at the opposite end, tracks standard 78 rpm records.

MANUFACTURERS NOTE LOW COST

Although it plays records that formerly required the use of two cartridges, the price of the "Triple Play" is 25% *less* than the price of two individual cartridges. It is adaptable to many types of tone arms and *its use as an initial component will effectively reduce set manufacturing costs.*

UNAFFECTED BY TEMPERATURE

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This impressive showing is a tribute to the research and quality production techniques employed by Sylvania.

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These leading television set manufacturers use Sylvania Television Picture Tubes

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Bendix • Crosley • DeWald • Emerson • Fada
Farnsworth • Garod • Hallicrafters • Hoffman
Magnavox • Midwest • Motorola • National • Olympic
Packard-Bell • Philco • Pilot • Raytheon-Belmont
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TV Servicing Pitfalls

TV, now in a boom stage and destined to out-distance radio's greatest ticker-tape days, has catapulted many Service Men to a gleaming position and many others, we regret to report, to a dismal low in acceptance. Why, we wondered, did the latter sad state exist? With installation business at its peak and servicing on the climb, the situation was truly puzzling. But there were reasons, and plenty of them, as a survey among manufacturers, distributors and TV owners revealed.

It was found, for instance, that the antenna was quite a troublesome factor. Too many Service Men, unfamiliar with the types of antennas to use, or how to install them for maximum effect, were finding these operations a loss item. Antenna exploration, an extremely vital procedure, was found suffering from complete neglect by these Service Men and as a result, poor antenna locations prevailed. Instead of choosing the antenna sites for their electrical proficiency, the physical qualities of the installation received prime consideration. Some Service Men were reported to be mounting antennas in an obviously incorrect position, following a prior installation without regard to its correctness. As a result time-consuming rechecks and repositioning have been found necessary. There is no denying that strong mechanical mounts are essential and as such, should receive careful consideration, but it is extremely important that the *rf* pickup factor be probed closely, too, and a just compromise made.

Installations made in haste were another contribution to income loss headaches. In many instances mount carelessness, resulting in falling antennas, caused property damage. Poor installation methods were also found to cause water leaks and subsequent damage to rooftops and living quarters.

Lack of a program to insure complete band coverage of operating stations served as another time-loss item, the survey revealed. Since all the stations are not always on the air when an installation is made, complete performance insurance cannot be certified, unless some check system is used. It has been found a wise policy to return once or perhaps even twice to check up on channel coverage and thus gain a satisfied customer. Many service shops have found it highly profitable to include these return trips as a part of a routine neighborhood program.

The lack of familiarity with antennas which can provide the best results in local or fringe areas have resulted in grave despair on many fronts. It is well recognized that there are many installations which are difficult, from a normal installation view, but such problems can be appraised carefully and, in most instances, solved with a plausible *sincere* explanation of the conditions at hand and the type of an antenna system that should provide the best possible signals.

The extensive activities of an ever-growing army of successful TV service shops reaccents the fact that the business of TV installation and service can be profitable, when sound business and technical know-how prevails up and down the ladder, in the shop and in the field.

Ultrahighs and the Service Man

THERE'LL BE QUITE an array of problems facing the Service Man when the ultrahighs finally receive FCC approval. As revealed in *Jots* and *Flashes* (see page 48, this issue) there is doubt that we'll have these higher bands before late next year, but the situation is so replete with variables that an early study of the peculiarities which do exist on these frequencies is warranted.

Reporting on this state of affairs before a recent IRE meeting in Cincinnati, John D. Reid of Crosley said that as we go higher in frequency . . . "*rf* preselection becomes increasingly difficult to obtain and the use of *uhf rf* stages ahead of crystal converters will generally result in a reduction of signal-to-noise ratio. The *rf* selectivity, which can be obtained from two circuits on the *uhf* band, is most unsatisfactory when considering the image rejection requirement predicated upon using *if*s below the *vhf* band. An *if* in the neighborhood of 400 megacycles would minimize the image problem, but such an *if* is not practical today from gain and selectivity standpoints. . . . Further consideration of this problem indicates that by careful design and the use of two tuned circuits in the preselector, an average image attenuation of 10 to 15 db can be expected in the *uhf* band in conjunction with a 41-mc *if*. This average figure would be approximately double at the low end of the band, and approximately half at the high end of the band."

Choice of IF

Commenting on the *if* frequency chosen by the RMA for combined *vhf* and *uhf* use, Reid stated that 41.2 mc was the first choice for a proposed standardization.

"Reexamining the factors entering into the choice of this frequency," he said, "it was found that the second harmonic of the sound *if* would fall 850-kc below the channel-six picture. The frequency of 41.65-mc, as indicated by image requirements for the ultrahigh band, would put this second harmonic within 50 cycles of the channel-six picture, and was therefore, desirable. The 41.3-mc frequency, as indicated by the *uhf* local oscillator radiation requirements would put this second harmonic 650 kc below the channel-six picture, which could probably be tolerated."

UHF Design Study

With these problems in mind, it was found that a 41.25-mc *if* would be the best compromise, since it provides a series of local oscillator frequencies starting with 522-mc, and increasing in 6-mc steps, all of which are divisible by six.

A detailed review of ultrahigh designs, including the RMA suggestions and other engineering proposals, is now being prepared. Watch for this important discussion.—L.W.

Design, Application and

Characteristics of Selenium Designs . . . How the Cell Operates . . . Limiting Factors . . . What Aging Means . . . Cell Circuits . . . Test Procedures . . . Servicing Problems and Solutions.

by IRWIN WOLF

Radio Receptor Company, Inc.

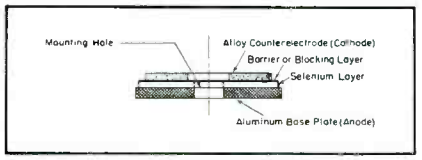


Fig. 1. A cross-sectional view, exaggerated, of a selenium cell layer.

IT HAS LONG BEEN KNOWN that in the crystalline state, the element, selenium, is a semiconductor, offering very high resistance to electric current in one direction, but conducting readily in the other. This property of rectification has been used commercially in converting *ac* sources to *dc*, by the proper series and parallel combinations of selenium cells or plates into rectifier stacks to supply electroplating, battery charging and other *dc* power needs.

In recent years, however, there has been developed the selenium rectifier with high back-voltage capabilities for use in receiver power supplies, performing the function of a tube, while providing several advantages not afforded by the tube type rectifier. Among these are ruggedness, small size, simplicity of mounting and connection (since there is no filament), comparatively cool operation, and long life. Such factors have made the selenium stack a particularly useful component of the small *ac/dc* table model and 3-way portable type receiver, and of the TV set as well. It is gaining increasing importance not only as a replacement for existing vacuum-tube rectifiers, but as a standard part of the transformerless type radios and compact TV receivers.

The selenium rectifier cell is constructed in the shape of a disc or plate consisting of four essential layers; the aluminum base plate, which serves as an anode as well as a strong mechanical support for the other sections; the thin selenium layer, which is applied to the base plate; an extremely thin barrier or blocking layer, at which the rectifying action takes place; and a counterelectrode layer, made of a metal alloy which acts as the cathode of the cell. The alloy can be recognized by its silvery crystalline appearance. It does not extend to the edge of the plate, but is usually applied with a slight margin to eliminate the possibility of direct shorts to the aluminum anode at the edge of the plate. The area of this alloy cathode is the effective rectifying area of the cell.

The type of rectifying unit most commonly used in standard receiver circuits is composed of a number of selenium cells in series (usually five) and is called a half-wave selenium-rectifier stack. The plates are separated by spacing washers to permit cooling by convection.

Electrical Characteristics and Limiting Factors

The selenium cell is essentially an electric valve, having roughly 2,000 times as much resistance to current through it in one direction as in the other. The direction in which conventional current will be easily conducted through the cell (from aluminum anode to alloy cathode) is known as the *forward* direction, while the opposite (high resistance) direction is termed the *reverse* direction.

In Fig. 2 appears the typical forward and reverse current characteristic of a cell. It can be seen that the value of resistance in either direction is not constant, but varies with the value of voltage across the cell. It is important that this non-linear current-voltage characteristic be carefully considered when performing tests on a rectifier. It should also be noted that the selenium rectifier will pass a small but measureable current in the reverse direction when operated under rated conditions.

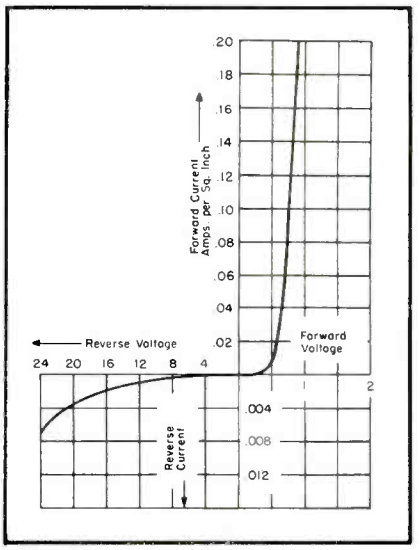


Fig. 2. Graph of forward and reverse current versus voltage. Note the differences in the forward and reverse scales.

If a selenium stack is subjected to a reverse voltage for some time, the reverse leakage current will decrease. This process is called *electroforming*, and it occurs every time the stack is put into use at rated voltage. Consequently, in a radio set, the average leakage of a selenium unit decreases with time. However, if the rectifier has been out of use for a day or so, the reverse leakage, upon reapplication of voltage, will be higher than normal, taking about a minute to reform to its previous value.

During the first month or two of operation, the average forward resistance of the rectifier stack will gradually increase, causing a drop in output voltage. Generally, this *aging* process will not cause any noticeable change in receiver performance; however, unusually severe operating conditions may result in excessive aging. Replacement of the rectifier is recommended in the event of a 15% drop in the original output voltage, at which time the for-

Servicing of SELENIUM RECTIFIERS

ward voltage drop across the stack would be approximately 15 volts *RMS* instead of the normal 5 volts *RMS* at rated load.

Although rated for a definite continuous normal operating load current, the selenium stack will withstand momentary overloads of many times this rated current without serious damage.

Plate temperature is an important factor in stack operating. Maximum selenium plate temperature for chassis operation has been set at 75°*C* (167°*F*). Since excessive heat accelerates aging, it is desirable to keep the rectifier unit at its normal operating temperature of 70°-75°*C* (158°*F*-167°*F*) or below, especially while the stack is new. For rated load conditions, a maximum ambient temperature of 45°*C* (113°*F*) will limit the plate temperature to acceptable values.

Typical half-wave selenium rectifiers for radio use at present have continuous *dc* load current ratings ranging from 50 to 500 ma. and vary in size from less than 1 cubic inch to about 4 cubic inches. For the most part, however, the 100-ma 1-cubic-inch size is found in standard receivers today. The larger sizes are more commonly being used in TV sets. Stacks are rated to withstand a maximum of 380-volt peak-inverse voltage, and 900 volts across the insulation between each terminal and the mounting eyelet. When used in a half-wave circuit with a filter, the *ac* line voltage should not exceed 130 volts *RMS*.

Common Circuits for Selenium Stacks in Radio Receivers

Of the types of selenium-rectifier or power supply circuits normally encountered in radio receivers, the simple half-wave system with filtered output is by far the most common. Used extensively in table model *ac/dc* receivers and 3-way portables, the typical basic circuit (Fig. 3) differs from the conventional tube rectifier circuit mainly in the absence of a rectifier filament connection, and in the addition of a series protective resistance element (R_1).

Diagrammed in Fig. 3 is a common type of selenium rectifier half-wave power supply circuit. In this circuit, the terminal marked *K* or + should be connected to the positive side of the electrolytic filter capacitors and to the *B*+ line. It is important that the proper rectifier polarity be observed; the cathode *K* can be identified by the crystalline appearance of the alloy. A minimum of 5 to 22 ohms 5-watt series resistance, R_1, is placed in the circuit to protect the stack and capacitors against the effects of current surges during operation, and to limit the value of *RMS* rectifier current to not more than 2.5 times the rated *dc* output current. The minimum value of R_1 depends on the load current rating of the stack, being 22 ohms for 100 ma *dc* and below, 15 ohms for 100 to 200 ma ratings, and 5 ohms for above 250 ma.

Many radio sets have been modified in the field to be power fed by selenium rectifiers instead of the original tube rectifier. For those which have been designed with provision for a pilot lamp (usually No. 47) connection across a low voltage tap on the rectifier tube filament, the replacement of the tube by a selenium stack makes it necessary for the pilot lamp to be moved to a new source of voltage. This may be done by placing the lamp across the series resistor R_1, or across a tap on the voltage dropping or ballast resistance when provided. Of course, a suitable compensating resistor, R_3, is connected in place of the missing tube filament where necessary. It is generally in the *ac/dc* table model receiver that the filaments are connected across the *ac* side of the line; filaments for miniature tubes in 3-way portable models usually are supplied with *dc* voltage from a tap on a power supply bleeder, R_3, as shown dotted in Fig. 3.

Since the *dc* output voltage of a selenium stack is normally higher than that of a tube operating under the same conditions, it often becomes necessary to insert sufficient extra series resistance into the converted circuit to keep the *B* supply voltage from being too high.

It should be remembered that in the half-wave circuit, the conditions of the selenium rectifier and input filter capacitor are somewhat interdependent. For instance, if the input electrolytic capacitor is leaky, the excessive current through the capacitor may cause the stack to overheat, while if the rectifier is not sufficiently formed, the electrolytic capacitor may in turn overheat and possibly decrease in capacitance due to internal changes. Typical values for C_1 are 40 to 100 mfd; very large input capacitance values should not be used without increased values of limiting resistance R_1, since the charging current would be very high and would tend to overheat the selenium rectifier, accelerating aging or possibly causing failure.

Two less commonly used power circuits involving selenium rectifiers are

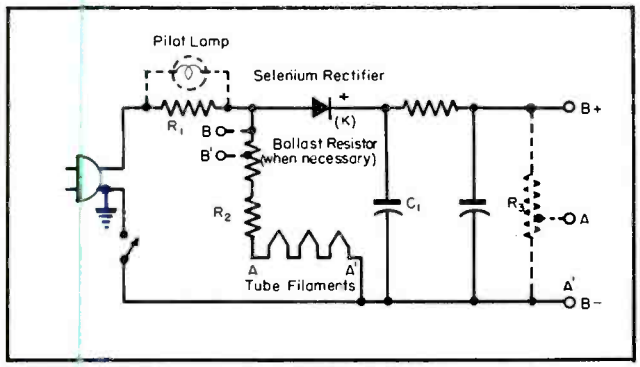
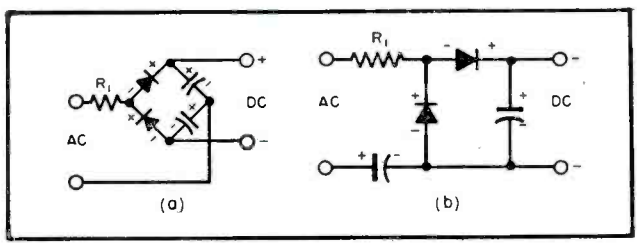


Fig. 3 (left). A typical half-wave power supply circuit using a selenium rectifier.

Fig. 4. Two types of doubler circuits. In *a* appears a symmetrical doubler and in *b* we have a series line feed doubler.



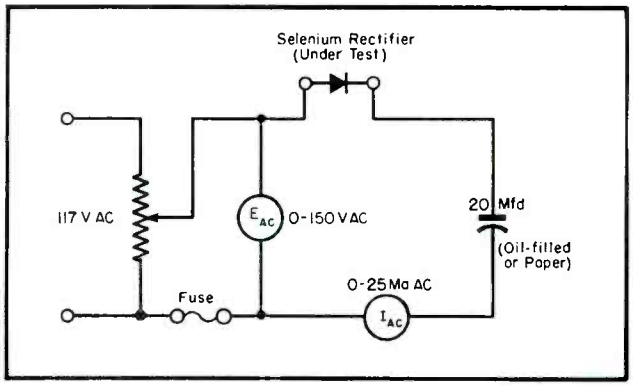


Fig. 5. A reverse testing circuit.

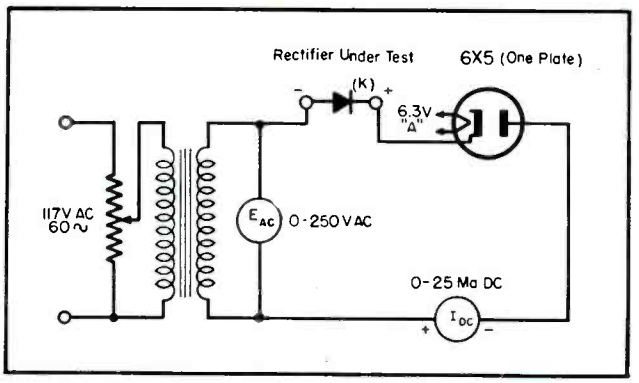


Fig. 6. Circuit of an alternate reverse testing setup.

the voltage doublers, shown basically in Fig. 4.

Again the series protective resistor is important. The same 130-volt *ac* input voltage limit should be observed as in the half-wave circuit, and R_1 should be 25 to 50 ohms depending on capacitor values and load conditions.

Test Procedures and Circuits

When a selenium rectifier has been subjected to excessive voltage, current, or temperature conditions, it may become partially or completely damaged. Final evidence of such condition is given by an electrical test; however, there are several physical indications of a faulty stack which may be helpful in recognizing possible trouble in the rectifier or in the external circuit:

Sparking: If a much higher than rated inverse voltage is applied across a selenium stack, a crackling, popping sound may be heard, accompanied by small blue-white sparks on the alloy surface. Ordinarily, this should not be mistaken for an indication of a permanently faulty rectifier, since the effect will cease as soon as the excessive voltage is lowered, and, if the surge lasts only a few seconds, the rectifier will then continue normal operation.

Blowout Patches: Many of the sparks leave small, round blowout spots which appear black against the silvery alloy. These blowouts are self healing, and will not short the rectifier; they decrease the alloy surface, however, and if the sparking condition has been severe, the effective rectification area may have been reduced below allowable values. Further passage of rated current through this reduced area may cause excessive heating and subsequent total failure of the stack. If blowouts are observed all around the contact washer at the center of the plate, it is best to replace the rectifier. Plates with greater than 20% blowout density are not recommended for further use.

Melted and Discolored Alloy: If the stack forward current is increased to several times normal value for an extended period of time, the temperature of the rectifier may rise beyond the melting point of the alloy cathode, which would cause it to soften and run, with possible surface discoloration. This condition indicates that the unit is unfit for further use. When a stack has been completely destroyed, there will usually be noticed a combination of blowout patches and melted, discolored alloy.

It is important that the selenium stack characteristics as noted previously be kept well in mind while proceeding with and evaluating tests made on the unit. Emphasis should be placed on the fact that an ohmmeter gives almost meaningless readings when used on a selenium rectifier in both the forward and reverse directions. The resistance reading will depend on the ohmmeter voltage and scale, since the resistance of a stack in either direction depends on the particular value of voltage across it. Therefore, ohmmeters should be used only to check stack continuity and never to determine the relative quality of a selenium unit.

There are several circuits and procedures concerning a high back voltage selenium rectifier which will be of use in indicating its general quality for operation in receivers.[1]

Continuity: To test a stack for an open connection, readings of resistance in both the forward and reverse directions should be taken with a high range ohmmeter. Two readings, one with the meter leads reversed, will normally read greatly different values in each direction for a stack having continuity, while an open rectifier is indicated by the same extremely high reading in forward and reverse directions.

Reverse Leakage: Blocking quality of a selenium receiver stack may be measured in several ways. Probably the most simple and convenient test circuit would be that illustrated in Fig. 5.

Polarity of stack connection in this circuit is immaterial. It is important that the 20-mfd capacitor be of the paper or oil-filled type, and not electrolytic.

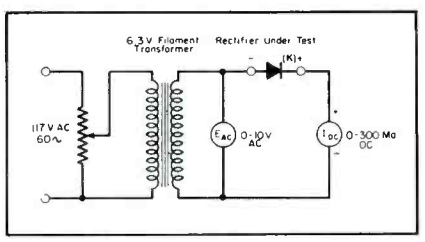
The input voltage should be increased from zero by means of a suitable potentiometer or variable autotransformer. If the stack begins to sputter and spark as the voltage E_{ac} is increased, the value of applied voltage should be allowed to remain for a few minutes at the highest value which will not cause sparking on the alloy, then slowly increased again, the procedure being repeated until the input voltage is up to 117 volts *ac* or until the *ac* milliammeter reads full scale. Only damaged or badly deformed rectifiers will exhibit this sputtering effect; for the most part, full rated voltage may be applied without causing sparking. The input voltage should be allowed to remain at 177 *v* for about five minutes before a reading of *ac* milliamperes is taken.

If the *ac* milliammeter reading is 10% of the rectifier rated *dc* load current or less, with the 117 *v ac* impressed, the stack reverse blocking quality is good. If the current reading is slightly higher than proper for the particular size stack tested the unit is poor in reverse grade, but may reform upon longer voltage application. High current readings indicate a damaged stack. For instance, if a selenium rectifier rated at 100 *ma dc* were put on this test, and the current reading were 10 *ma ac* or less at 117 *v ac* in-

(*Continued on page* 45)

[1]Ratings apply to all radio half-wave rectifier sizes.

Fig. 7. A forward voltage-drop test circuit.



TV Model With

by WALTER H. BUCHSBAUM

Chief Engineer
Tech-Master Products Company

RECENTLY A TV circuit innovation, keyed agc (*cover*), was developed to improve the noise characteristic of a receiver and prevent overloading. It was found possible to include this new system in a 630TS chassis (Fig. 1) and obtain extremely effective results. For example, in tests a model with the circuit was found capable of holding the picture steady with up to 30% flutter modulation from airplanes flying up to 400 mph.

The operation of the keyed *agc* system is based on the principle that horizontal sync pulses are of constant amplitude which change only as the signal strength changes. The *agc* bias voltage is made dependent only on the sync pulse amplitude and does not vary as the picture components vary.

One of the two main advantages of this system is that the 60-cycle sync pulse does not enter into the *agc* circuit, and therefore need not be filtered out from the *agc* bias voltage. Filtering the 60-cycle pulse requires a long time constant filter and that, in turn, means that the *agc* cannot respond to fast changes in signal strength. This is particularly objectionable in the case of airplane flutter, caused by the beat between the direct signal and that reflected from the speeding plane. The beat frequency which causes airplane flutter is usually up to about 100 cycles, and naturally the conventional type of *agc* filter simply filters out any change in *agc* bias due to this flutter frequency.

Keyed *agc* employs filters which have a much shorter time constant and therefore the *agc* bias is able to compensate for airplane flutter. The other advantage of keyed *agc* is its practical immunity to noise. Standard *agc* systems, using the entire picture signal, are naturally influenced by the amount of noise present in the picture. In a difficult location the noise pulses may be so strong as to cause a strong negative bias to be set up, which then cuts down the amplification of the desired picture signal. In the keyed *agc* system only the sync pulse amplitude affects the *agc* bias, and since the sync pulses take up less than 5% of the duration of the entire signal, less than 5% of the total noise present can have any effect on the *agc*. In actual field tests this noise immunity is apparent, providing a difference between a weak, snowy picture, and a strong picture with occasional noise spots.

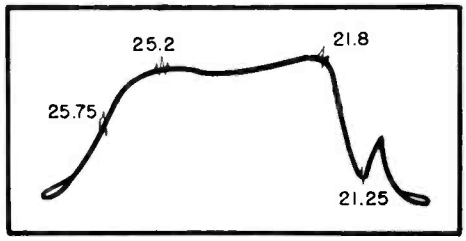
The *agc* tube, a 6AU6, obtains its plate voltage from a special winding on the width control. This plate voltage is a sharp, positive pulse from the horizontal sweep system. Only during the period of this pulse, which is about 190 volts peak-to-peak, can the tube conduct; the cathode is 140 volts positive and no current can flow. During the conduction period, the amount of plate current is determined by the control grid bias, which is fixed at about 5 volts negative. The sync pulse, which is positive, appears on the grid at the same time as the sharp pulse appears on the plate, if the horizontal sweep is in synchronism. The amplitude of the sync pulse therefore determines the plate current. If the sync pulse is strong, from a strong picture signal, it will drive the grid less negative and permit more plate current. The plate current flows through 150,000- and 100,000-ohm resistors and charges a .5 mfd capacitor (C_{142}), thus creating a negative *dc* bias across these resistors. The voltage across the 100,000-ohm unit is then applied to the grids of the first three *if* amplifiers and the *rf* stage, controlling the gain of these tubes. The screen potential of the 6AU6 *agc* tube is obtained from a convenient 210-volt *dc* point and remains fixed.

RF Tuner

The tuning unit in this modified model is the popular standard front end tuner, which has a different set of *rf* and oscillator coils for each channel. Individual sets of coils can be removed for repair or adjustment without dismantling the unit. Oscillator alignment is possible from the front of the set. Each channel can be tuned separately and the adjustment of one has no effect on any of the others. The first *if* coil is mounted on the tuner sub-chassis and tuned from the top.

In a 21.25-mc sound *if* trap there is a separate coil, mounted next to the first *if* coil and also tunable from the top. A 6AG5 is used as an *rf* amplifier and a 6J6 duo-triode as an oscillator and mixer.

Fig. 2. Response curve of the stagger-tuned *if* circuit; picture *if* carrier is at half-power point with a full 4-mc bandwidth. The sharp dip at 21.25 mc is due to action of the sound *if* traps.



Video IF Amplifiers

The stagger-tuned *if* system used in this model is identical to that used in the 630 type circuit, in alignment procedure and performance. Peaking frequencies are at 23.4, 25.2, 22.3, 25.3 and 21.8 mc. These coils, in the *rf* front end, with their varied loading consisting of the different grid and plate resistors, provide a response curve like that shown in Fig. 2. The picture *if* carrier is at the half power point, with a full 4-mc bandwidth. The sharp dip at 21.25 mc is due to the action of the sound *if* traps, one of which is located on the *rf* tuner and the second one being in the cathode of the last picture *if* tube. As cited previously, the outstanding difference between this circuit and the original 630 appears in the *agc* circuit, with the control grids of the mixer and the first three *if* stages obtaining their bias from this *agc* circuit. For alignment purposes it is necessary to deactivate this circuit temporarily. During the *if* alignment process, the *agc* tube must be removed and a 3-volt battery connected across the *agc* network (100,000 ohms) and C_{142} (.5 mfd). Two 1½-volt flashlight batteries connected in series will do the trick. The brass center stud is connected to the chassis and the outer shell to the *agc* network, and a negative bias simulating the action of the *agc* tube will be obtained. The alignment of the *if* traps at 19.75 and 27.75 mc will be

(*Continued on page 26*)

KEYED AGC SYSTEM

[*See Front Cover*]

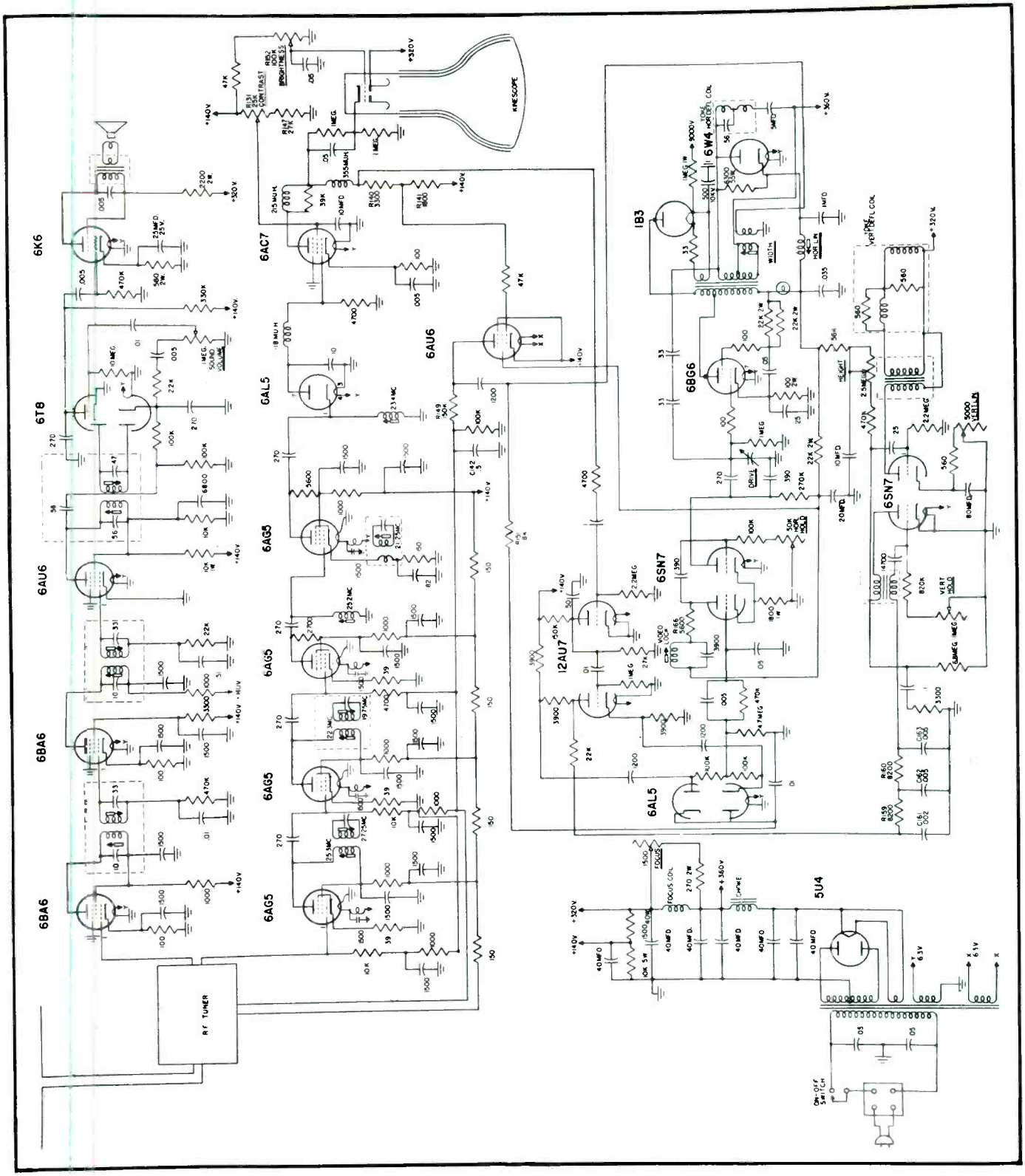


Fig. 1. Complete circuit of the Tech-Master Model BC-1223 receiver which features keyed *age*.

Performance Diagnosis Of Vacuum-Tube Circuits

How to Use Tube Characteristic Curves For Circuit Analyses and Determine Possible Sources of Trouble.

by EDWARD M. NOLL

Instructor in Television
Temple University

THERE ARE NUMEROUS occasions when complete circuit information is not available and operational characteristics of a particular circuit are desired. Often the only information provided may be the schematic with tube types and parts' values listed. At times the gain or output voltage may be the unknown and at other times, when trouble-shooting, it would be helpful to know just the operating plate voltage or grid bias. Occasionally we'd like to know what would happen if a different part value were substituted in place of a value shown on schematic.

Most of this type of information can be readily calculated, knowing only tube types and parts' values. The only tools necessary are a common sense approach and a set of tube characteristic curves. A working knowledge of curve procedures is also of the utmost importance in basic practical design work.

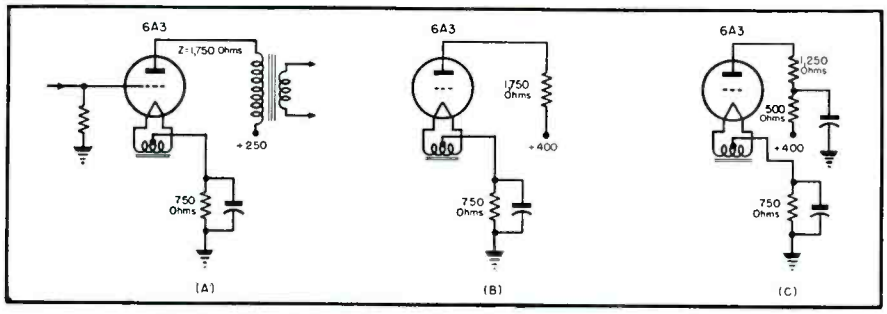


Fig. 1. Three 6A3 triode circuits with the same operating point.

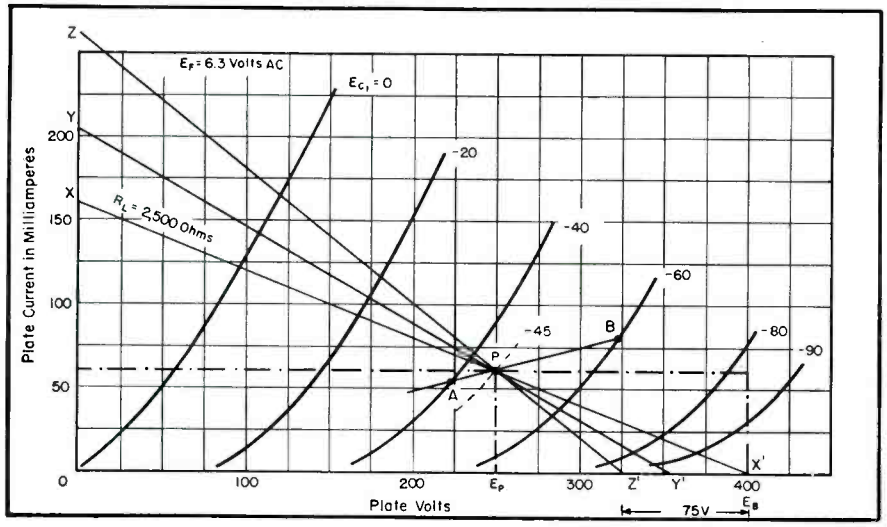
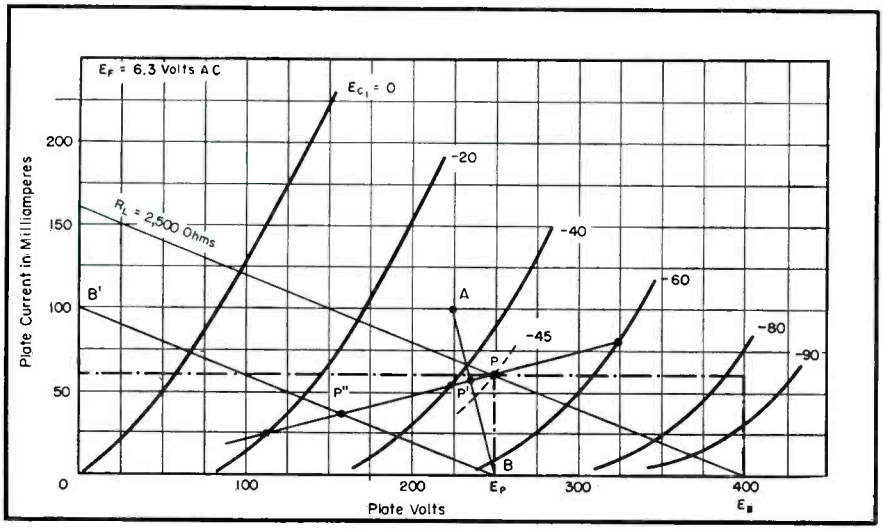


Fig. 2*a*. Characteristic curves of the 6A3s.

Fig. 2*b*. Plot illustrating the corrections for winding resistance and plate-load resistor. Area at left represents plate dissipation and area at right the *dc* dissipation in the load resistor.



The Operating Point

In diagnosing stage performance one of the most important considerations is the operating point. Once it has been found the remainder of the information to be gathered presents no particular problems. Thus, the very first task is to find the operating point by plotting a dynamic load line on the curves.

Suppose 6A3 circuits were the problem. Selecting three typical 6A3 circuits (Fig. 1) we find that each one has the very same operating point. This is found for each case on the curve of Fig. 2. In the first example, an output stage is shown feeding a 1,750-ohm reflected load; cathode resistor value is 750 ohms. To find the operating point the procedure is as follows:

(*1*) A straight vertical line is drawn from the plate voltage axis along the 250-volt line. The operating point is along this curve, for at the operating point the plate voltage must be 250 (neglecting resistance of the transformer).

(*2*) Now we have to draw a curve, which represents a possible loci of

(*Continued on page 27*)

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PHONO installation and service

Magnetic Tape Playback-Recorder System Operation and Servicing Notes*

by KENNETH STEWART

MAGNETIC tape-recording systems appear to have outgrown their gadget stage and become quite a factor in home very-long-playing phono-type applications.

Of particular importance in the setup is the tape.

The physical properties of a magnetic tape are of considerable importance to the behavior of the recording system. Most of the magnetic tapes produced and used today are composed of a coating of the magnetizable material on a stable, non-metallic backing. Backings commercially used are made of organic materials and may be of a fibrous type such as paper or of a continuous film type, a typical example of which is cellulose acetate film. An ideal backing would be one which had infinitesimal thickness and an infinite modulus of elasticity. Such an ideal backing would then have no stretch, but at the same time have a high degree of flexibility.

Since we must obviously deal with practical materials and since performance must be balanced against cost, for a commercial product, certain compromises with an ideal backing must be made. Cellulose acetate has long been used as the *safety* base material for home movie film, where its aging properties and its stability under varying conditions of temperature and humidity have been thoroughly evaluated. Since its performance has been studied over a period of years and since it has reasonable mechanical strength in the thickness desired for magnetic tape, it has found wide acceptance. Since magnetic tape must be subjected to a certain amount of tension during the recording operation, it must necessarily experience a certain degree of elongation. If this elongation is constant in the recording and playback operations, the recorded signal will be reproduced without alteration with respect to time. Variations in tape thickness would cause corresponding variations in elongation of the tape at a given tension, and while such tape might give consistent performance when recorded and played on the same machine of different type would be subject to appreciable elongation. It can readily be seen, therefore, that thickness variations have to be reduced to a minimum, a condition which is satisfactorily accomplished in present commercial practice.

On most recording machines, the tape is dragged across several stationary surfaces including the erase, record and playback heads. Because of this treatment, the coefficient of friction between the tape and the stationary surfaces must be reasonably low. If such is not the case, the tape will not have a uniform tension throughout its path of travel to the capstan, as the tension will build up from friction point to a friction point. An appreciable increase in tension may be produced by the time the tape reaches the playback head (usually the last element in the head lineup) and this tension can cause the playback head to wear at a rapid rate. A high degree of friction also results in a certain amount of chatter of the tape passing over the head. This chatter becomes audible, in some cases, as a squeal which may appear both as a mechanical noise and as a modulation of the signal on the tape. This type of modulation can become very objectionable and can ruin an otherwise satisfactory recording. For this reason, the coefficient of friction must be held to as low a value as is possible, consistent with adequate traction at the capstan. Satisfactory tape must have no appreciable tendency to stick to itself when wound up in a tight roll.

Equipment Features

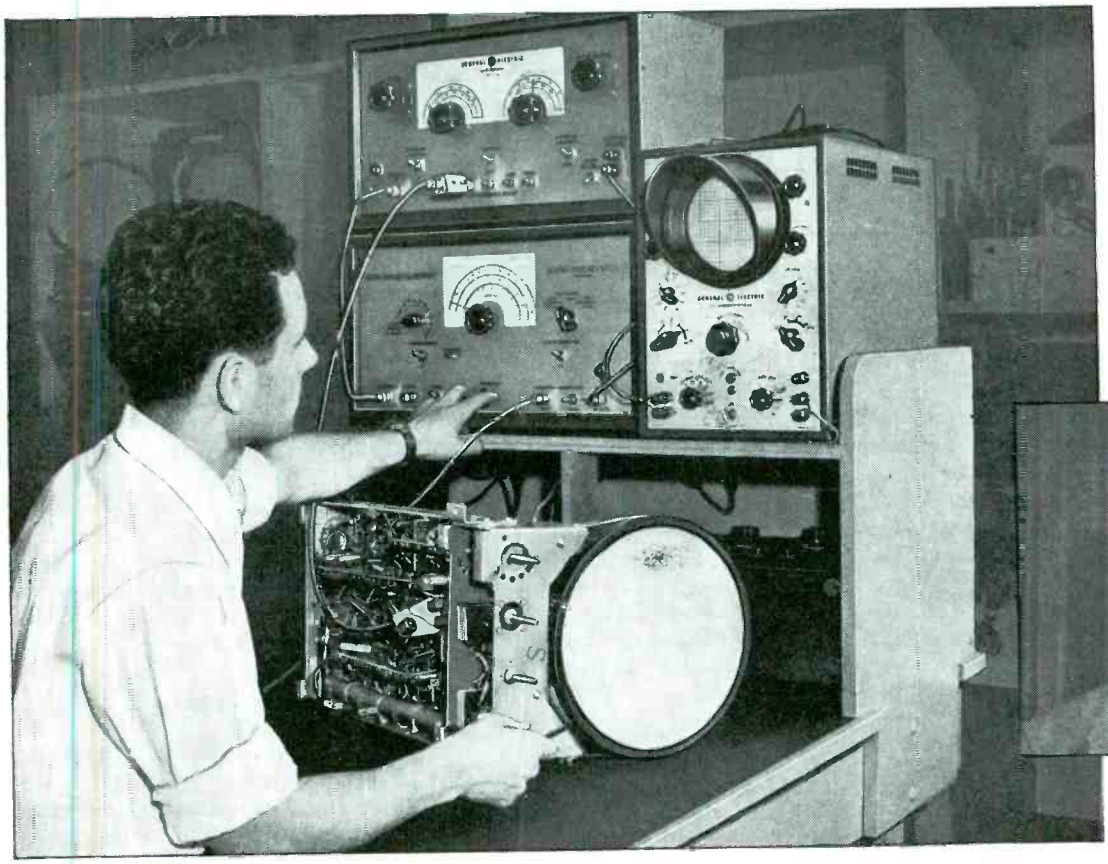
It must be recognized that the recorder and playback design must be correlated with the mechanical properties of the tape. Recording equipment designed to permit rapid forward or rewind motion of the tape must be capable of accelerating the tape to a running speed or braking the reels to a quick stop without subjecting the tape to momentary stresses of high value, since such stresses may produce elongation of a permanent nature. Rewinding of plastic-back magnetic tape is preferably done at constant torque, so that the tape tension decreases as the reel becomes larger. However, some compromise between constant torque and constant tension will usually give satisfactory results. Most of the tape recorder manufacturers, making equipment for high-fidelity use, have designed mechanisms to drive the tape at either the standard NAB[1] speed of 15″ per second or the secondary speed of 7.5″ per second, permitting flexibility of operation and maximum economy in use of tape.

On a magnetic recorder, the playback head must be very carefully aligned with the magnetic image produced by the record head to insure proper reproduction of the recorded signal. The recorded magnetic image on the tape must also be oriented exactly perpendicular to the direction

(*Continued on page* 31)

*From a paper presented at the NAB Broadcast Engineering Conference by Reynolds Marchant, development engineer of magnetic tape at Minnesota Mining and Manufacturing Co.

[1]The NAB magnetic tape committee has recently recommended use of a standard hub for magnetic tape reels. Tape would be supplied by the tape manufacturer on this standard hub. A suitable flange, or flanges, can be attached to this hub to permit use of the tape on any professional recording equipment. Tape made on one recorder can thus be readily adapted to use on another type of machine with no necessity for rewinding the tape.



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SER-CUITS

Analyses of the Admiral AM/FM Tuner and 16" Tube TV Chassis.

COMBINATION AM/FM/TV receivers appear to be gaining acceptance, particularly those with the large picture tubes. In Figs. 1 and 2 appear an excellent example of this type of set, which uses a 16" metal viewing tube.

In the *rf* tuner section of this model (Admiral 21A1 TV and 4K1 FM/AM tuner) balanced 300-ohm and unbalanced 75-ohm (coaxial line) input impedances are provided by a center-tapped primary winding L_{101A}. The secondary winding of this circuit is tuned by the input capacity of the 6AG5 input capacity in series with the parallel combination of a pair of 5 and .5 to 3 mmfd capacitors, C_{101} and C_{102}, the latter also being used for alignment. Loading of the secondary by a 3,900-ohm resistor, R_{101}, provides the required bandpass in this first tuned circuit.

The primary coil L_{102A} is the plate load of the *rf* amplifier. A trimer, C_{104}, and tube output capacity tune this coil. A 10,000-ohm damping resistor, R_{103}, provides the required bandpass.

Channel selection is accomplished by rotation of a turret assembly, a different set of coils (L_{101} and L_{102}) being switched in for each channel.

Mixer

Secondary coil L_{102B} feeds the *rf* and oscillator injection voltages to the grid of the mixer stage, one triode section of a 6J6. The secondary, L_{102B}, is tuned by the tube input capacity and .5 to 3 mmfd trimmer, C_{107}, also used for alignment adjustment. A 100-mmfd capacitor and two resistors, 4,700 and 220,000 ohms, (C_{106}, R_{105} and R_{104}), develop grid-leak bias for the mixer stage. The two resistors are used in this circuit in order that their junction can be brought out as an alignment test point. A 'scope can be connected to a test point without materially affecting the operation of the circuit.

The output of the mixer stage is coupled to a video amplifier by means of a network composed of a 10-mmfd capacitor, 22.3-mc iron-slug coil, 300-mmfd unit, 4.2 microhenry *rf* choke, another choke coil, and a 72-mmfd capacitor (C_{114}, L_{106}, C_{116}, L_{301}, L_{105} and C_{115}). The remainder of the network comprises two tuned circuits and a trap. The plate of the mixer has the tuned circuit of L_{106} and C_{114} (in series with the trap, L_{105} and C_{115}) which with the tube output and distributed capacities are resonated to the video *if* bandpass. The tuned circuit to which this is coupled is composed of L_{301} and the input capacity of the first video *if* amplifier. Overcoupling of these two tuned circuits is provided by the mutual reactance of the trap circuit. C_{115} and L_{105} comprise a trap, tuned to approximately 17.5 mc, which performs the function of adjacent channel picture rejection.

HF Oscillator

In this circuit, using the other half of the 6J6, the oscillator coil L_{102C} is inductively coupled to a mixer grid coil, L_{102B} for oscillator injection to the mixer. A 10-mmfd capacitor, C_{109}, in series with a parallel .3-5 mmfd combination, C_{110} and C_{111}, form the split capacitor of a Colpitts oscillator. Variable-dielectric type capacitor C_{111} is the sharp tuning control.

Grid-leak bias for the oscillator is developed by a 10,000-ohm resistor and 20-mmfd capacitor, R_{107} and C_{108}. The oscillator plate is shunt-fed by means of a 4,700-ohm resistor, R_{108}.

Audio IF Amplifiers

Two high-mu sharp cut-off pentodes, 6AU6, are used in a two-stage *if* amplifier of conventional design. Cathode bias is used on both stages. The sound *if* signal is taken from a video sub-chassis by a 21.25-mc series-tuned circuit which is link-coupled to the plate coil of the first video *if* amplifier. (Early production video *if* sub-chassis employ two stages of amplification before the sound signal is applied to the grid of the first sound *if*.)

Ratio Detector

A 6AL5 ratio detector is used for FM sound detection. The network between point *Z* and ground (de-emphasis filter and volume control circuit) is the *af* output load circuit. A 330-mmfd capacitor (C_{205}) serves as an *if* bypass.

Ratio detector limiter action is provided by the filtering action of 4-mfd capacitor, C_{207}, which is effectively connected across the tuned secondary of T_{202} through the two diode sections of the 6AL5. This tends to hold the *if* signal amplitude at its average value and results in limiter action.

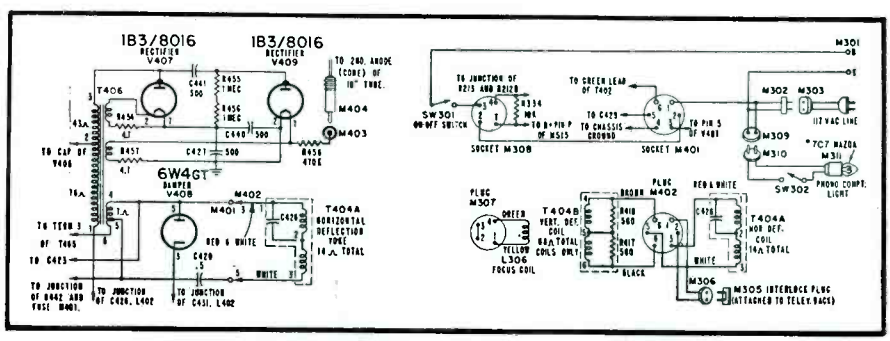
Since C_{207} charges to a value proportional to average *if* signal amplitude and then limits at that level, the circuit will adjust itself to any signal level. As a result, limiter action is effective on weak as well as strong signals.

Straight Television Model
Audio Amplifiers

The television (only) audio amplifier system consists of a 6SQ7 voltage

(*Continued on page* 42)

Fig. 2. The second anode supply, deflection yoke and *ac* interlock circuit used in conjunction with the 16" type TV receiver.



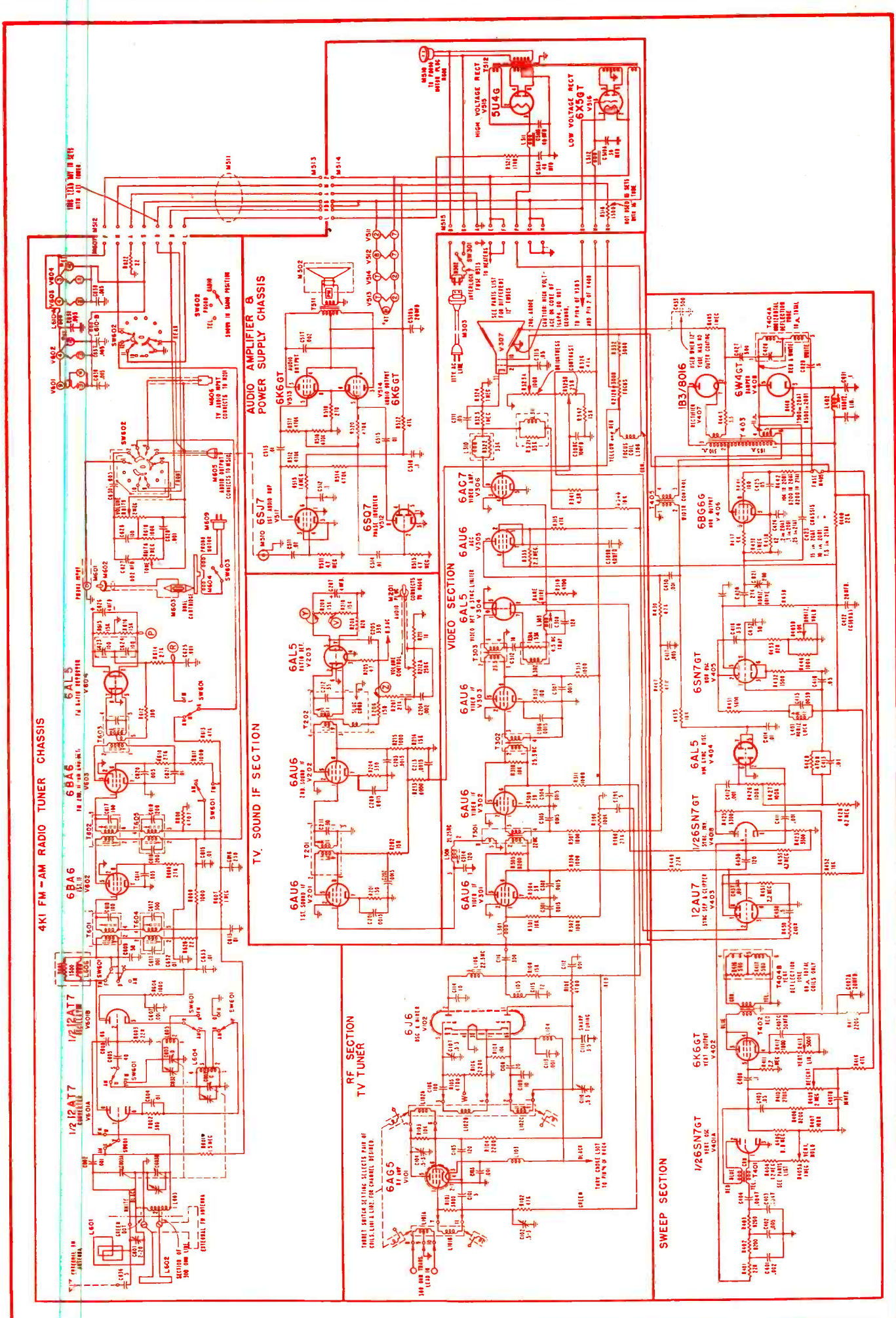


Fig. 1. Schematic for the Admiral 4K1 AM/FM tuner and 21A1 TV chassis with a 12AU7 sync separator and clipper.

TV Receiver Production Changes

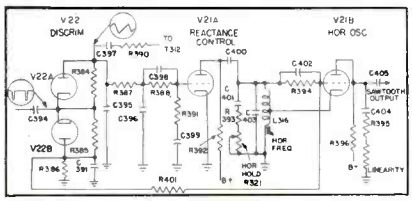


Fig. 1. The G. E. horizontal sweep generator and *acf* control circuit. (C_{398}, C_{390}, R_{388} and R_{391} constitute an anti-hunt circuit).

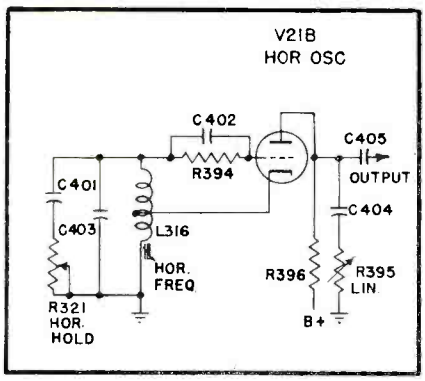


Fig. 2. Sweep generator circuit.

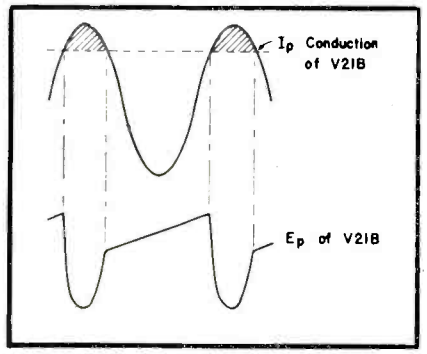
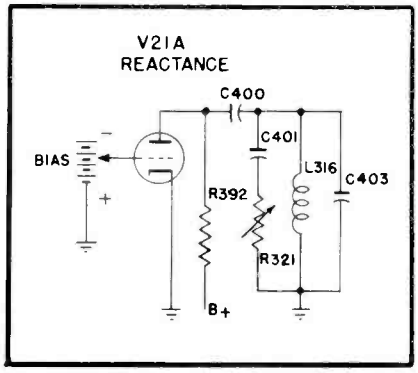


Fig. 3. Wave shapes which result when the capacitor charges exponentially during the time that the I_p of the sine wave oscillator is cut off and then discharged during the conduction period.

Fig. 4. Reactance tube circuit.



New Horizontal Sweep Generator and AFC Circuit For G. E. Receivers.

by DONALD PHILLIPS

SERVICE MEN will find in the newer G. E. TV models a horizontal sweep generator and *afc* circuit, known as the *Gruen sync*, which makes use of a sine-wave oscillator, V_{21B}, to generate a sweep waveshape. The sine-wave oscillator frequency is controlled by a reactance tube, V_{21A}, the plate resistance of which is determined by the bias applied to the grid of this tube. The bias voltage is derived from a discriminator circuit consisting of V_{22A} and V_{22B}, the function of which is to compare the phase between the incoming horizontal sync pulses and the output sawtooth wave. When they are at the same frequency and in phase, no correction voltage is generated, whereas if they are either leading or lagging, a correcting voltage is derived, the polarity of which is determined by the phase (lead or lag).

Sweep Oscillator

The sweep generator (Fig. 2) uses a triode which is connected as a grounded-plate Hartley oscillator.

L_{316}, with the capacitive element, C_{403}, form a tuned circuit resonating near the horizontal sweep frequency of 15,750 cps. This tank is shunted by a small capacitor, C_{401}, in series with a variable resistance, R_{321} (horizontal hold control), so that the frequency of this oscillator may be manually controlled about a mean frequency value. The oscillation voltage on the positive half cycle drives the sine-wave oscillator into grid current which causes a bias to be established across C_{402} and R_{394} of such a magnitude that plate current flows for only a small portion of the cycle. The oscillator may be termed class *C* as far as plate current flow is concerned.

In the plate circuit, therefore, if a large resistor, R_{396}, is connected to *B*+ and a capacitor, C_{404}, is connected at the plate of V_{21B}, the capacitor may be made to charge exponentially during the time that the I_p of the sine-wave tube is cut off and then discharged during the conduction period; Fig. 3. A resistor, R_{395}, is placed in series with the capacitor, C_{404}, so as to modify the sawtooth waveshape to give it a peaking voltage at the start of the trace.. The value of the resistance determines the extent of peaking. It is usually made variable in the receiver and called a *peaking* control. The degree of peaking influences both the linearity and high voltage available from the horizontal output stage.

Reactance Tube

Across the sine-wave oscillator tank circuit linked through a capacitor, C_{400}, is the reactance tube, so identified because it effectively changes the capacitive reactance across the tuned circuit as the bias on this tube is changed.

When the tube is highly conductive, as would be the case when the bias voltage applied to the grid is low, then the tube plate resistance is low and the capacitor in series with this relatively low resistance has an appreciable reactive effect across the tank circuit, resulting in a lower frequency of oscillation. As the bias is made more negative, the tube plate resistance rises, causing the linking capacitor to have less shunting effect across the tank circuit. This results in a rise in frequency. It will be seen that the frequency of the sine-wave oscillator, and thereby the sweep voltage output, may be controlled by the change in grid bias voltage on this tube.

This circuit is operated at all times with an initial negative bias. The

(*Continued on page* 33)

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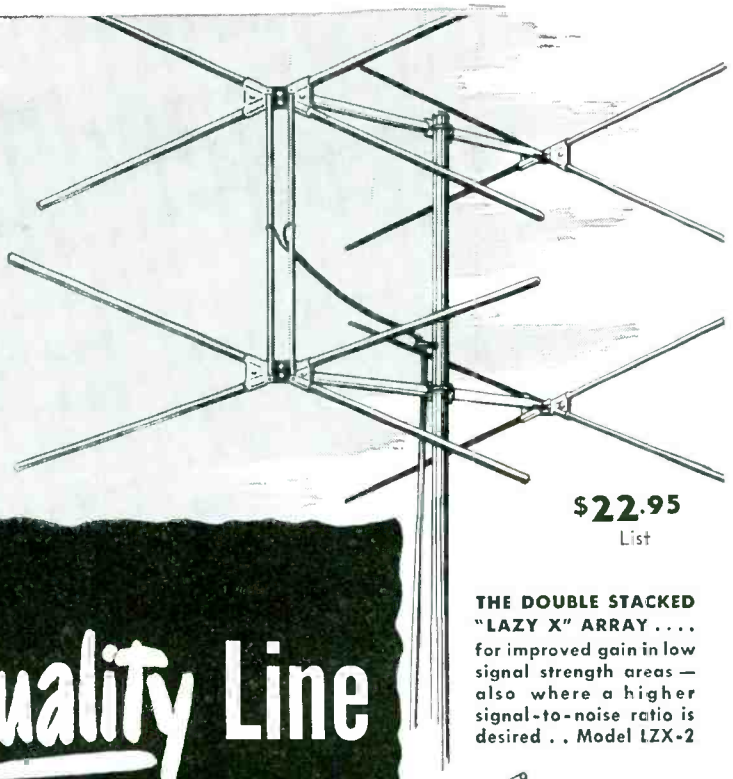

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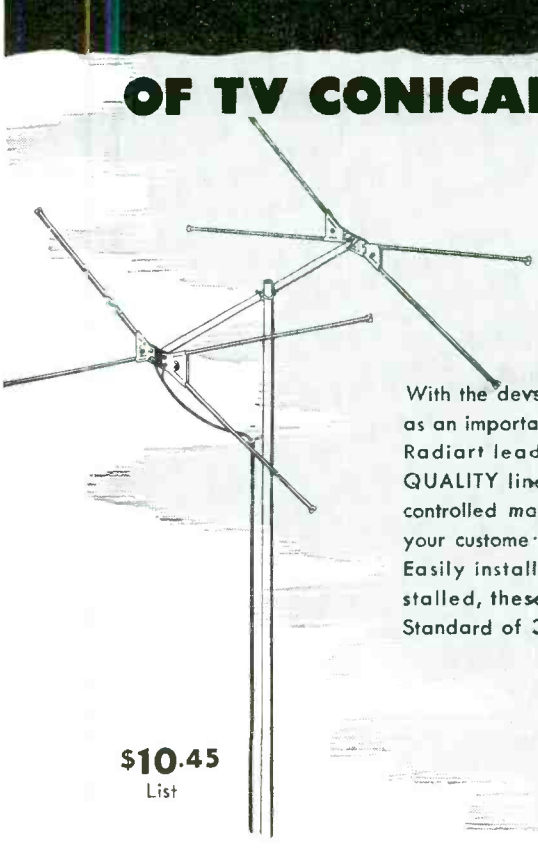

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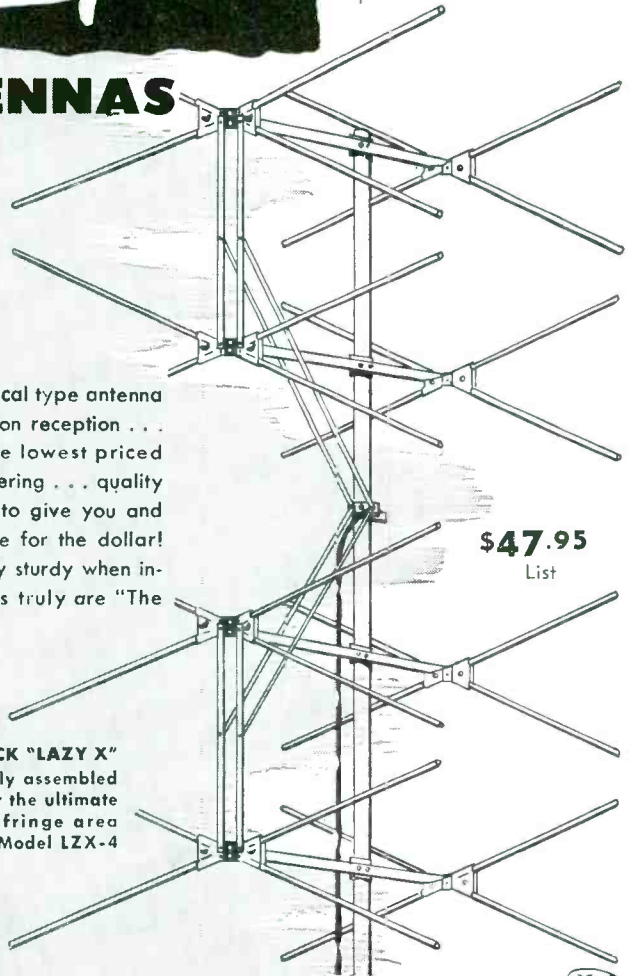

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Application of Picture Width-Control Circuits. Eliminating Sync Troubles, Black Line-White Line Problems and Tuning Drift in TV Models.

by M. A. MARWELL

ONE OF the particularly interesting circuits in the TV receiver is the picture-width control arrangement. With novel circuitry, the picture can be made to horizontally fill out the entire mask of the picture tube.

In the early models, such as the Philco 48-700, the gain of the horizontal-sweep-output tube was varied by adjusting a variable resistor in the cathode of that circuit (Fig. 1), thus changing the amplitude of the sawtooth voltage.

In the larger sets, using electromagnetic deflection, the width control had to be designed somewhat differently. Since the high voltage is also derived from the horizontal output amplifier, the tube gain cannot be varied to control the width, as it will affect the high voltage.

For instance, the Philco 48-1000 and similar chassis, featured a width control consisting of a pair of inductances with an adjustable powdered iron core; Fig. 2. To obtain a larger picture horizontally, it is necessary to have a means of increasing the amount of current fed into the horizontal deflection coils; to obtain a smaller picture, this current must be decreased. As the slug is varied, the inductance of coils L_1 and L_2 vary inversely. This is due to the physical location of the coils with respect to the position of the slug.

With the width control turned out counterclockwise, the slug will be centered in coil L_1, causing a greater inductive reactance, and, consequently, an increased opposition to the flow of current in the deflection coils. Since the slug is out of L_2 the reactance of the coil is lowered, and, since this coil is in parallel with the horizontal deflection coil, more current is shunted away from the deflection coils, resulting in a smaller picture. When the iron slug is turned clockwise, so that it is centered in L_2, the reactance of the coil increases, while the reactance of L_1 decreases, resulting in a larger picture.

In the Philco models 49-1040 and similar chassis, a more versatile control (Fig. 3) has been included and can be used to replace the older type control.

The arrangement of the coils is somewhat like the 48-1000, except that there is a link switching arrangement available, to short out portions of coils L_1 and L_2. With the link in the upper position, part of coil L_1 is shorted out, decreasing the reactance of that coil, and allowing more current to flow to the parallel network of L_2 and the deflection coil. Since the full amount of L_2 is in the circuit, the reactance of that coil is greater, causing most of the available current to flow through the deflection coils, thus increasing the width. With the link in the lower position, part of coil L_2 is shorted out, decreasing its reactance, and the entire length of L_1 is back in the circuit. The increased reactance of L_1 opposes the flow of current to the network of L_2 and the deflection circuit, cutting down the size of the picture. By combining the use of the link and the adjustable core, a much greater control of width may be obtained.

TV Tuning Drift Problems

A common cause of tuning drift in early Philco models was the discriminator transformer. This drift was severe only in the first few thousand sets with capacitor-tuned transformers.

Discriminator transformers[1] using inductive tuning were found to be the solution.

The major part of the tuning drift in the early models was traced to the heterodyne oscillator. To offset the oscillator drift, it was found necessary to change the 10-mmfd capacitor, from the grid to the oscillator to ground, to a temperature compensating type, and install an inductive tuning discriminator transformer. Otherwise, the short-time tuning drift becomes a problem since the compensation introduced by the capacitor will be in the direction opposite to the drift in the earlier type transformers. Severe cases of tuning drift warrant changing to these new

(*Continued on page 29*)

[1]Philco 34-4317.

Fig. 2. Another type of width-control circuit used in the Philco model 48-1000. T_1 is the horizontal output transformer and L_1 and L_2 are the width coils.

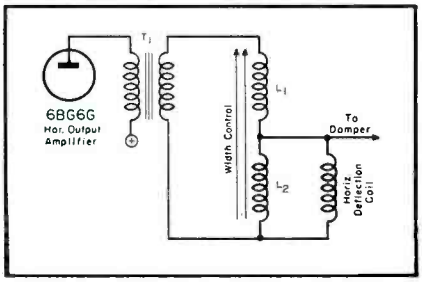


Fig. 1. A width-control circuit used in Philco model 48-700.

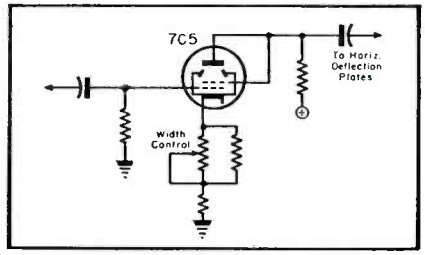
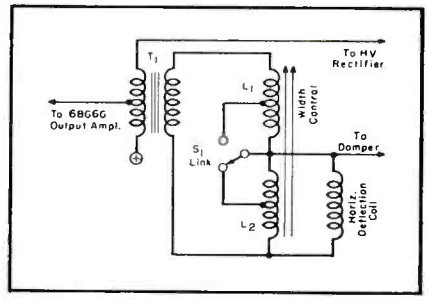


Fig. 3. A third type of width-control circuit, featured in the Philco model 49-1040. T_1 is a horizontal output transformer, L_1 and L_2 are the width coils and S_1 is an adjustable link which is used to short out portions of the L_1 and L_2 coils and thus control the reactance of the coil.



VIDEO

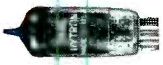

6AG5

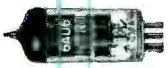

6J6


6AL5


6AU6

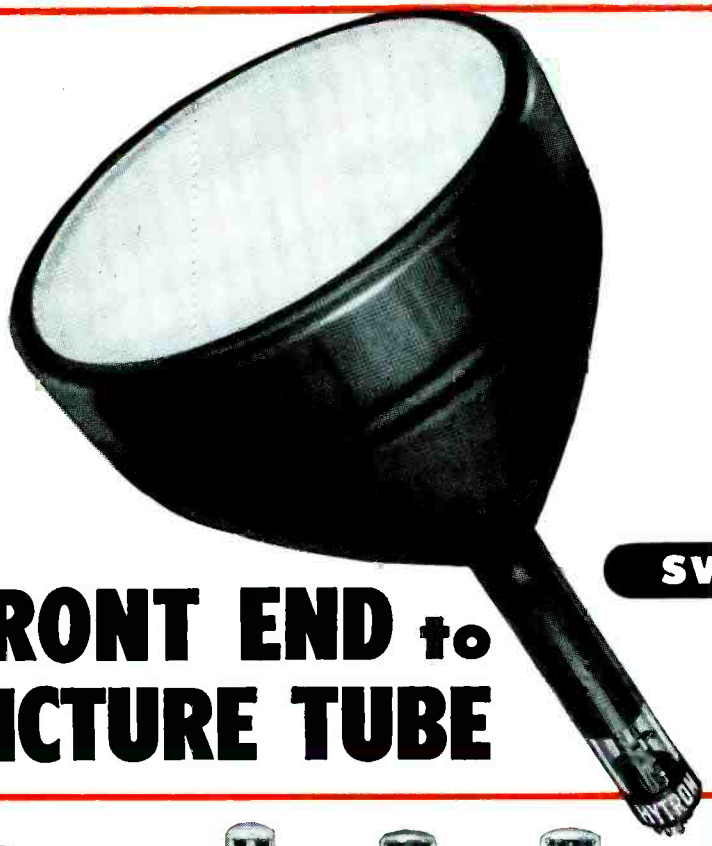
AUDIO


6BA6


6AU6


6AL5


6K6GT



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(*Continued from page* 14)

found to add to the adjacent channel rejection qualities of the set.

Sound Section

Three stages of sound *if* amplification are used in the receiver. The last sound *if* stage with a 6AU6 sharp cut-off pentode, acts as a limiter to remove amplitude modulation from the FM sound signal. As diode and audio driver amplifier the model uses the 9-pin miniature 6T8 which has been found to provide the same performance as the conventional 6AL5 diode and 6AT6 triode. A single 6K6 acts as audio output tube.

Picture Amplifier

The picture amplifier section consists of a 6AC7 pentode directly coupled to the second detector and to the picture tube, thus eliminating the need for a *dc* restorer. Because of the requirements of the keyed *agc* system, the picture signal at the plate of the 6AC7 must have positive polarity. Thus the sync pulses must go in a positive direction. A positive polarity signal must be applied to the cathode of the picture tube to cut off the electron beam during the retrace time. The grid of the picture tube is kept at a *dc* potential which is varied by a *brightness* control. Adjustment of this control sets the bias of the picture tube and therefore regulates the electron beam current and thus the brightness of the picture.

To vary the gain of the picture amplifier the screen of this tube is connected to a voltage divider consisting of R_{147} and the *contrast* control, R_{131}. Changing the screen voltage changes the plate current of the 6AC7 and therefore the amplitude of the picture signal. The range of the *contrast* control is so designed that it permits no overload and does not cut off the signal entirely.

The frequency response of this picture amplifier has been adjusted so as to give a flat curve with 4 mc at the half power point. The plate load resistance, a total of 5,100 ohms, has been split up into a pair of 3,300-ohm (R_{140}) and 1,800-ohm (R_{141}) resistors to provide a sync pulse source for the keyed *agc circuit*.

Sweep Circuits

The horizontal and vertical sweep circuits feature a 12AU7 dual triode which serves as clipper and phase inverter. The phase inverter section produces horizontal sync pulses of equal amplitude but opposite polarity, which are then coupled to a 6AL5 phase discriminator. A feedback sawtooth voltage is obtained from the *agc* winding on the width control and fed through R_{151} and C_{143} to the phase discriminator. This tube compares the phase and frequency of the sync pulse and the horizontal oscillator and generates a *dc* voltage which controls the bias and therefore the frequency of the horizontal oscillator.

The horizontal oscillator is one-half of a 6SN7 dual triode, and contains an *LC* tank circuit together with a resistance R_{166}, which results in a combination sine and square wave. The second section of this tube acts as a discharge tube and forms a sawtooth voltage which drives a 6BG6 horizontal output amplifier.

The vertical sweep circuits employ a single 6SN7 dual triode as blocking oscillator and output tube. Vertical sync pulses are obtained from the plate of a 12AU7 phase splitter and pass through an integrating network (R_{169} R_{100}, C_{101}, C_{102}, and C_{103}).

Performance Diagnosis

(*Continued from page 16*)

operating points for the 750-ohm cathode bias resistor. This can be done by taking a few values of bias and finding the values of plate current which produce this value of bias with a 750-ohm cathode resistor; this is plotted on the proper bias curve.

$$\textit{Point A} \quad I = \frac{-E_c}{R} = \frac{40}{750} = 53 \text{ ma}$$

$$\textit{Point B} \quad I = \frac{-E_c}{R} = \frac{60}{750} = 80 \text{ ma}$$

(3) A line is then drawn between these points. Where this line crosses vertical plate voltage we have the operating point. This point, I_o, is at –45 volts E_c, 250 volts E_p, and 60 ma I_o. To check this point we multiply 60 ma times 750 ohms and our answer is 45 volts bias.

(4) To obtain additional information a load line is drawn through the operating point with a slope of 1,750 ohms. Conventional load line procedure is used to do this. Since two points determine a straight line and one point is the operating point, a second point is obtained by assuming a plate voltage change. In the interest of simplicity this change was taken to be 250 volts to bring us down to the plate current axis.

$$\textit{Point Y} \quad \Delta I = \frac{\Delta E}{R} = \frac{250}{1750} = 142 \text{ ma}$$
$$+ 60 \text{ ma } I_o = 202 \text{ ma}$$

Thus loadline crosses plate current axis at 202 ma, which along with operating point permits plotting of load line YY'.

(5) Other information can be found using conventional formulas and procedures. Suppose we assume a 5-volt peak grid signal.

Power output

$$= \frac{(E_{max} - E_{min})\ (I_{max} - I_{min})}{8}$$

$$= \frac{(345 - 108)\ (142 - 6)}{8} = 4 \text{ watts}$$

$$\text{Voltage gain} = \frac{237}{90} = 2.6$$

Per cent second harmonic distortion

$$= \frac{\frac{I_{max} + I_{min}}{2} - I_o}{I_{max} - I_{min}} \quad \frac{\frac{142 + 6}{2} - 60}{142 - 6} = 10\%$$

Consideration of Transformer Resistance

If a high static current is drawn and transformer winding has an appreci-

(*Continued on page 28*)

(*Continued from page 27*)

able resistance it must be considered in locating the operating point. For example, if the circuit of Fig. 1*a* has a winding resistance of 250 ohms, the plate voltage line cannot be drawn vertically, but with a slope of 250 ohms, Fig. 2*b*. This is apparent when we consider that the only time it could be possible to apply 250 volts to the plate would be when plate current is zero. Plate voltage due to winding resistance becomes progressively less, with an increase in plate current. The actual decline is a function of a line with a slope of 250 ohms on the curve. One point is known as 250 volts on the plate voltage axis and the second point can be obtained by assuming a plate voltage change again.

Point A $\Delta I = \dfrac{\Delta E_p}{R_w} \quad \dfrac{25}{250} = 100$ ma

The corrected operating point can be located at a point where plate voltage line AB crosses the bias line; Fig. 2*b*. Thus at this new operating point P' all parameters, $-E_c$, E_p, and I_o, are a bit less.

Resistor Plate Load

In the *b* circuit of Fig. 1 the total resistance in plate-cathode-circuit is 2,500 ohms and therefore this total resistance must be considered in drawing the dynamic load line because of its effect on the *dc* component of plate voltage. In this circuit our first task also is to find the operating point:

(*1*) A plate load line of 2,500 ohms is drawn first. In the case of a resistor load, one point of the load line will always be the supply voltage at zero plate current, because the only time 400 volts could be applied to the plate would be with no drop in the load or zero plate current. This differs, of course, from the first example because, with a reflected load the operating plate voltage is the supply voltage and during an *ac* cycle the plate voltage swings above this value on positive alternation. With the resistor load this never occurs and operating plate voltage is always less than supply voltage by drop in load. To proceed, with one point located at plate supply voltage, a second is obtained by assuming a plate-voltage change. An assumed 400-volt change would locate the point on the plate current axis at $\dfrac{400 \text{ v}}{2{,}500 \text{ ohms}} = 160$ ma; line XX' should be drawn.

(*2*) A loci of operating points is next to be drawn, as per first example, line AB.

(*3*) Operating point is again at same position as per first example. It will be noted, however, that the plate supply voltage is considerably higher to obtain same operating point; *dc* drop across plate load resistor.

(*4*) Although the operating point has been found and a load line drawn, it is not the true output load line because the cathode resistance is present in it. The true dynamic load line is now drawn with a slope of 1,750 ohms, the operating point serving as one point already located. This true load line of course could not have been drawn without first locating the operating point to represent one point on its slope.

(*5*) The true load line with a slope of 1,750 ohms is the same as the line YY' drawn for the first example. Operation is quite similar except for higher supply voltage.

(*6*) If the supply voltage had been left at the same value as in the first circuit, this voltage of 250 would be

the supply voltage, and in case of the resistor load would be on the plate voltage axis, as shown in Fig. 2*b*. This would, therefore, locate one point on the load line and the second can be found by assuming a plate voltage change. We thus have a new operating point *P''* (where the new load line *BB'* crosses bias line), which is at a considerably lower plate voltage and bias point.

Consideration of Decoupling Circuit

In circuit *c* of Fig. 1, the supply voltage is fed through a decoupling circuit to the stage and therefore it must be considered, because of the influence it exerts on plate voltage, as a function of *dc* component of plate current. The procedure for locating the operating point is as follows:

(*1*) The total plate-cathode resistance to supply point is again 2,500 ohms and, therefore, it must again be used to draw the first load line which locates operating point. This is again line *XX'*

(*2*) The bias line *AB* is again necessary. Intersection of *AB* and *XX'* locates the operating point.

(*3*) The true operating output load line must now be drawn because only across the 1,250-ohm plate-load resistor is there an *ac* output variation. A constant *dc* component of voltage exists across the cathode and decoupling resistors. The true load line is drawn with a slope of 1,250 and the operating point serves as one point on its slope.

(*4*) From this line, output, distortion, etc., can be ascertained.

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Servicing Helps

(*Continued from page* 24)

parts. As a further step to improve oscillator stability the grids of the 6J6 were silver-plated to eliminate those cases where the oscillator *ran away* due to grid emission in the tube.

To compensate for the effects of tuning drift, Philco has a *channel adjuster* or *diadier* kit. The *channel adjuster* provides for manual control of the control voltage to the reactance tube in the oscillator circuit without completely disconnecting the *afc* system. It is thus possible to retune the oscillator manually when the signal is too weak to operate the *afc* system or when tuning drift causes the set to lose sound.

Increased correction range in the reactance tube has been obtained by changing the neutralizing capacitor between the grid of the reactance tube

(*Continued on page* 30)

(*Continued from page 29*)

and the grid of the oscillator from 3.3 to 2.2 mmfd, and thus increasing the reactance variation available. The increased range allows *afc* to operate over a greater range of oscillator drift.

Sync Trouble‡

Many service problems are the result of operating on weak signals. Sync troubles are especially prominent in the list of problems due to weak signals, but the other extreme is also undesirable. Locations very close to television transmitters may also have sync troubles.

Sync troubles near the transmitter usually fall into two general classifications; first, troubles due to multiple path reception, and second, troubles due to overload in the receiver. Troubles due to multiple path reception do not submit to any cut and dried procedure, although in most cases the chief repair is attenuation of the signal. In high signal locations antenna and lead-in combinations or locations may result in sync trouble. Attenuation of the signal by cutting one side of the antenna coil or installation of a pad often works. In some cases rerunning of the leadin or use of a shielded leadin becomes necessary.

The second cause of sync trouble on strong signals is much more common. As in the first case, attenuation of the signal often clears the trouble but this kind of repair sometimes does not produce a picture with satisfactory contrast or may cause too much *snow*. Overload on strong signals can be caused by excessive leakage in the *agc* line bypass. This circuit uses large capacity electrolytics to obtain the desired filtering for the system using resistors which are limited in value by other circuit considerations. What would be considered a very negligible leakage in any other circuit cannot be tolerated in the *agc* circuit if a strong signal is applied at the antenna. Capacitors for use in this circuit must have a leakage resistance of more than 500,000 ohms when measured with a meter having approximately 10 volts or less in the ohmmeter circuit.

There are often cases where there is no *agc* circuit leakage and no other fault, and yet sync trouble exists. A number of such cases have been reported with the Philco 1040, code 121. However, since provision has been made in the set to switch to manual gain control which permitted increasing bias on the *if* amplifiers to overcome the overload conditions which caused sync clipping or video feedthrough the trouble is not serious. If desired, sync clipping on strong sig-

‡From Philco service notes.

nals can be eliminated in this chassis, even in automatic gain operation, by moving the sync take-off point back to the detector. To avoid loading the detector, a 10,000-ohm isolation resistor should be connected from the detector output to the sync amplifier. This method is recommended only if all stations give enough signal to sync properly with the new take-off point.

Black Line—White Line Trouble

A problem of long standing in TV servicing is the *black line* and *white line* trouble. The trouble appears as one or more black or white vertical lines in the picture. It is most common on weak signals and on the higher channels but can also appear on the low channels. The cause is well established as being due to spurious oscillations in the 6BG6 tube.

Recently with the introduction of built-in antennas the problem received additional attention because it became more serious when the antenna was placed inside the receiver cabinet. Investigation indicated that in most cases the oscillation took place at the end of the return trace and that the time delay in passing through the receiver made the lines appear within the raster. A method has been devised for minimizing the spurious oscillations during the return trace by coupling opposing voltages in the output system to suppress oscillations.

This circuit is used in the Philco 50-T1400 and other models in this series. A 250-microhenry choke has been inserted in series with the 6BG6 screen, and the screen then coupled to terminal 5 on the sweep output transformer through a 100-mmfd. capacitor.

In a second method, used in the Philco 50-T1104 chassis, code 123, a parallel tuned circuit has been installed in series with terminal 4 of the sweep output transformer. The trap consists of a 470-ohm resistor, a 600-microhenry coil and a .0022 mfd. capacitor in parallel.

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Phono Installation

(*Continued from page* 18)

of tape travel, if tapes are to be interchangeably recorded and played on different machines. A small degree of misalignment of the playback head with the recorded signal can cause a serious reduction in output at the higher frequencies. Recorders are usually furnished with the record and playback heads properly aligned, both with respect to each other and with respect to the tape travel. Provision is made, however, on all machines for

(*Continued on page* 32)

(*Continued from page* 31)

adjustment of the heads in the field. One tape manufacturer has made available a standard head alignment tape which will enable adjustment of the heads to be made within ±1½ minutes of arc at a wavelength of .001", which corresponds to 15,000 cycles at 15" per second. A head misalignment of 10 minutes of arc will cause a 6 db reduction in output at the 15,000-cycle point. This effect is less serious at lower cycles under foregoing conditions. It is recommended that regular checks using a standard head alignment tape be made as part of a routine checking procedure.

All of the professional recorders produced in this country are driven by synchronous motors, so that the speed of the tape should be independent of line voltage fluctuations; however, if the recorder has been designed to use the full rated power of the drive motor at rated voltage, serious speed variations may occur at lower line voltages, since some types of synchronous motors, when operated at reduced voltage, will lose synchronism and run as straight induction motors.

Large variations in line voltage may have even more serious effects on the performance on the rest of the system. Optimum recorder design utilizes voltage regulator tubes to stabilize the voltage supply to the amplifier and bias oscillator tubes. Such regulator tubes usually have a fairly critical regulating range and abnormally low line voltages will often result in loss of control of the regulator tubes and serious reduction in supply voltage to the bias oscillator. Line voltages varying from 95 to 125 are commonly encountered in field use and can produce a bias current change greater than 2 to 1. A bias change of this magnitude can produce a serious alteration in high-frequency response and may have a marked influence on the amount of harmonic distortion produced.

Recorders which employ slipping friction clutches to control the tape tension are subject to variations in performance due to wear or contamination of the friction surfaces. Satisfactory checks of such equipment can usually be made with a small spring scale, which can be tied to the free end of tape on a full tape reel. A spring scale having a maximum capacity of 16 ounces can be used. In use, the reel can be placed on a friction driven winder spindle and the stalled tension thus measured. Tape can be pulled off the reel at a slow rate by means of the spring scale when the reel is placed on a stationary unwind spindle.

Wear on both the record and playback heads may be expected, although most recorders are designed so that a minimum life of several hundred hours is obtained. The effects of wear on a record head are rather complex. One effect is to reduce the cross-section area of the magnetic material at the pole tips, so that saturation of the magnetic material at this point results. Such saturation may have two secondary effects: First, spreading the recording flux over a wider area, and second, introduction of third harmonic distortion in the recorded signal. The net effect of spreading the recording flux would be to introduce a loss of signal at the higher frequencies. Where appreciable wear can be visibly noted, a new record head should be installed. The worn heads must then be returned to the manufacturer for examination. A record head may be checked by a high power microscope examination of the magnetic pattern recorded on the tape, but the process is usually too complex for normal application.

TV Production Changes

(*Continued from page 22*)

amount of this bias influences the pull-in sensitivity of the system. A voltage divider consisting of resistor R_{401} and R_{386} is connected to the grid of the sine-wave oscillator (which is a good source of bias voltage), and the resistance value of R_{380} is selected to provide the optimum bias.

Discriminator

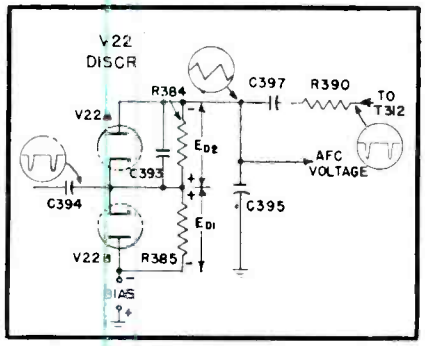
The discriminator, consisting of tube sections, V_{22A} and V_{22B}, and their associated components, is used to develop a *dc* correcting voltage by comparing the phase between the output sawtooth waveform and the incoming horizontal sync pulses.

The sync pulse is negative-going, as applied through C_{394} to the discriminator diodes. The tube sections conduct as peak rectifiers and develop voltages of equal magnitude across R_{384} and R_{385}, but of opposite polarity, as shown in Fig. 5.

Because of this condition no voltage can be developed across C_{395} by virtue of the sync pulses alone. It will be noted, from Fig. 1, that any voltage developed across C_{395}, will be applied as bias to the sine-wave tube.

From the sweep output transformer, a waveshape having the frequency and phasing of the horizontal sweep generator is applied across capacitor C_{393} through the resistor R_{390}. Integration of the output waveshape takes place at C_{395} with the resultant that the voltage across it is a sawtooth waveshape with a frequency and phase of the sweep generator. Thus across R_{384} and R_{385} appear not only a sync pulse voltage, but also a sawtooth voltage. The sync pulse has about twice the amplitude of the sawtooth waveshape. The sawtooth voltage across R_{384} is equal in magnitude and polarity to that across R_{385}. Since each diode operates as a peak rectifier, they produce a *dc* voltage across the load resistors, R_{384} and R_{385}, which is equal to the peak value of the composite pulse and sawtooth waveshapes applied.

Fig. 5. Discriminator circuit.



ASSOCIATIONS

RTG, New England

A RECORD attendance prevailed at the annual outing of the Whaling City Chapter of the Radio Technicians' Guild in New Bedford, Massachusetts. A feature of the outing was a softball game and an impromptu lecture by Al Saunders.

At a subsequent meeting of the Guild, municipal regulations governing the installation of TV antennas in New Bedford were discussed. Representatives of the RTG, who played a major role in preparing the code, which may be adopted soon, disclosed that these regulations represent the first attempt of a city in Massachusetts to control such installations.

FRSAP

THE POSSIBILITIES of guilds, licensing or unionization were discussed at a recent meeting of the Federation of Radio Servicemen Associations of Pennsylvania. Robert Riedy, vice chairman of the Federation, is in charge of a seven-man committee considering the choice of each of the three organization controls.

TEN YEARS AGO

From the Association News Page of SERVICE, November-December, 1939

TWENTY-FIVE CHAPTERS participated in the NAB-RSA promotional program to better service business. . . . A radio Christmas promotion was initiated at this time, too, members of RSA checking up and repairing receivers, in the various chapter cities, for presentation to the local charities, who planned to distribute them during Christmas week. . . . A guarantee service plan was introduced to guarantee the work of individual Service Men and protect the public from unscrupulous operators. . . . Joseph Tallman was named president of the Amsterdam chapter of RSA. Samuel English became secretary and A. R. Kindl, treasurer. . . . Orville C. Mason was named president of the Minneapolis chapter, Arthur Lane becoming vice president and Sears Milnor, secretary-treasurer. . . . Leon Podolsky of Sprague Products Company lectured before the Boston chapter on capacitors and resistors. . . . Dave Krantz was chairman of the technical committee of PRSMA.

Members of the Whaling City Chapter of the Radio Technicians' Guild at their annual outing.

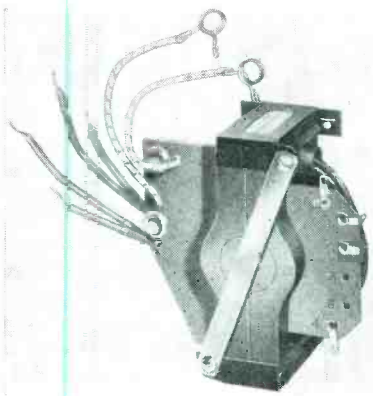
New TV Parts . . . Accessories

STANCOR TV TRANSFORMERS

Three horizontal deflection output and high voltage transformers have been announced by Standard Transformer Corp., 3580 Elston Ave., Chicago 18.

Included are the A-8119, an exact duplicate of RCA type 211T5, for use with the 16AP4 and similar picture tubes; A-8127, an exact duplicate of RCA type 211T3, for use with the 10BP4, and the A-8128, designed to fill the need for a transformer between the 10" and 16" sizes and also for use in converting a smaller receiver to a 16" receiver.

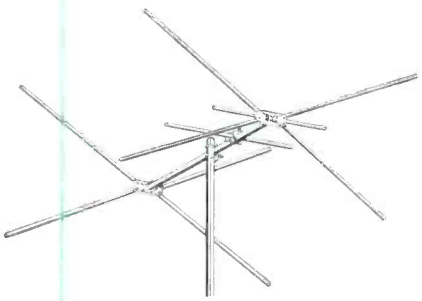
Complete description and prices available in bulletin DB3-354.



* * *

INSULINE BI-CON TV ANTENNA

A modified conical type antenna, with separate high-frequency and low-frequency reflector elements, the *Bi-Con,* has been developed by the Insuline Corporation of America, Long Island City, 1, N. Y.



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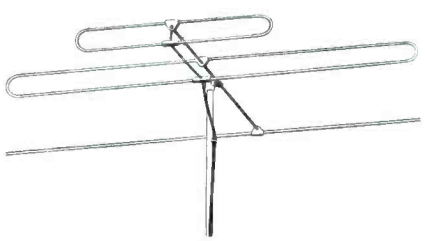
C-D TV ANTENNAS

Five TV antenna types, the *Skyhawk Strate-Line* series, with hi-lo band coverage of channels 2-6 and 7-13, have been produced by Cornell-Dubilier Electric Corp., South Plainfield, N. J.

One model, 85X, has an 8-foot mast, a phase line, 6 standoffs, and a base mounting bracket; model T85X is similar except that it has a 60" transmission line.

Model 85XAX is a double stacked 85X with feeder bars, 6 standoffs, an 8-foot mast, phase lines, and base mounting bracket; T85XAX is the same model, plus 60" transmission line.

The fifth unit is K85X, with a single 85X bay, feeder bars and *U* bolt mast bracket for converting single to double stack.



CLAROSTAT TV BALLAST REPLACEMENTS

Five TV ballast replacement numbers have been announced by Clarostat Mfg. Co., Inc., Dover, N. H.: Emerson 397022 and 397023, Motorola 17A485459, Teletone TPR 102D, and Belmont B9M 16067.

* * *

RAYTHEON PULSE TRANSFORMERS

A line of pulse transformers for use in driver circuits as blocking oscillator or interstage units, has been announced by Raytheon Manufacturing Co., department 6460-NR-2, Waltham 54, Mass.

A chart, DL-K-315, with complete data on the most popular of Raytheon's pulse transformer designs is available upon request.

RMS TV PREAMP

A TV preamplifier, SP-4, which has been approved by the Underwriter's Labs, has been announced by Radio Merchandise Sales, Inc., 550 Westchester Ave. N. Y. 55.

Preamplifier features individually shielded input, output and power sections. Entire unit is said to be further shielded against outside and TV receiver interference.

Shock hazard is said to be eliminated by use of an isolation-type transformer.

Both the input and output of the preamplifier are iron-core tuned to resonance with the desired frequency. Coils are wound with flat ribbon.

* * *

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933.

Of SERVICE, published monthly at New York, N. Y., for October 1, 1949.

State of New York } ss:
County of New York }

Before me, a notary, in and for the State and county aforesaid, personally appeared B. S. Davis, who, having been duly sworn according to law, deposes and says that he is the Business Manager of SERVICE, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, to wit: 1. That the names and addresses of the publisher, editor, managing editor, and business manager are: Publisher, Bryan Davis Publishing Co., Inc., 52 Vanderbilt Avenue, New York 17, N. Y.; Editor, Lewis Winner, New York, N. Y.; Managing Editor, None; Business Manager, B. S. Davis, Ghent, N. Y.; 2. That the owners are: Bryan Davis Publishing Co., Inc., 52 Vanderbilt Avenue, New York 17, N. Y.; B. S. Davis, Ghent, N. Y.; J. C. Munn, Union City, Pa.; A. B. Goodenough, Port Chester, N. Y.; P. S. Weil, Great Neck, N. Y.; F. Walen, Teaneck, N. J.; G. Weil, Great Neck, N. Y.; L. Winner, New York, N. Y. 3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgagees, or other securities, are: None. 4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, 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 is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief 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; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) B. S. DAVIS, Business Manager.

Sworn to and subscribed before me, this 14th day of September, 1949.

(Seal) NATHAN JELLING,
Notary Public.

Commission expires March 30, 1950.

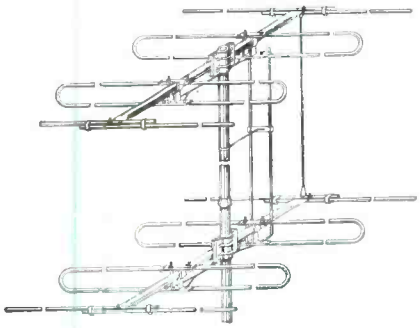
TACO TWIN-DRIVEN YAGI

A twin-driven type yagi is now being made by Technical Appliance Corporation, Sherburne, N. Y.

Physically, the yagi, a low-band system, is made up of two 300-ohm folded dipoles and two parastic elements on one horizontal crossarm. Instead of the conventional yagi whereby energy for the director elements is transferred by mutual coupling from the one driven element, this antenna has a director system which is fed with a transmission line from the main driven element.

Gain may be increased through the use of a stacked array of this antenna.

Jiffy-rig construction is used.



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JFD TWINLEAD LIGHTNING ARRESTER

A twinlead lightning arrester, *safeTV-guard,* has been announced by the JFD Manufacturing Co., Inc., 6101 Sixteenth Ave., Brooklyn 4, New York.

Arrester, Underwriters' Laboratories Approved, can be installed on a mast, grounded pipe, wall or window sill and other flat surfaces. Twinlead is slipped into the horizontal slot on top of the arrester and tightened in place by a pair of cap nuts and toothed washers.

Discharge contacts are sealed in rare gas tubes to dissipate charges that may cause damage. Glazed porcelain construction. Hardware is solid brass and nickel-plated.

* * *

GORDON TV FILTER

A filter that is said to eliminate TV screen glare and intensify picture contrast by blocking out unwanted light, has been announced by J. M. Gordon Laboratories, 437 Tenth Ave., New York 1. Has self-adhering press-on feature along the edges. Viewing area is said to be rigid and will not react or adhere to the screen under any conditions.

ERIE RESISTOR RESCO MEETING

At a recent Radio Electric Service Corp. store managers' meeting in Philadelphia, where J. K. Poff, manager of Erie Resistor Corp. distribution sales department, delivered a talk. Among those in attendance, left to right, front row: George Scarborough, L. D. Lowery, Inc., manufacturer's rep.; John Stern, Resco owner; J. K. Poff. Standing, left to right, back row: Larry Oebhecke, manager Germantown Ave., store, Philadelphia; A. Regan, export manager main store, Philadelphia; R. Kammel, assistant manager, Easton, Pa., store; N. Steedle, manager Allentown and Easton, Pa., stores; J. Goldstein, manager, West Philadelphia store; J. Berman, manager, Camden, N. J., store; A. Kass, general manager; G. Hautenschild, purchasing agent; and S. Furman, manager Wilmington, Delaware, store.

RAYTHEON TV TUBES

Two new TV tube types, the 1X2 and the 6BQ6GT, has been announced by Raytheon.

The 1X2 is a filament type rectifier of miniature construction designed for use as a high voltage rectifier. It can be used in *rf*, flyback, and power line frequency types of rectifier circuits.

The 6BQ6GT is a beam pentode for use as a horizontal deflection amplifier. Employs a T-9 bulb, and a standard octal base. Plate connection is made through a top cap.

* * *

AEROVOX METALLIZED-PAPER MINIATURIZED TUBULARS

Metallized-paper tubular capacitors in cardboard tubes, Aerolite type P'82, have been announced by Aerovox Corporation, New Bedford, Mass.

Aerolite construction is said to eliminate metal foils used in conventional paper capacitors; high-purity paper tissues are coated with a thin film of metal (½ to 1 millionth inch thick) under high vacuum. Weak spots and particles are said to be *burned out* or isolated in the insulation.

Standard capacitances are from .01 to 2 mfd, and voltages of 200, 400 and 600 *DCW* at the start. The 2-mfd 200-volt type measures 23/32" diameter by 1⅝" long.

* * *

STANDARD COIL TV BOOSTER

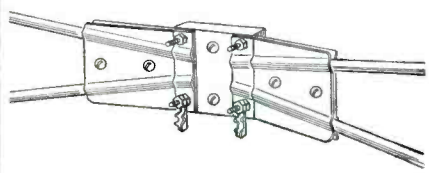
A one-tube printed-circuit TV booster, featuring 2-knob control (one-knob controls a 3-position switch that turns on the TV set only, or the TV set and booster) and continuous tuning which eliminates a switch from high to low channels, has been announced by Standard Coil Products Co., Inc., 2329 N. Pulaski Rd., Chicago 39; 2901 E. Slausson Ave., Huntington Park, Calif. Adaptable to either a 300 or 75-ohm line.

* * *

TELREX CONICAL V BEAM ANTENNAS

A conical V-beam antenna line, the *Special Series*, has been announced by Telrex Inc., 26 Neptune Highway, Asbury Park, N. J.

Models available include S1X-BD, S2X-BD, S2X-TV and S4X-TV.



Telrex special element mounting assembly.

New Parts, Accessories

IRC Q REPLACEMENT CONTROLS

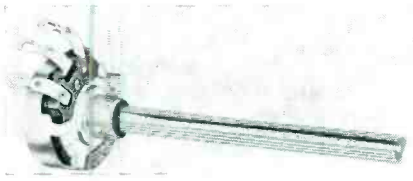
A line of 59 15/16" Q controls with knob master fixed shafts for TV, AM and FM replacements has been developed by the International Resistance Co., 401 N. Broad St., Philadelphia, Pa.

Knurled, flatted and slotted, the shafts are said to be so proportioned that they fit at least 90% of the ¼" shaft knobs—knurled, spring-type, flat or set-screw—without any alteration except cutting to length. Shafts may be split lengthwise and the ends spread for fitting to oversize or worn knobs; 3" long from mounting face of control.

Controls also feature an interchangeable fixed shaft, with a special resilient retainer ring, which is said to permit rapid removal of the fixed or permanent knob master shaft and replacement with any of 11 special fixed shafts.

Major external parts—covers, shafts, ground plates and bushings—are nickel-plated. Outer terminals are tinned and switch terminals silver-plated.

Operating at ½-watt power rating, Q controls are available plain or tapped in a wide selection of values. Free catalog DC1 is available.



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G. E. TWIN STYLUS VARIABLE RELUCTANCE CARTRIDGE

A twin stylus variable reluctance phonograph cartridge, model RPX-050, capable of playing conventional and microgroove records, has been announced by the receiver division of G. E.

Changing from one stylus to the other is accomplished by depressing and turning a knob on the top of the cartridge, which projects through the tone arm of the player.

Twin stylus assembly is replaceable as a unit with sapphire tips having one and three mil tip radii. Stylus pressure with either stylus is eight grams.

The new cartridge is the same in size as present models featuring the replaceable stylus.

* * *

SYLVANIA TUBES

Three tubes, including an *af* amplifier; *rf* amplifier for TV, and a horizontal deflection amplifier have been announced by Sylvania Electric Products, Inc.

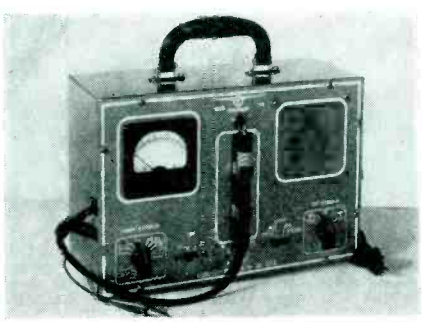
Audio amplifier, type 12AY7, is a T6½ miniature, medium-mu duotriode particularly suitable for the use in the first stage of *af* amplifiers. Supplied with a center-tap heater for use with 6.3 or 12.6-volt source.

The *rf* amplifier, type 6BC5, is a T5½ miniature sharp cut-off pentode having high mutual conductance. Tube is listed as an equivalent of 6AG5.

The horizontal deflection amplifier, type 6BQ6GT, has been designed for transformer operated sets where high peak interelectrode voltages are encountered.

RCP SIGNAL TRACER

A signal tracer, model 777A Dynatracer, has been announced by Radio City Products Co., 152 West 25th Street, N. Y. 1.



Uses a 6AU6, 6AT6, 6AQ5 and 6X4.

Attenuation is 10,000 to 1 by means of ladder attenuator with vernier control. Sensitivity is 10,000 microvolts for full scale deflection of meter or 200 microvolts per division.

Frequency range covers approximately 160 mc.

A jack is provided for testing microphones and pickups. Automatic control switch permits either speaker or meter to be used alone or together or standby.

* * *

WILLARD FLAT B BATTERIES

A flat-pack, 90-volt *B* battery has been announced by the Willard Storage Battery Co., Cleveland, Ohio.

Batteries feature flat cells inserted in a plastic jacket, clamped with a metal band and sealed into a polystyrene container.

TRANSVISION 5" 'SCOPE

A 5" 'scope, model 450A, has been announced by Transvision, Inc., New Rochelle, N. Y.

Vertical amplifier response to 1 mc; sensitivity, .15 *rms* volt/inch; horizontal amplifier, 2 cycles to 500 kc. Decade attenuators are frequency compensated. Z axis input. Direct connection to deflection plates. Calibration test signal. Push-pull amplifiers on horizontal and vertical. Three stage amplification on both. Sweep frequency to 50 kc.

Tube complement: vertical amplifier, two 6SN7; horizontal amplifier, two 6SN7, and 5Y3, 2X2 and 5BP1; 884 sweep generator.

* * *

UNIVERSITY TWEETER

Tweeters employing a cobra horn, models 4408 and 4409, have been announced by University Loudspeakers Inc., 80 South Kensico Ave., White Plains, N. Y.

Bakelite diaphragms, Alnico V magnets, aluminum voice coils and featherweight phenolic varnishes are used. Used with an efficient cone speaker, the 4408 is said to be able to handle up to 15-20 watts of program material; 4409 full undistorted output of 25-40 watt amplifiers.

Response, 600-15,000 cps; impedance, 16 ohms; dist. area 40° × 80°; dimensions, 5¾" h, 7⅜" w, 11⅛" d.

* * *

BELDEN ANTENNA CONTROL CABLE

A 4-conductor antenna control cable has been announced by Belden Manufacturing Company, Chicago, Illinois.

Designed primarily as a motor leadin cable for antenna rotating devices requiring four conductors.

Type 8484, four-conductor antenna control cable is a No. 20 AWG, cable with seven strands of No. 28 tinned copper wire, .010" wall vinyl plastic insulation.

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C-D TO EXHIBIT AT CLEVELAND NEDA SHOW

L. B. Calamaras, NEDA; Ken Burcaw, C-D sales manager and William Many, advertising manager of Cornell-Dubilier, selecting booth space in the Cleveland Auditorium where the 1950 radio parts distributors' convention will be held.

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Ser-Cuits

(*Continued from page 20*)

amplifier and 6V6GT power amplifier. These two stages provide the necessary audio power to drive the speaker. The circuit is conventional.

Radio-Phono-Television Model Audio Amplifiers

Television combination models use a push-pull audio system in place of the single-ended system used in the straight television models. A 6SJ7 functions as a voltage amplifier and a 6SQ7 as a phase inverter.

A pair of 6K6GTs are used in a cathode biased push-pull power amplifier stage.

Video IF Amplifiers

Three stages of 6AU6 transformer coupled, stagger-tuned video *if*, use three self-resonant, slug-tuned transformers (T_{301}, T_{302} and T_{303}) as coupling devices between stages. Two accompanying sound traps are provided within the *if* sub-chassis. A trap is inductively coupled to T_{301} and serves as the sound take-off point and audio absorption trap. A second trap is slug-tuned to parallel resonance at 4.5 *mc* and comprises part of the video detector load. This trap offers a high impedance to sound voltage (intercarrier beat) appearing at the detector and prevents it from being passed on to the video amplifier grid. Automatic gain control bias developed across a 100,000-ohm resistor, R_{308}, is supplied to the control grids of the first two 6AU6s through *RC* decoupling networks.

Video Detector

The video detector diode (one-half of a 6AL5) connections are such as to obtain a positive picture phase across the diode load. Since one phase reversal occurs in the 6AC7 video amplifier positive picture phase at the picture-tube grid is achieved by feeding the picture-tube cathode from the plate of the 6AC7. Series peaking is accomplished by L_{302} and a flat response is thus obtained over the entire video frequency range. A 10-mmfd capacitor, C_{312}, serves as the usual *rf* bypass and removes the video *if* carrier from the detected video signal. The detector load is direct-coupled to the 6AC7, video amplifier.

[To Be Continued]

NEWS

SNYDER TV CATALOG

A TV antenna catalog, covering the Redi-Mount series of antennas, as well as the Head-Line group, plus the Tele-Port indoor models and Redi-Mount TV accessories has been published by Snyder Manufacturing Co., 22nd and Ontario Streets, Philadelphia 40, Pa.

Catalog requests should be addressed to Dick Morris.

* * *

ACA TWIN-TRAX TAPE RECORDER CATALOG

A 16-page catalog, which illustrates and describes magnetic type recorders, has been published by the Twin-Trax Division, Amplifier Corp. of America, 398-31 Broadway, N. Y. C.

Discussed are table and portable models operating at the standard tape speeds of 7½, 15 and 3¾ inches per second. Basic mechanical chassis and variable tape speed compensated amplifier data are included.

* * *

AL FRIEDMAN JOINS RMS

Al Friedman, formerly with the J. F. D. Manufacturing Co., as chief engineer, consultant, and field sales engineer, has been named chief engineer of Radio Merchandise Sales, Inc., 550 Westchester Ave., New York 55.

Al Friedman

* * *

MUELLER DESCRIPTIVE PRICE TAGS

Descriptive price tags covering the jobber line of clips, insulators, ground clamps, *tenna-clampipes tenna-clamps,* and snappers have been sent to distributors by the Mueller Electric Company, 1583 East 31 St., Cleveland 14, Ohio.

PYRAMID ELECTRIC NAMES REPS

Henry W. Burwell, John O. Olsen, and James P. Hermans, former Solar reps, are now representing Pyramid Electric Co., 155 Oxford St., Paterson, N. J.

Henry W. Burwell of Atlanta, Georgia, will cover North Carolina, South Carolina, Tennessee, Georgia, Alabama, Mississippi, Florida, and Virginia; John O. Olsen, Cleveland, will cover West Virginia, Ohio, Kentucky, Western Pennsylvania and Maryland; and James P. Hermans, San Francisco, will cover northern California.

* * *

STOTTS AND FRIEDMAN OPEN STORE

A new distribution center has been opened by the Stotts Friedman Co., 620 South Main Street, Dayton 2, Ohio.

Standard brands of radio and TV parts and accessories have been stocked.

Co-owners of the new enterprise are Ray Stotts and Harry Friedman.

* * *

SUN RADIO NOW STOCKING PEERLESS TRANSFORMERS

Sun Radio and Electronics Co., Inc., 122-24 Duane St., N. Y. C., has been named exclusive distributor of Peerless transformers in the New York metropolitan area, which includes Westchester County, Northern New Jersey and Long Island.

Transformers are made by the Peerless Electrical Products Division of Altec Lansing Corp.

Samuel Gerard, Sun Radio general manager.

* * *

RODRIGUEZ JOINS SHELDON ELECTRIC

A. E. Rodriguez is now with the Chicago office of the Sheldon Electric Division of Allied Electric Products, Inc., 426 South Clinton Street.

* * *

EPL IN NEW BUILDING

Electro Products Laboratories has moved to a new plant at 4501 North Ravenwood Ave., Chicago 40, Ill.

* * *

KAMEN COAX ARTICLES IN DECEMBER

THE CONCLUDING installment of the Ira Kamen paper on coax installation techniques will appear in the December issue of SERVICE.

•

CHICAGO PARTS SHOW PREPARATIONS

William O. Schoning, president of the '49 show; Kenneth C. Prince, show manager and Jerome J. Kahn, president of the Stevens Hotel '50 event (left to right) with brochures and display space contracts now being mailed to members of the co-sponsoring associations. At right, Emily Lazar and Margie Kirby of the show staff.

Selenium Rectifiers

(*Continued from page* 12)

put, the unit would be good. A reading of 11-12 ma *dc* would indicate poor reverse quality, while higher readings would point out the stack as bad.

An alternate circuit for grading rectifier reverse quality is shown in Fig. 6.

For this circuit it is necessary to have a 60-cycle voltage source that will supply 250 *v ac* at 10 ma. This may be accomplished, for instance, with a step-up transformer which has a 117 *v* primary, such as a plate-voltage transformer. The voltage E_{ac} may be controlled by means of a suitable potentiometer or variable autotransformer connected to the primary as shown. Only one plate of the 6X5 is to be used in this circuit. Stack connection polarity is important; the alloy of the rectifier should be connected to the cathode of the 6X5.

The operating procedure for this test is essentially the same as for the circuit of Fig. 5. Indication of a good rectifier reverse is given by a *dc* milliammeter reading of 10% of stack rated load current or less, with an impressed voltage of 250 *ac*.

Forward Voltage Drop: Grading of the voltage drop across a selenium rectifier due to internal forward resistance at approximate load current may be accomplished with the circuit of Fig. 7.

The common 6.3-volt filament transformer may be most convenient for supplying this circuit with power. In all cases, the transformer of highest current rating available should be used, since it is necessary that the internal resistance of the secondary be as low as possible. Input voltage should be made variable by suitable means as suggested previously.

Input test voltage for this forward grading circuit is 6 *v ac*. Good forward quality in a selenium rectifier is indicated by a *dc* milliammeter reading of 90% rated stack load current or greater. Current readings below the proper value for each particular size rectifier indicate that the stack has aged or that the alloy area has been seriously reduced by excessive blowout patches.

It should be noted that the foregoing test circuits and procedures serve merely as a general guide to the quality of a receiver type selenium rectifier; the best evaluation of selenium stack quality is obtained with the rectifier actually operating in its intended power supply circuit. Limiting conditions are then dictated largely by the par-

(*Continued on page* 46)

Symptoms	Possible Trouble	Test and Repair Procedures
(*1*) Sparking on plate	Deformed rectifier	If slight crackling occurs upon first turning set on after long inoperative period, power should be allowed to remain on. The stack should quickly reform. If the sparking is severe, the power should be turned off, the stack isolated and the reverse grading circuit and procedure applied. If sparking persists the rectifier should be replaced.
(*2*) No output *dc* voltage:		
(*a*) Series resistor intact	Open stack	Test for *ac* voltage between negative stack lug and (*B*–). Test for *dc* voltage between positive stack lug (*K*) and (*B*–). If with *ac* input to the rectifier, no *dc* voltage appears at the output, the stack is open and should be replaced.
(*b*) Series resistor burned out	Bad capacitor Shorted load Stack breakdown	Isolate and check rectifier stack for damage: Continuity. Reverse leakage test (to safeguard filter). Forward drop test. Replace series resistor and rectifier (if necessary). Check for shorted load circuit or filter.
(*3*) Low *dc* output:		
(*a*) Weak audio output	Excessive stack forward drop	Isolate and test rectifier for forward drop. If drop is excessive, stack should be replaced.
(*b*) Hum in loudspeaker	High stack reverse	Isolate and perform reverse leakage test on stack. If rectifier does not reform the unit should be replaced.
Warm electrolytic	Leaky electrolytic	Check effect of filter by disconnecting negative lead from (*B*–) and observe behavior of *dc* output voltage between stack terminal (*K*) and (*B*–) as the filter lead is momentarily touched to (*B*–). Voltage should increase noticeably as the filter is reconnected.
Very hot series resistor	Excessive load current	
Rectifier plates very hot		External load circuit should be checked for possible partial short.

Table 1 (left)
Tabulation of trouble shooting data

(*Continued from page* 45)

ticular circuit; a rectifier may be judged by output voltage and ripple values obtained under normal circuit operating conditions. If the prescribed output voltage and ripple ratings are met, with the stack running at not more than 30° *C* temperature rise above ambient temperature, the unit may be considered good. If rated conditions are not obtained in a circuit whose components have been carefully checked, the rectifier should be replaced. Inspection should be made for possible causes of rectifier deterioration, since under normal operating conditions, a selenium stack should last the life of the receiver.

Troubleshooting Methods for the Half-Wave Circuit

In servicing a faulty receiver power supply which employs a selenium rectifier, it will become necessary to isolate the stack electrically. This may, of course, be accomplished by unsoldering one rectifier terminal connection; however, there is another method which, once learned, may prove quite convenient for isolating the stack from shunting circuit components. The following procedure will disconnect the negative terminal of the rectifier from the rest of the power supply circuit in a great majority of transformerless (half-wave) power supplies used in *ac/dc* table model or *ac/dc*/battery portable receivers:

(*1*) With the line cord plug out of the power socket, the *on-off* switch should be turned to the *off* position. If the receiver is a 3-way portable model, the power selector switch should at the same time be kept in the *ac-dc* position.
(*2*) All tubes should be removed if convenient, or the nearest series filament tube to the ungrounded line should be removed.
(*3*) The pilot lamp should then be removed.
(*4*) If the set has a phono motor, the motor power switch should be turned to *off*.

Connection may then be made directly across the isolated rectifier stack terminals.

Servicing procedure for selenium rectifier power supplies is very similar to that for circuits using rectifier tubes. In table 1 appears a tabulation of troubleshooting data for the common half-wave receiver power supply circuit shown in Fig. 3. Analysis and procedure is based upon a normal *ac* or *dc*

line input to the receiver, and upon normal ambient temperature about the rectifier. The general continuity, forward, and reverse tests which have been described in detail may be used where suggested in the tabulation.

Care and Replacement Techniques

Although the selenium rectifier is quite rugged, there are a number of precautions which should be considered in insuring long life and satisfactory operation of the unit in a radio set:

(*a*) During the process of soldering the rectifier terminals to circuit wires, the heated soldering iron and solder should not be brought in contact with the plates, nor should the iron be applied to the terminals for long periods of time. Extreme heat may melt the alloy or damage the stack.

(*b*) In mounting the unit under a chassis, the plates should be kept in a vertical plane, and provision made for adequate ventilation.

(c) Under no conditions should the selenium rectifier be painted in the field without consultation with the manufacturer, since certain paints have adverse effects on the selenium stack characteristics.

(*d*) Mercury vapor is extremely detrimental to selenium rectification properties; care should be taken so that mercury vapor tubes are not broken near a selenium stack, and that no mercury globules be allowed to remain in the vicinity of the unit. By and large, however, the rectifier stack requires no attention once it has been installed and used, if normal operating conditions prevail.

Not only has the selenium rectifier earned a niche in the construction of radio and TV receivers, but it is being increasingly employed in other applications. Thus, familiarization with the general characteristics and performance qualities of the selenium cell and stack may help not only in dealing with the specific circuits discussed, but with the other uses of the rectifier as well, should they be encountered in the future.

Credits

The author is grateful to G. V. Smith, design engineer, and J. Loebenstein, sales manager of Radio Receptor, for their aid in preparing and editing this paper.

JOTS AND FLASHES

THE ULTRAHIGHS, which now appear to have little chance of commercial adoption before 1950, and then *perhaps* the latter part, are unfortunately being advertised by too many set manufacturers as an immediate possibility, requiring little modification or conversion work. Previous and present work in *uhf* indicate that there is no simple way to adopt those turret tuners as the advertised copy now stipulates. Nor are *uhf* adapters easy to apply. The ultrahighs, critical in behavior, demand close crystal control with special circuitry and particularly careful installation to assure consistent, stable pickup performance. . . . Lafayette Radio, 100 Sixth Avenue, New York 13, New York, have released a radio and TV catalog which includes data on receivers, PA systems, parts and tools. . . . An all-glass rectangular TV picture tube has been announced by the American Structural Products Co., a subsidiary of Owens-Illinois Glass Co., Toledo, O. . . . The G. E. parts section has released a 52-page replacement parts catalog for their radio and TV receivers. . . . Ab Waxman is now general manager of the Wireway Corporation of America, 1331 Halsey Street, Brooklyn 27, New York. . . . Joseph B. Elliott, vice president in charge of RCA Victor consumer products, told the fourteenth conference of the National Association of Electrical Leagues at a luncheon in Cleveland that TV means more to the electrical industry than any business which has emerged during the past two decades. . . . Raytheon Manufacturing Co. has transferred the merchandising of its mobile radiotelephone from the Belmont Radio Division, Chicago, to its main plant at Waltham, Mass. . . . James Lansing, president of the James B. Lansing Sound, Inc., died recently at his ranch in San Marco, Calif. . . . The NEDA Convention and Exhibit will be held in Cleveland, August 27 to September 1, 1950. . . . O. F. Martin, 17 East 42 St., N. Y. C., has become a manufacturers' rep for the Cannon Electric Company, 3209 Humboldt Street, Los Angeles 31, Calif. . . . R. C. Cosgrove has resigned as executive vice president of the Avco Manufacturing Corp. He will remain, however, as a member of the board of directors and represent the Crosley Division in RMA, of which he is president. . . . The L. S. Brach Manufacturing Corp., 200 Central Avenue, Newark, N. J., has been sold and is being operated as a wholly owned subsidiary of the General Bronze Co., Garden City, L. I. Leon S. Brach, founder and president, will continue to be active in Brach operations.

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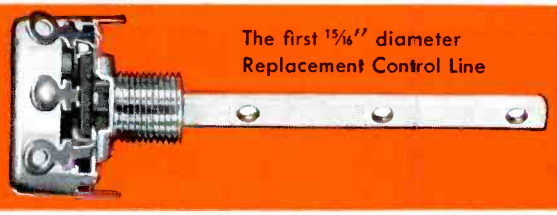

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