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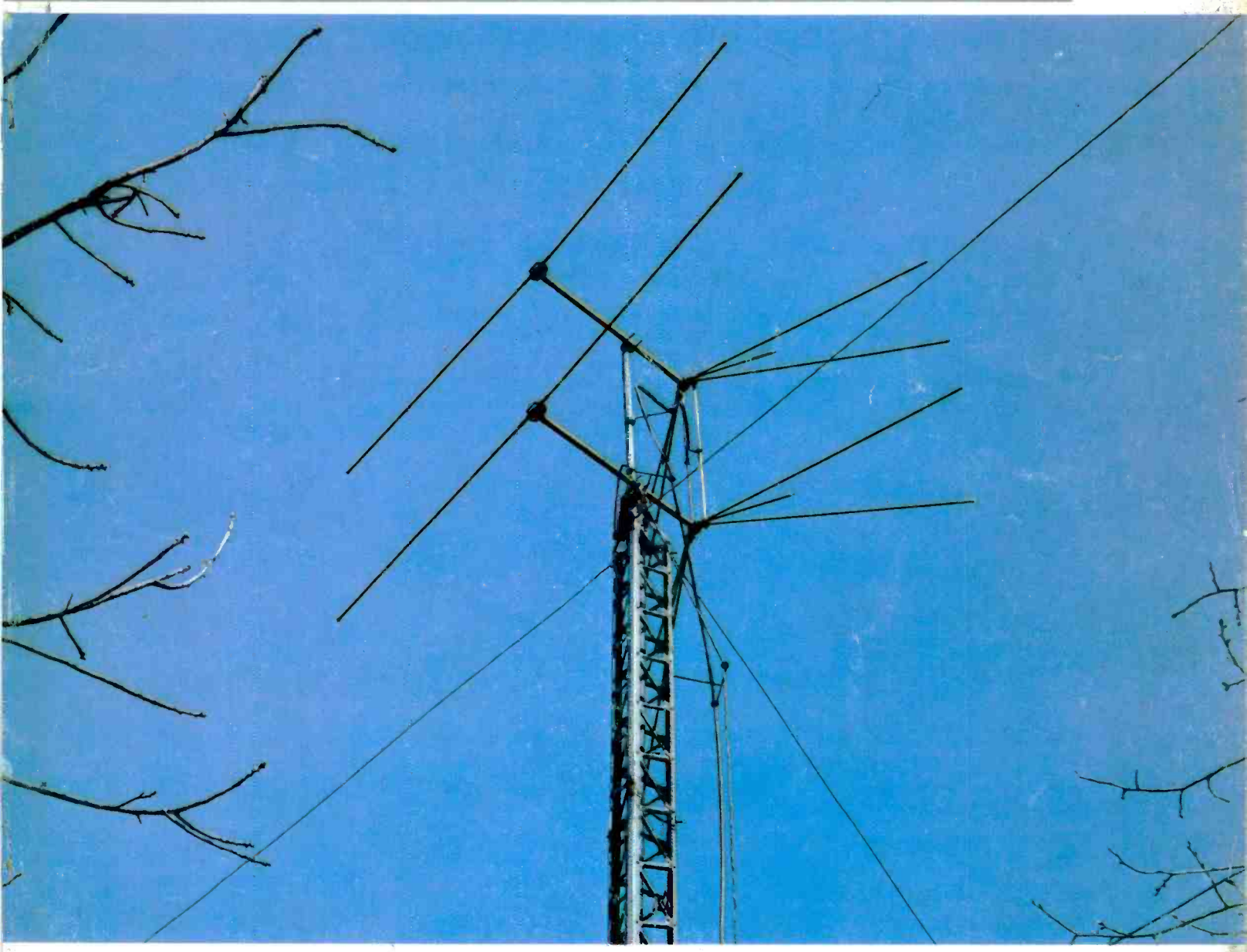

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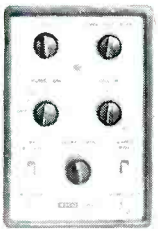

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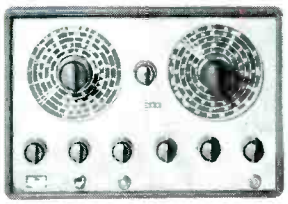

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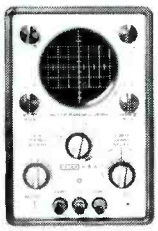

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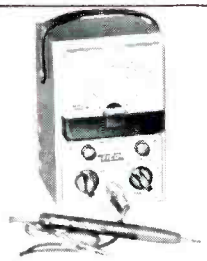

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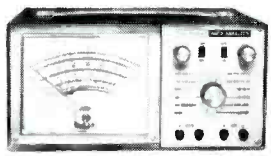

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The Transistor Amplifier

by George B. Mann

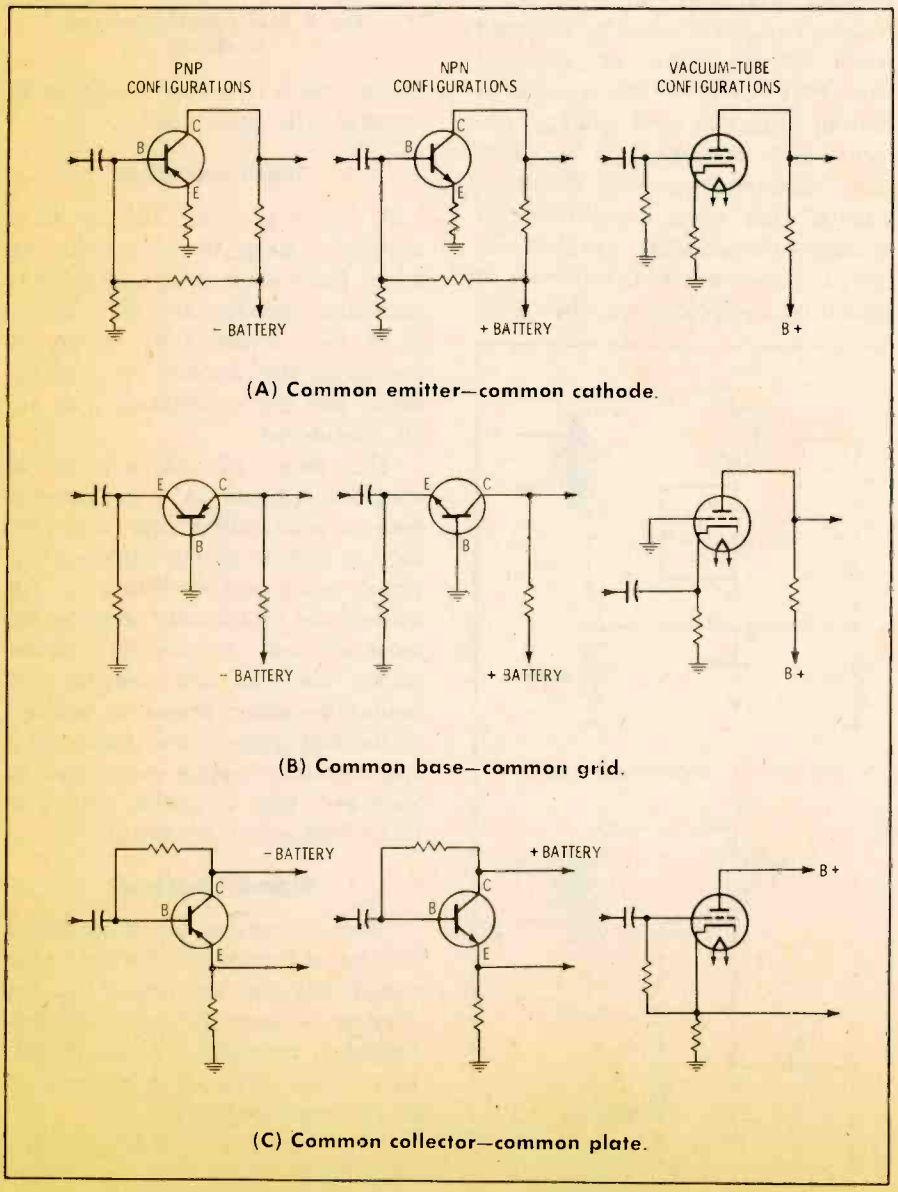
Amplifier-Circuit Recognition

The transistor amplifier circuits differ considerably from the familiar vacuum-tube circuits. At the same time there is a reasonable amount of similarity between the two. We want to point out some of the more outstanding differences and similarities between transistor circuitry and vacuum-tube circuitry.

The transistor can be connected in three circuit configurations. The vacuum-tube can also be connected in three basic configurations. These configurations are: common cathode, common grid or grounded grid, and common plate or cathode follower. The comparisons are shown in Fig. 1. For each vacuum-tube configuration there are two transistor configurations, one for the PNP type and one for the NPN type. The two types of transistor, PNP and NPN, employ opposite polarity voltages and are referred to as complementary types.

The transistor circuit in Fig. 1A is the common-emitter circuit that is used almost exclusively for most amplification purposes, just as the common- or grounded cathode vacuum-tube circuit is also used extensively. The remaining common-base and common-collector circuit configurations in Fig. 1 are used for more special applications, such as impedance matching to and from transmission lines or in place of matching transformers between amplifier stages.

A familiar tube circuit can be redrawn into another form that will be almost unrecognizable. The circuits used with the transistor can



(A) Common emitter—common cathode.

(B) Common base—common grid.

(C) Common collector—common plate.

Fig. 1. The transistor circuit configurations and vacuum-tube counterparts.

Material for this article was adapted from the Howard W. Sams book ABC's of Transistors *(Second Edition) by George B. Mann.*

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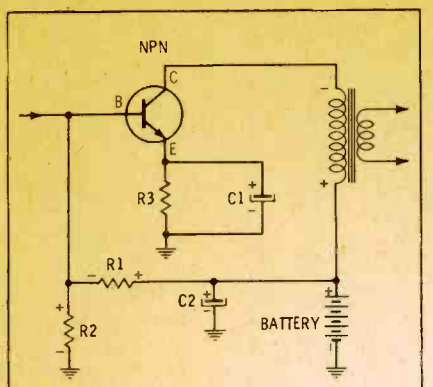
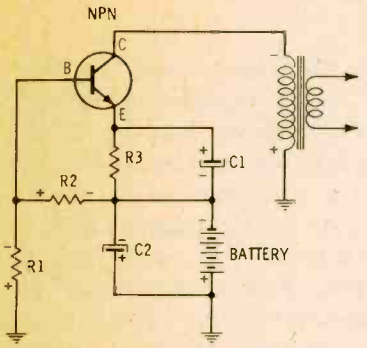


(A) Common-emitter amplifier with battery negative grounded.



(B) Circuit of (A) with battery positive grounded.

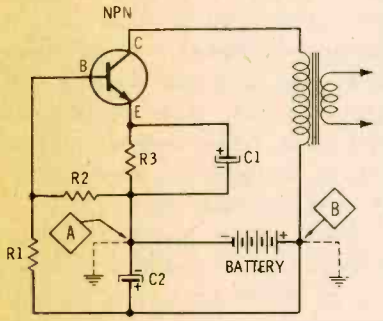


Fig. 2. Circuit variations.

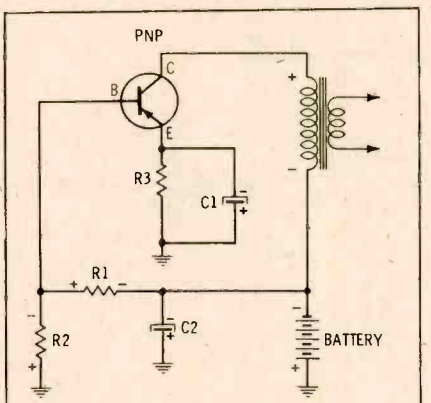
be even more unfamiliar. First, the circuits are new; and second, they can be arranged in two ways, with a PNP transistor and with an NPN transistor.

If the common-emitter circuit is drawn as in Fig. 2A and if an NPN transistor is used, the circuit will closely conform to those to which we are accustomed. The positive battery terminal is connected to the collector. Bias is obtained from the tapped bleeder made up of resistors R1 and R2. The bias-current path to the base of the transistor is from the positive battery terminal through resistor R1.

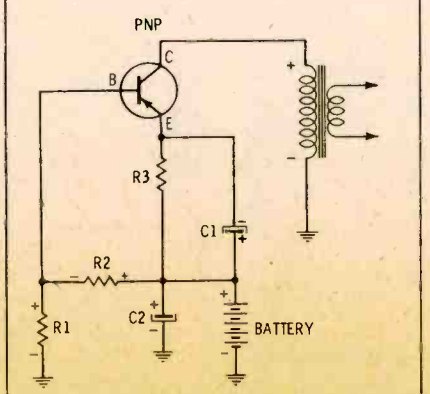
This same circuit can be rearranged to look like Fig. 2B. The grounding of the battery terminal is the only difference between this circuit and the one in Fig. 2A. The bias-current path is still through resistor R1 except that in this circuit the path is from ground to the base. The same circuit is reproduced in Fig. 2C without a ground reference. Point A is the ground used in Fig. 2A, and point B is the ground used in Fig. 2B.

If a PNP transistor is used in this circuit, two drawings can again be made, one with the positive terminal grounded as in Fig. 3A and one with the negative terminal grounded as in Fig. 3B.

Compare the PNP circuit with the NPN circuit and notice that the current is reversed in all the components. Therefore, all of the electrolytic capacitors must be reversed when the transistors are changed from PNP to NPN. The reversal of current direction and voltage polarity does not exist for vacuum-tube circuitry; therefore, transistor circuits that have no parallel in vacuum-tube circuitry can be produced. Nevertheless, the circuits of transistor equipment are quite similar in many respects to those in vacuum-tube equipment.

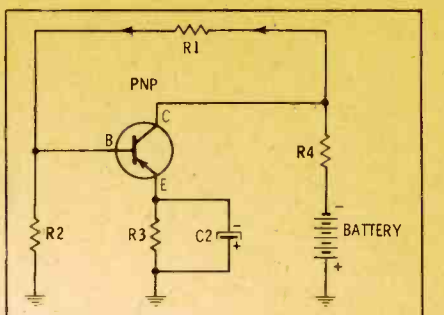


(A) Battery positive grounded.

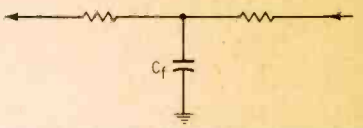


(B) Battery negative grounded.

Fig. 3. Common-emitter amplifier using a PNP transistor.



(A) R1 provides biasing and signal feedback.



(B) A frequency-selective network that can replace R1 in (A).

Fig. 4. Bias stabilization and feedback.

Input and Bias

A signal can be coupled to a transistor stage in a number of ways. Each stage is designed for a particular purpose; and the efficiency of the coupling, the biasing of the stage, the amount of gain desired, and the component cost are all considered.

The most efficient system of coupling a signal to a transistor is with a transformer that will provide a correct match between the signal source and the transistor. Although the transformer may be the most efficient, it has certain drawbacks, such as cost, weight, and limited frequency response. Because of the high gain of the transistor, a less efficient coupling system can be used and there is a wide variety of these from which to choose.

Signal Feedback

When a portion of an amplified voltage or current is returned to an earlier point in the circuit for the purpose of controlling the stability, frequency response, bias, or impedance of the circuit it is referred to as an signal feedback.

An arrangement for providing feedback in a signal transistor stage is shown in Fig. 4A. Resistors R1 and R2 are used as a voltage divider to bias the transistor and, at

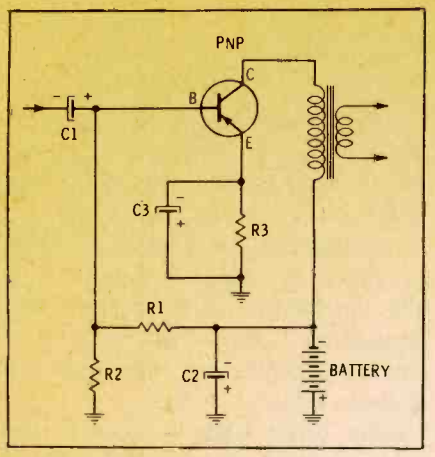


Fig. 5. Common R-C coupled circuit.

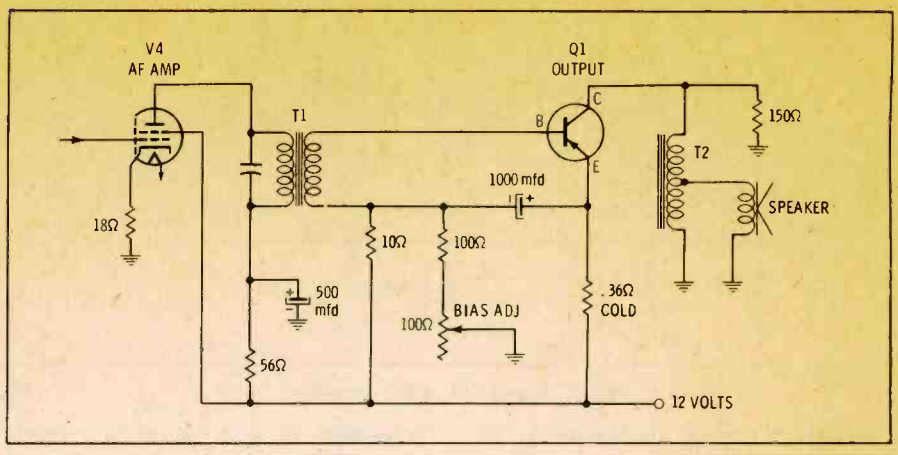


Fig. 7. A vacuum tube driving a transistor.

the same time, they become part of a feedback system for the signal. The signal at the collector is impressed across resistors R1 and R2, and part of the output signal is also applied to the transistor base.

The signal at the collector is 180° out of phase with the signal on the base, and the feedback now is degenerative. Resistor R1 can be replaced by a network like the one shown in Fig. 4B. If the values of the capacitor and resistors are varied, the feedback can be made frequency selective. If capacitor C_f is made large, the signal can be bypassed to ground and no signal feedback will take place. However, the DC bias stabilization will still be maintained.

NOTE: Observe that the load R4 is a resistance. This type of feedback circuit is seldom used with an inductive load. The voltage drop across an inductor is not great enough to provide sufficient bias feedback. Bias stabilization is the primary purpose of collector-to-base feedback.

The collector-to-base feedback of the signal is used principally in amplifiers designed to produce a particular frequency response, such as phonograph preamplifiers and high-fidelity sound systems.

Collector-to-base feedback is often used in transformer-coupled output stages to counter the effect of rising transformer impedance at the higher frequencies.

R-C Coupled Amplifiers

The input circuit in Fig. 5 is used more in audio amplifiers than probably any other circuit. This is an R-C coupled input with an electrolytic capacitor to block the DC voltage from the previous stage. The electrolytics in such transistor stages range from about 1 mfd to 100 mfd. Since the transistor is a low-impedance device, the high capacitance is needed to pass audio frequencies.

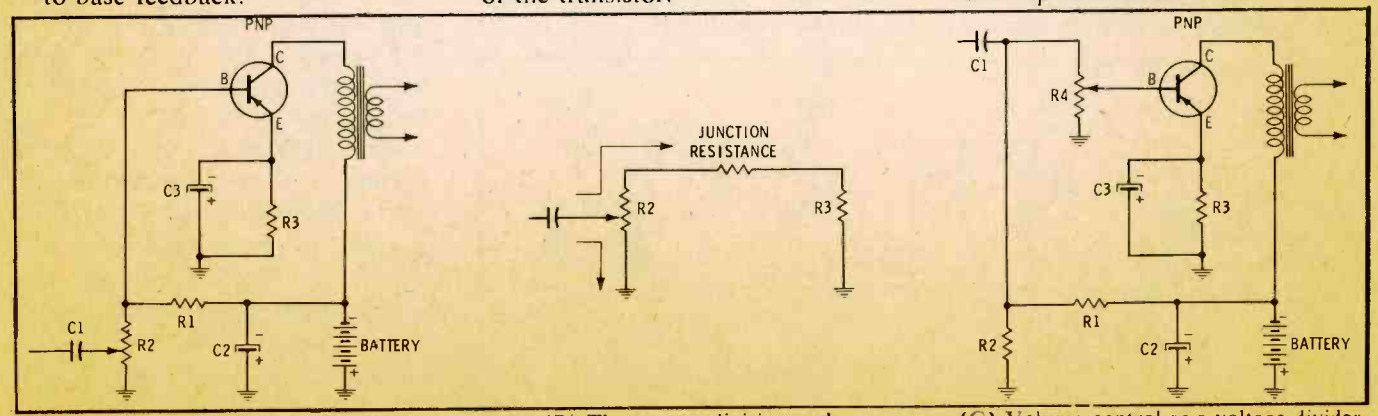
Coupling capacitor C1 in Fig. 5 may be connected in either polarity, depending on whether the voltage at the take-off point of the preceding stage is positive or negative with respect to the voltage on the base of the transistor.

Fig. 6A is another R-C coupled stage in which R2 is part of the bias network and acts as the volume control. The resistance of R2 becomes a current divider for the incoming signal. The signal current is divided into two paths, as shown in Fig. 6B.

The volume control of Fig. 6C is a voltage-divider type. The signal is developed as a voltage across resistor R4. Moving the slider changes the signal voltage at the transistor base and, at the same time, also changes the bias of the transistor. The signal level and the bias change simultaneously (less signal and less bias) and cause less battery power to be consumed on low volume than on high volume.

Transformer-Coupled Amplifiers

The transformer is used for coupling when high efficiency and proper impedance matching are important. However, the transformer is more expensive than the resistor and capacitors necessary to couple two amplifier stages, particularly when special transformers are re-



(A) Volume control as a current divider. (B) The current-division paths. (C) Volume control as a voltage divider.

Fig. 6. Different volume-control circuits.

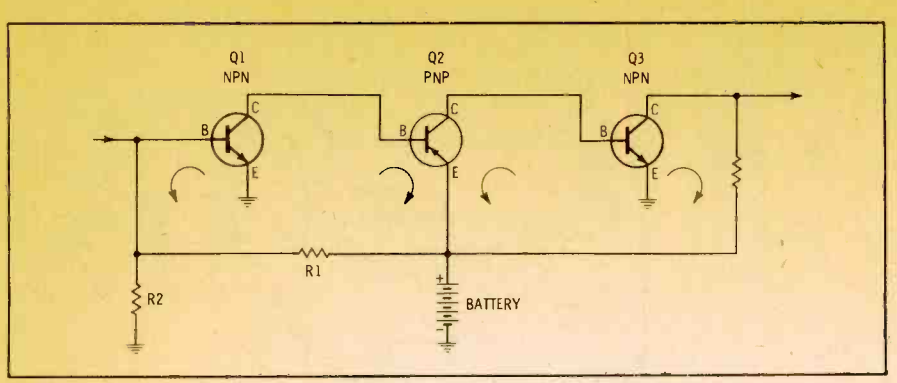


Fig. 8. A simplified DC amplifier.

quired to obtain the desired frequency response.

Many functions, such as accurately matching the output impedance of one transistor stage to the input of the next, are fulfilled extremely well by the transformer. With good matching, the maximum gain of the transistors can be approached.

A good example of transformer impedance matching is the coupling between the audio-amplifier and power-output stages of a hybrid auto radio. The diagram of such a circuit is shown in Fig. 7. The audio amplifier is a vacuum tube with a rather high output impedance, and the output stage is a power transistor with a very low input impedance. The difference between the two impedances is so great that, without the transformer T1 (or some form of impedance-changing device), tube V4 cannot provide adequate drive signal to the base of transistor Q1. The transformer T2 in the collector circuit of the transistor is used to match the collector impedance to the speaker impedance.

Direct (DC) Coupled Amplifiers

The main advantage of DC-coupled amplifiers is that they eliminate transformers and coupling capacitors. These latter two devices tend to limit the frequency response of an amplifier. The DC-amplifier will amplify signals from zero freqency to the high limit imposed by the amplifying device (transistor or tube) and by the associated wiring. In other words, direct coupling is quite a desirable feature in an amplifier.

Because high-voltage DC supplies are needed, direct coupling has never been very popular in vacuum-tube circuitry. Each stage must have a higher supply voltage than that of the preceding stage; thus, the final signal must have an extremely high DC component.

The ideal system would be to have a small DC change above and below a given reference level, amplify this changing voltage, and end up with an amplified change that still swings above and below the original reference point.

A transistor can operate as a DC amplifier. A simplified version of a DC amplifier using PNP and NPN transistors is shown in Fig. 8. The arrows indicate the direction of electron flow.

The single battery supplies the power to all of the DC-coupled transistors in Fig. 8. Transistor Q1 is biased from the bleeder circuit of R1 and R2. The bias of transistor Q2 is controlled by the current in the collector of Q1. Similarly, Q3 is biased by the current in Q2.

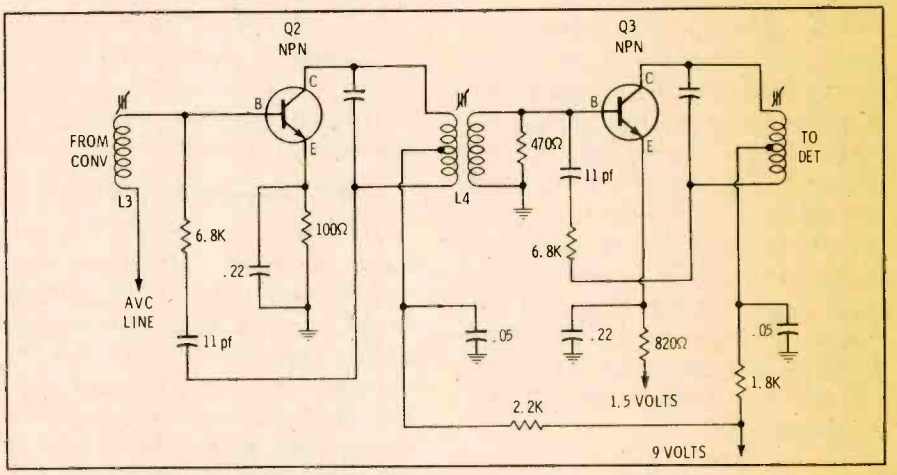


Fig. 10. An IF amplifier with single-tuned transformer.

Any current change at the first transistor Q1 is amplified greatly at the last stage. This high amplification is a property of the transistor DC amplifier. However, high amplification is also a detriment because transistors are temperature sensitive; therefore, any change in conduction due to a change in temperature will also be greatly amplified. A high-gain DC amplifier must have some system of compensating for temperature changes.

The circuit in Fig. 9 is the audio portion of a transistor portable receiver. Audio amplifier Q4 is direct coupled to output transistor Q5. Transistor Q4 is biased near cutoff to permit only a small current to exist in the collector of Q4, and in the base of the following stage. This current provides the bias for output transistor Q5.

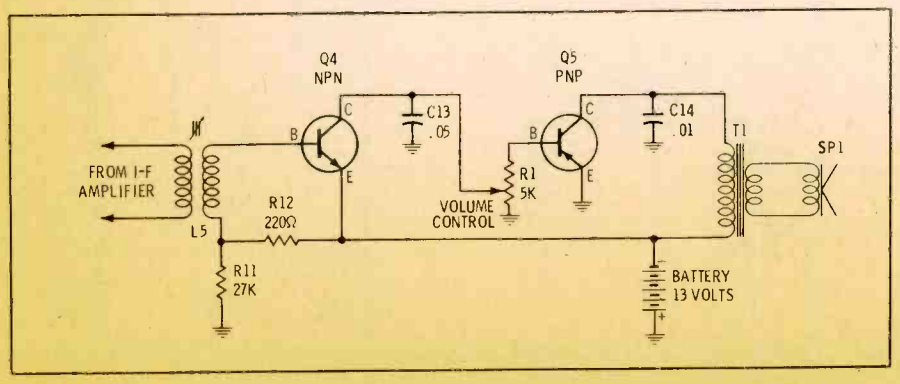


Fig. 9. A DC coupled amplifier employed in a receiver.

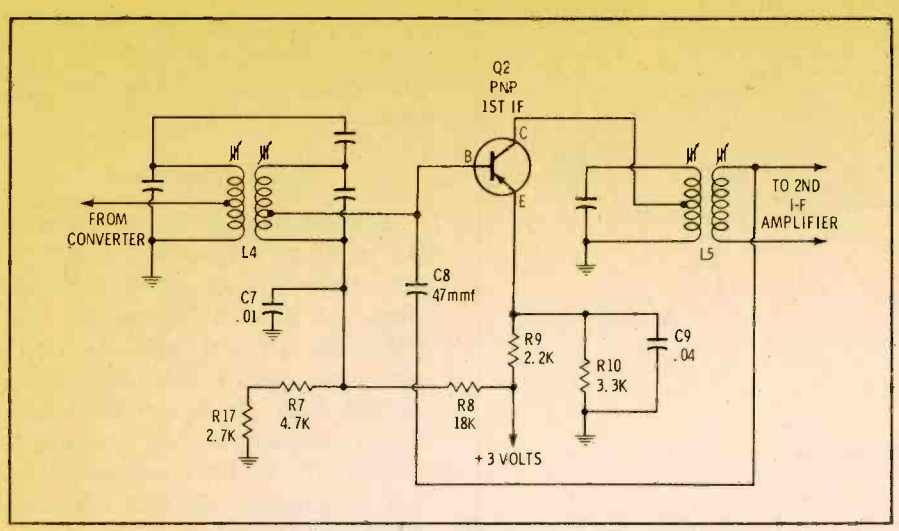


Fig. 11. An IF amplifier with double-tuned transformer.

The volume control not only controls the signal level, but acts as a divider for the bias current. The signal and bias are increased or decreased simultaneously; and at zero-signal setting, output transistor Q5 is cut off. This system provides a saving in battery current because the amount of current depends on the volume setting.

Transistor Q4 operates as the detector and first audio amplifier. The transistor is biased near cutoff; therefore, practically no conduction takes place between the base and emitter. The base-to-emitter junction acts as a diode and blocks the current on the negative swing of the IF signal, but conducts on the positive swing. These current pulses are amplified in the collector circuit. The RF is bypassed to ground by the .05-mfd capacitor (C13), leaving an audio signal with an amplitude great enough to drive the output stage of the receiver.

Remember that a transistor, unlike a vacuum tube, may be biased by a part or all of the output current of another transistor. This is particularly true of the DC-coupled amplifier.

This method of biasing is used particularly where both PNP and NPN transistor types are contained in the same piece of equipment.

A major obstacle to the use of the DC amplifier is that each stage controls the bias of the following stage and any change in transistor conduction caused by temperature changes or shifts in component value will also be amplified. When a number of stages are employed, compensating for bias changes becomes a definite design problem.

Many amplifiers use a combination of R-C, transformer, and DC coupling arrangements to obtain the best features of each.

RF and IF Amplifiers

The RF and IF amplifier employs transformer coupling between stages. The impedance match from one stage to the next is of prime importance; for this reason the IF transformers of a transistor radio are quite different from those in vacuum-tube receivers.

The IF amplifier circuit shown in Fig. 10 incorporates a tapped-primary IF transformer, single-slug tuning, low-impedance untuned secondary, and feedback to the base.

The impedance of tuned circuits are high compared to the collector and base impedances. The former are matched by using a tapped-primary IF transformer. Only a portion of the total impedance of the tuned circuit exists from collector to ground. A secondary winding must have even lower impedance, since it must drive the base of a common-emitter circuit. Untuned secondary windings are normal in transistor receivers, although some double-tuned (primary and secondary) transformers will be encountered.

A double-tuned transformer is shown in Fig. 11. Both the primary and the secondary are tapped at impedance points that will match the collector of the converter to the base of the first IF stage. Double-tuned transformers are not generally used in the personal-sized portable receivers because of the added weight and size. One double-tuned transformer may be used in a receiver, between the mixer and the first IF amplifier, to provide a greater degree of isolation between the oscillator and the first IF stage than a single-tuned transformer will provide.

Neutralization

In the circuit of Fig. 11, a small-value capacitor C8 is connected from the output of transistor Q2 to the input circuit of the same transistor. Capacitor C8 is a neutralizing capacitor and cancels the effect of the base-to-collector capacitance. The principle is identical to the neutralizing of a triode vacuum tube in a tuned IF amplifier.

The transistor is also a three-element device that must be neutralized when it is used as a tuned RF amplifier. When both the input and output of a transistor amplifier stage are tuned to the same frequency, voltages and currents are built up across the tuned circuits. The phases of these voltages and currents at resonance are such that a positive feedback occurs from the collector to the base through the base-to-collector capacitance.

Capacitor C8 couples a signal, that is nearly 180 degrees out of phase with the signal on the collector, from the output circuit back to the base of the transistor. Cancellation is not complete. The feedback is only enough to keep the stage from oscillating when the input and output circuits are tuned to resonance at the intermediate frequency.

A circuit designed to operate with a neutralizing network will break into oscillation if the capacitor is open, missing, or is the wrong value. The IF strip of such a receiver cannot be aligned until the correct neutralizing capacitor is inserted.

Automatic Volume Control (AVC)

The audio output of a receiver can be controlled by affecting the gain of the IF amplifiers. In a transistor receiver, the gain of the IF amplifier depends upon (1) the gain of the individual transistors and (2) the impedance match between

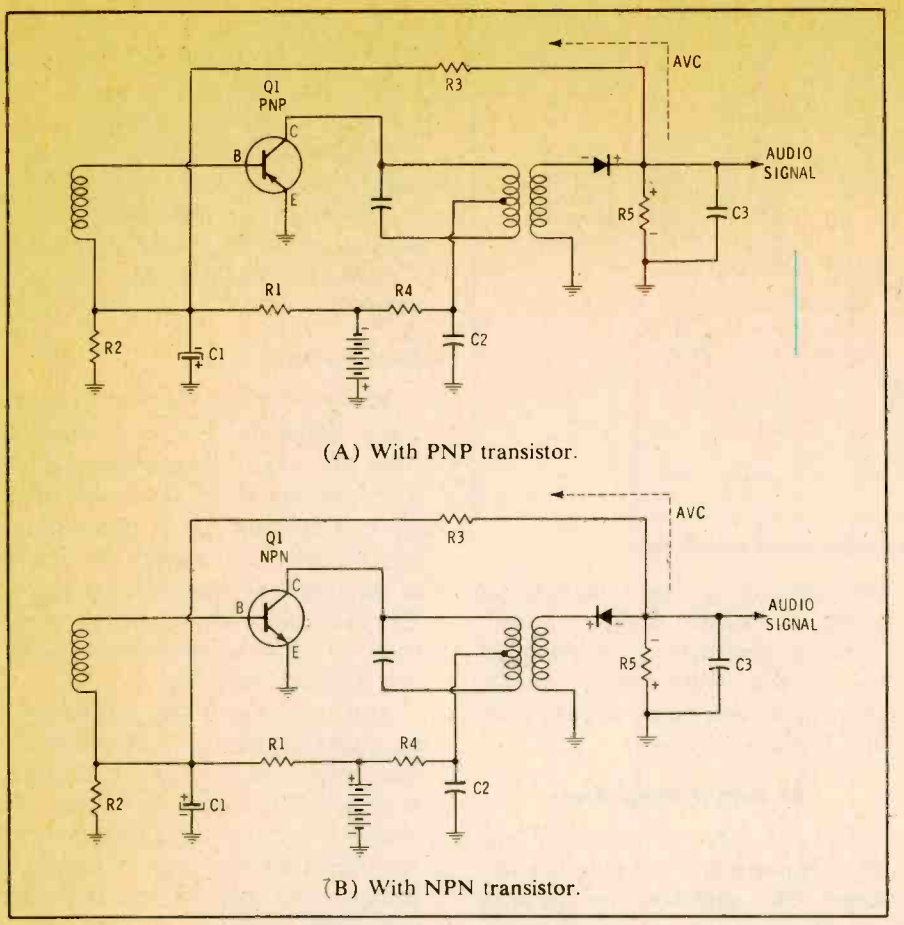


Fig. 12. Simplified AVC system.

each stage. Both can be changed by varying the voltage applied to the transistor and the current in the transistor.

When the bias current in a transistor is reduced, the gain of the transistor drops and the output and input impedances rise. The impedance rises because of the rise in collector voltage due to the reduced conduction in the transistor. The impedance change causes a mismatch between stages and lowers the IF amplifier gain.

The current necessary to produce this lower gain is derived from the detection of the IF signal. The detector is generally a diode that serves as an AVC diode and as an audio detector. The circuits in Fig. 12 show a simplified version of an IF stage, an AVC detector, and the AVC path to the transistor base. In Fig. 12A the rectified current through the diode changes the potential on the transistor base. The base of the PNP transistor normally is negative. A positive potential will reduce the current or will move the base potential nearer to that of the emitter.

An NPN transistor stage is shown in Fig. 12B. The voltage and current are the reverse of the PNP circuit. Current at the anode of the detector produces a negative voltage that moves the base in a negative direction or toward cutoff.

An increase in signal level will increase the detector output, and the increased detector potential will reduce the current in the base circuit. Two actions result: (1) The current through the transistor is reduced and (2) because the IR drop across R4 is reduced, the voltage rises at the collector terminal.

Resistor R4 and capacitor C2 in Fig. 12 isolate this IF stage from the other stages and from the common supply line.

As previously stated, the change in output impedance affects the gain of the stage. The output impedance of transistor Q1 in Fig. 12 will be determined by the current in the transistor and by the voltage between emitter and collector.

The collector current is controlled by the AVC current generated by the detector. This collector current must exist in resistor R4; as the transistor current is reduced, the collector potential rises and the output impedance of transistor Q1 therefore increases.

Audio Amplifiers

The last stage of an audio amplifier is the power output. Although this stage is an audio-amplifier stage, it is different because the amplification is power gain. The output stage usually consumes more current than all the other stages. Power consumption is important, particularly to the customer, who has to purchase the batteries that supply this power.

Two output circuits serve as power stages: the single-ended (containing a single transistor) and the push-pull (containing two transistors). The single-transistor output must operate as a Class-A amplifier, whereas the push-pull arrangement can operate as Class-A, Class-B, or Class-AB (in which the operating point is somewhere between Class-A and Class-B).

Class-A operation takes place when the transistor bias sets the collector current at a point midway between design maximum and cutoff; the collector conducts current at all times. Class-B operation takes place when the collector conducts current for only half of the alternating cycle. Class-AB operation is at a point between A and B; current conduction occurs during more than half the alternating cycle, but not for the full cycle.

The class of operation is quite important for a battery-operated receiver. Class-A operation requires that the full current be present in the circuit any time the receiver is on—regardless of the volume set-

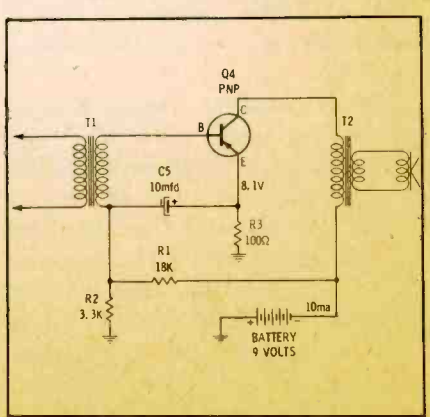


Fig. 13. A class-A output stage.

ting. Class-B operation permits a minimum of current conduction during quiescent periods and when the volume is turned down. Class-A operation consumes more battery energy but requires only one transistor. Class-B operation is more saving of battery power, but the output stage must employ two transistors.

Single-Ended Output

Fig. 13 shows a single transistor, used as the output stage of a broadcast receiver. The transistor will be biased for Class-A operation, and a current of about 8 ma will exist in the collector circuit at all times. An improper bias would distort the audio. Notice that about 80 percent of the receiver current is in the output stage.

It is difficult to accurately measure the bias of a transistor amplifier stage directly. However, because the collector current is greatly affected by small changes in the bias current, the collector current can be measured and will provide an indirect measure of bias. Note in Fig. 13 that the total current from the battery is 10 ma and (from the preceding discussion) that the output stage of the receiver consumes a large portion of this current. A change in the bias current of the output transistor will measurably affect this current reading. The transistors in the preceding stages will have little effect upon the supply current.

Voltages are the best indication of whether the current is proper or not. In Fig. 13 the voltage at the emitter is .81 volts and the emitter resistor (R3) is 100 ohms. The current can be calculated using E/I or 8.1 ma of current in resistor R3. This is also the emitter current for the transistor.

Push-Pull Output

The push-pull circuit can be operated as Class-A, Class-B, or Class-AB. The Class-A, push-pull operation will provide only twice the power output of the single-ended, Class-A stage; and average collector current will exist at all times. The Class-B operation is very economical because almost no current exists when no signal is applied. This no-current condition is due to the transistors being biased to cutoff. However, Class-B operation causes distortion at the crossover point (the point at which one transistor ceases conduction and the other begins).

The circuits in Figs. 14 and 15 are simple forms of a push-pull circuit; current waveforms for Class-B and Class-AB operation are shown. Transformer T1 is the input and T2 is the output. The secondary of T1 and the primary of T2 are shown as separate windings for each transistor in order for the reader to maintain the thought of two separate amplifiers. Signal coupling between them is accomplished by the mutual couplings of windings A, A1, and A2 in the input circuit and windings B, B1, and B2 in the output. The battery supplies power to both sides of the push-pull arrangement. The dotted horizontal line through each of the waveforms represents the current in the circuit when no signal is applied. There will be no current in the input and output windings A and B when the signal is removed.

In the Class-B amplifier in Fig. 14, the transistors have zero bias. For a transistor, zero bias is equivalent to cutoff bias; and the collector current should be zero. However, because of leakage current, the collector current is not completely cut off. Current induced in winding A1 causes base-to-emitter conduction in transistor Q1 on the positive half of the cycle, and this produces current in the collector and in winding B1. During this half cycle, transistor Q2 is not conducting. During the negative swing of the signal, Q1 is cut off and Q2 conducts through B2. The combined effect of currents in B1 and B2 produces the output current in winding B. One of the main disadvantages of Class-B operation is crossover distortion that

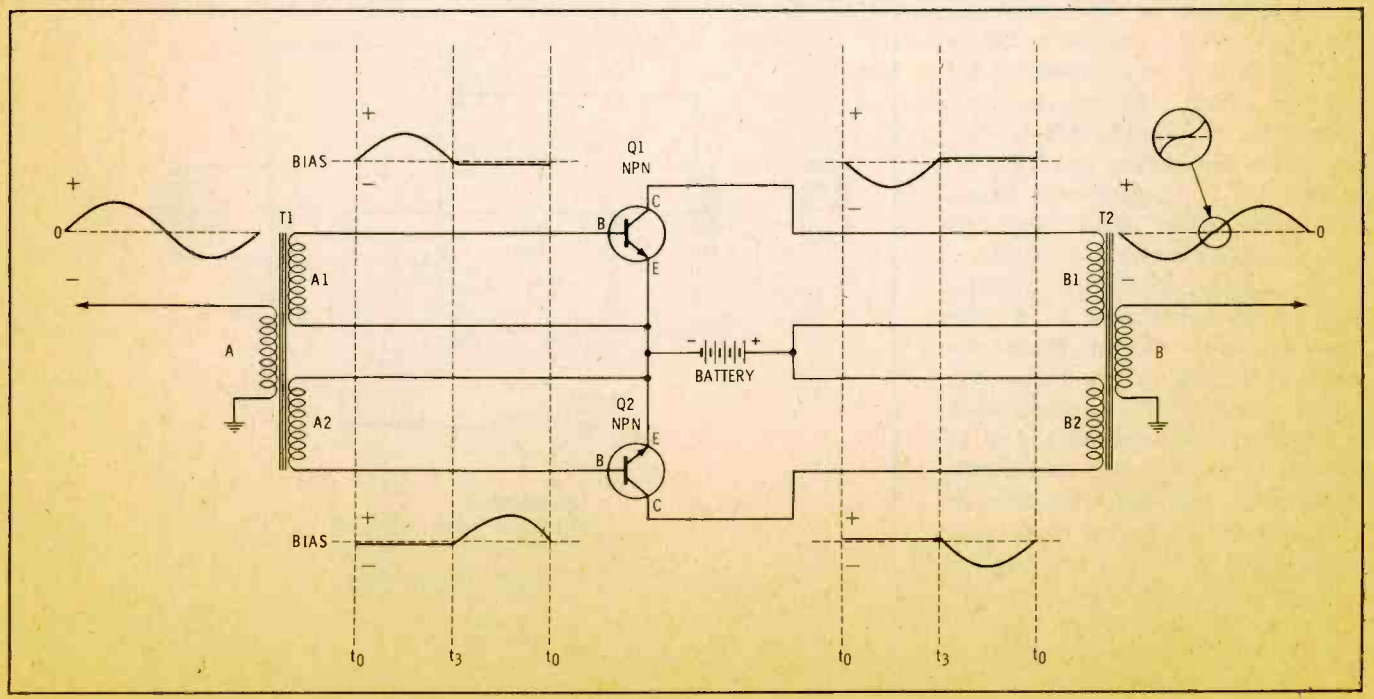


Fig. 14. A class-B output stage with current waveforms. (Waveforms are not drawn to scale.)

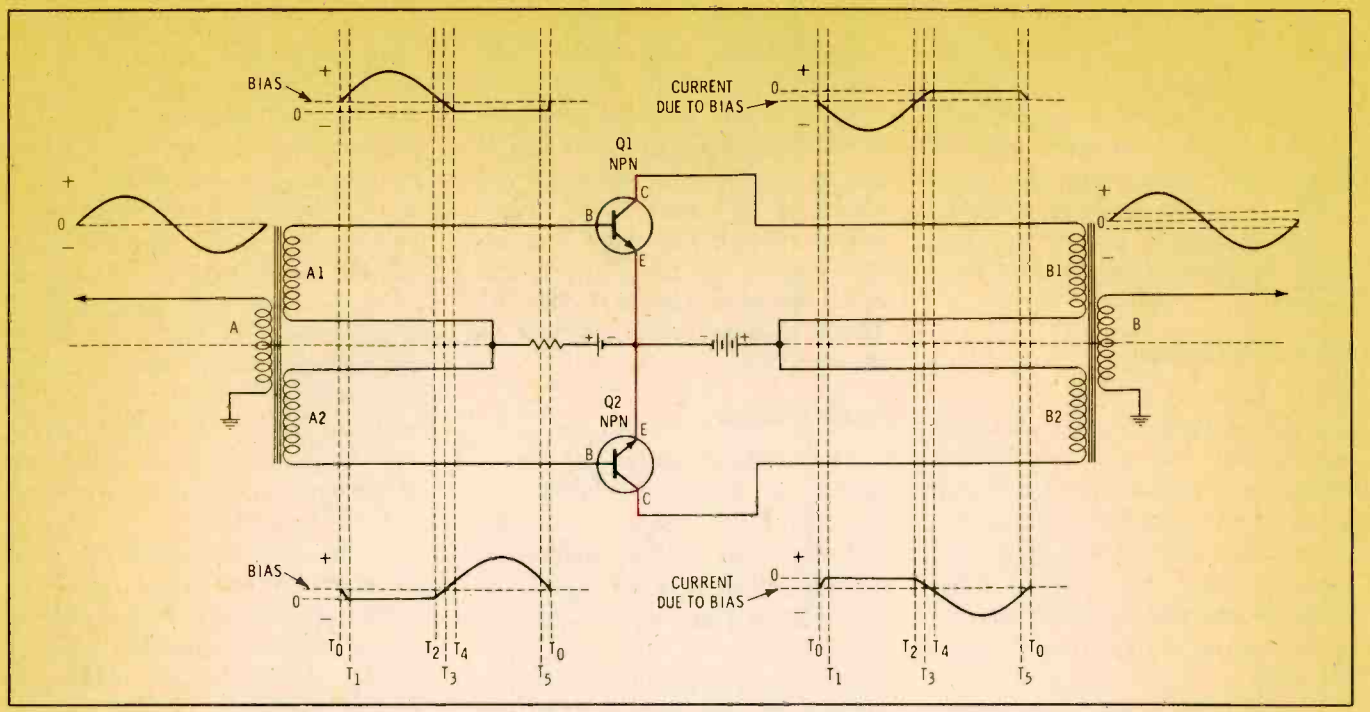


Fig. 15. A class-AB output stage with current waveforms. (Waveforms are not drawn to scale.)

is produced by the switch in conduction from one transistor to the other. For this reason, the Class-B amplifier is seldom used for audio-output stages. The input change in conduction can be eliminated by using a combination of Class A and Class B features.

The arrangement shown in Fig. 15 is a Class-AB, push-pull amplifier that is biased to permit current in the collector circuit when no signal is applied. The positive half of the input signal drives transistor Q1 into conduction at time zero. Between t_0 and t_1, transistor Q2 is also conducting. At t_1, transistor Q2 reaches cutoff. During the time from t_1 to t_2, transistor Q1 reaches maximum conduction and then decreases. At t_2, transistor Q2 begins to conduct again. Both transistors are conducting between t_2 and t_3.

The beginning of the negative half of the signal is at t_3. At this time, transistor Q1 is decreasing conduction and Q2 is increasing. At t_4, transistor Q1 reaches cutoff. During the time between t_4 and t_5, transistor Q2 reaches maximum conduction, and then decreases. At t_5, transistor Q1 begins to conduct again. Both transistors are conducting when t_0 is reached. The currents of windings B1 and B2 combine to form the output current in winding B. The dotted lines in the output waveforms show the portion of the cycle during which both transistors were conducting. The change from the positive to the negative portion of the cycle is smooth, and crossover distortion is greatly reduced. This is the push-pull arrangement most used in power-output stages. The power dissipated by the transistors is very small during a no-signal condition, but increases as the signal increases.

The output circuit of a broadcast receiver is shown in Fig. 16. This receiver, powered with a 6-volt battery, conducts 9 ma when the volume control is turned to minimum. At a normal volume level, the current is about 18 ma. It is apparent that the volume at the speaker determines the power drain from the battery. The change in battery current will be greater for receivers that have the lowest battery voltage, and receivers with higher voltage batteries will have a smaller current change. ▲

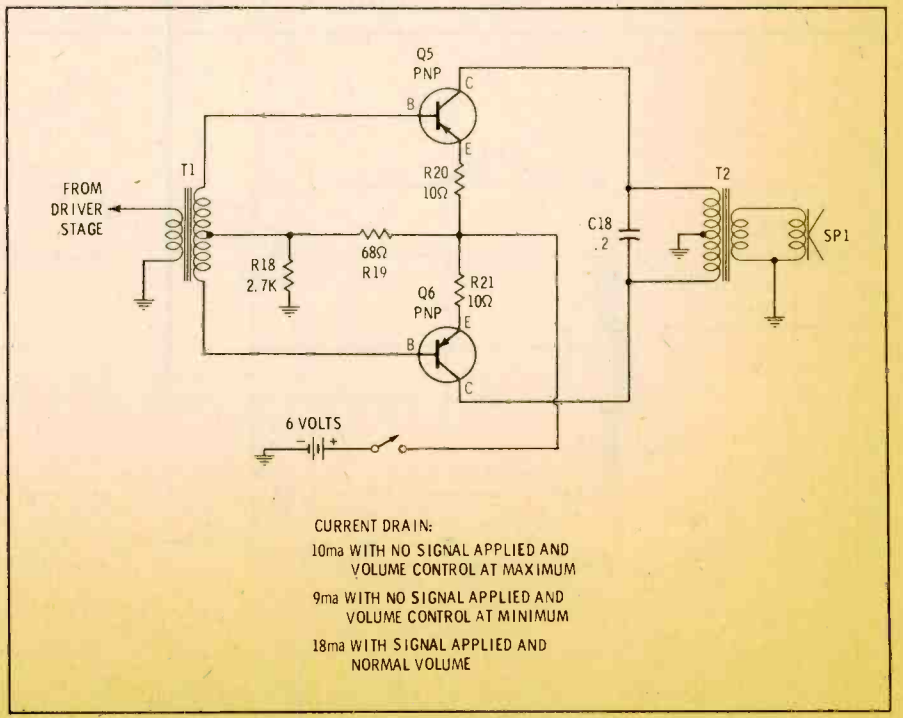


Fig. 16. A push-pull output stage with current drains.

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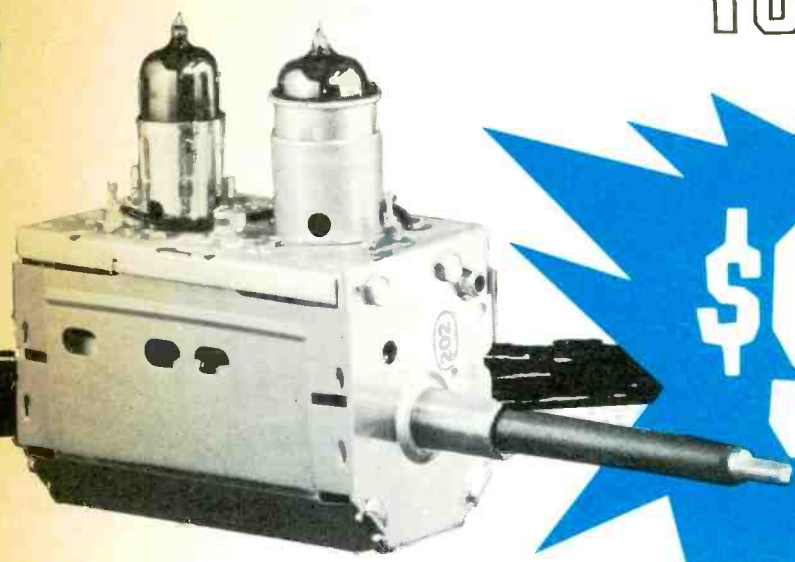

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PF Reporter™

PHOTOFACT

the magazine of electronic servicing

VOLUME 16, No. 6 JUNE, 1966

CONTENTS

About the Cover

This month's cover highlights the outdoor antenna installation. Antennas have always been a good source of income, with adequate profit margins. Sales and installation need not close the book on profits, however. The article starting on page 21 shows how profits can continue to be made after the antenna is up.

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Letters to the Editor

Dear Editor:

Please explain to me the difference between the 12AD6 and 12BE6 tubes.

According to my tube manual the base connections are the same, yet on both of my tube testers the 12AD6 has only one test while the 12BE6 has two.

In one auto radio I've been working on, I've used the 12BE6 in place of the 12AD6 and it seems to be working.

ELMER B. COOK
North Highlands, California

The main difference between the 12AD6 and the 12BE6 is that the 12AD6 was designed to operate with only 12.6 volts on the plate and screen, whereas the 12BE6 was designed for much higher voltages—256V on the plate and 100V on the screen.

The 12BE6 will operate with 12.6V on plate and screen, but how well? Only the tube manufacturers could answer this! The published characteristic curves for this tube do not show operation at 12.6V, but the tube obviously can operate at this voltage.—Ed.

Dear Reader:

We have received many letters from readers who would like to see PF REPORTER *assembled in such a way that editorial features and departments could be removed and filed. We are sympathetic to requests such as these when we can accomplish what is requested. However, in this case such requests are impossible.*

The makeup, or layout, of a magazine is an exhausting process involving many hours of work. The process begins with the selection of the editorial articles and ends with the production manager merging these with the advertisements.

The advertisements arrive in a confusing assortment of sizes, shapes, colors, numbers, and specified pages. The production manager must lay out the magazine to please both the readers and the advertiser. After all, the advertisers make it possible to bring you the magazine at a reasonable price.—Ed.

"I'll be back, Doc. I'm afraid it's going to take four or five adjustments."

The Electronic Scanner

news of the servicing industry

Money Matters

Apparently it is one thing to repair a TV set. It is another thing to get paid for the work.

While the international balance of payments problem gets more attention, it seems that this domestic imbalance of exchange is also creating a home grown economic problem. The result seems to have interrupted the expansion of the service industry which long has been considered the most promising field for the small and independent businessman.

The analysis of the first 23,000 returns from independent business proprietors, from the 1966 year-long continuous field survey conducted by the **National Federation of Independent Business,** shows that not only are the service operations running into trouble, but that many are expanding into other fields to solve their problems.

Of the total returns, 37% identify themselves as engaged in service primarily. Their rate of expansion since last year is only 22%, as compared with an expansion rate of 36.2% for all independent business. However, this overall expansion rate is heavily weighted by the expansion among independent manufacturers.

The expansion trend in the service industries has not resulted in a large number of new jobs. In fact, only 31% have made any change in their work forces, and about one-third of these have closed out jobs, rather than develop new ones. The net rate of job expansion is approximately one-half of a new job per firm.

However, the reported expansion has been heavily in the form of increasing accounts receivable, with 52% reporting investing more money in this direction. This ties in with 32% reporting difficulty with collections.

Only 29% report they are able to finance their accounts receivable. While 66% report they depend on banks for financial aid, 5% are depending on finance companies, 11% on their suppliers or manufacturers, with 2% lookinw toward the Small Business Administration.

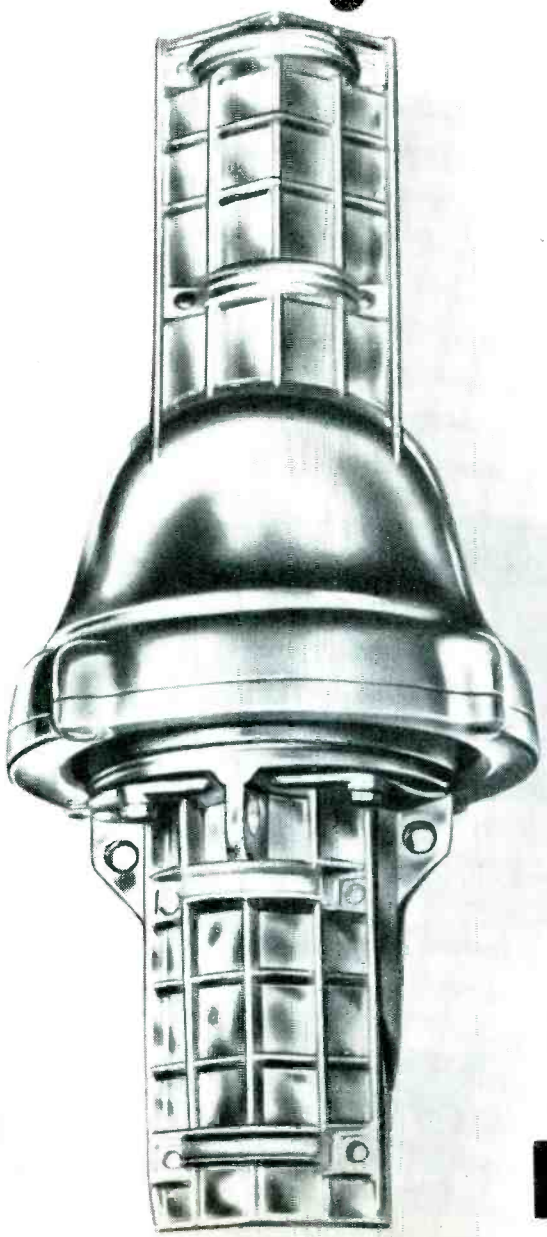
The trend toward service firms entering other fields—first noted last year—seems to be increasing. Of the total who expanded, 6% have gone into professional fields as a sideline, 40% into retailing, 10% into wholesaling, 6% into manufacturing, and 7% into contracting-construction.

This expansion into other fields was apparently accomplished without any substantial gain in employment and was presumably done to afford employment to present work forces. Of those who expanded and dropped employees, 42% say it was due to increased labor and payroll costs.

There appears to be no labor shortage, since 26% report a supply of skilled labor available for work, and 67% report that they are able and willing to train unskilled labor.

(Editor's note: The above release from NFIB describes the situation of the appliance service industry as a whole. The percentage of the figures pertaining to TV servicing was not given.)

Never ask a lightweight rotor to do a heavyweight's job.



Selling your customer a lightweight rotor when he has a large antenna array just doesn't make sense. Especially since you can offer him an alternative: the heavy-duty "Bell Series" rotor, from CDE.

Available in both automatic and manual forms, this rotor is designed specifically for large, heavy antenna arrays... designed specifically for unmatched fringe-area reception... designed to give your customers the finest color TV reception possible. In fact, this is the *only* heavy-duty rotor available.

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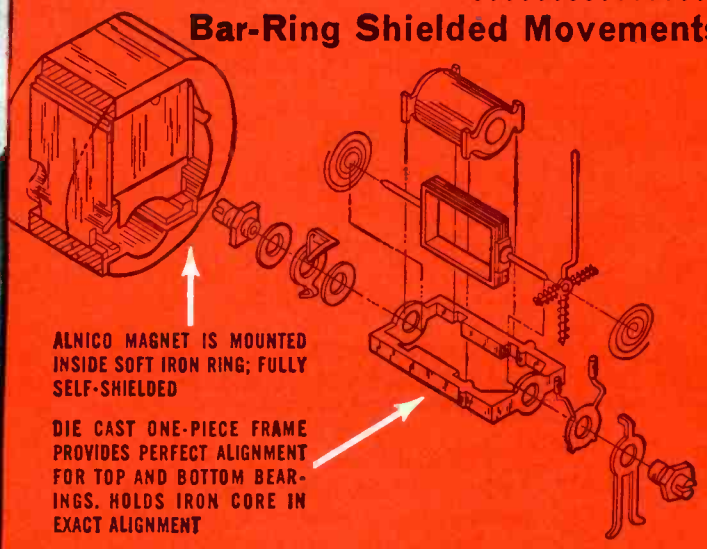

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had been reached on the terms under which the Sams Company will join the ITT system.

It is expected that the Sams Company will operate as a wholly-owned subsidiary of ITT. The transaction is subject to approval by the stockholders of Sams at a meeting later this year.

Howard W. Sams & Co., Inc., is a diversified publisher and printer of books, magazines, training and reference services, particularly in the electronics and other technical areas. ITT is engaged on a world-wide basis in the development, manufacture, sale and service of electronic and tele-communication equipment.

Expansions

A new 16,000 square feet, air-conditioned building has been added to the facilities of SENCORE. The new building permitted tripling of office, laboratory, and quality control departments, and brings the factory total to 35,000 square feet, according to president Herb Bowden. New engineers have been hired and the quality control department doubled to keep pace with a 58% increase in sales for the company's first three quarters compared with last year. Mr. Bowden especially invited any and all to visit their new headquarters in Addison, Ill., on their way to the NEW show.

Semiconductor division of the **Bendix Corporation** announced plans for a major expansion of manufacturing facilities.

General Manager Albert J. Harcher said the 50% space increase is needed to "permit the division to keep pace with the strong demand being made for commercial transistors by manufacturers of transistorized TV, radios, and appliances. The new

The electronics industry took the post-Christmas season in stride with scarcely a ripple in its phenomenal growth pattern. One of the most spectacular gains was made by **Andrea Radio Corporation,** whose first quarter sales were up 95% over a like period last year. With a backlog of orders over $3¼ million, Andrea is both optimistic and enthusiastic about the future.

Littlefuse, Inc. reports a first quarter sales increase of 24%, and Thomas M. Blake, chairman of the board, directly attributed the record gain to the heavy demands of the television and computer industries.

Sales of electronic speakers by **Oxford Electric Corporation** showed a gain of 15% in January '66 as compared to January '65. According to C. Paul Harpley, general manager, part of the outstanding sales growth was a reflection of an aggressive expansion and modernization program that has been in effect since last November. The other portion of the sales was the result of increased demand from both equipment manufacturers and the consumer replacement market.

In the 1965 annual report just released, **International Telephone and Telegraph** shows sales and earnings up 11% at nearly $1.8 billion. More significant is the growth pattern for the past six years which shows a 162% increase in revenues. The biggest gain in 1965 was in the commercial and industrial products group, which grew 86% during the year. ITT spent $146 million last year on capital equipment.

For the fiscal year ending Feb. 28, **Electro-Voice, Inc.,** announced net sales were $14.4 million, up nearly 20%. President Albert Kahn said that sales increased in nearly all product lines.

International Telephone and Telegraph Corporation and **Howard W. Sams & Co., Inc.,** announced that agreement

electronics training. The FCC recently revised its examination, and the new course is planned around this revision, with up-to-date transistor coverage. Additional courses are now in preparation at STI.

Sometime this year, **Delco Radio** division of General Motors will produce its 50-millionth auto radio. Delco started operations May 1, 1936, and in the past 30 years has grown from a nucleus of 400 employees to the present 8,500.

Broadening their base of operations, **IRC** has penetrated the battery market with the brand name "Vidor." After an extensive search for a manufacturer capable of meeting IRC's quality and quantity requirements, an agreement was reached with Royston Industries of Scotland and England. IRC has exclusive distribution rights in the U.S. and, has undertaken an aggressive campaign of advertising and distribution. Comparatively unknown in the U.S. heretofore, "Vidor batteries are known and sold in every country in the free world," according to IRC.

A 23″ color TV, which has been largely transistorized, has been built by **Fairchild Semiconductor** division. The only circuits using tubes are the horizontal and vertical outputs, high-voltage rectifier, and tuner. Obviously, the tuner and vertical circuits could have been solid state, though the horizontal circuits present more of a problem. Horizontal-output stages in a color set normally peak at about 4 KVA, and considerable work must be done to develop this stage into solid state.

However, the rest of the set is solid state and operating. The reduction in heat thus attained should go a long way toward increased reliability.

This set is only experimental, but a recent production model from **Philco** has solid-state IF, AGC, and video-driver stages. ▲

plant is to be finished in September, and will create an additional 200 jobs.

Muntz Stereo-Pak, Inc. increased its floor space by 20% to help keep up with increasing demands for its tape cartridges. The company is currently enjoying a 20% monthly growth and now has a tape inventory of 30,000 titles.

Construction is underway on a new 200,000 square-foot plant for **Viking Industries.** The new plant is solely for manufacturing cable for the CATV and communications industries, and production will begin next September.

Potpouri

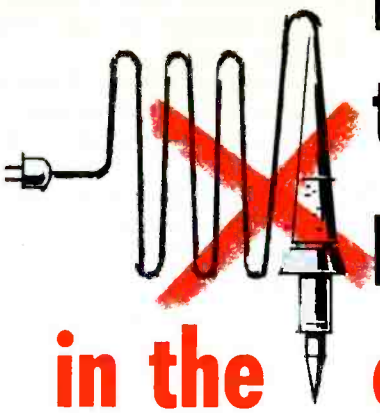
A manufacturer without an automotive product attracted considerable attention at the recent Auto show in New York. The interest centered around 5″ and 9″ **Sony** TV sets being offered by several auto manufacturers as optional equipment.

"Maybe my wife will join the kids in the back and leave the driving to me," was the way one motorist put it.

Development of a new semiconductor device was announced by **Radio Corporation of America.** Capable of generating frequencies up to 40 GHz, the new device takes advantage of the "Gunn Effect." This occurs when a voltage applied to the crystal exceeds a certain level, causing electrons to pass through in bunches rather than as uniform current. The bunching produces microwaves, the frequency of which is determined by the number of bunches per second.

A new home study program was recently introduced by **Sams Technical Institute, Inc.** The new course is an extension of technical training for those who can't attend classes at any of the STI resident centers.

The initial course available is a 2nd Class FCC license course designed for technicians who have already had basic



Leave those parts in the circuit

Tracing troubles without unsoldering.

by Larry Allen

If you will remember from our previous discussion, the episode of solder-splattering in Jim's shop triggered a long session on testing components in the circuit, to avoid as much soldering as possible. I described methods of testing small capacitors because that appeared to be a good place to introduce the techniques and reasoning used in this kind of servicing. You may wish to reread that installment to refresh your memory before you go to the next paragraph.

Table 1.

10 pf	30 mHz
100 pf	3 mHz
1000 pf	300 kHz
.01 mfd	30 kHz
.1 mfd	3 kHz
1 mfd	300 Hz

Testing Electrolytics

We'll pursue our discussion of electrolytic capacitors, as we did with small capacitors, by considering primarily the types of faults ordinarily encountered in them: open, loss of capacitance, leaky, and shorted.

In tube circuits, electrolytics are used primarily for bypassing and decoupling because of their large capacitance and consequent low reactance. In transistor circuits, the input (base) impedances are so low that the low reactance of electrolytics is needed in most audio coupling configurations. Therefore, we will consider both coupling and bypass units in discussing methods of testing for various electrolytic faults.

The ohmmeter charge-reaction test we applied to values over .001 mfd is also good for electrolytics, but it must be applied differently. With electrolytics, reversing the leads has a different effect, because the electrolytic must be polarized by the DC potential from the ohmmeter.

However, unless there are very low values of shunt resistance, you can check electrolytics more readily in the circuit than you can small-value capacitors. Your ohmmeter is the quickest way. Connect the leads across the electrolytic. The ohmmeter needle should deflect to a very low value and then climb rapidly, then more slowly, until it stabilizes. Make a note of the final reading. Reverse the leads and watch the pointer action again. This time, you should notice the same deflection, then an increase to some resistance value lower than that noted in the first test. The action described first is that of a good electrolytic; the second test (lower final reading) is with the wrong polarity applied to the unit. Obviously, if you notice the second action first, you have applied the wrong polarity first instead of last. The test with *correct* polarity applied is the one by which to judge (we'll discuss what the actual reading should be when we move to leaky electrolytics).

Table 2.

1 mfd	10,000 Hz
10 mfd	1,000 Hz
50 mfd	200 Hz
100 mfd	100 Hz

If you obtain no reading on the ohmmeter—that is, if the needle moves but very little—the unit is open. This test is good with almost any kind of electrolytic capacitor, because all electrolytics have some inherent leakage that should be readable on your ohmmeter.

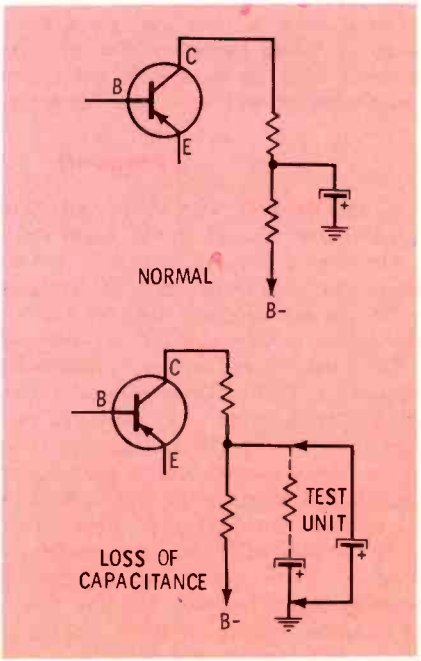


Fig. 4. Loss of capacitance has effect of resistor in series with electrolytic.

This test is useful whether the unit is a coupling capacitor or a bypass unit. Connect the ohmmeter across it. If there is a shunt path of very low resistance—a low-value resistor, a transformer winding, or a diode, for example—you must disconnect one end of the capacitor.

You can use the signal-generator-and-scope technique with coupling electrolytics in transistor circuits, if your ohmmeter tests aren't conclusive. Table 2 shows a few typical values and the generator frequencies to use. The frequencies shown are lower than those listed in Table 1 (first installment) because the circuits have inherently lower impedances.

Loss of Capacitance

Loss of capacitance is not easy to detect with an ohmmeter. An electrolytic with this fault acts as if a resistance were added in series with the capacitance, thus lessening its effect in the circuit. The best test for such an electrolytic is to bypass it (with the set in operation) with a good electrolytic, being sure to use the proper polarity. Fig. 4 shows how loss of capacitance can reduce decoupling effectiveness of an electrolytic, and how a test unit can be bridged to eliminate the effect of "series resistance." Remember, however, that this bridging test is useful only when leakage is not excessive.

This substitution test will work with both coupling and bypass capacitors. If you prefer using test instruments, or don't have a similar electrolytic for bridging, use the signal generator and scope (frequencies shown in Table 2) as you do for small capacitors. As with small capacitors, a good coupling electrolytic should have the same amount of signal at both ends, while a good bypass unit should reduce the scope trace by at least half whenever the scope and generator leads are connected across it.

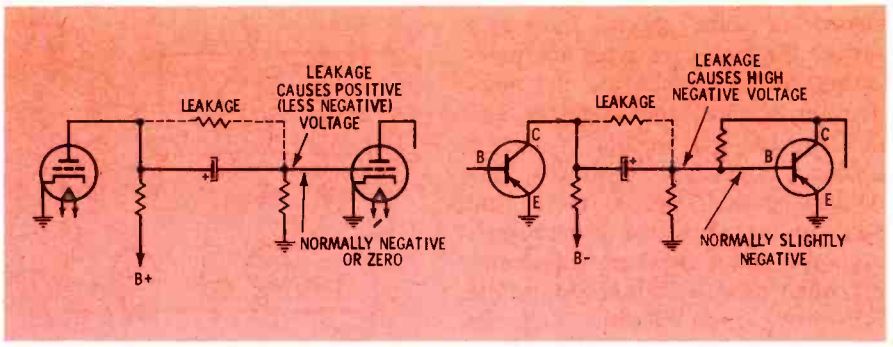


Fig. 5. Leakage in coupling capacitor affects bias on next stage.

The same *open-end* test used for checking small-value capacitors cannot be applied to electrolytics. An electrolytic has its own inherent leakage. In addition, there is always the problem of polarizing voltage for electrolytics, which may not be applied properly during an ordinary open-end test for leakage.

Your ohmmeter, however, can give a fair evaluation. The procedure for connecting the ohmmeter first with proper polarity and then with reverse polarity was described under "Opens." With the ohmmeter connected for *proper* polarizing voltage, note the final reading; a good electrolytic should read 50K ohms or more.

Dynamic tests may be preferable —tests with the set operating. When testing a coupling electrolytic, take a reading across the grid (or base) resistor that follows the capacitor. A reading indicating reverse polarity usually means capacitor leakage, unless the tube itself is gassy (or the transistor is faulty). Fig. 5 shows how this test works in both tube and transistor circuits. You can often recognize leakage in bypass electrolytics by excessive current being drawn in the circuit. To trace the overload, you may have to decrease the circuit load by unsoldering a few leads, one at a time. Figs. 6 and 7 give some ideas on how to check leakage this way.

Shorted

A shorted electrolytic shows all the symptoms displayed by shorted capacitors of any value. We discussed the symptoms and methods of testing shorted capacitors in the first part of this series; apply the same techniques for checking shorted electrolytics.

Coils and Transformers

Classifying and analyzing breakdowns according to the type of fault works well in explaining how to test capacitors of various kinds, so we'll do the same for coils and transformers. They exhibit open windings, shorted windings, leakage or shorts between windings, and shorts or leakage from a winding to the core or mounting.

Quick Testing

Before we get into specific faults, let's discuss one quick test that can uncover any of the several faults that might exist in a coil or transformer.

Each coil and transformer is de-

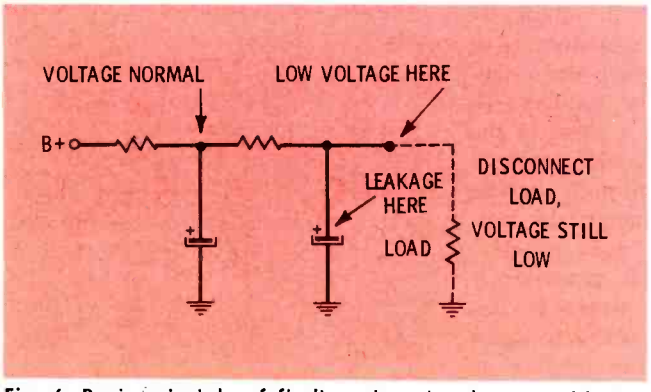


Fig. 6. Basic principle of finding short involves unsoldering loads.

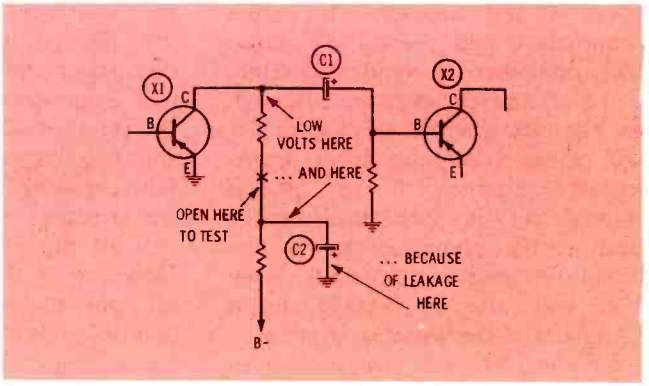


Fig. 7. If voltage becomes normal, C2 is bad. If not, trouble is in X1 or C1.

signed for some general frequency range: the iron-core types for power and audio frequencies; the powdered-iron core types for RF; and the air-core and ferrite types for higher frequencies. With this frequency characteristic in mind, you can see that a signal generator is a good tool for checking transformers when used with a scope, or the RF probe and VTVM. With the set turned off, feed a signal into any single winding of the transformer and check each individual winding with the scope or VTVM to locate a fault. One fault this system won't always reveal is a short from a winding to ground; it can reveal this condition only if the short happens to be near the "high" end of the winding. Choose the generator test frequency from the chart in Table 3. Although the frequency isn't too critical, you should use a signal near the characteristic frequency of the transformer.

Particular attention should be paid to the circuits connected to the transformer. Low-resistance paths that shunt windings can give some surprising results, especially if the shunting circuit happens to be faulty. However, since these same external faults can be misleading in other methods of testing, they should not prevent you from using the signal generator and scope. In fact, this method is probably the most dependable system for testing transformers.

Open Windings

Your ohmmeter is usually dependable for indicating open windings. The difficulty is in evaluating windings that have shunt paths. Note the circuits in Fig. 8; they represent a few of the shunting arrangements you might encounter. In Fig. 8A, the interelement resistance of the transistor is across terminals 2 and 3, and will cause the ohmmeter to read differently if the ohmmeter leads are reversed. In Fig. 8B, normal leakage of C1 will show continuity from transformer terminal 1 to ground through X1, provided the negative lead of the ohmmeter is on terminal 1. Reversing the leads, however, will raise the reading almost to infinity if the winding is open.

In Fig. 8A, the easiest way to check the secondary winding of the IF transformer is to connect the

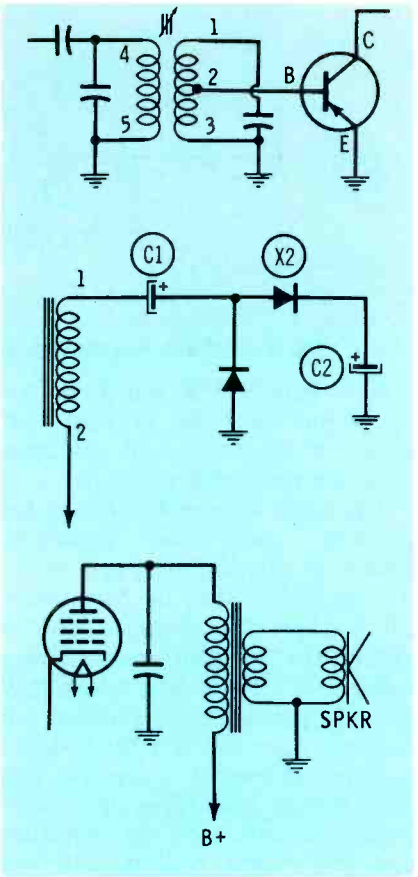


Fig. 8. A few of the many external circuits that affect transformer checks.

ohmmeter ground lead to ground or terminal 3 and touch the other test lead to terminal 1. No reading means it is open; a reading means it may be all right. Touch the test lead to terminal 2, then reverse the meter leads. If the bottom half of the winding is open, one reading will be infinite or nearly so; if the winding is all right, both readings will be low. Of course, you can unsolder the transformer lead going to the transistor, but the objective is to eliminate as much soldering as possible.

Fig. 8C is almost hopeless as far as testing the secondary winding of the voice coil is concerned. Since the resistances are both inherently low, the only practical answer is to disconnect one lead from the voice-coil connection at the speaker. In the primary winding, a short in the shunting capacitor could cause a false reading of continuity across the winding, even though the bottom of the primary goes to B+. However, if the shunt capacitor is all right, the reading would be dependable. One quick test is to listen for a "click" from the speaker as the ohmmeter is connected across the primary.

Consider all the possible shunt paths when testing transformer windings. Otherwise, you can get some confusing results.

Shorted Windings

This is probably the most difficult defect to find in any transformer or coil. The signal generator and scope are your most valuable instruments. Use them as pointed out under "Quick Testing" and you will find a good percentage of shorted windings—a shorted winding cannot pass the signal properly.

Single-turn shorts are the most elusive problem. It is nearly impossible to determine when a single turn is shorted on a low-Q, loose-coupled winding. If the Q is higher, the signal-generator-and-scope test will usually reveal the fault.

In tunable transformers, you often find that a dynamic test is best. Try alignment. If you can't get a normal tuning indication when turning the slug or trimmer, the winding or an associated circuit is faulty. Single-turn shorts will appear in these tuning tests as unnecessarily broad tuning, even in relatively low-Q windings.

Short Between Windings

If the primary or the secondary of the transformer is connected in a circuit carrying B+, you will have an easy time detecting interwinding leakage or shorts—a positive voltage will appear in the other winding.

The same situation occurs in transistor circuits—Fig. 9 shows an example in which negative voltage from the preceding collector circuit leaks into the normally positive base circuit. However, if the secondary was directly grounded, you might have a problem measuring the leaking voltage because of the low DC resistance of the winding.

• *Please turn to page 48*

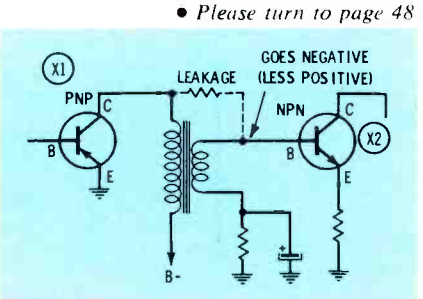
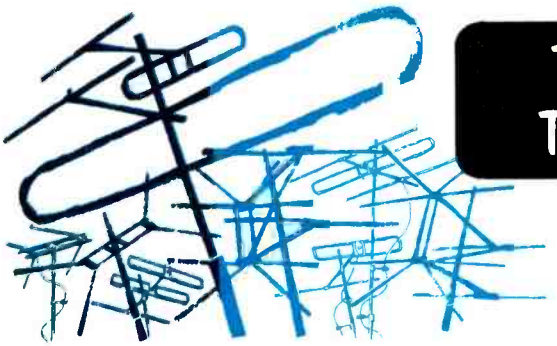


Fig. 9. Leakage has effect similar to leaky coupling capacitors.



THAR'S GOLD IN THAT THAR SKY!

Start an antenna inspection program.
by Howard S. Pyle

Concentrated selling and repair of TV, radio, stereo/hi-fi and recording equipment can often create a "wall" around the activities of the average radio/TV establishment and prevent them from "seeing the woods for the trees," to borrow a cliche. Perhaps it's time such dealers took a look *over* the wall and thought about the trees themselves!

The technician-salesman is actually operating in a veritable forest which he has created through aggressive selling. We are talking about the maze of TV towers, masts, and antennas found in every community—urban, suburban and rural. You've sold l-o-t-s of these yourself; in most cases you've erected them as well. Ninety percent of the dealers are missing a bet by considering the deal closed when the sale is made and the antenna system installed. They then tackle a *new* prospect and go to work on him with color TV, a fancy recorder, or a stereo/hi-fi setup.

Having sold the earlier customer all that they feel he is able to handle at the time, they move his card from the prospect file to that labelled "possible future service" and ignore him from there on, or until they get a trouble call from him, or until his gear has become obsolete, which may again make him a prospect.

Take a second look at the prominent towers, masts, and antennas as you drive around. They are out in the weather all year; many show rust patches, and those in coastal towns more often than not have a salty, corrosive film. Others are leaning at odd angles—any number have loose or broken guy wires. All of these conditions are definite hazards and chances are the owners have no insurance protection against damage to life or property should these deteriorated antennas come crashing down in a wind storm.

This is where *you* come in, Mr. Dealer. Two good avenues are opened to you to provide a tidy sum in additional revenue if you work at it. First is an antenna-maintenance setup which will include periodic inspection of antennas and support structures, followed by a condensed written report including an estimated cost for necessary repairs. Such inspections should of course be "free—no obligation;" you can handle them in your own time, during slack shop periods. The second opportunity is that such examination is going to turn up an impressive number of antenna systems which, it can be pointed out to the owner, would be more costly to repair than to replace. The result? A chance of a new antenna sale, possible including even a new tower or mast. And when you've "got your foot in the door" by suggesting the antenna inspection, repair, or replacement, you will find more than a few customers thinking about getting a new TV set as well.

Maintenance of the outdoor portion of a TV installation is just as important as servicing the equipment in the home, which is, of course, never exposed to the elements and the ravages of nature. The inside equipment is treated as a fine piece of furniture which seldom gives trouble unless Junior gets curious with his screwdriver or do-it-yourselfer father gets his fingers into it! Never a thought is given by the householder to the antenna structure on his roof. If his TV acts up, in his opinion there is "something wrong with the set—call the service man." We all know that many cases of trouble have been traced directly to loose, broken, or corroded connections at the antenna; perhaps a lead-in cable has chafed itself to the point where it is grounding on the rain gutter. Or perhaps one of the cable strands is broken. Again, your inspection would reveal such faults, often before they actually occur. Some preventive maintenance could correct a fault before real trouble appears.

Work it this way: Make up a chart (see Fig. 1) of possible troubles in antennas, guy wires, masts, towers, insulators, and lead-in cable. Use this as a guide in selling your prospect on a "free" inspection. From the ground you can point out to him the leaning antenna mast or tower and the drooping antenna elements. You can probably show him the deterioration of the lead-in cable and its entrance bushing or insulator through the wall or window. Point out that rusty spots appear on the roof structure and you can see them from the ground; they should be wire-brushed and possibly repainted. It won't take much convincing for him to realize that if what can be seen from the ground is bad, it must be much more so close up, and

BENSON CITY
RADIO-TV CENTER
Benson City, Minn.

ANTENNA SYSTEM INSPECTION REPORT

for _____

Date _____

Technician _____

CONDITION:	Satisfactory	Hazardous	Loose	Corroded	Broken	Rusted
ANTENNA						
Elements						
Electrical connections						
LEAD-IN CABLE						
Insulation						
Terminals						
SUPPORT MAST						
Section joints						
Mounting base						
Bolts, nuts, turnbuckles						
Guy wires & anchors						
Guy-wire insulators						
TOWER STRUCTURE						
Section joints						
Bolts, nuts, U-clamps						
Crank-down mechanism						
Tilt-over hinging						
Hoist cable						
Safety catch						
Guy wires & insulators						

We will be pleased to discuss the above items with you and to submit an estimate of probable repair costs. Just telephone us at ADams 2-3241 at your convenience and we will arrange an appointment to suit you.

BENSON CITY RADIO-TV CENTER _____ Proprietor

DROP IN AT OUR SHOWROOMS AND INSPECT OUR LATEST TV, HI-FI, AND RECORDING EQUIPMENT.

• *Please turn to page 54*

NEW SIMPSON 7-INCH VTVM MODEL 312

Immediate delivery from Electronic Distributor stock.

Extra Wide Frequency Response. 40% Less Circuit Loading Than Conventional VTVMs.

Here's a rundown on all the goodies Simpson has packed into this new VTVM. With its accessory probe, you can make measurements from 10 KC to 250 MC at ±1 db. With its 16 megohm (rather than 11) input resistance, you don't have to worry about circuit loading. Moreover, you can run your tests with a tracking error of less than 1%. And don't worry too much about meter burnout. There's a specially designed protection circuit. You can handle solid state testing easily and accurately because of the ½-volt DC range. Accuracies are ± 3% (FS) on all AC and DC ranges. Resistance accuracy is ±3° of arc. Model 312 has a big, easy-to-read 7-inch meter housed in a rugged phenolic case. Operating line voltage is 105/125 V, 50/60 cps. High voltage and RF probes available. See Bulletin 2070; copies sent on request. Model 312 price . . . **$79.95**

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DC VOLTAGE: 0-0.5, 1.5, 5, 15, 50, 150, 500, 1500 (16 Megohms input impedance)

AC VOLTAGE: (R.M.S.): 0-1.5, 5, 15, 50, 150, 500, 1500 (1 Megohm minimum input impedance)

AC VOLTAGE: (Peak to Peak): 0-4, 14, 40, 140, 400, 1400, 4000

RESISTANCE: RX1, RX10, RX100, RX1K, RX10K, RX100K, RX1M (10 ohm center)

FREQUENCY RESPONSE: ±3% from 15 cps to 3 megacycles per second on all AC voltage ranges through 150 volts. With R.F. Probe: 10KC to 250 MC ± 1 db. R.F. probe usable up to 40 volts rms.

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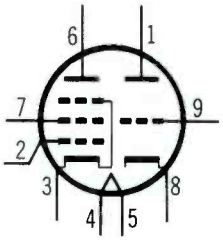
TUBE and TRANSISTOR DATA

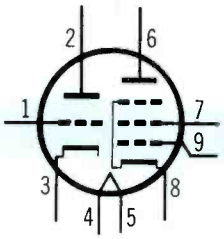
RECEIVING TUBES

5KZ8
VHF Converter
Fil.—4.7V @ 0.6A (11 sec)



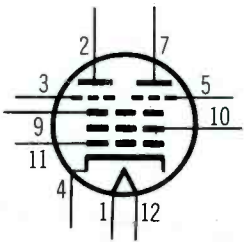
9FZ

5MB8
Pentode—Burst Amplifier
Triode—Video Amplifier
Fil.—5.6V @ 0.45A (11 sec)



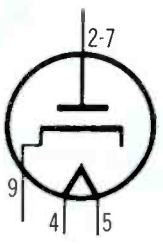
9FA

6AG10
Color Demodulator
Fil.—6.3V @ .75A



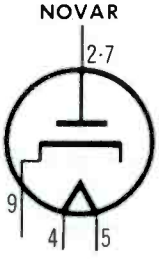
12GT

6CJ3
Damper
Fil.—6.3V @ 1.8A
PIV.—5.5KV @ 350ma



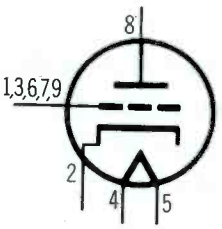
9HP
NOVAR

6CK3/12CK3/17CK3
Damper
Fil.—6.3V @ 1.2A/12.6V @ .6A (11 sec)/16.8V @ .45A (11 sec)



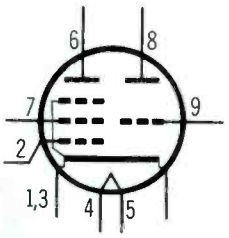
9HP
NOVAR

6DL4
VHF Amplifier
Fil.—6.3V @ .165A



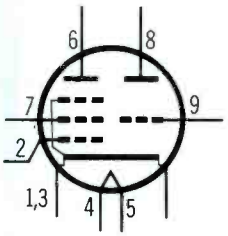
9NY

6HD7
Pentode—VHF Mixer
Triode—VHF Oscillator
Fil.—6.3V @ .45A (11 sec)



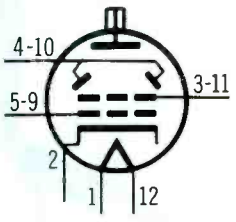
9QA

6HJ7
Pentode—VHF Mixer
Triode—VHF Oscillator
Fil.—6.3V @ .45A (11 sec)



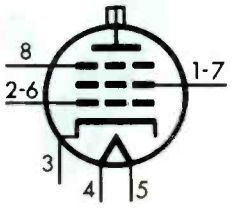
9QA

6KD6
Horizontal Output
Fil.—6.3V @ 2.85A



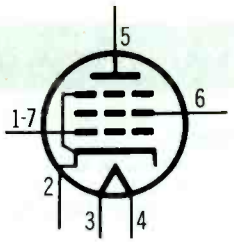
12GW

6KM6
Horizontal Output
Fil.—6.3V @ 1.6A



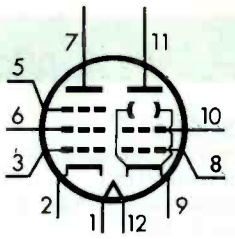
9QL
NOVAR

6HR5
Vertical Output
Fil.—6.3V @ 0.45A (11 sec)



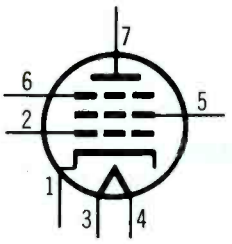
7BZ

13V10
Pentode #1—Audio Output
Pentode #2—Audio Detector
Fil.—13.2V @ 0.45A (11 sec)



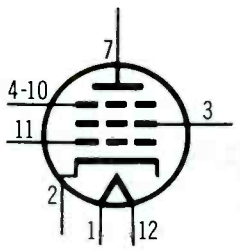
12EZ

6KS6
Audio Detector
Fil.—6.3V @ 0.3A



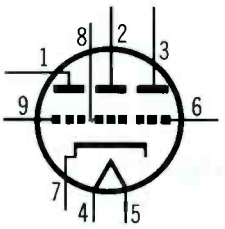
7DF

21JV6
Horizontal Output
Fil.—21.0V @ 0.45A (11 sec)



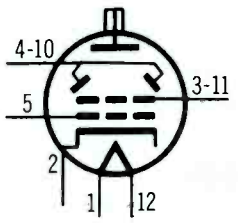
12FK

6MD8
Matrix Amplifier
Fil.—6.3V @ 0.9A



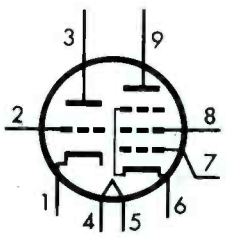
9RQ
NOVAR

31JS6A
Horizontal Output
Fil.—31.5V @ 0.45A (11 sec)



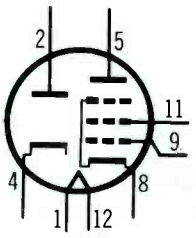
12FY

10LZ8
Pentode—Video Amplifier
Triode—General Purpose
Fil.—10.5V @ 0.45A (11 sec)



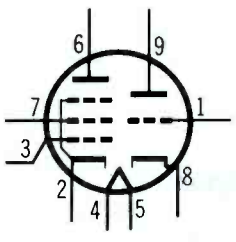
9DX

38HK7
Horizontal Output and Damper
Fil.—37.8V @ 0.45A (11 sec)



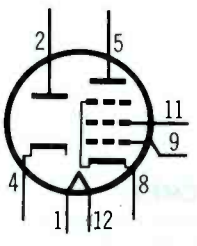
12FS

11BM8
Pentode—Vertical Output
Triode—General Purpose
Fil.—10.7V @ .45A



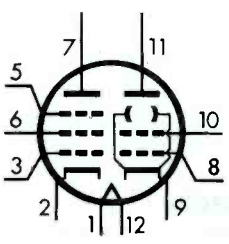
9EX

58HE7
Pentode—Horizontal Output
Diode—Damper
Fil.—58V @ .3A (11 sec)



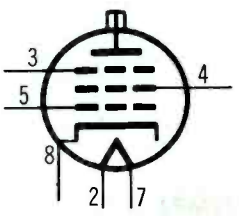
12FS

12T10
Pentode #1—Audio Output
Pentode #2—Audio Detector
Fil.—12.6V @ 0.45A (11 sec)



12EZ

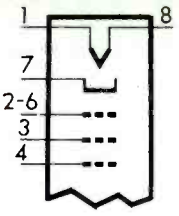
50JY6
Horizontal Output
Fil.—50.0V @ 0.15A



8MG

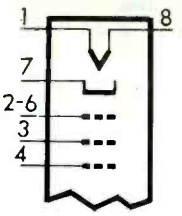
CATHODE-RAY TUBES

23HQP4
Protection—tension band
Deflection—110°
Filament—6.3V @ 0.45A (11 sec)
Grid 2—400V



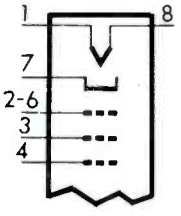
8HR

19ESP4
Protection—tension band
Deflection—114°
Filament—6.3V @ .6A (11 sec)
Grid 2—50V



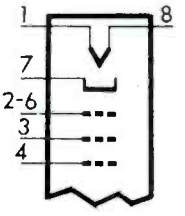
8HR

25JP4
Protection—none
Deflection—110°
Filament—6.3V @ 0.3A (14 sec)
Grid 2—300V



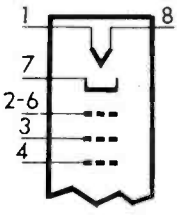
8HR

19FEP4
Protection—tension band
Deflection—114°
Filament—6.3V @ .45A (11 sec)
Grid 2—30V



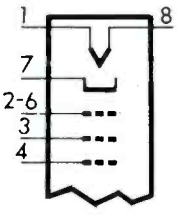
8HR

25KP4
Protection—bonded glass
Deflection—110°
Filament—6.3V @ 0.3A (14 sec)
Grid 2—300V



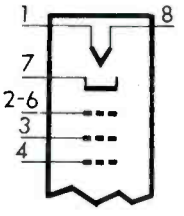
8HR

19FNP4
Protection—tension band
Deflection—114°
Filament—6.3V @ .6A (11 sec)
Grid 2—300V



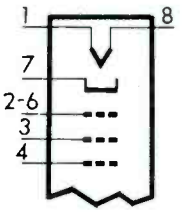
8HR

16CHP4
Protection—tension band
Deflection—114°
Filament—6.3V @ .45A (11 sec)
Grid 2—30V



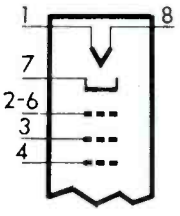
8HR

21FXP4
Protection—filled rim
Deflection—114°
Filament—6.3V @ .6A (11 sec)
Grid 2—400V



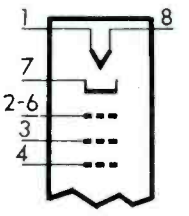
8HR

16CMP4
Protection—tension band
Deflection—114°
Filament—6.3V @ .45A (11 sec)
Grid 2—400V



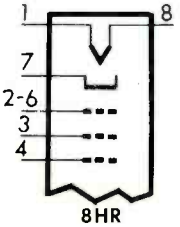
8HR

23GTP4
Protection—tension band
Deflection—110°
Filament—6.3V @ .6A (11 sec)
Grid 2—300V



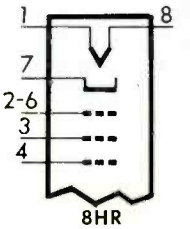
8HR

17EMP4
Protection—tension band
Deflection—114°
Filament—6.3V @ .45A (11 sec)
Grid 2—50V



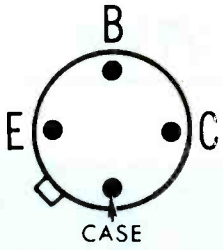
8HR

23HGP4
Protection—tension band
Deflection—110°
Filament—6.3V @ .45A (11 sec)
Grid 2—300V

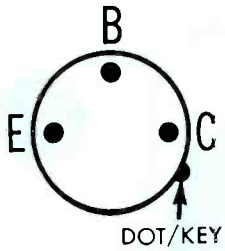


8HR

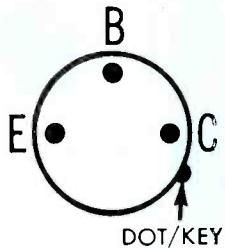
2SA163
VHF Amplifier
PNP—Germanium



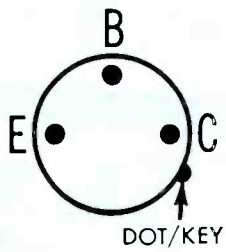
2SA189
RF Amplifier
PNP—Germanium



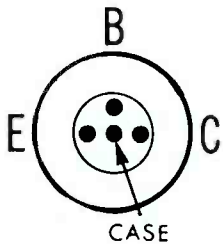
2SA201
Audio Amplifier
PNP—Germanium



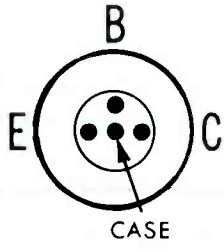
2SA203
RF Amplifier
PNP—Germanium



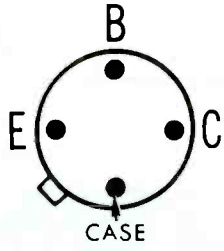
2SA222
RF Amplifier
PNP—Germanium



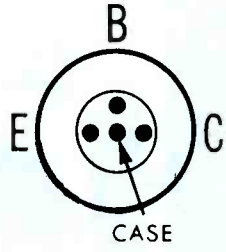
2SA225
Audio Amplifier
PNP—Germanium



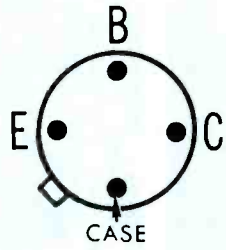
2SA230
VHF Amplifier
PNP—Germanium



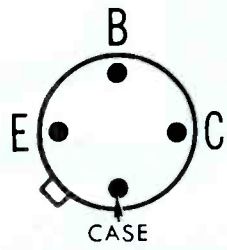
2SA234C
Video-IF Amplifier
PNP—Germanium



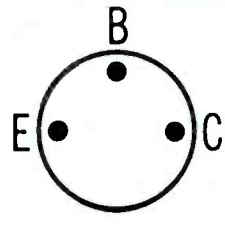
2SA240
Video-IF Amplifier
PNP—Germanium



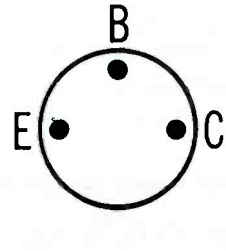
2SA243
VHF Amplifier
PNP—Germanium



2SA250
Video Amplifier
PNP—Germanium



2SA323
Video Amplifier
PNP—Germanium



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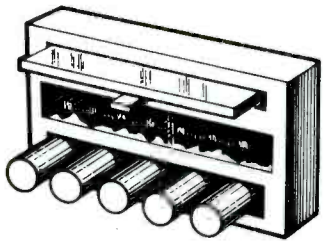

Transistorized
AUTOMATIC TUNING AUTO RADIOS

Service those automatic tuners.

by E. F. Rice

Many of the medium—and higher priced automobiles are equipped with *"Signal Seeker"* or so-called *"Wonder Bar"* radios. With just a momentary touch of the driver's finger on the bar, or a tap of his toe on the floor switch, the tuner automatically moves to the next strong station on the dial, regardless of where the car travels. Because it does not depend on a fixed mechanical adjustment of push buttons, which must be reset for each area where the car is used, the signal seeking radio eliminates constant dial twisting to keep a strong local station tuned in while traveling.

Troubleshooting the newest versions of the signal seeker calls for a lot of experience with transistor circuits. Plenty of practice with printed-circuit surgery plus some study of the new trigger circuitry and the causes of some common symptoms are prerequisites for the technician who wants to learn to repair these radios. The explanations which follow will bring you up to date on the circuits and symptoms and give you some troubleshooting tips so when one of these receivers comes to your service bench, you'll be able to decide whether to tackle it yourself or to "send it out."

Vacuum-Tube Circuit

Let's take the vacuum-tube trigger circuit used in the 1963 Cadillac radio for our first example. The skeleton schematic of Fig. 1 shows a special triode-tetrode relay tube, 12AL8, used in the trigger circuit; the rest of the radio is transistorized. When the start switch, M12, energizes the relay coil, the spring-loaded dial mechanism is released and it begins to scan across the dial until an incoming carrier appears in the IF channel. The recycle solenoid, M10, rewinds the spring after each trip across the dial; it is operated by the switch, M11,

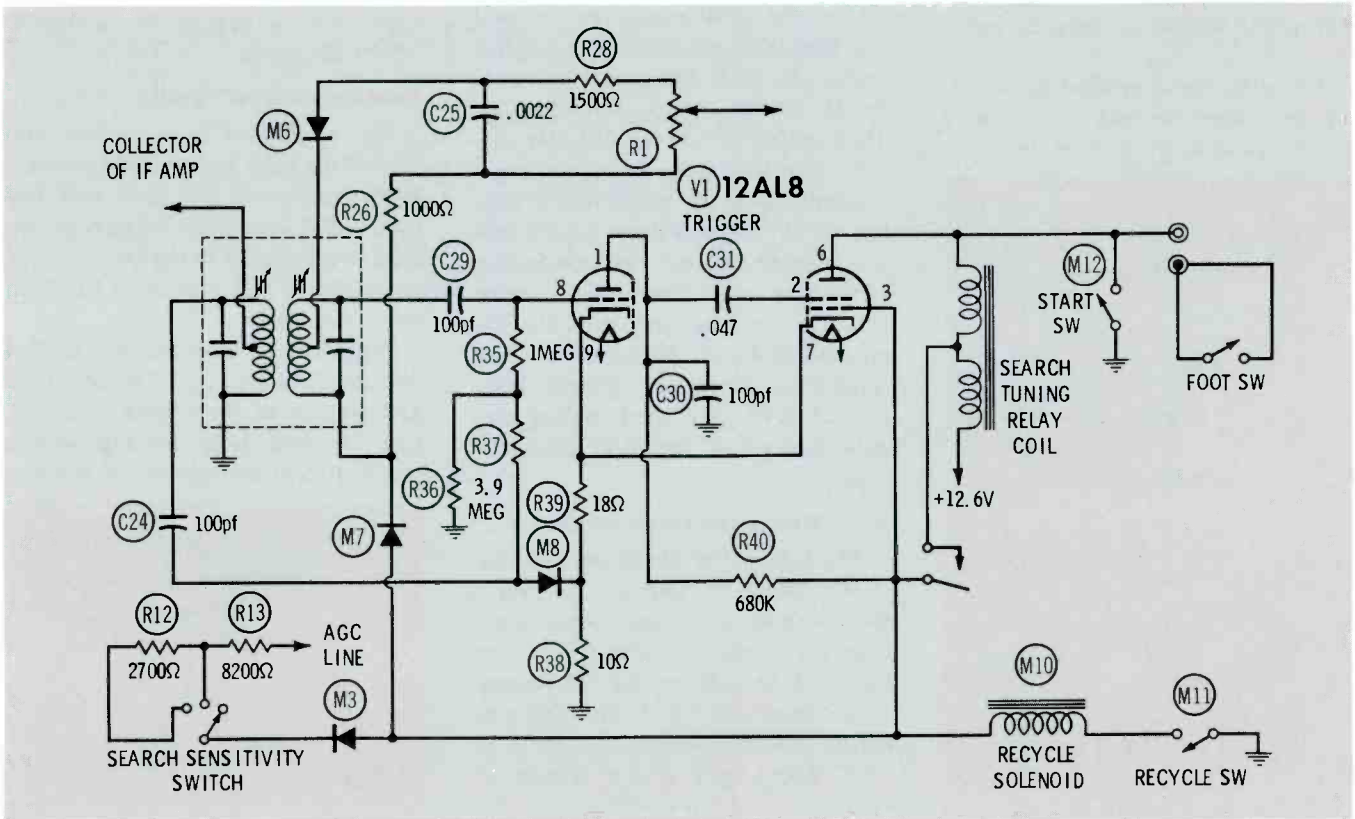

Fig. 1. Circuit of 1963.

which is closed momentarily when the tuner reaches the end of the dial.

The Starting Circuit

Fig. 2 shows the essential parts of the starting switch. When the start switch is closed momentarily, the starting current passes through the relay coil and closes the relay contacts to apply 12 volts to the accelerating anode (pin 3) of the tube, and at the same time, the gear train is unlocked. The plate current holds the relay closed so the search action continues after the starting switch is opened.

The search action stops when a strong carrier in the receiver generates a negative pulse at the control grid (pin 2). The resulting dip in plate current releases the relay, disconnecting the battery from pin 3, and locking the gear train. The development of this negative pulse is a rather complex process and will be explained in detail in the next section.

The Stopping Circuit

On first thought it might seem that the receiver's AGC voltage could be used directly to stop the searching when a station is tuned in, but this leads to inaccuracy of the stopping point. On strong stations the AGC may increase to the trigger level before the carrier is centered in the IF passband, and the tuner might stop before the station is correctly tuned in.

This difficulty is avoided by designing the trigger so that it requires a *positive* pulse at the grid of the triode

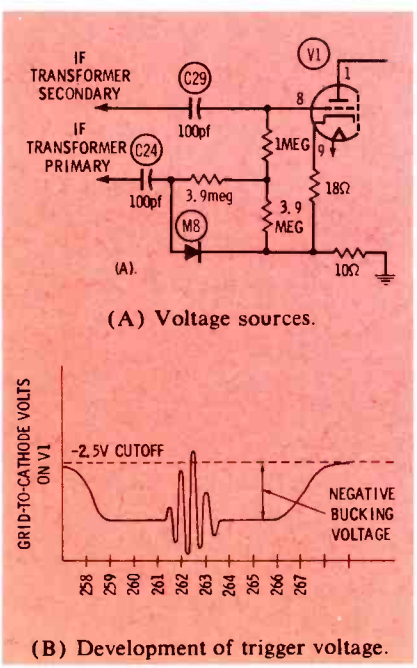

Fig. 3. Voltage-comparison circuit.

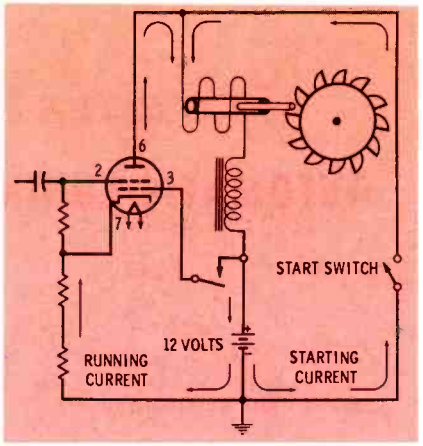

Fig. 2. Current paths.

section (Fig. 3) to stop the searching action. In this way, a special *negative* voltage proportional to the carrier strength can be used as a bucking voltage to prevent early triggering on strong stations. The graph of Fig. 3 shows that when the tuner is approaching a station, the negative bucking voltage appears as soon as the carrier reaches the edge of the IF bandpass. This voltage keeps the triode stage cut off until a signal from the detector-transformer secondary is applied through C29. This signal reaches a peak when the carrier is centered correctly in the IF bandpass

In older models the special negative bucking voltage was the receiver's AGC voltage; but in this transistorized model, PNP transistors are used and the AGC produced is a positive voltage. So diode M8 is used to rectify the IF carrier coming through C24. The positive half of the 262-kHz carrier is shorted by the diode; the negative half biases the triode with a voltage which is proportional to the carrier strength and prevents conduction of the tube until a strong signal comes from the secondary through C29. The positive peaks of this signal increase conduction of current through plate resistor, R40, producing the negative pulse needed at pin 2 to open the relay.

Audio Muting and Sensitivity Control

The instant the bar is pressed, the AGC voltage is reduced to nearly zero because the tuner moves away from the station on which it has been locked. If it were not for the muting circuit shown in Fig. 4, the high sensitivity resulting from the drop in AGC would cause a large amount of noise to be present in the speaker between stations. As soon as the relay closes, the positive terminal of the battery is connected to the anode of M7, and conduction of this diode puts the positive battery voltage on the cathode of the detector diode. This prevents any signal from reaching the audio stages during the search.

In earlier models a less-complicated method was used to silence the receiver during the search; either the speaker or the volume control was simply shorted out by the relay contacts.

Another difficulty arising from the increased sensitivity during the search is the tendency for the tuner to stop on stations which are actually too weak for comfortable listening. Because of the great variations in the conditions under which the receiver is used, a Search Sensitivity Control is provided. This control permits the driver to reduce the sensitivity when driving in a city, so that only local stations will stop the tuner; on the highway between cities the sensitivity can be increased so that less carrier strength is needed to stop the tuner.

Fig. 4 shows the search-sensitivity switch and its associated components: M3, R12 and R13. When the relay is closed the positive terminal of the battery is connected to the anode of M3 and a part of the positive voltage from the battery is applied to the AGC line, decreasing the sensitivity of the IF stages.

Solid-State Trigger Circuits

Fig. 5 shows a transistorized trigger circuit used in the 1964 models. NPN transistors are used and this means that a negative voltage on the base (with respect to the emitter) will cause cutoff, and a positive base will cause conduction.

Two different voltages are applied through C28 and C27 to the base and emitter of the trigger amplifier. One of these is a bucking voltage rectified from the primary of the sec-

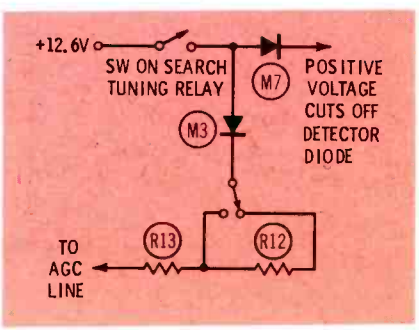

Fig. 4. Muting and sensitivity voltages.

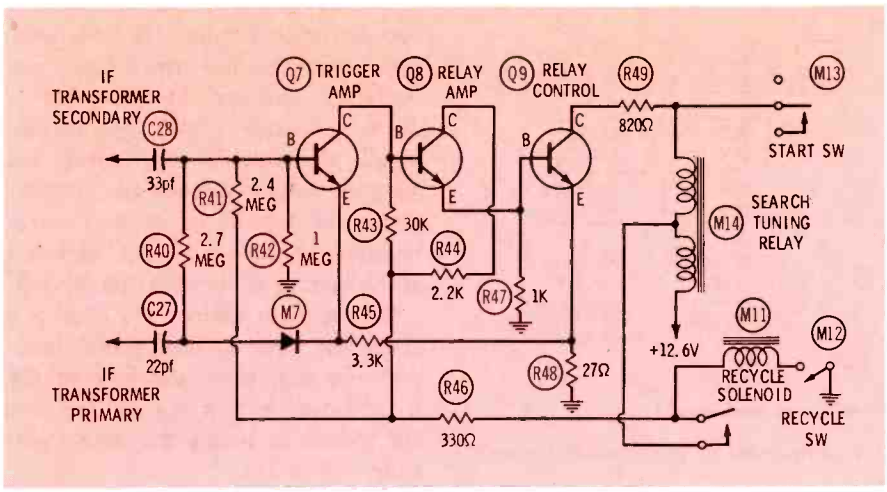

Fig. 5. Circuit of 1964.

ond IF transformer. The other voltage is the signal from the secondary of the transformer. This is similar to the method used in the vacuum-tube model except that now the bucking voltage is applied to the emitter and the IF signal is applied to the base.

Closing the start switch causes current to flow through the relay coil to release the gear train and connect the battery to Q7 and Q8. Q7 is biased near cutoff by current through R41 and R42; the additional current drawn through R48 by output transistor Q9 drives Q7 further into cutoff by increasing the positive voltage on the emitter.

With Q7 cut off, it causes no voltage drop across R43. The second stage therefore has maximum positive voltage on its base and it conducts heavily, providing a path for base current from the output stage. This keeps the output stage conducting and the relay closed after the switch is opened.

When a carrier appears in the detector stage of the receiver, the signal from the transformer primary is rectified and current in R48 is increased. This increases the positive bucking voltage at the emitter of the Q7 to prevent it coming into conduction before the carrier is centered in the IF channel. At the proper instant the signal coming through C28 develops a large enough positive peak at the base of Q7 to cause it to conduct, and the resulting current makes a larger voltage drop across R43.

With less positive voltage on its base, Q8 conducts less current and the base current of the output stage decreases. This produces a dip in the collector current of the final stage permitting the relay spring to return the armature to the lock position, stopping the gear train instantly when the station is centered in the IF bandpass. Opening the relay contacts also opens the battery connections to the first two stages so that the search action cannot be started by signals or noise coming through C28.

Fig. 6 shows one of the latest models and includes more details such as the muting and sensitivity circuits. NPN transistors are used and the circuit operates in basically the same way except that the first two stages are coupled through C7 instead of being DC coupled as they were in earlier models. Also, of special interest to the troubleshooter is the Zener diode added for voltage regulation and protection against surges from the coils.

Sensitivity and Muting

The sensitivity control consists of M17 feeding the positive battery voltage through R11 alone, or R11 and R12 in series, to the bases of the IF and RF stages via the AGC line. This is the same type of circuit used in the tube version.

The muting circuit is different however. Positive battery voltage is supplied through the series circuit consisting of the relay coil and contacts, M18, R26, and the detector transformer, to the cathode of the detector diode. Since this voltage is reverse bias, the diode is cut off while the search is in progress. If instead of tracing through R26 you trace through R28, you will find that a positive voltage is applied to the base of the first audio amplifier also. The result of this is that the NPN transistor conducts heavily and its collector voltage drops to zero. Zero voltage on this collector means zero voltage on the base of the audio driver also, and this silences the receiver during the search.

The extra contact on the start switch is another improvement over previous models. The upper contact improves the audio muting at the instant the switch is pressed. Without this connection, there would be no muting voltage until *after* the relay closes, connecting the positive battery voltage to M18. This would allow a sharp click to appear at the speaker when the switch is first closed. By using the three contacts as shown the positive voltage is applied to the audio

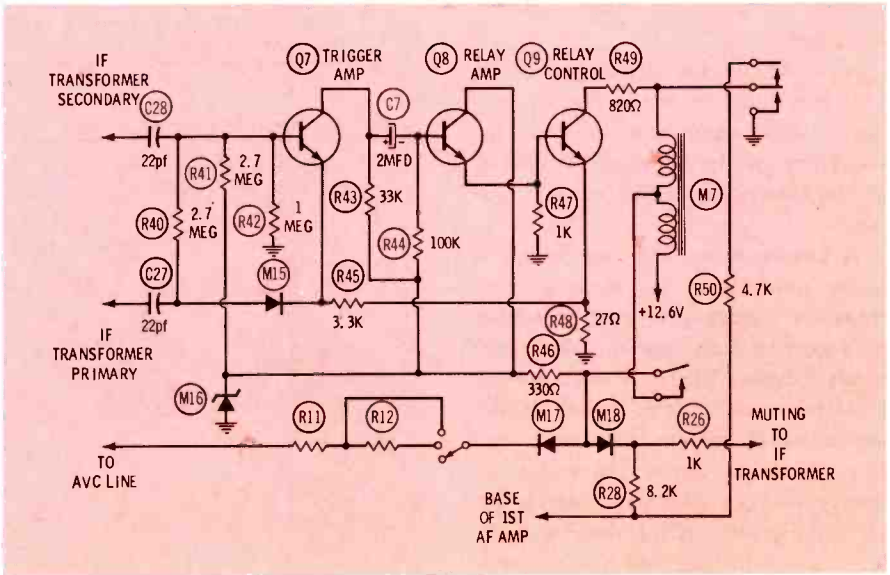

Fig. 6. Circuit of 1965.

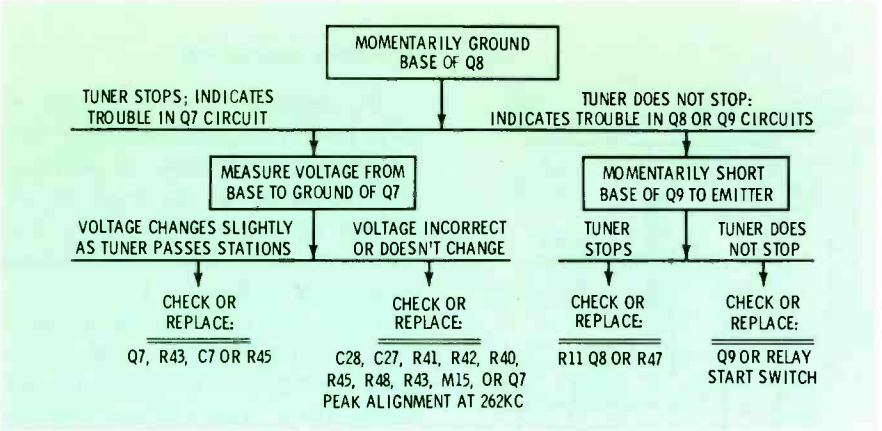

Fig. 7. Trouble chart for continuous seeking.

stage through R50 before the relay closes.

Troubleshooting

One very important thing to remember is that all voltages given by the manufacturer are measured with 14 volts applied. Also, you should know that the recycle solenoid draws 16 amps when energized! You may have to crank up the voltage on your battery eliminator to support this load when operating the receiver on your test bench.

Another thing which is likely to cause the repairman to waste some time is the fact that the antenna, RF, converter, IF, and detector stages must *all* be working properly or the tuner will "miss" stations. Of particular importance in this connection is the antenna trimmer which must be adjusted on a very weak station at or near 1400 kHz *when the radio is installed in the car*. When operating the radio on your service bench it might be necessary to change the peaking to match your own antenna conditions.

A short in the sensitivity diode (M17 in Fig. 6 or M3 in Fig. 1) produces some confusion because the sensitivity of the receiver is reduced all the time, even during manual tuning.

A simple thing, but one which is often overlooked in working with transistor circuits, is the possibility of incorrect readings on the ohmmeter because there is a transistor junction in the circuit which is being activated by the ohmmeter battery. When in doubt about the accuracy of your ohmmeter simply reverse the probes: if the reading is the same in both directions you're probably safe; if not, better disconnect the component in question and check it.

Also keep in mind that resistors and coils may appear to be open when in reality only the printed circuit leading to them is open.

Symptom: Continuous Seeking

Fig. 7 illustrates a system for pinpointing a faulty component. The receiver with this symptom can be tuned manually and picks up stations with normal sensitivity, proving that the front end is operating properly. But once the seeker is started it scans the dial continuously. A trick used by many experts is to disable the muting system (by removal of M18 in Fig. 6 for instance) so that the sound from the speaker will indicate when the tuner passes a local station which should have caused it to stop.

The first step in the chart is to ground the base of Q8 in Fig. 6. This isolates the first stage from the other two as a cause of the trouble. If the tuner stops when the forward bias is removed from Q8, this indicates that the last two stages are operating correctly. Measurement of the base voltage of Q7 will further isolate the trouble into either the input or output circuits of the first stage. The parts to be checked corresponding to the test results are listed at the bottom of the chart on the left.

On the right side of the chart are given the steps to take if the tuner *does not* stop when the base of Q8 is grounded. As you can see, the tests are chosen to isolate the defect into either Q8 or Q9.

Symptom: Tuner Stops Immediately When Start Switch Is Released

The steps to take are diagramed in Fig. 8 where it is suggested that a preliminary inspection of the relay contacts and the start switch should be made. Next, make certain the power supply is adequate as explained before and then measure the voltage across R47. Presence of 1.4 volts here means that the Q8 is probably conducting normally and the defect lies somewhere in Q9. The next test on the left will tell you whether to check the transistor or to examine R48, R49, or the relay coil.

If you don't find 1.4 volts across R47, then it is clear the tuner is stopping because of lack of forward bias on Q9. But because this bias is the result of conduction through Q8, which depends on the relay contacts

• *Please turn to page 52*

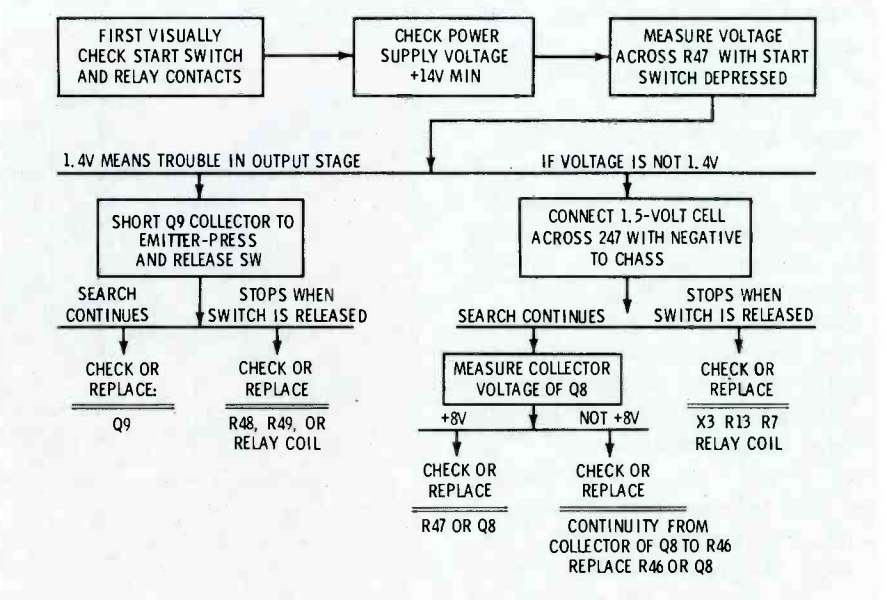

Fig. 8. Trouble chart for no searching.

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SQUARE-WAVE Testing of RF/IF Circuits

Advanced service techniques—Determine performance with square wave generator and an oscilloscope.
by Robert G. Middleton

A wideband triggered-sweep scope, described in the March 1965 PF REPORTER article "Learning About Triggered-Sweep Scopes," and a fast-rise square-wave generator, described in the April 1965 PF REPORTER article "Advanced Techniques for Future Servicing," were used in obtaining the photos in this article. If you can arrange to use equipment such as this, try to do so. Even if you cannot, at present, make use of one of these scopes, follow with us. Information in this and preceding articles of this series will be invaluable to you in the future.

—The Editor

Square-wave tests in RF and IF circuits employ slightly different test setups from those used in tests of audio amplifiers. The difference is based on the fact that an audio amplifier will directly pass the fundamental frequency of the square wave, while an RF/IF amplifier rejects the fundamental. Even if a particular RF/IF amplifier could accept the fundamental frequency of a square-wave generator signal, it would serve no useful purpose. Let us take a practical example:

Suppose that you have a good square-wave generator that provides a 1-mHz square-wave output. If you apply this signal to an AM broadcast receiver, the RF/IF amplifiers can accept the fundamental frequency of the square-wave. On the other hand, the third harmonic (3 mHz) and all the higher harmonics are rejected. From a practical viewpoint, the square-wave generator provides no more test data than an ordinary AM generator. The beginner is often surprised by this situation—he tends to feel that if a square-wave generator has a sufficiently high repetition rate, it should be possible to make a square-wave test of *any* amplifier directly. Of course, this is not so.

Basic Amplifier Responses

It is necessary to recognize that there is a basic distinction between an audio amplifier and an RF/IF amplifier. This distinction is aside from the center frequency of the amplifier, and concerns both bandwidth and signal-processing characteristics. An audio amplifier, of course, has a bandpass that includes the complete *audio* spectrum — from approximately 20 Hz to 15 kHz. On the other hand, and RF/IF amplifier has a bandpass that includes only a very small portion of the complete *radio-frequency* spectrum. But because of the high center frequency of an RF amplifier, this small portion includes audio frequencies (Fig. 1A).

Similarly, the RF/IF amplifier in a TV receiver has a bandpass that includes only a very small part in the VHF spectrum. Nevertheless, because of the high center frequency of the RF amplifier, this "slice" includes video frequencies and audio frequencies. These facts are illustrated in Fig. 1B. The basic system design is such as to provide for tuning an *extensive series of modu-*

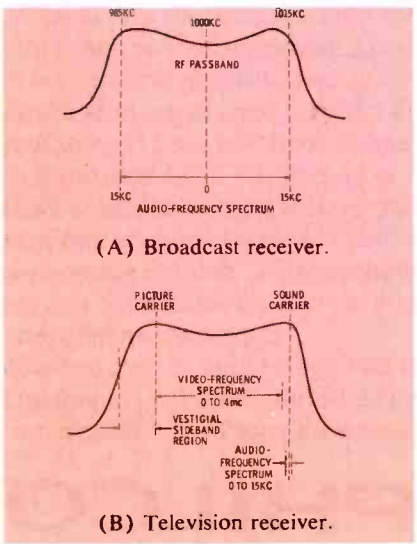


Fig. 1. Frequencies in the RF bandpass.

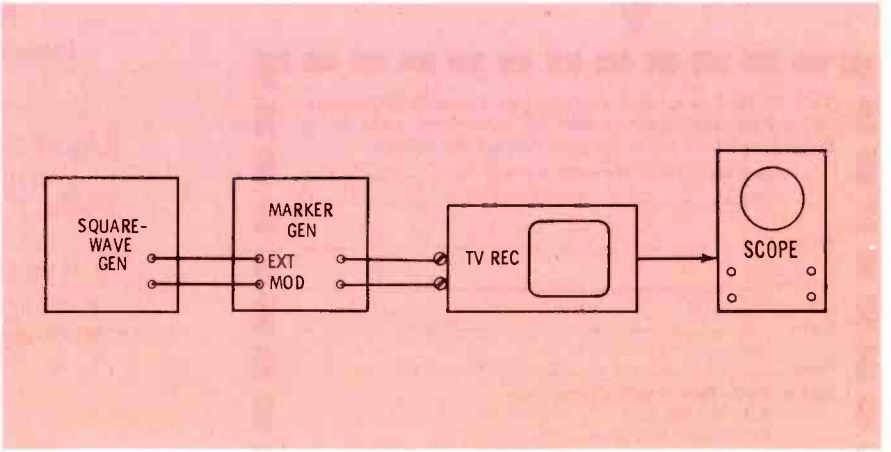
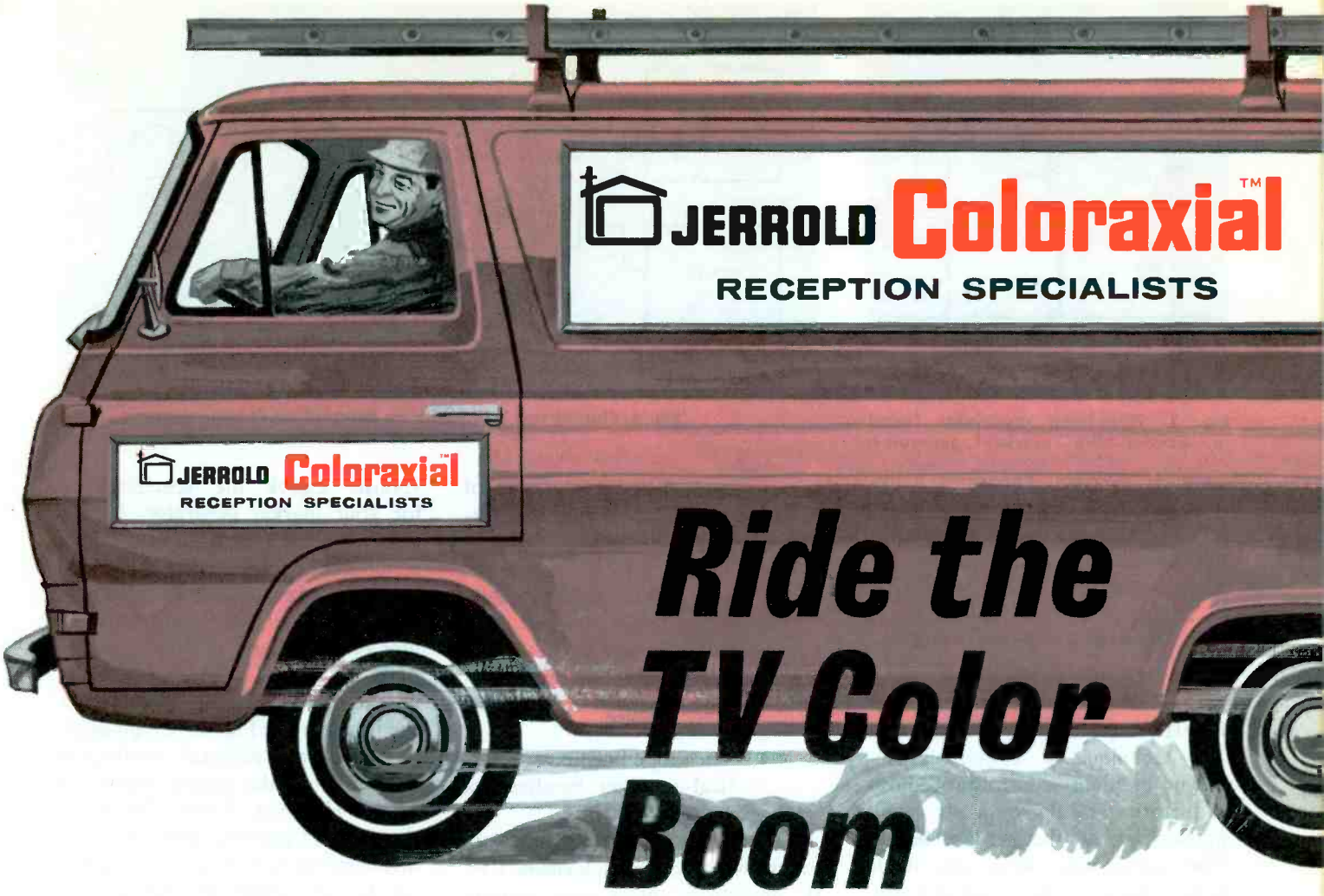


Fig. 2. Basic test setup.



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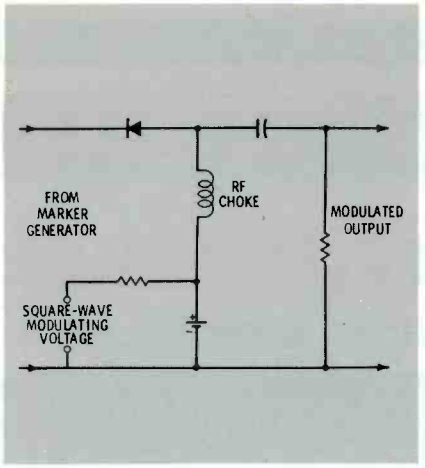


Fig. 3. Wide-band modulator found in good-quality marker generator.

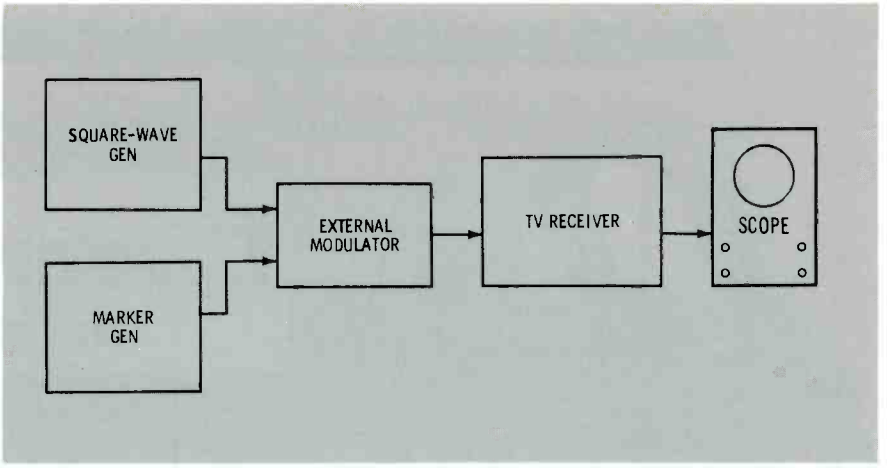


Fig. 4. Plan of test setup with an external modulator.

lated RF carriers. Therefore, it follows that a square-wave test of an RF/IF system can be made only by modulating the square-wave signal upon an RF carrier frequency.

General Considerations

Let us consider the general principles of square-wave testing for RF/IF amplifiers in TV receivers. This technique is commonly employed in quality-control procedures in factories and finds equally useful application at the service bench. The square-wave tests are made with a square-wave generator, signal generator, and scope. As shown in Fig. 2, the square-wave generator is used to modulate a marker generator. The modulated output from the marker generator is applied to the TV receiver under test. In turn, the output from the TV receiver is applied to a scope.

There are some basic equipment requirements, as follows:

1. The square-wave generator must have a rise time of 0.08 microsecond, or better.
2. The marker generator must have an accurately calibrated RF output.
3. The external modulator in the marker generator must have a bandpass of at least 44 mHz.
4. The scope must have a vertical-amplifier bandpass of at least 4 mHz.

Accordingly, do not attempt square-wave tests of television RF/IF amplifiers unless your square-wave generator has a suitably fast rise time. Your marker generator may or may not have a built-in frequency calibrator. If it does not, you can use an external quartz-crystal calibrator; but you *must* be able to calibrate your marker generator accurately if the tests are to be useful and reliable. Again, the modulator in your marker generator may or may not have wide-band response. Check the specifications for your marker generator. Fig. 3 shows the configurations of a wide-band modulator built into a good-quality marker generator.

Suppose that your marker generator does not have a built-in, wide-band modulator. Then, you can use an external modulator, as shown in the test setup in Fig. 4. A high-quality, lab-type external modulator may employ the circuit shown in Fig. 5. However, if you wish to use the simplest possible modulator, the arrangement shown in Fig. 6 gives satisfactory results for service applications. Your scope should have good square-wave response—otherwise, the deficiencies of the scope will be fasely charged to the RF/IF amplifier under test.

Test Frequencies

It is standard practice to check the response of an RF/IF amplifier with a 100-kHz square-wave. The marker generator must be tuned ac-

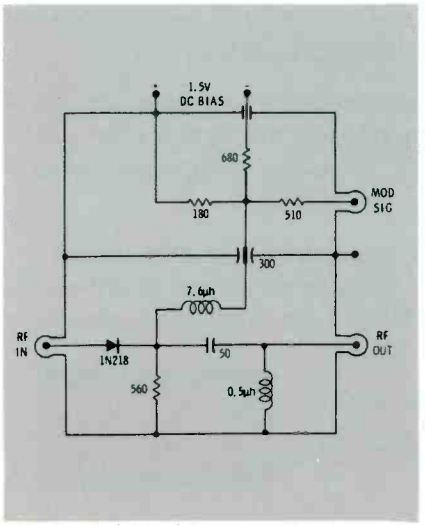


Fig. 5. High-quality external modulator.

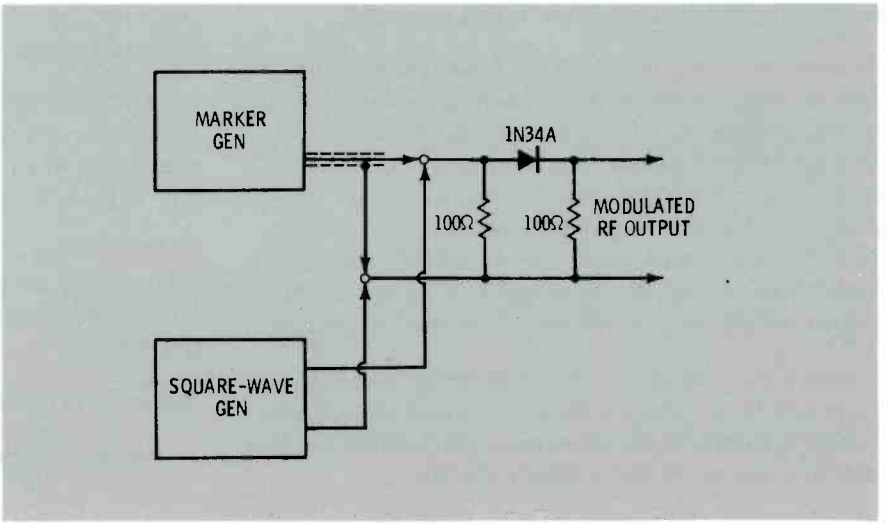
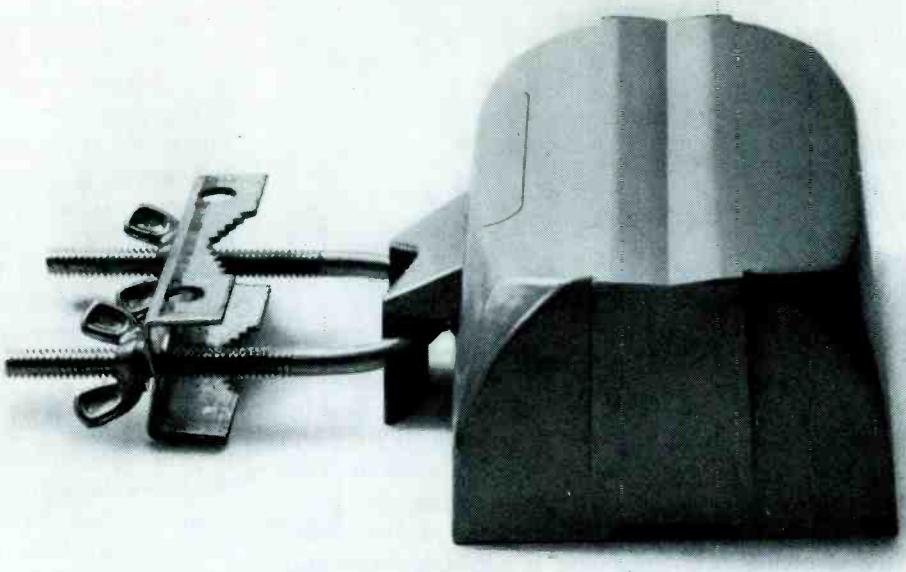


Fig. 6. A satisfactory external modulator.



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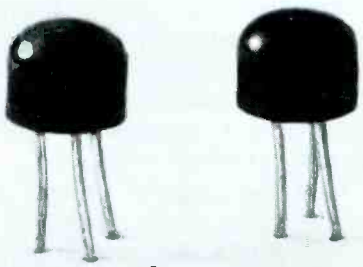

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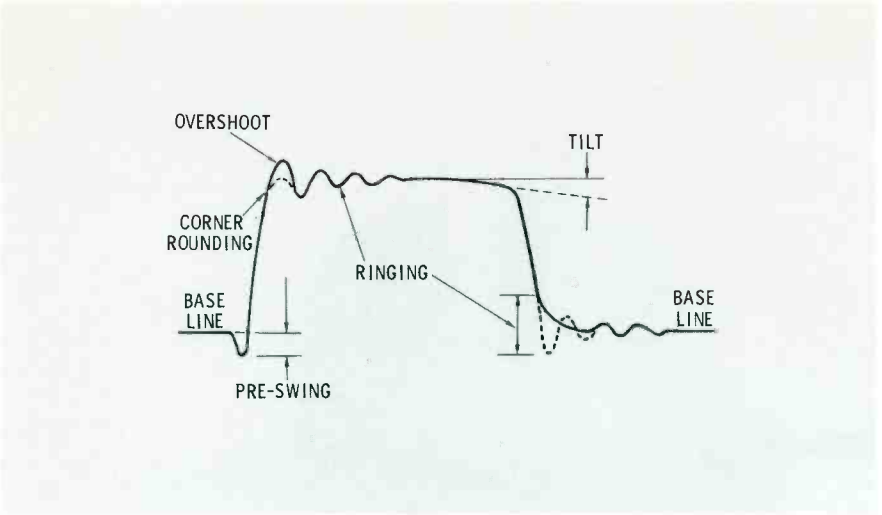
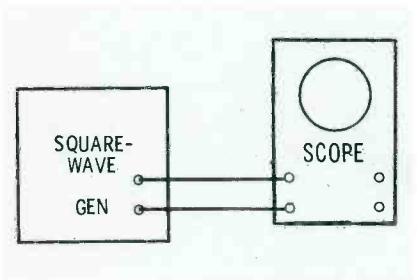


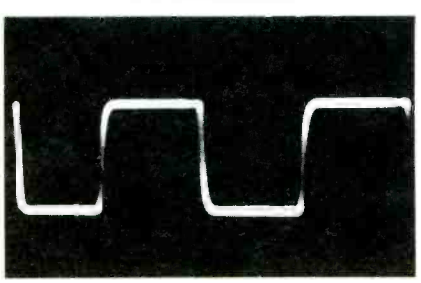
Fig. 7. Results of improper frequency.

curately to the picture-carrier frequency of the channel to which the TV receiver is set. If you do not tune the marker geneartor accurately, the picture carrier will not fall at the correct point on the response curve; in turn, the reproduced square wave will be fasely distorted, and you cannot evaluate the test results properly. For example, if the picture carrier is placed too far down on the response curve, the result is excessive pre-swing and ringing (see Fig. 7). On the other hand, if the picture carrier is placed too far up on the response curve, the result is excessively slow rise and rounded corners in the reproduced square wave.

To make sure that your scope has ample frequency (and transient) response, feed the output from the square-wave generator directly to the scope, as shown in Fig. 8A. Set the square-wave generator for a 100-kHz repetition rate. If a good square wave is displayed, the transient response is adequate. It is also advisable to check the rise time in this equipment test, if you are using a triggered-sweep scope. Expand the leading edge of the reproduced square wave, as shown in Fig. 9. If the rise time is 0.08 microsecond or less, the generator and scope will be satisfactory for square-wave RF/IF tests.



(A) Connections.



(B) Good scope response.

Fig. 8. Equipment test.

Test Procedure

Let us assume that you have a marker generator with built-in, wide-band modulating facilities, and wish to make a check of the RF/IF amplifier response of a TV receiver for modulated square-wave signals. Proceed as follows:

1. The output from the square-wave generator is fed to the external-modulation connector of the marker generator.
2. The output from the marker generator is fed to the antenna-input terminals of the TV receiver under test.
3. The scope is connected through a low-capacity probe to the control grid of the video-amplifier tube.
4. Set the square-wave generator for a 100-kHz repetition rate.
5. Adjust the peak-to-peak output voltage of the square-wave generator to the level recommended by the specifications for the marker generator.
6. Tune the marker generator to the picture-carrier frequency for which the TV receiver is set.
7. Adjust the scope controls for display of the reproduced square wave.

There are certain incidental considerations of practical interest. You may not have specifications for correct input-signal level to the external-modulation channel of the marker generator. If not, start with minimum output voltage from the square-wave generator. Observe the scope screen, and advance the square-wave level until you see a waveform amplitude of 1 volt peak to peak. Note that you *cannot overmodulate* the marker generator with a square-wave signal; however, an excessive modulation signal could damage the modulator diode. You cannot overmodulate with a square-wave signal, because the signal merely "switches" the CW output from the marker generator on and off at 100-kHz rate.

There is also a loading consideration. A low-capacity probe has a certain input capacitance, typically 7 pf. This input capacitance is shunted across the grid of the video-amplifier tube, and tends to slow down the rise time of the reproduced square wave. Hence, it is good practice to make reasonable compensation for probe loading. This is done by unplugging the video-amplifier tube. In turn, the probe input capacitance substitutes for the grid input capacitance of the video-amplifier tube.

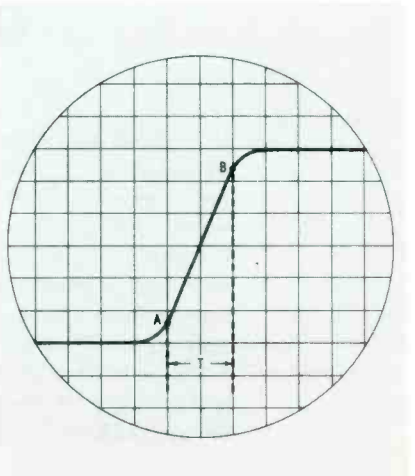


Fig. 9. Measure rise time from A to B.

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Evaluation of Results

Measurement of rise time is the first step in evaluation of results. The rise time should be at least 0.1 microsecond. If the measured rise time is greater than 0.1 microsecond, either the RF amplifier or the IF amplifier, or both, are in need of alignment. Slow rise time indicates subnormal bandwidth. Only a good quality TV receiver can be aligned for a rise time as fast of 0.08 microsecond. If you are working with an economy-type receiver, a rise time of 0.11 microsecond might be the best value obtainable.

Waveshape is the next step in evaluation of results. An ideal RF/IF system would reproduce an undistorted 100-kHz square wave. However, there is always more or less distortion present. Fast rise is associated with overshoot and ringing from the practical point of view. Hence, RF/IF amplifier response is specified for a reasonable *compromise* between rise time and overovershoot. Fig. 11 shows an example of substantial overshoot and ringing. This produces trailing reversals and "repeats" following sharp edges in the picture image. The overshoot and ringing can be reduced by aligning for a slower rise.

Here are some practical guidelines:

1. Overshoot and ringing are increased by aligning for a rising slope toward the sound carrier (instead of a flat-topped response).
2. Overshoot and ringing can be increased by substantial peaks in the response curve.
3. Rise time is reduced by increased bandwidth.
4. Rise time is reduced by aligning for a rising slope toward the sound carrier (however, overshoot and ringing are increased).

The beginner can make square-wave tests of RF/IF circuits to best advantage by means of *comparative* observations. In other words, the 100-kHz square-wave response is observed for a receiver that is in good operating condition. Then, a

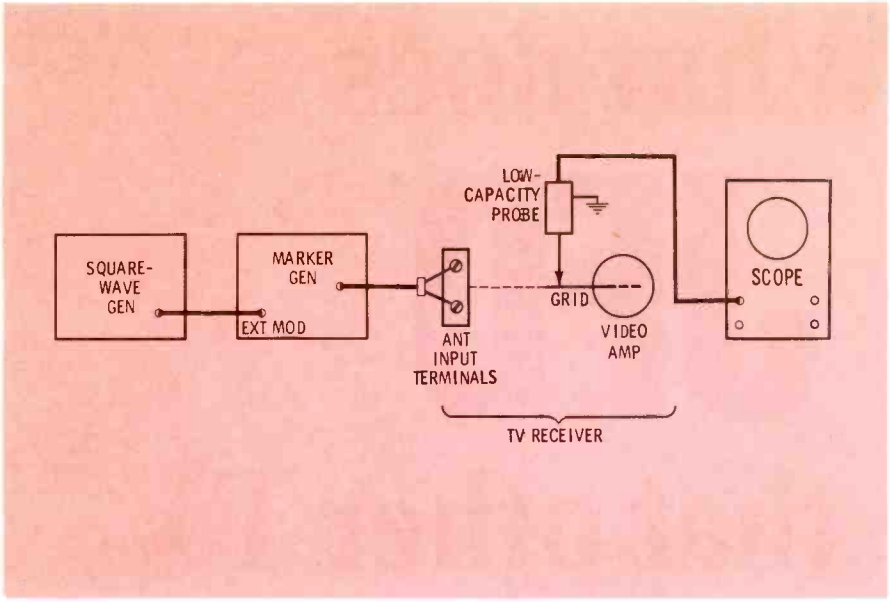

Fig. 10. Complete test setup for receiver check.

comparison is made with the square-wave response of a receiver that is being serviced for unsatisfactory picture quality. Consider the following test results:

1. The RF/IF amplifier response is noticeably inferior. In such case, a careful realignment of the RF and IF amplifiers is in order.
2. The RF/IF amplifier response is satisfactory. In this event, the trouble is in the video amplifier, or even possibly in the picture detector. Remember that the picture detector is part of the video-amplifier system. Hence, do not overlook checks of the detector-load resistor and the peaking coils in the detector circuit. An open capacitor in the detector output circuit can seriously distort the square-wave response.

To check the video-amplifier response, plug the video-amplifier tube back into the receiver. Transfer the low-capacity probe to the output terminal of the video amplifier. Now, the scope will display the square-wave response as modified by the video amplifier. Poor waveshape can be corrected by attention to load-resistance values, peaking coil values, and checks of bypass capacitors in the video-amplifier circuit.

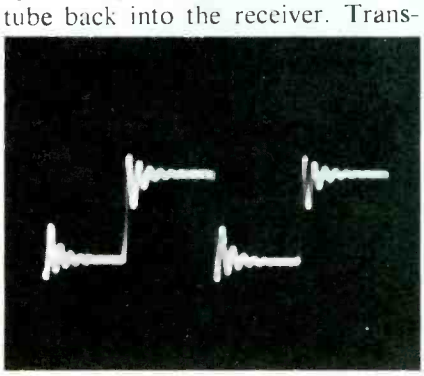

Fig. 11. Overshoot and ringing.

If you wish to make a more extensive square-wave test, observe the response to a 60-Hz square-wave input, and to a 500-kHz square-wave input,. You will doubtlessly observe appreciable tilt in the 60-Hz response, and substantial ringing in the 500-kHz response. Tilt is caused by poor low-frequency response and phase shift. Ringing is more in evidence in a 500-kHz square-wave test because the square-wave harmonics are stronger at higher repetition rates.

There are various details of circuit action in transient response to square-waves which cannot be considered in a single article. However, the points explained above provide adequate data for useful square-wave tests of RF/IF amplifiers. Of course, an RF amplifier can be checked by itself for square-wave response, as can an IF amplifier. A video amplifier can also be checked by itself for square-wave response. However, the technician is primarily concerned with the square-wave response of the RF/IF *system*. This is the area in which pertinent test procedures are most frequently questioned. ▲

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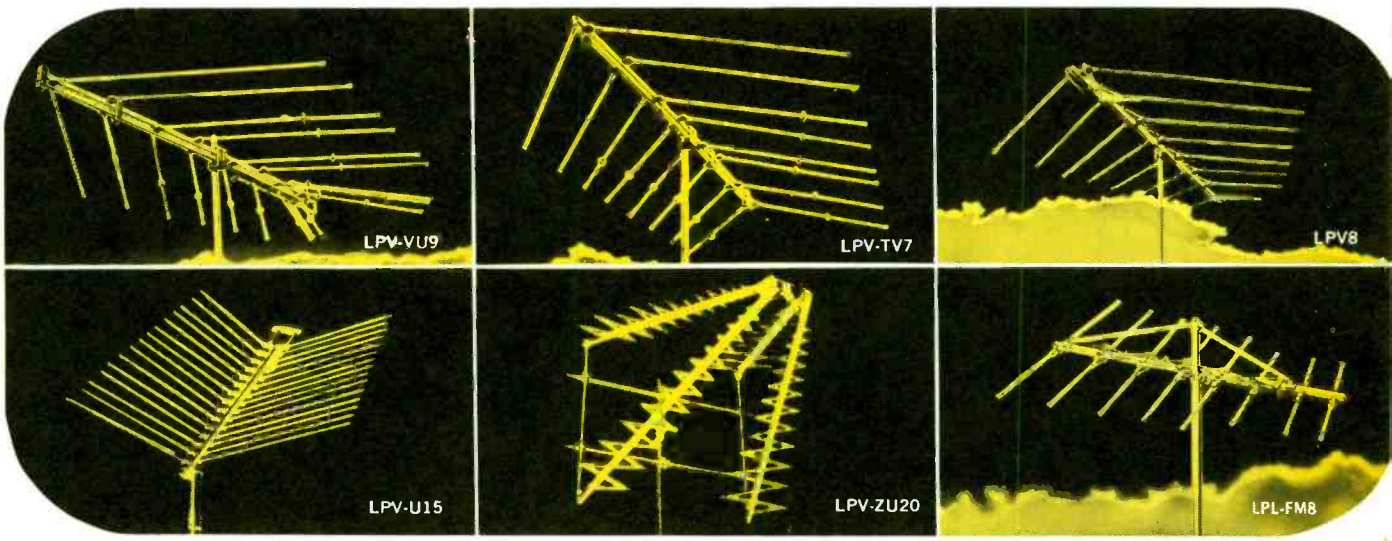

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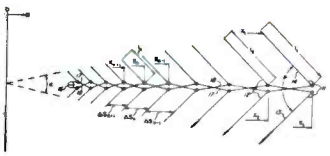
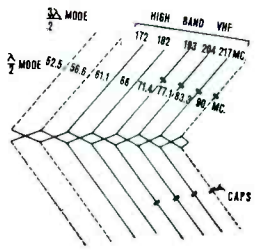


- ONLY the JFD LPV delivers genuine **frequency-independent** performance. The **entire** antenna (not **part** of the antenna as in other ordinary antennas) responds to **every** channel.

$$\frac{L(n+1)}{Ln} = \tau$$

- ONLY the JFD LPV follows the **patented log periodic** design of the University of Illinois Antenna Research Laboratories.



- Only the JFD LPV uses **Cap-Electronic** (capacitor-coupled) elements. This permits (1) precise and independent tuning for optimum performance in **both** fundamental **and** harmonic modes—**plus** (2) increased capture area—**plus** (3) directors tuned to perform on **all** bands, not just one. The result is **higher** gain, **narrower** directivity, **higher** front-to-back ratios for brilliant color, better-than-ever black & white—on channels 2 to 83.

ADVERTISED IN LIFE NATIONALLY ADVERTISED IN LIFE. Month after month, 32 million readers of LIFE are being exposed to the reasons why the JFD LPV works best.

JFD Color ANTENNA COLORFULLY ADVERTISED OVER TELEVISION. Spectacular motion-picture commercials in full-color are pre-selling millions of present and prospective color TV owners.

25 DIFFERENT LPV LOG PERIODICS TO CHOOSE FROM. Interested in VHF? . . . UHF? . . . VHF/UHF/FM? Whether it's just **one** band or **all,** town or country, you get the precise antenna-answer when you make it **an** LPV Color Log Periodic. Interested in more facts? Just write us.

MERCHANDISED IN DEPTH. Banners, direct mail, newspaper mats, radio/TV commercials . . . you name it JFD's got it to help **you** sell your way to top antenna profits.

- A WORD ABOUT OUR PATENTS . . . **Eleven** different U. S. patents and patents pending embrace the scientific advances of the JFD LPV—**more** than any other outdoor TV antenna. Our competition's attorneys are burning the midnight oil trying to find loopholes and ways to circumvent this patent protection which assures you of getting the **only** genuine antenna designed according to the **original patented log periodic** design of the famous **University of Illinois Antenna Research Laboratories.**

LICENSED UNDER ONE OR MORE OF U.S. PATENTS 2,958,081; 2,985,879; 3,011,168; 3,108,280; 3,150,376; 3,210,767; RE. 25,740 AND ADDITIONAL PATENTS PENDING IN U.S.A. AND CANADA. PRODUCED BY JFD ELECTRONICS CORPORATION UNDER EXCLUSIVE LICENSE FROM THE UNIVERSITY OF ILLINOIS FOUNDATION.

AT THE MOMENT OF TRUTH THE PICTURE IS THE PROOF WHY JFD LPV COLOR LOG PERIODICS WORK BEST!

JFD ELECTRONICS CORPORATION

15th Avenue at 62nd Street, Brooklyn, N.Y. 11219
JFD International, 64-14 Woodside Ave., Woodside, N.Y. 11377

Circle 16 on literature card

Notes on Test Equipment

analysis of test instruments . . . operation . . . applications

707 Jet

No wings, but it is as fast as its namesake. That's the new Dyna-Jet tube tester from B&K Mfg. Co. For instance, 19 tubes in a CTC 16 chassis can be checked by adjusting only heater and bias settings.

The Dyna-Jet is essentially an updated version of the model 700 Dyna-Quik, which was described in PF REPORTER July, 62. However, along with widening the capabilities of the tester for new tubes, there has been some definite improvements in design.

The older model had a lack of contrast between the lettering and background on the panel. It seemed to be rather difficult to read the numbers next to the sockets. The new panel of the 707 is finished in flat light gray with blue trim. The numbers are black and easy to read. In addition, the panel finish takes pencil writing quite well, so you can write in numbers of the tube types that recur in your shop.

B & K Model 707

Tube-socket complement:

8 pin octal
8 pin loctal
7, 9, and 10 pin miniature
9 pin novar
12 pin compactron
nuvistor

Tests performed:

Interelement leakage, shorts, gas, grid emission, cathode emission (some types), transconductance (most types).

Sensitivity:

Grid emission; 25 megohms (adjustable to 100 megohms)
Shorts; 1 megohm or better

Power requirements:

105-125 VAC, 50/60 Hz.

Size: (HWD)

6¼" x 16½" x 16½" with cover installed.

Weight:

15 lbs.

Price:

$189.95.

Fig. 1. High speed tube tester.

The 707 uses 35 prewired sockets to test most popular tube types in a transconductance bridge circuit. The type numbers and bias settings for about 125 of the most popular types are printed next to their sockets. An index gives socket and set-up data for many other types.

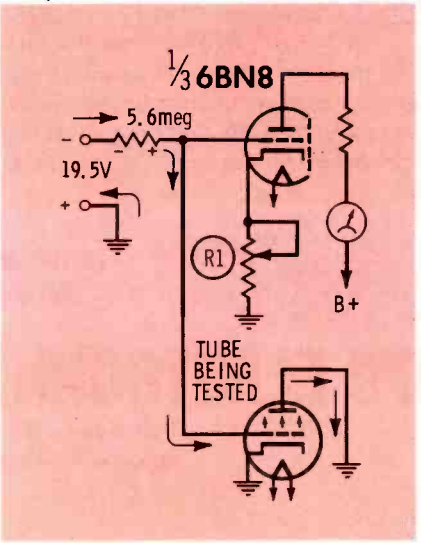


Fig. 2. Simplified schematic shows how grid-emission test is accomplished.

An emission tester is built in the lower section of the instrument, for the tubes which cannot be tested in the prewired section. There are four set-up switches in this section, which ground all elements except the cathode and heater. The cathode of the tube under test has a negative voltage applied through a meter which measures the current flow.

The grid-emission test uses the schematic shown in Fig. 2. The tube under test has —19.5 volts applied thru a grid-leak resistor, and the metering circuit reads any voltage drop across the resistor. The sensitivity of the circuit can be adjusted by R1. This control is factory set to reject tubes with a leakage of 25 megohms or less.

The shorts test is accomplished by interconnecting all the elements of the tube and measuring current flow. The test is very sensitive; one megohm or less will cause the lamp to glow, while the meter will indicate even higher resistance shorts.

For further information, circle 69 on literature card

Portable VTVM

The Model 1700 (shown in Fig. 3) is a new design from Mercury Electronics Corp.

The sample tested in our lab far exceeded all the manufacturer's specifications. For instance, the square-wave response of the AC ranges was found to be flat (± ¼ db) from 4Hz to over 1 mHz with 25 Hz reference.

The AC and DC ranges run from 1.5V to 1500V full-scale, which

Fig. 3. New lightweight VTVM.

Zowie! Here's big news for "Mister Right"—the independent service dealer who carries Sylvania tubes.

Every time you order Sylvania picture or receiving tubes from a participating distributor, you receive Sylvania Means Business (SMB)-Mister Right dealer certificates. They're redeemable for an exciting selection of gifts. For yourself, your family, your home.

You get certificates for your purchases of receiving tubes and every SILVER SCREEN 85®, *color bright 85*™ or COLOR SCREEN 85 picture tube.

So you're a winner in two ways: big profits and top-quality prizes. Sylvania Means Business.

See your participating Sylvania Distributor for all the details. Sylvania Electronic Tube Division, Electronic Components Group, Seneca Falls, New York 13148.

SYLVANIA

SUBSIDIARY OF
GENERAL TELEPHONE & ELECTRONICS GT&E

Circle 18 on literature card

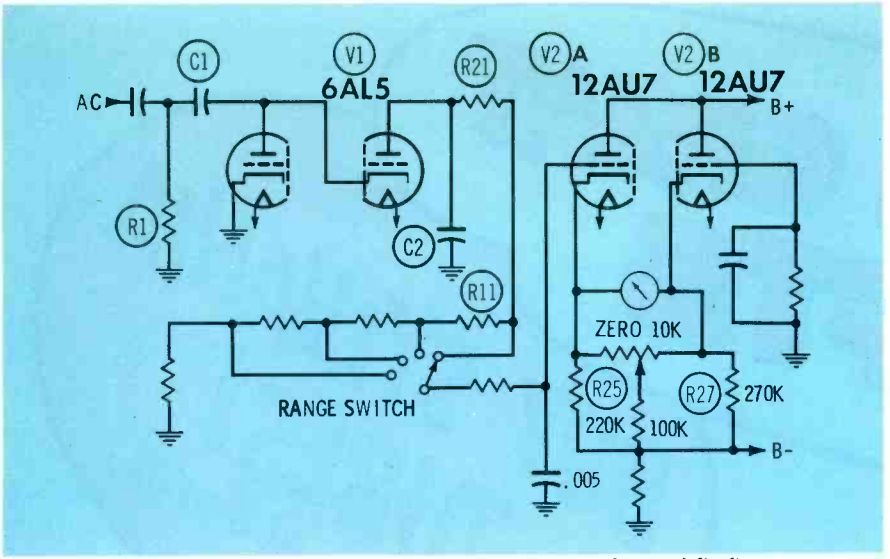


Fig. 4. VTM circuit shown in AC function (much simplified).

makes the meter suitable for the high boost voltages found in color sets. Resistances from .2 ohm to 1000 megohms can be read with 2% accuracy, and a center-scale zero is available for aligning discriminators. The meter is also calibrated for peak-to-peak measurements.

The circuit is shown much simplified in Fig. 4. R1 is actually part of the range switch but presents a constant 1.4 megohm impedance to the probe. V1 is connected as a full-wave rectifier and through charging cycles of C1 and C2, presents the peak-to-peak voltage to the range switch. The measuring circuit is a bridge made up of V2A, V2B, R25 and R27. Not shown in this diagram are the calibrating resistors or the AC balance circuit.

When the function switch is in the DC mode, the probe is connected to the junction of R21 and R11, and the 6AL5 is removed from the circuit.

In the ohms function, a new set of range resistors is switched in with a 1.5 volt battery in series.

When the function switch is in the off position, the meter is short-circuited. This damps the meter to prevent damage in transit. The instrument weighs less than 3 pounds and is housed in a high-impact plastic case with a heavy vinyl carrying strap. The control knobs are designed for an easy grip, and the meter scale has large easy-to-read markings.

For further information circle 70 on literature card

Mercury Model 1700 Specifications

Meter ranges:
0 to 1.5, 5, 15, 50, 150, 500, 1500V DC and RMS
0 to 4, 14, 40, 140, 400, 1400, 4000V P-P
—20 to +65 dbm
0 to 1, 10, 100 Kohms; 0 to 1, 10, 100, 1000 megohms.

AC input impedance:
1.4 megohms shunted by 30pf

DC input impedance:
11 megohms shunted by 2pf

Accuracy:
DC 2% of full scale
AC 5% of full scale
Ohms 3% of full scale

Frequency response:
30 Hz to 500 kHz within 3%

Tubes:
12AU7, 6AL5

Battery:
one size-C flashlight cell.

Power requirement:
105-125 VAC 50/60 Hz 10 watts.

Size (HWD):
7½" x 6" x 4¼"

Weight:
2¾ lb.

Price:
$39.95

Now In Our Lab

The latest test instruments being analyzed for future Notes columns.

B & K	970	Radio Analyst
Eico	378	Audio Gen.
Lectrotech	CRT 100	CRT Tester
Sencore	SS 137	Sweep Analyzer
Sencore	CG 10	Color Gen.

Winegard's original BC-208 4-set Booster Coupler is now available in a 75-ohm model; the BC-475.

Producing a 75-ohm, 4-set booster coupler as good as the BC-208 wasn't easy. After all, the BC-208 was the first 300-ohm, 4-set booster coupler made. And it's still the best. It still out-performs and outsells anything like it on the market!

And so will the new BC-475!

Here's why: the new BC-475 is actually two products in one. It's a small system amplifier that will drive 2 to 8 sets for homes, apartments and store displays. And it's an amplified line splitter and extender for adding up to 16 trunk lines in large master antenna systems.

More reasons? The new BC-475 is coax; it provides a 6db gain to each of four outputs instead of the usual 6db loss (for an overall gain of 12db per output); it takes up to 400,000 microvolts of signal input (200,000 per band) without cross modulation; and it provides exceptionally high isolation to eliminate interaction between sets.

Sound expensive? How does only $34.95 list sound for the best 75-ohm 4-set booster coupler made? A booster coupler that drastically reduces snow, picture smear, noise and interaction between TV sets (color and black & white). And does wonders for FM sets, too.

Better call your Winegard distributor or write for Fact Finder WBC-475 today!

Winegard antenna systems

WINEGARD CO. ■ 3000 KIRKWOOD ■ BURLINGTON, IOWA 52602

Circle 21 on literature card

Parts in Circuit

(Continued from page 20)

Referring again to Fig. 8C, you find another situation in which the low DC resistance of the secondary makes it difficult to detect any leakage voltage—very little is developed across such a low DC resistance. When you find a transformer such as this and suspect interwinding leakage, you have little alternative but to unsolder the ground connection of the low-resistance winding. With the winding floating, leakage voltage can be measured.

The ohmmeter is not very dependable for testing interwinding leakage, although it will reveal shorts. Unless you take all the leads loose, circuit connections may introduce shunt paths that mislead you. Of course, a shunt path is no problem when testing for a dead short.

Winding-to-Case Short

This trouble occurs most frequently in iron-core transformers, although an IF transformer can develop a winding-to-case short.

If the fault is a dead short, it usually involves a winding carrying B+ and may damage other parts, blow a fuse, or cause considerable smoking. The procedure for isolating such a fault is the same as that employed for hunting a shorted capacitor: Disconnect the various paths from B+ until you find the leg that contains the short, then work your way to the defective component. If the smoking or the fuse blowing prevents dynamic testing (to avoid unsoldering—our basic aim here), use the ohmmeter as described under "Shorted" for small capacitors in Part 1; the same procedure and reasoning will pin down the winding-to-ground short.

If the short is to the cover of an IF transformer, the method of testing will depend on whether the IF can is grounded. Since most are, a short will act much the same as it would in an iron-core unit. You can also trace it down the same way.

Leakage from winding to ground will not be as easy to pinpoint, but the same procedures for finding shorts can also be applied to leakage. Tests with the set on are more likely to be useful, because the leakage may not be heavy enough to do any damage—just enough to cause the main voltages to be unexplainably low. When low voltages are found, and the overload is isolated to a transformer, you may have to isolate the mounting or frame from the chassis and make a test similar to the open-end test used for capacitors or the floating-secondary test used with other transformer faults.

Keep Your Gun Cool

There are many other ways to avoid unsoldering parts unnecessarily, and there are also many other component hookups that will present problems of making tests without unsoldering. The extra safety and time saved—in actual testing and in not having to clean solder specks out of the chassis or off the printed board—is worth the few seconds required to figure out a way of testing components without removing them from the circuit. ▲

Book Review

Basic Electricity for Electronics: Robert Middleton and Milton Goldstein; Holt, Rinehart and Winston, Inc., New York, 1966; 694 pages, 6″ × 9″, cloth, $9.95.

Extended treatment of the fundamental principles of electricity is given by this book. Briefly discussing the history of electrical knowledge, it skips through elementary physics and proceeds rapidly to the meat of its subject content.

Chapters consider the subjects of basic laws, resistance, capacitance, induction, magnetics, tubes, and semiconductors. The theory of series, parallel, and series-parallel circuits, in both AC and DC applications is developed. Considerable attention is given to circuit analysis including network theorems. Also considered are meters and motors. Appendixes are numerous and include mathematics, tables, and extensive treatment of identification codes.

A feature of this book is the depth with which each subject is treated. Some of the material is college level, but mathematics used does not include the calculus. It is well written and would best serve as a review text of fundamental electricity, or as an extended introduction to the subject.

TVer's LAMENT

A TV set is like a gal,
Her moods are most diverse.
You treat her gently, tune her finely—
But reception just gets worse.

You show her such great patience;
Such kindness you bestow!
But then you find the only cure
Is dough — more dough — Ah so!

by Ralph M. Scott

New design for color ...and all other!

QUICK-CHECKS MORE COLOR TV TUBES WITH Gm* ACCURACY

*Makes test under actual set-operating conditions

NEW B&K model 707 DYNAMIC MUTUAL CONDUCTANCE TUBE TESTER *with obsolescence protection*

Tests:
New and old TV and Radio Tubes. Tests Nuvistors, Novars, 10-pin tubes, 12-pin Compactrons, European Hi-Fi tubes, Voltage Regulators, and Most Industrial types.

You're always ahead with B&K. The new "707" gives you the famous B&K professional tube-testing speed and efficiency—plus the ability to test more color TV tubes with Gm* accuracy.

Provides multiple-socket section to quick-check most of the TV and radio tube types the *true dynamic mutual conductance way**—plus simplified switch section to check other tube types in Dyna-Jet emission circuit. Also includes provision for future new sockets.

You can quickly check all the tubes in the set, detect hard-to-locate weak tubes that need replacement . . . sell more tubes, save call-backs, and make more profit. *Makes test under set-operating conditions.* Checks each section of multi-section tubes separately. Checks for *all* shorts, grid emission, leakage, and gas. Makes quick "life" test. Exclusive adjustable grid emission test provides sensitivity to over 100 megohms. *Quickly pays for itself.* Net, $189.95

See your B&K Distributor or Write for Catalog AP22-R

NEW TUBE INFORMATION SERVICE
Keep your tube tester up-to-date. Subscribe now to tube information service, available every 3 months.

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Circle 26 on literature card

Auto Radio

(Continued from page 32)

remaining closed, the trouble could actually be in the collector circuit of Q9 as well as in the circuit of Q8. The application of the battery bias in the next test isolates these two areas; and, finally, the parts to be tested are listed.

Symptom: Tuner Stops Intermittently Between Stations

This is often due simply to a defective relay or poor condition of the relay contacts. The tuner may stop on weak stations but miss the strong ones.

Symptom: Stops Slightly Before or After Stations Are Perfectly Tuned

Improper operation of relay again is the most common cause. You may be able to correct the trouble by adjusting the relay arm closer to the gear train. Insufficient bucking voltage on the first stage of the trigger would be suspected if the tuner consistently stops early. Check C27, C28, M7, and M15 in Fig. 6.

Symptom: Tuner Stops at Low End Of Band and Draws Heavy Current

This is a sure sign of a defective recycle solenoid coil or the solenoid switch. Often repairs are as simple as removing a piece of foreign matter which has lodged in the moving parts. Be sure the power supply is adequate to operate the solenoid which normally draws 16 amps.

Symptom: Muting Does Not Work

Check M18, R50, R28, R26, and the start switch (Fig. 6).

Conclusion

Even though these receivers employ some unusual circuits, they still respond to the troubleshooting technician's three main tools: (1) knowledge of electronic fundamentals, (2) mechanical skills, and (3) common sense. Failures of electronic components can be analyzed in short order when you know a few key tests to use. But the days are gone when we could fix things by "tinkering around" with them until we discovered how they worked. These receivers, like the rest of the intricate equipment we are called upon to service these days, must be thoroughly understood before they can be repaired. ▲

Getting a hernia and not getting paid for it?

Let Arcolytic® capacitors lift the load off your mind. Or anywhere else it happens to be.

These aluminum electrolytics are built to last: wound with computer-grade 99.99% pure aluminum foil so they'll keep operating in your customers' sets even at continuous temperatures of 85°C.

You'll find they take the worry right out of premature failure, lost customer confidence and costly call-backs.

There's no premium cost, either. Arcolytics are priced along with other home entertainment capacitors.

Ask your Authorized Arco Distributor for Arcolytic electrolytic capacitors in single-section tubular, multiple-section tubular, or twist-mount designs. It may be the best break you get this year.

Arco Electronics

A DIVISION OF LORAL CORPORATION
Community Drive, Great Neck, N.Y./ Dallas, Texas/Pasadena, Menlo Park, California/Write for our free catalog.

Circle 53 on literature card

Gold in Sky

(Continued from page 22)

your inspection will no doubt reveal more trouble at spots which can't be viewed from below.

Have these forms mimeographed or printed in a check-book style similar to those which the big oil companies give you when they do a lubrication job on your car or truck. List the items which your inspection will include, with spaces that may be checked off as accomplished. When you get a job of this type, make a carbon copy of your completed check sheet for your file, give the original to the householder. Provide space at the bottom labelled "recommended repairs" and another for "estimated cost of repairs." Fill these in when your inspection is completed and hand it to the customer. Then discuss it with him, tell him just what you will do (for a price, of course; only the inspection is "free.") Emphasize the "hazard" angle, if it is warranted.

You don't need to confine inspections and resulting repair jobs to TV installation *only*. If you're in a small community you probably have your local law-enforcement-agency offices, state and local police, sheriff's deputy — possibly others. All probably have, or possibly share, radio-communication facilities using a base station right in your town; get them on your antenna-system inspection list also. In the larger metropolitan areas, a full-time electronics service technician is usually employed to handle the mechanical problems of their communication system as well as the radio equipment itself, but in the smaller areas this should be *your* meat.

How about taxicab companies? No doubt you have radio-dispatched cabs in your area of operation. True, they usually have service contracts with some nearby metropolitan electronics organization to remedy their equipment troubles, but how about that antenna on the roof at the dispatch headquarters? Seldom do the contract technicians pay any attention to that unless it has actually caused an equipment failure. You could

FINCO®-AXIAL COLOR-KIT

the complete color TV reception system

FINCO-AXIAL COLOR-KIT, Model 7512 AB

High performance Indoor and Outdoor Matching Transformers convert old-fashioned and inefficient 300 ohm hook-ups to the new Finco-Axial 75 ohm color reception system.

List price for complete kit . . . 7512AB $8.95

7512-A Mast mounted matching transformer . . . list $5.40

7512-B TV Set mounted matching transformer . . . list $4.15

FINCO-AXIAL SHIELDED COLOR CABLE, CX Series

Highest quality, 75 ohm swept coaxial cable (RG 59/U) complete with Type F fittings, weather boot ready for installation.

Available in 25, 50, 75 and 100 foot lengths. List price . . . $5.55, $8.65, $11.50 and $14.20.

Write for Color Brochure # 20-349

For the best color TV picture

eliminates color-fade, ghosting and smearing!
Improves FM and Stereo, too!

QUICK, EASY INSTALLATION

ENJOY brilliant "TV-Studio" color reception today by changing over to the new Finco-Axial Color Reception System. NOW, color fade, ghosts and smears are a thing of the past. Finco-Axial shields color sets against signal loss . . . eliminates outside interference and mismatch problems.

THE FINNEY COMPANY 34 WEST INTERSTATE STREET, DEPT. 310 BEDFORD, OHIO

Circle 33 on literature card

NOW! Save up to $60 per year on the world's finest TV-radio service data! JOIN THE NEW

PHOTOFACT®-OF-THE-MONTH CLUB

membership starts in July, 1966

only $10 per month brings you 20% more monthly current Photofact service data coverage to boost your daily earnings

STARTING IN JULY, 1966!

6 New Photofact Sets per month—20% more coverage than ever before—**FOR ONLY $10 PER MONTH!**

more TV coverage
6 Color models per month
more Black & White coverage

more AC-DC coverage
more FM-AM models
more STEREO HI-FI
more RECORD CHANGERS
more PHONOGRAPHS

Complete service data on at least 50 chassis each and every month to meet all your service needs!

How the Photofact-of-the-Month Club benefits you

more for your service data dollar

Starting in July, 1966, as a member of the P.O.M. Club, you get **6** new Photofact Sets monthly (20% more coverage) for just $10 per month! You save $5 per month—$60 per year (regular price for individually purchased Photofact Sets is $2.50, effective July 1, 1966). Now you can keep right up with the flood of current equipment output. Now you get the world's finest service data on at least 50 different chassis each month—to help you turn out more repairs daily, with a bigger profit on every job.

IMPORTANT NEWS FOR OUR THOUSANDS OF PRESENT PHOTOFACT SUBSCRIBERS

Your loyalty through the years is deeply appreciated. You will automatically be enrolled as a charter P.O.M. Club member. Starting in July, 1966, you will receive 6 Photofact Sets monthly (20% more coverage), and pay only $10 per month. Your subscription to Photofact becomes more valuable than ever.

how this is possible

We have explained the new Photofact-of-the-Month Club plan to hundreds of electronic technicians. From what they have told us, and from their enthusiastic response, we expect to add substantially to the thousands of present monthly subscribers to Photofact. This means we can effect greater economies through large-volume production, and that's what makes possible not only lower costs to P.O.M. Members, but greater coverage than ever before. It's as simple as that!

HERE'S ALL YOU DO TO BECOME A MEMBER OF THE NEW PHOTOFACT OF THE MONTH CLUB

See your Sams Distributor today, or fill out and mail the membership form below. That's all there is to it. Do it today! It's the opportunity you've been looking for—the chance to be a regular Photofact subscriber at the price you can afford. Get started on the road to the kind of profits you've always wanted.

DO IT TODAY...

Fill Out This Form For Membership In The Photofact-Of-The-Month Club

HOWARD W. SAMS & CO., INC. 4300 West 62nd Street, Indianapolis, Indiana 46206 Dept. PFF-6

Please enroll me as a new member of the Photofact-of-the-Month Club. I agree to pay $10 per month for my membership, and understand my subscription will begin with the July, 1966 issue, consisting of 6 current Photofact Sets, to be delivered by my Sams Distributor (named below).

Name _____

Business Name _____

Address _____

City _____ State _____ Zip _____

My Sams Distributor is: _____ Sign here: _____

sign up now and save!

step in there to take care of the *mechanical* inspection and repair of parts which show signs of impending failure!

Most suburban and rural fire departments tie their headquarters and their trucks together with a two-way radio system with the main station at the fire hall. We'll lay a little bet that most of these have their antenna on a pretty high tower which is ordinarily ignored by whatever electronic service organization they may contract with to service their *equipment*. You probably have one or more organizations using Citizens-band radio between a main store or office and one or more trucks or cars. Once more, the base-station antenna is more than likely tower mounted on the roof top at their headquarters; who's going to climb, inspect, maintain, and repair it? *You* should—for a price!

Another prime source for sales of antennas and distribution systems are the builders of these giant apartment complexes springing up through the country. Anyone who has ever tried to orient a "rabbit-ear" antenna to receive a strong, ghost-free picture in one of these giant steel and concrete structures should be able to deliver a good sales pitch for a roof-top antenna and distribution system. The time to sell an installation of this type is before the building is completed. Watch your local newspaper for announcements pertaining to contemplated construction of new complexes. Contact the builder or developer and make your pitch. Once you have sold an installation of this type, you won't have trouble (in fact the developer will probably insist) on getting the maintenance contract on the equipment.

In many areas outside installations are a rarity due to the proximity of the broadcast stations. Many service dealers have found it impossible to sell outside installations, but with the increasing acceptance of color receivers, and the more important role of the antenna to color reception, sales resistance to antennas will diminish. The percentage of population owning color receivers is approaching 12% nationally and is increasing just as fast as the various manufacturers can get them on the market. An outside installation should be part of the package when you are selling a color receiver; this will prevent many service calls resulting from poor color reception due to an inadequate antenna.

Now is the time to get started with a program such as this. Spring is here and summer is not far behind. The weather will be just right for outdoor work aloft. And the beginning of the summer slump in your *inside* business will be creeping up on you before you know it. Not much attention is paid to TV viewing when the family can spend leisurely afternoons and evenings on the beach or in the hills with a little transistor radio for entertainment.

Right now is an ideal time to make the rounds of your working area, taking a more than casual look at the most obvious of the rooftop antennas and those which are mast or tower mounted. Mail a flyer to all such addresses explaining your free-inspection offer; ask them to phone you for an appointment and when you make a date, *keep* it! And, if you want to make this a regular source of summer income, work up an "Inspection Contract" whereby you agree to take care of such inspections every spring, summer, or early fall on a fixed-annual-fee basis. Also, while you are about your preliminary rounds, keep an eye peeled for amateur-radio antennas, particularly of the rotary-beam type, almost always tower supported. Many hams take care of their own maintenance and repair but remember, *all* hams are not "kids;" many are mature men who can't or won't climb a tower structure. Remember, too, most of these older hams have sufficient income to pay for the services of a younger, more agile man. At the same time, you'll make a friend who may some day want a new TV or who has friends who look on him as their buying counselor when *they* are in the market; see that he recommends *you!*

Go to it now . . . 'thar's a lot more "gold" up there than you've probably realized — how about cashing in on it?

▲

The Troubleshooter

answers your servicing problems

Buzz

The trouble in a Philco Chassis 9L42B (PHOTOFACT Folder 423-2) first appeared as a loud buzz which drowned out the audio. It was intermittent and would disappear when the channel selector was switched from one station to another. Finally, the audio became so weak it was almost inaudible. I replaced the audio detector and increased the audio to a satisfactory level, but the buzz continued.

Adjusting the quad coil has no effect on the buzz; in fact, the audio is unchanged with it out of the set. I have realigned the sound and video IF circuits, and replaced C30, C32, C28, C29, and the quad coil L18. I have also checked C31 and have changed all RF, IF, and sound tubes. Adjustment of the adjacent-channel sound traps does not change the buzz.

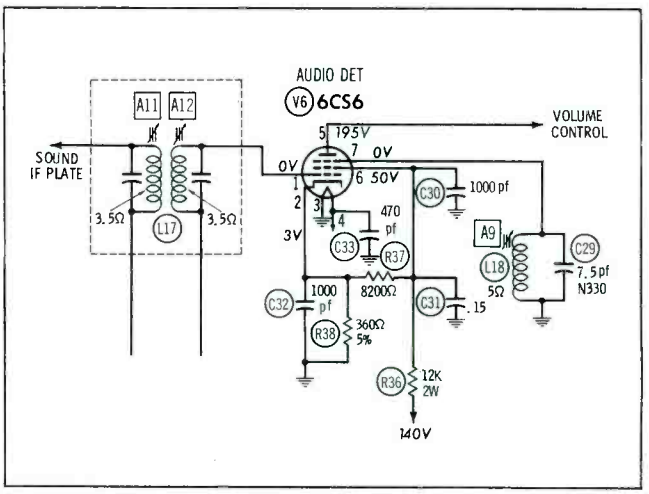
When the AGC is clamped with a variable-bias source, the buzz disappears only when the picture and sound have almost disappeared. The buzz is louder with the range switch in the fringe position.

B+ voltages are slightly low with 250 volts at the 260-volt source and 225 volts at the 255-volt source. Resistance checks at all sound tubes and sound transformers are extremely close to what is shown in PHOTOFACT. Picture quality has remained good and the set has no other symptom except the buzz.

LOWELL BREILAND

Buxton, N. D.

It seems that you have eliminated most of the more common causes of buzz, although it is possible that you have aligned the video-IF stages so that the sound carrier is riding too high on the video-IF response curve. When this happens, the sync modulation will become prominent on the 4.5-mHz beat-frequency output and a buzz in sound will result. Another possible cause of sync buzz is poor lead dress between the audio and vertical or sync stages. Improper lead dress between these stages can pick up the vertical or sync pulses and transfer either to the audio section. This is normally a difficult problem to eliminate. The ideal solution would be a comparison of the lead dress in the chassis you are servicing with that of the same chassis without buzz. The alternative is the trial-and-error method. Also, a careful check for new solder joints or component changes could point to poor lead dress.



Why are RCA solid copper circuits made with computer precision?

To give them

Space Age dependability.

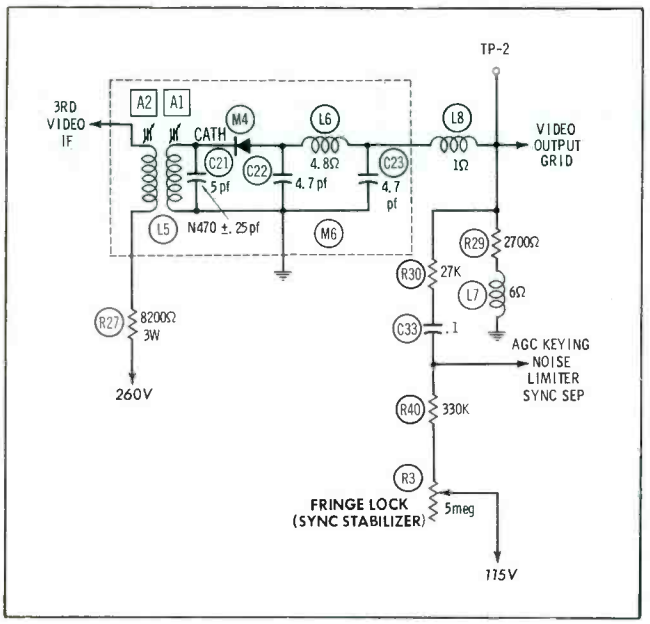
RCA SOLID COPPER CIRCUITS

They won't come loose.
Won't short circuit.
Won't go haywire.
That's why they're the circuits of the Space Age.

RCA The Most Trusted Name in Electronics

Shorted Diode

I am having trouble with a Zenith 17D20 chassis (PHOTOFACT Folder 469-2). The set has raster but no sound or picture. Using an audio generator and starting at the video-amplifier plate, I get sound bars until I reach the video-detector diode. Starting at the tuner with a signal generator and signal tracer, I can trace a signal up to the IF side of the detector, but not through it. I have replaced IF transformer L5 and video-detector diode M4, and the capacitors and coils associated with these two components. All voltages are normal, the diode is not in backwards, and all tubes are good. I have also clamped the AGC, but it has not helped.



LESTER RAVEN

Williamsport, Pa.

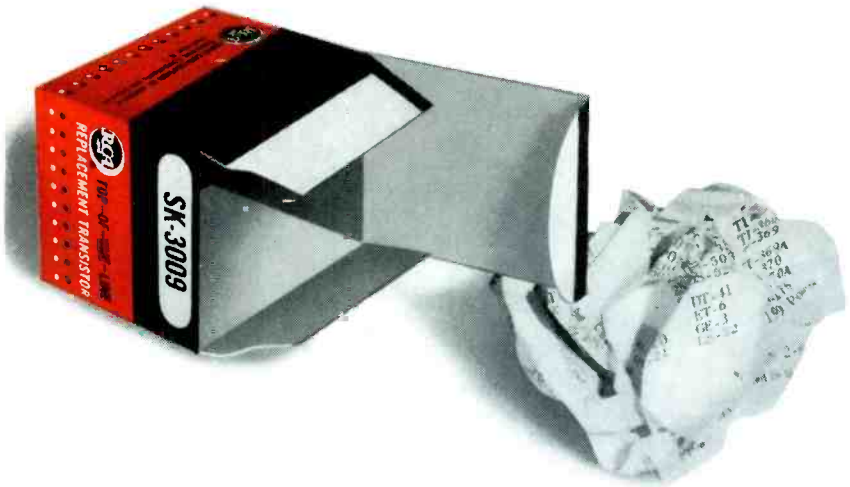
The symptoms you have described indicate that the anode side of video-detector M4 is grounded or that signal detection by the diode is being blocked by a positive potential on the anode. M4 is a series video detector which conducts on the negative portion of the composite video signal with the conduction path being from left to right through the diode, down to ground through load resistor R29 and back through the tuned circuit in the secondary of L5. If C33 were shorted, a high positive voltage would be present at the top of R29 and at the anode side of M4, preventing detection. A shorted filter capacitor, C22 or C23, would produce the same symptoms by grounding the detector anode and video-output grid. Other troubles that would produce the same symptoms are an open video-peaking coil L6, a short at test point 2, or a gassy video-output tube.

Color Beat

I have an RCA color set, Chassis CTC15, (covered in PHOTOFACT Folder 673-2) in which a beat pattern appears during color telecasts on channel 8. All other channels are normal. Adjusting the fine tuning will remove the interference, but also kills the color. The fine-tuning range is normal, alignment of the set is normal, and the sound traps are set properly.

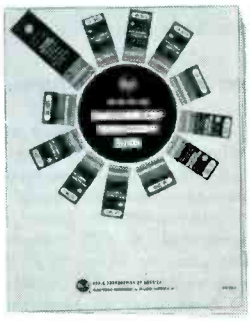
DAVID L. TWOMBLEY

Osceola, Iowa



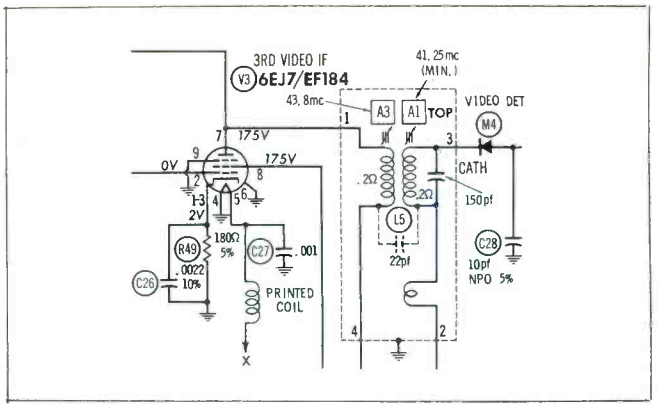
The SK-3009 transistor that came in this box replaced one transistor in original equipment. But, it could just as easily have replaced almost 600 different transistors. RCA has 16 such replacement transistors plus 2 replacement rectifiers comprising the SK Top-of-the-Line series. If you stock all 18, you can replace more than 4,000 transistors, both domestic and foreign types, and over 1,000 selenium or silicon rectifiers. Stock the Top-of-the-Line series. The time that you will save in looking for replacements alone is well worth the investment.

RCA's new Top-of-the-Line Replacement Guide SPG-202A is an absolute necessity if you are servicing solid-state entertainment-type equipment. It lists the 18 RCA types and the more than 5,000 types which they replace. Ask your RCA Distributor for your copy or write: Commercial Engineering, Section F 33SD, RCA Electronic Components and Devices, Harrison, New Jersey.



RCA® **The Most Trusted Name in Electronics**

Circle 39 on literature card

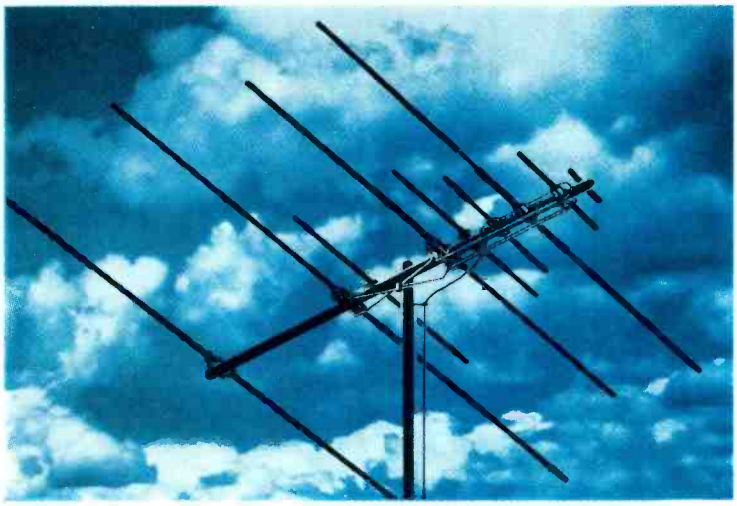


The beat pattern you are experiencing has also occurred in earlier RCA chassis and is a result of the 4th harmonic of the picture IF carrier, generated in the picture-detector circuit, being picked up by the 300-ohm lead associated with the UHF/VHF switch. The frequency of the interference is approximately 183 mHz, depending on the position of the fine-tuning control.

Suppression of the interference can usually be accomplished by installing a 22-pf capacitor between the primary and secondary of the 4th picture IF transformer. If this fails to suppress the beat sufficiently, rerouting of the tuner leads may be necessary.

Elimination of this problem in RCA CTC12 and later chassis was accomplished by adding a cable hanger under the mounting bolt at the top left corner of the picture-tube purity shield and rerouting the IF cable directly from the chassis to the new hanger and then to the tuner IF jack. ▲

UNDER 18



There is now a good 82-channel COLOR antenna for city and suburbs...that lists for only $17.50

Remember the name. The Channel Master Crossfire Color·Star

That's important.

Because even if it's only price that interests you, that's not the main reason you'll be interested in us.

On price alone, the new Channel Master Color·Star stacks up against any comparable 82-channel antenna you can name for medium to strong signal areas.

But if its overall UHF and VHF performance you want—in color or black-and-white—the Color·Star shapes up as decidedly superior.

Of course, there's its unique dual-function VUtronic element design (the patent is pending). For the first time a driven UHF element is used to support a parasitic high band VHF director. (Which also acts as a UHF reflector.)

This electronically interleaves both the UHF and VHF sections on a single antenna. So the antenna is more compact — practically a foot shorter than it would be otherwise.

Still it's in the VHF section that you can see the difference (where it really counts). The Color·Star employs Proportional Energy Absorption. This is the exclusive Channel Master Crossfire principle that produces maximum signal power on both the high and low bands.

A unique "Golden Overcoat" provides lasting protection against corrosion. And our U-V Band Splitter is included (Model 0032).

To repeat: When you sell the Color·Star you lead with your price —but you wrap up the sale with performance.

That keeps everyone happy.

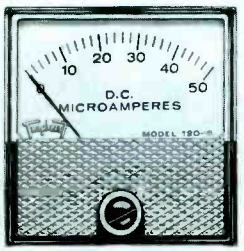
CHANNEL MASTER
ELLENVILLE, NEW YORK

Also available. A complete line of 82-channel Ultradyne Crossfires for every area.

Circle 42 on literature card

Product Report

For further information on any of the following items, circle the associated number on the Catalog & Literature Card.



New 1½" Panel Meter

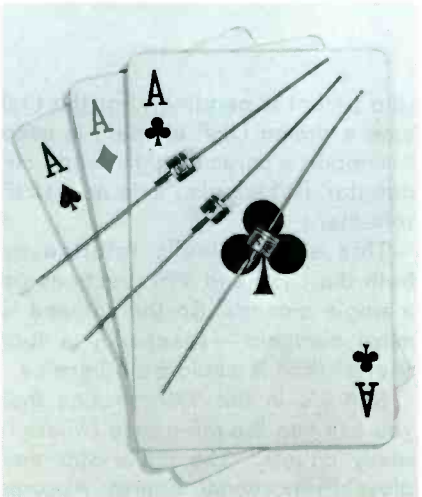
(71)

A new addition to the G-Series panel instrument line has been announced by the **Triplett Electrical Instrument Company.** The Model 120-G provides greater slection opportunities for the user.

The meters feature the BAR-RING DC movements that provide exact, reliable readings and are self-shielded from stray magnetic fields. A special flat insert for the masked portion of the meter front may be painted any color customer desires and can be imprinted with company logos, instructions, or names for personalizing the meter.

The Model 120-G measures 1-3/4" sq. and extends 1-1/2" behind the panel. A special short-barrel Model 120-GS is available.

The movements range from 10ua DC up, and are priced from $13.00.

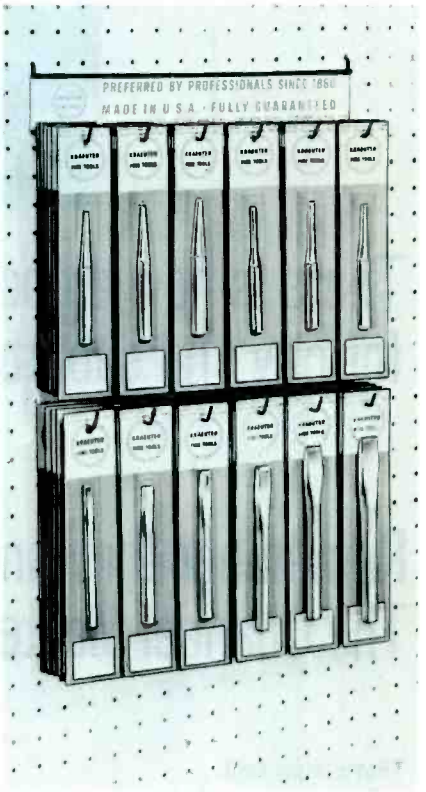


Top Hat Loses Its Brim

(72)

Sarkes Tarzian has announced a new "brimless" series of metal-and-glass-encased, hermetically sealed rectifiers that replace the "Top Hat" style. The new "C" Series" rectifiers are physically smaller than the Top Hat types and are universally applicable to replacement of either silicon or selenium rectifiers. The case is 7/32" in diameter and 11/64" long with the cathode and anode leads (1.4" minimum length) color coded for easy identification of polarity.

The new units have avalanche characteristics, which provide assured protection against any damage from temporary surges of over-voltage.



Chrome Punches and Chisels

(73)

A new selection of punches and cold chisels most used by mechanics and handymen is now available from **Kraeuter Tools.** In all, 12 numbers are offered, with each tool hammer forged, heat treated, and nickel-chrome plated and polished.

Included in the line are three pin punches with point sizes of 1/8", 5/32" and 3/16" and each 4-1/2" long; three center punches in sizes 5/16", 3/8" and 7/16", each 4-1/2" long; and six octagonal cold chisels ranging in size from 1/4" by 5" to 3/4" by 7".

Kraeuter punches and chisels, as well as the company's professional line of wrenches, pliers, and snips, are available locally in mass merchandising outlets.

the instrument with endless uses...the all new improved completely solid state

SENCORE FS134 FIELD STRENGTH METER

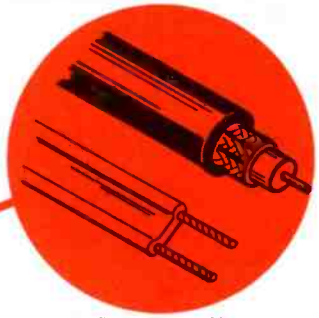
HERE ARE JUST A FEW OF THE MANY USES...

A. Distribution Systems

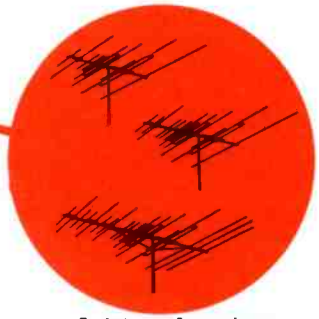
B. Antenna Installations

C. Color Insurance

only **199.50** lowest price going



D. Transmission Lines



E. Antenna Comparisons

F. Checking Generators

A. INSTALLING AND CHECKING OUT DISTRIBUTION SYSTEMS

Qualify for this multimillion dollar business in hotel, motel, and hospital installations.

B. INSTALLING UHF, VHF, AND FM ANTENNAS

Cut down installation time and pay for the FS134 in a short time on critical UHF as well as VHF and FM antennas.

C. COLOR INSURANCE

Be sure the signal is adequate on each channel for proper color TV operation.

D. CHECK TRANSMISSION LINES

For the first time read actual db loss in either 75 or 300 ohm transmission lines.

E. COMPARE ANTENNAS

For actual db gain; see which is best for each location, both VHF and UHF. Also excellent for orienting "dishpans" for translator use at the high end of UHF band.

F. CHECK ANY GENERATOR OUTPUT

For correct frequency and output all the way up to a tenth of a volt RMS. What a time saver when you want to know if your generator is putting out.

PLUS: LOCALIZE NOISE AND INTERFERENCE

Find noise source fast; pick quiet locations for antenna installations or orient antenna away from noise when possible.

These are only a few uses of this UHF-FM-VHF accurately microvolt calabrated field strength meter. You can start paying for the FS134 tomorrow in the time saved today — if you see your Sencore distributor now. Why not pick up the phone and ask him to show you the new FS134?

SENCORE

NO. 1 MANUFACTURER OF ELECTRONIC MAINTENANCE EQUIPMENT

426 SOUTH WESTGATE DRIVE, ADDISON, ILLINOIS 60101

Circle 44 on literature card

new 8290

Shielded Permohm*

Shown Actual Size

82 Channel TV lead-in

for the strongest, cleanest picture signal and best color... ever!

- Provides 82 channel color reception
- Less installation time and cost
- Eliminates transmission line pick-up of noise and ghost signals
- No expensive matching transformers required
- Can be installed anywhere

Photos courtesy of WGN-TV.

Unshielded twin-lead
Severe picture disturbance due to ignition noise.

Coaxial Cable
Ignition noise minimized— but not eliminated.

*** Shielded Permohm**
Eliminates automobile ignition noise.

New 8290 Shielded Permohm TV Lead-in combines the strong signal strength of twin-lead with the clean signal protection of shielded cable. Because it is a balanced line for 300 Ohm TV antennas and receivers, *costly matching transformers and connectors are eliminated.*

8290 is specifically designed for superior color reception on all 82 channels. The twin-lead is encapsulated in low-loss cellular polyethylene insulation, Beldfoil** shielded against all outside disturbances, and protected with a weatherproof jacket. A drain wire is provided for grounding the shield. The need for stand-offs, twisting or routing of lead-in is eliminated. 8290 can be taped directly to a mast or tower, routed through metal pipe, buried underground, or even installed in rain filled gutters to reduce installation time and cost.

Ask your distributor about 8290 Shielded Permohm TV Lead-in cable, today! Or, write P. O. Box 5070-A for complete information.

*Belden Trademark—Reg. U.S. Pat. Off.

**Belden U.S. Patent 2,782,251 and Patent Pending

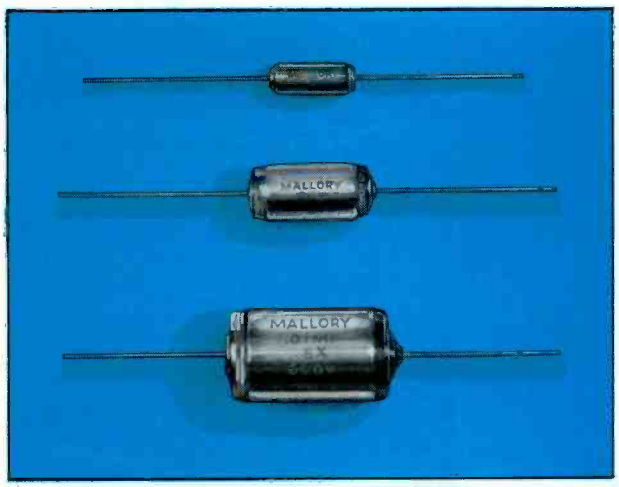
8-9-5

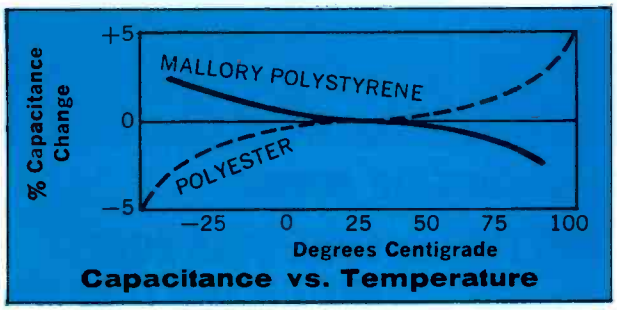
BELDEN MANUFACTURING COMPANY **Belden** **P.O. Box 5070-A • Chicago, Illinois 60680**

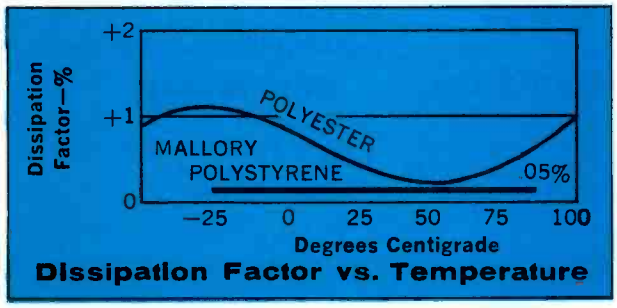
Circle 37 on literature card

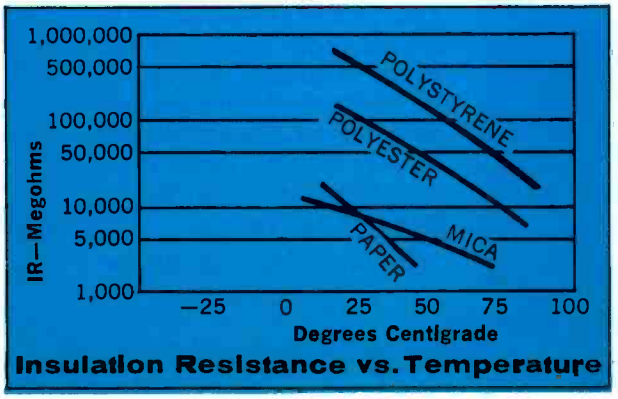
MALLORY Tips for Technicians

When you need a stable capacitor...









Temperature makes most capacitors wander. For electrolytics, capacitance goes down when temperature gets colder, goes up when things get hot. But this usually doesn't cause trouble, because most electrolytic applications are in filtering—and as long as you have low enough AC impedance, you get the filtering you need. Where drift can bring problems is in tuned circuits, timing and differentiator circuits; here you've got a paper, film, ceramic or mica capacitor, in the fractional-microfarad range. If it changes value due to temperature variations or just plain old age, you're going to have some headaches.

Today's tip: when you need extra stability, try the *new* Mallory polystyrene capacitors. They're the most stable you've ever seen. They look different, and they act different. They're made of a unique kind of stretched polystyrene film and high purity aluminum foil, wound up in a compact roll and then fused together in a self-sealed case of solid clear plastic.

What's extra special about these new capacitors is the way they hold their original microfarad value while temperature varies all over the lot. Temperature coefficient is considerably lower than that of polyester film capacitors—under 150 parts per million per degree C. And it's negative—which means that instead of going up with temperature, capacitance goes down. This is the direction you need to change capacitance in order to compensate for the effect of temperature on the inductive part of a tuned circuit. From −10°C to +70°C, their *total* capacitance change is less than 1.3%. And brother, that's *stable!*

And that's not all. These little dandies don't grow old. They hold their characteristics month after month. You just connect 'em and forget 'em.

One more thing. Mallory Polystyrene Capacitors have the lowest dielectric loss in the business. Their dissipation factor (similar to power factor, a measure of efficiency as a capacitor) is extremely low . . . only 0.05%, which is a small fraction of that of other capacitors. And it stays at this low value over the whole temperature range. This means that they're high Q capacitors, ideal for tuned circuits. And their insulation resistance is way higher than polyester, mica or paper capacitors.

In case you were wondering how much dough you would have to lay out to get such wonderful capacitors—here's the best news of all. They are really low priced. You can get them in values from 5 pF to .01 mfd, all rated 600 volts, from your Mallory Distributor. See him soon—and ask for your copy of the 1966 Mallory General Catalog. Mallory Distributor Products Company, a division of P. R. Mallory & Co. Inc., Indianapolis, Indiana 46206.

50th ANNIVERSARY

Circle 45 on literature card

Win fabulous prizes in big Krylon® "dealer's choice" sweepstakes!

121 GIVEN AWAY

FIRST PRIZE—DEALER'S CHOICE OF

1966 FORD MUSTANG OR **TRIP TO EUROPE FOR TWO** OR **LONE STAR BOAT, MOTOR AND TRAILER**

The sporty one with the racy lines that gives you top power and performance.

A three-week vacation to see the sights of London, Paris, the Riviera—all fully paid.

For fishing or relaxation, here's just what the doctor ordered.

4 SECOND PRIZES
Choice of:
RCA 25" Color TV Console or Autumn Haze Mink Stole

6 THIRD PRIZES
Choice of:
Vespa Motor Scooter or RCA Stereo Hi-Fi Console with AM/FM Radio

10 FOURTH PRIZES
Choice of:
American Tourister 2-Piece Luggage Set or RCA Tape Recorder

100 FIFTH PRIZES
Choice of:
2 Hathaway Shirts or Kodak Instamatic Camera Outfit

**All Krylon dealers are eligible.
Nothing to solve. Nothing to write about.
Good luck. (Sweepstakes close July 31, 1966)**

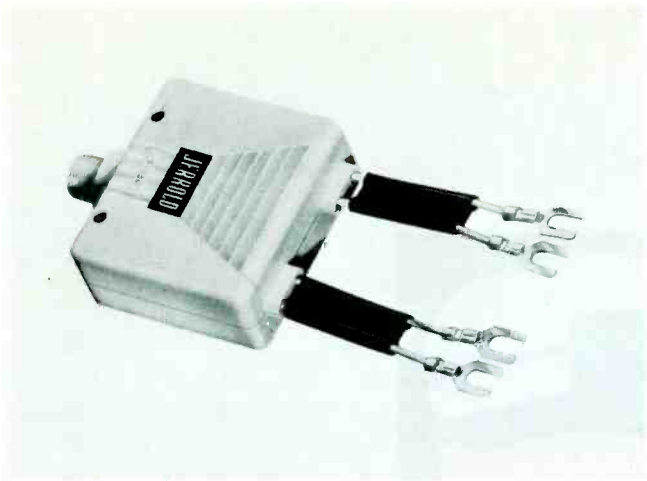
Here's one game of "dealer's choice" where you can't lose! Not only do you have a chance to win a big prize. In addition, you're a sure profit-winner when you sell Krylon. Krylon is far and away America's No. 1 Spray Paint—the fastest mover, the biggest money-maker...and there's no better time to order than right now when your jobber is offering this extra-profit deal. If you order now...you get 12, yet you pay for only 11 (either cans or cases).

BORDEN CHEMICAL

Your jobber salesman will be around soon. There's no purchase required, so ask him for complete details and free entry blanks. For an interesting Krylon extra-profit story, also ask him about the "1 free with 12" special.

(Sweepstakes void where prohibited by law.)

Circle 43 on literature card



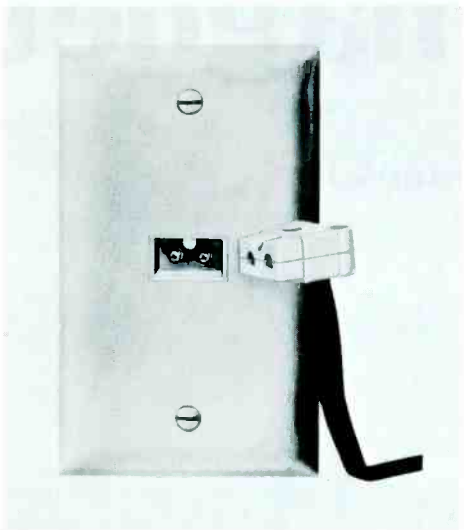
82 Channel Units

(72)

Until recently, two separate antennas were required for a modern 82 channel TV set — one for UHF and one for VHF. Several manufacturers, however, are now marketing 82 channel antennas. But there is still a problem. The output of an 82 channel antenna is a single twinlead or coaxial cable. Yet an 82 channel receiver requires two inputs—one for VHF and one for UHF.

Jerrold Electronics has announced two new products to solve this problem. The Model 1460B twinlead splitter/mixer splits a single twinlead into two separate outputs. UHF signals are sent to the UHF antenna inputs of the TV set and VHF signals are sent to the VHF antenna input. The 1460B can also be used as a mixer to combine the output of separate UHF and VHF antennas into a single downlead. Price is $4.95.

The second unit is made for coaxial installations. Designated Model T-380, this matching transformer/splitter matches 75 ohm coaxial cable to 300 ohm TV sets and splits the signals, providing separate UHF and VHF twinlead inputs to the TV set. Price of the T-380 is $7.95.



TV-FM Wall Plates and Plugs

(73)

A line of combination TV and FM wall plates, incorporating the STA-Kleen design feature, has been introduced by **Slater Electric.** The TV and FM devices incorporate receptacles recessed in flush-mounted wall plates, providing a slim, compact installation. A TV and FM plug is keyed to fit the receptacle, permitting easy connection to receivers. The plug attaches to connector line without soldering, providing a permanent installation and insuring proper polarity. The devices fit either new or existing installations.

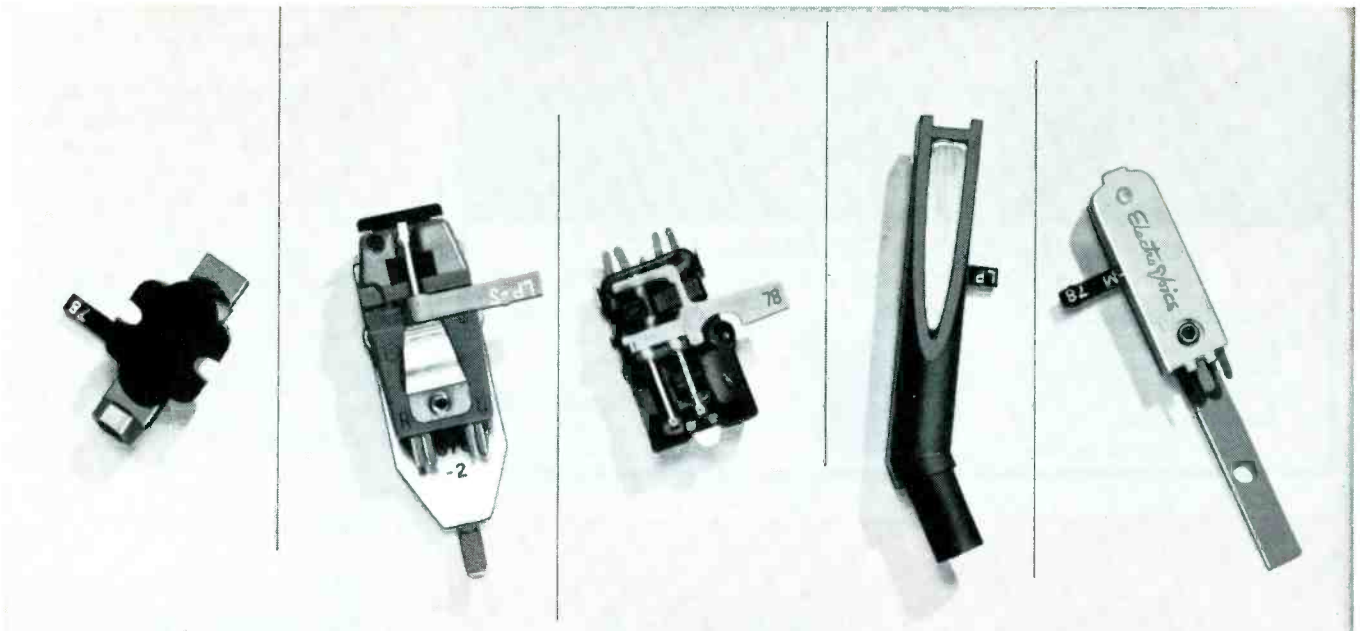
The TV and FM receptacles are available in six different configurations: single and double gang, single and double gang with one duplex outlet, architectural-face single gang and double gang with one duplex outlet. Fire decorator colors

We'd like you to try our mighty magnet.

(It attracts customers.)

Action-People* are drawn to the Yellow Pages when they're ready to buy. And this emblem reminds them to look for you. We'll give you reproducible artwork—and ideas on how to use this money-making attraction. Call your Yellow Pages man. He's listed under: Advertising—Directory & Guide.

*The 3 out of 4 busy Americans who shop the Yellow Pages way.



How long was your distributor out of stock after these new cartridges were introduced?

It isn't easy to keep up with the many new phono cartridges being introduced these days.

And if your distributor doesn't order until you ask for them — you're in trouble.

After all, a delay of more than 24 hours can cost you plenty in customer goodwill — perhaps even a sale.

But that problem is eliminated when you deal with an Electro-Voice distributor.

Here's how. He can place a standing order with us. We ship every new model to him *automatically*, as soon as it comes out. He doesn't wait for an order, and neither do we.

This way, the new models are waiting for you *before* you need them. It's good business to see your E-V distributor — he's first with everything in needles and cartridges.

Electro-Voice®

The *modern* complete line of replacement phono cartridges

ELECTRO-VOICE, INC., Dept. 667R, 632 Cecil Street, Buchanan, Michigan 49107

Circle 37 on literature card

are available: ivory, brown, gray, tan, and white.

Slater single-gang wall plates are also packaged for consumer merchandising and rack display, in clear polyethylene bags. The TV-FM plug is mounted on a header card which contains installation instructions. The header card is designed with a mounting hole and may be mounted to the wall plate by the contractor on new construction. In this way the plug is available for installation by the occupant. All other TV and FM wall plates are packaged in clear polyethylene bags together with TV plugs and instruction sheets. All devices are packaged with color-matching mounting screws for box installation and wood screws for mounting to the wall.

FM Base Stations
(74)

A new series of extensively transistorized desk-top and wall-mount FM two-way radio base stations designed to provide communications flexibility has been introduced by **General Electric.**

The desk unit is 5¾" high, 20" wide and 13¾" deep. The wall model is 21¼" high, 22½" wide and 6⅞" deep.

The desk-top design can be modified for remote control with less hardware than was previously required. When a user wants additional dispatch positions miles apart to work off the same desk unit, a remote control platter in the desk station permits expansion of his system. The desk unit then becomes a remote control point, saving the cost of one remote control console.

The equipment may be obtained for purely local operation, remote control

If your reverb isn't tuneable...

NEW EXCLUSIVE FEATURE IT'S TUNEABLE!

it's obsolete!

The new Ranger Stereo 66 Tuneable Reverb. Unique electronic Verb-A-Tone control custom adjusts degree of reverberation to your car . . . to your ear.

Stereo 66 . . . a member of the Ranger Hot Line family . . . the most advanced automotive sound systems on the market. Order now! Dimension 48 Stereo Tape Player · AM Car Radio · AM/FM Car Radio · FM Converter · FM Multiplex Marine Short Wave Converter.

PACKED WITH SELLING FEATURES

- Compact, solid state, under-dash unit includes "on-off" reminder light
- Plug-in harness assembly assures fast, easy installation
- Adjustable mounting brackets permit custom fit to dash panel
- Completely universal . . . no additional transformer required

SELLS ON SIGHT . . . shrink-packed in self display for maximum visibility and attractiveness.

QUALITY BRANDED A WIDE RANGE OF SOUND

RANGER AUTO RADIO

. . . division of Tenna Mfg. Co.

19201 CRANWOOD PARKWAY • CLEVELAND, OHIO 44128

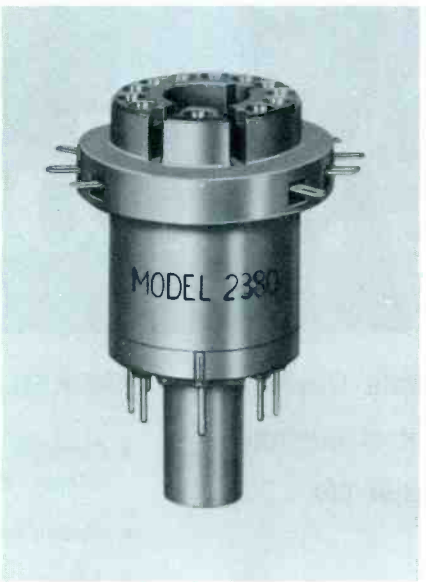
Circle 29 on literature card

or a combination of local/remote. Extended local control hardware is not required.

A wide range of options is available. Multi-frequency operation may be used, up to four frequencies in local applications and up to two frequencies in remote. Other options include a built-in tune-up meter for quick test of 11 key transmitter-receiver points normally checked in routine maintenance; a 12 or 24-hour cyclometer clock, Channel Guard, selective signaling and other functions.

Stabilized performance characteristics and extended component life are achieved by electronic voltage regulation. Silicon transistors, guaranteed for two years, are used in the solid state receiver and in the transmitter. The wall version comes in a weatherproof case which can be permanently mounted indoors or on a pole outdoors.

Both stations are designed for in-place maintenance. The wall unit, for example, has "swing out, tilt down" construction. Where mounting quarters may be cramped, it is unnecessary to swing the entire cabinet out of place to get to the rear; the radio is serviceable from the front. In the desk-top version, the transmitter-receiver section slides back and tilts up to make maintenance checkpoints accessible. Plug-in modules further simplify maintenance.



Test-Socket Adapter
(75)

A new test-socket adapter, designed to simplify the servicing of color CRT's with miniature diheptal bases, is announced by **Pomona Electronics.**

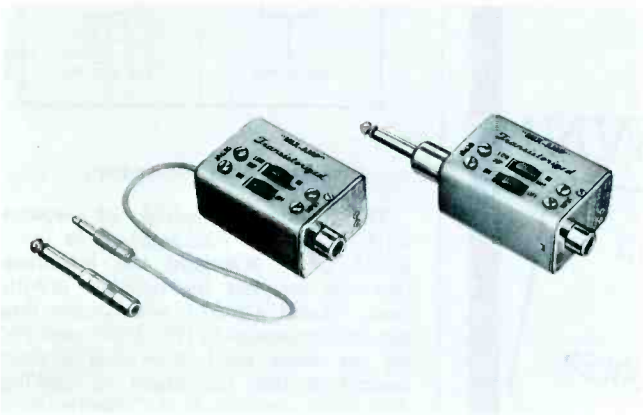
Installed between the CRT and its socket, the model 2380 makes it possible to take voltage, resistance, video, and other measurements at the tube base instead of tracing circuitry to test points underneath the chassis. Extended test tabs provide convenient contact points for either alligator clips or test prods. The unit, which also features a provision for accepting tube bases equipped with spark gaps, is priced at $4.95.

FM Stereo Generator

(76)

The MXII Channelizer, a solid state FM stereo generator, has been designed to fill the need for simplification of multiplex channel separation checks, and takes the mystery out of FM stereo servicing. The generator eliminates the need for complicatd db formulas, complicated set-ups or multiplex theory. The serviceman can now align, troubleshoot, and service FM multiplex receivers and have full control over the output signals by the use of simple slide switchs.

The stereo signal is available on an RF carrier adjustable from 95 to 105 MHz or as composite stereo without RF from the stereo jacks on the front panel for injection into the detector. The **Sencore** generator has two-built-in speaker meters to measure the signal output of each channel of the receiver and the actual separation in LOW, GOOD, or HI from the meter or in actual db. The Channelizer has built-in 8 ohm speaker loads so that the speakers may be disconnected without damaging the receiver under test, and thus avoid listning to the annoying 1000-cycle note. Price is $99.50.



Transistorized Preamps

(77)

Two new high-gain audio preamplifiers, designed for internal DC power operation, have been announced by **Switchcraft.** Called Mix-Amps, these miniature, transistorized devices provide uniform gain across the audio-frequency range and can be used to increase the output of low-level microphones and reduce high-frequency response loss in long microphone cables. These devices can also be used for impedance-matching and fixed-gain applications and for boosting low-level outputs of attenuating networks and pads.

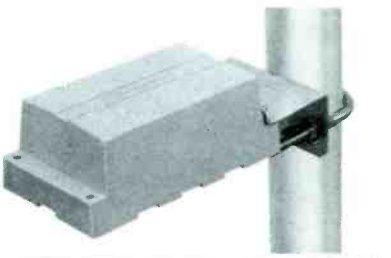
Models 503 and 504 have uniform response (+ 1db) across the audio-frequency spectrum from 20 to 20,000 Hz. An impedance switch allows selection of a low-impedance output (2k ohms) with 25-db gain or a high-impedance output (35k ohms) with 6-db gain. The units have a separate on/off switch. A standard AA penlite cell provides 1000 hours or more of operating time.

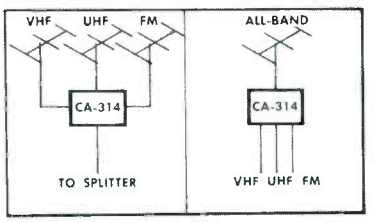
A high signal-to-noise ratio is possible for long wiring and cabling runs when Mix-Amps are used. Connecting Mix-Amps close to electrical sources—microphones, signal generators, audio transducers, etc.—provides immediate amplification so that interference (induced hum and noise) will have a greatly reduced effort on the audio signals.

The unit is suited for laboratory applications, test equipment, experimental circuits, attenuating networks such as T-pads and L-pads, and other low-level signal devices which require a well-shielded, linear, audio-amplification device.

Model 503 Mix-Amp accepts a standard ¼" phone plug. The amplified output is connected through a molded 12" two-conductor cable to a **Tini-Plug.** A Model 364A adapter plug is included to convert the output connector to a standard, two-conductor phone plug. The metal preamp housing is finished in a metallic-tan color and provides electrical shielding for all internal circuits.

Model 504 has the same design features, except the output plug is a long-shouldered, standard phone plug which may be used for all normal connections and for equipment with recessed jacks. Price of Model 503 is $16.50 and of Model 504, $14.50.





Antenna Couplers

To facilitate coupling of separate VHF, UHF and FM antennas in mixed signal areas, **Winegard** has introduced two new couplers for rotorless installations. Model CA-314 will couple three separate antennas (VHF, UHF and FM) on the same mast, providing a single down-lead into the home or building. The VHF circuitry is AC passive to allow use of a preamplifier on the VHF antenna if desired.

The CA-314 can also be used inside as a splitter to separate VHF, UHF and FM signals into individual transmission lines. This means, of course, that it can be used with an all-band (VHF, UHF, FM) antenna. The coupler is designed for extreme low loss, allowing use in weak signal areas without adversely affecting performance.

Model CA-312 is designed for areas where separate antennas are used for the high and low VHF bands. It couples a low band (Channels 2-6 and FM) antenna, a high band (Channels 7-13) antenna and a UHF antenna in order to run a single down-lead. To split signals back into separate lines, CA-283 or CS-283 splitter is recommended. Both models are packaged individually with a five-way mounting bracket. Model CA-314 is priced at $4.95 and Model CA-312 at $4.50.

Matching Transformers

(83)

A new line of indoor and outdoor matching transformers, used to convert home TV or FM antenna systems from 300-ohm twin-lead hook-ups to 75-ohm shielded-coaxial cable operation, has been announced by the **Finney Company.** The FINCO-AXIAL Matching Transformer Kit, Model 7512-AB, includes both indoor and outdoor matching-transformer baluns, weather boot, mounting hardware and complete instructions for installation. Only the simplest tools are required to do the job.

Individual indoor and outdoor balun transformers are also available. The Model 7512-A indoor mast- or boom-mounting matching transformer, for matching any 300-ohm TV or FM antenna to 75-ohm coax, is packed complete with mounting hardware, type "F" fitting, and weather boot. The indoor "behind the set" matching transformer, Model 7512-B, is designed for matching 75-ohm coax to the 300-ohm input terminals of any TV or FM receiver.

All FINCO-AXIAL components are designed for UHF, VHF, and FM signals and will pass AC or DC current. Prices of the units are: Model 7512-AM, $8.95; Model 7512-A, $5.40; Model 7512-B, $4.15.

Large-Scale VTVM

(83)

This general-purpose VTVM, featuring a 9" display meter, measures DC current, AC and DC voltage, resistance, capacitance, and inductance. The **Hickock** Model 209C has an input impedance of 11 megohms on DC and AC tests, 3% accuracy, and is capable of measuring AC up to 200 mHz. Ultrastable circuitry eliminates the need for readjusting the zero during operation.

Seven ranges are available in each of the following functions: DC voltage, 0 to 1500 volts; DC current, 0 to 1500 ma; AC voltage (RMS and P-P) 0 to 1500 volts; decibels, −10 to +66 db; resistance, .2 ohm to 1000 megohms; capacitance, 50 pf to 2000 mfd. Price is $184.50.

Antenna Matching Network

(84)

A VSWR of 1:1 occurs when the impedance of a transmitter and an antenna are identical. Any ratio higher than 1:1 indicates a mis-match between the two.

An antenna-matching network, the **GLC Matchbox,** is designed to provide a 1:1 VSWR for 11-meter-band installations. The Model M-1 is inserted between the transmitter and the antenna leadin-. Adjustment is accomplished by removing the two snap-in plugs and adjusting for a 1:1 VSWR as indicated by a VSWR bridge or meter insered between the transmitter and the matching network.

The **Gold-Line** unit measures 1⅝" high, 2" wide and 3¼" long, and has a gray hammertone finish. Standard PL-259 connectors can be used with the unit, which is capable of handling 10 watts of input power. Price is $12.95.

Audio Amplifier

(85)

This low-power amplifier (Model 4P5C) has provisions for two inputs with a switch arrangement for selecting either mike/tape/high-gain phono or radio-tuner/crystal-phono program sources. The **Trutone Electronics** unit has outputs for 8 ohms and 25- or 70-volt lines, and is designed for uses such as paging, back-ground music, public address, stereo conversion, and other applications where low power output is required.

The unit, which features a chassis with a perforated cover for better ventilation, comes in a gray finish; price, $47.45.

Test Application Booklet

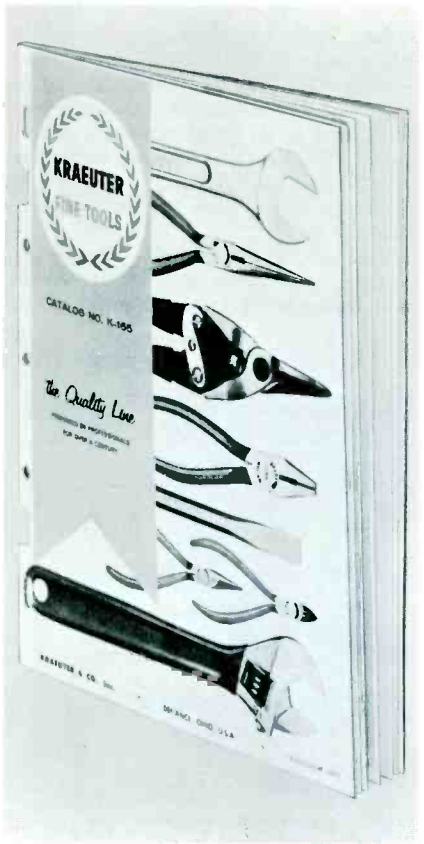
(86)

A 90-page, paper-backed book titled "1001 Uses for the 260 Volt-Ohm-Milliammeter" has just been published by **Simpson Electric.**

The book is a comprehensive collection of all known test applications for the Simpson 260 VOM, and is divided into nine sections: Measuring Voltage, Measuring Current, Measuring Resistance, Measuring Power, Other Measurements, Receive Measurements, Transmitter Measurements, Industrial Measurements, and Automotive Tests.

Each test application is thoroughly explained in text as well as by schematic or circuit diagrams which show exactly how to set up the VOM and the equipment to be tested. Useful information in the form of tables, charts, and formulas help make "1001 Uses" a handy reference for engineers and skilled technicians or a valuable text book for beginners.

The section titled "Other Measurements" covers tests of frequency, transistors and diodes, capacitance, microvolt attenuation, batteries, and field strength. Other sections provide technical data on the 260 family of VOM's and its accessories, which include plug-in adapters that convert the VOM into a transistor tester, temperature checker, and battery tester. The price of the book is 75 cents. ▲



Tool Catalog

(79)

A new 20-page catalog describing the complete line of **Kraeuter Tools** has just been issued. Among the tools shown are a broad selection of solid-joint pliers, alloy wrenches, slip-joint pliers, snips, wrench sets, punches, and chisels.

Also introduced in the catalog is a series of new displays. Known as "Profi-Tier" Display Assortments, the new group of displays are designed for self-service, pegboard merchandising — with each tool individually blister-packaged.

The catalog, along with prices and policy data, is available on request from Kraeuter.

Power Inverter

(80)

A new solid-state power inverter has been introduced by **Terado Corp.** The Gemini Model 50-128 changes the regular storage-battery current of a car or boat to 117 volts, filtered A.C. Capacity of the inverter is 450 to 500 watts.

Typical items that can be operated by Gemini are amplifiers, radios, portable TVs, lights, can openers, mixers, electric shavers, electric drills, and soldering irons.

The unit is housed in a heavy-gauge copper-clad base with carrying handle and is priced at $88.00.

Adapter Cables

(81)

These four new molded hi-fi adapter cables are ideal for interconnecting a wide variety of electronic devices such as phono turntables, microphones, radio tuners and other sources of audio signals to preamplifiers, power amplifiers, and speaker systems. They are also well suited for interconnecting DC and AC control signals between many types of transducers and instrumentation devices such as accelerometers, electrical-metering equipment, and laboratory test equipment.

The **Switchcraft** adapter cables range in length from 6' to 15', and have all-molded construction with a variety of 2-conductor plug styles. One plug is convertible to a receptacle by removing its coupling ring. Prices for the cables range from $1.90 to $3.95.

Solid-State CB

This solid-state, 6-channel CB two-way radio features "touch-top" tuning which provides instant channel selection —push the button and the channel changes automatically. Other features of the **Pearce-Simpson** Companion 111 are a public address system jack, a two-stage receiver RF, squelch and automatic noise-limiting circuits, 100% modulation capability with automatic limiting, receive/transmit indicator light, and a push-pull audio amplifier. An LC filter in the receiver gives finer selectivity.

The unit is built on a corrosion-proof *Iridited* aluminum chassis and measures 2¼" high, 8½" wide, and 6⅜" deep. Weight of the unit is 3 lbs.

Compact size, a front-panel speaker and a chrome-plated, die-cast front panel are other cabinet features which make it adaptable for dashboard mounting.

The Companion 111 comes complete with channel 9 crystals installed. Price is $139.90.

Magnetic Tape Bulk Erasers

(82)

A new line of portable and conveyor-belt magnetic-tape bulk erasers has been introduced by **Ferrantic Electric, Inc.** The three portable models are capable of erasing saturated tapes at the rate of 100 to 250 reels per hour. All recorded data—audio pulses, or any kind of signal, from DC to video—is erased to better than 80 db below saturation-recording level.

Portable Models 6, 7, and 8 are static instruments without moving electrical parts and provide instant erasure without leaving a tape hiss or background hum. Model 8 handles reels of magnetic tape up to 14½" in diameter and accommodates tape widths from ¼" to 2". Model 7 is suitable for continuous tape cartridges not exceeding 8" square, with maximum tape width of 1" for broadcasting studios. Model 6 handles reels up to 8¼" in diameter and accommodates ¼" to 1" tape widths.

The conveyor-belt bulk erasers are capable of handling 1000 reels of magnetic tape per hour under continuous operating conditions. The Model 14 bulk-erase system was specifically designed for tape or film manufacturers or other firms processing large quantities of magnetic tapes. It handles all size reels up to 14½" diameter and tape widths to 2". Model 14A is available to handle audio tapes in ¼" and ½" tape widths and 16-mm film. Both models are capable of erasing tapes to better than 85 db below saturated signal at any frequency.

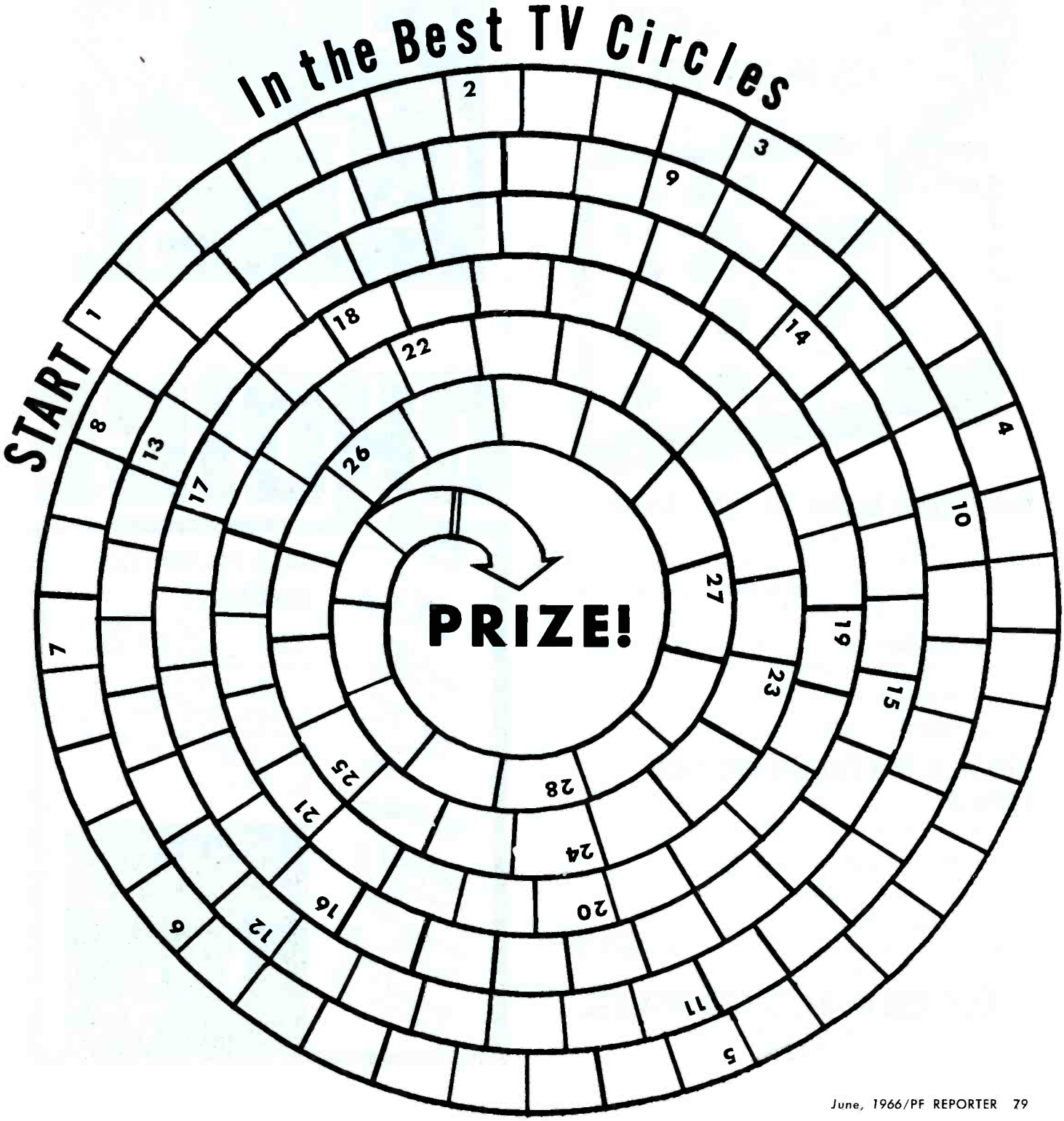
PFR Puzzler

IN THE BEST TV CIRCLES

We're sure you know your electronics but it's still a dollar-to-doughnut bet that you'll be dizzy before you solve *this* puzzle! Yet, it's quite simple: the last letter of a word is the first letter of the next word. Solve it completely and you'll be entitled to a Surprise Prize. Miss only one or two parts and you'll still earn a Consolation Award. Ready? Then, put on your thinking cap and GO!

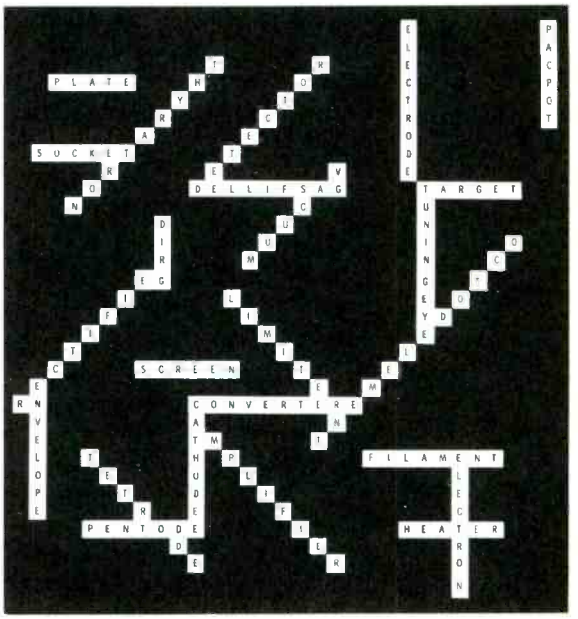
1. Aerial.
2. Pertaining to sound.
3. Opposite of input.
4. Changes AC voltage.
5. Makes current unidirectional.
6. Electromagnetic switch.
7. Coils on a picture tube.
8. Type of gun.
9. Frame or base of set.
10. Diagram.
11. AC, DC.
12. For making good connections.
13. Similar to a phone receiver.
14. Its ears are valued in TV.
15. Radio with a picture.
16. Chain of stations.
17. A protuberance.
18. Opposite of dullness.
19. Type of holder.
20. Adjusting device.
21. Opposes passage of current.
22. Emits energy.
23. Normal only during storms.
24. Unit of power, what?
25. Some are glass, others metal.
26. Wave from a station.
27. Projections.
28. Front of picture tube.

Solution and prize list in July issue.



SOLUTION TO MAY PUZZLER

VACUUM-TUBES



INDEX TO ADVERTISERS

JUNE, 1966

FREE Catalog and Literature Service

**Check "Index to Advertisers" for further information from these companies.*

Please allow 60 to 90 days for delivery.

ANTENNAS & ACCESSORIES

90. *ALLIANCE* — Colorful 4-page brochure describing in detail all the features of Tenna-Rotors.
91. *AMPHENOL CORPORATION* — New 28-page catalog aids selection of RF connectors and coaxial cable. Specifications are detailed for nearly 1400 items.*
92. *ANTENNACRAFT* — Four-color catalog sheet about the new *"Big-Shot-8"* VHF-UHF-FM antenna designed for city and suburban use.*
93. *BLONDER-TONGUE* — New products catalog, featuring all channel UHF-VHF-FM amplifiers, couplers, converters, etc.
94. *FINNEY* — Form 20-349 describes the new Finco-axial color matching transformer kit.*
95. *GC ELECTRONICS* — Catalog FR-3-CM is a 12-page catalog describing color-magic antennas, other antennas and accessories.
96. *JFD* — New 1966 dealer catalog covering complete line of log-periodic outdoor antennas, indoor antennas, rotators, converters, amplifiers, masting, splitter-couplers/combiners, matching transformers, lightning arrestors, antenna mounts, and hardware.*
97. *PARKER METAL GOODS CO.* — Catalog sheet illustrating rachet type chimney mount.
98. *WINEGARD* — 12-page brochure "Color Spectacular" featuring antenna products designed for color TV use.*
99. *ZENITH* — Information bulletin on antennas, rotors, batteries, tubes, power converters, record changers, picture tubes, wire, and cable.*

AUDIO & HI-FI

100. *ADMIRAL* — Folders describing line of equipment; includes black-and-white TV, color TV, radio, and stereo hi-fi.
101. *BENJAMIN* — Product literature on *Miracord* 40A, 40H and 50H automanual turntables and associated accessories. Product literature on stereo 200 and stereo 200/FM compact systems.
102. *CLEVELAND ELECTRONICS INC.* — 3 multi-color flyer sheets describing *Babe* reverberation kit, *Cathedral-Sonic* self-contained reverberation kit, and *Cletron* TV camera components.
103. *JENSEN* — Multicolored 24-page catalog No. 165-L featuring speakers and headphones. Also, 22-page catalog No. 6801 supplying phono-cartridge list and cross-reference.
104. *NUTONE* — 16-page full-color booklet illustrating built-in stereo music system and intercom radio systems. Includes specifications, installing ideas and prices.
105. *OAKTRON* — "The Blueprint to Better Sound," an 8-page catalog of loudspeakers and baffles giving detailed specifications and list prices.*
106. *OXFORD TRANSDUCER* — 4-page catalog describing three lines of automobile rear-seat speaker kits.
107. *PHONOLA* — Full-color 18½" x 12" brochure depicting full line of phonographs, tape recorders, and consoles.
108. *SWITCHCRAFT* — Bulletin 159 about two new high-powered miniature pre-amps.

COMMUNICATIONS

109. *ACTION! COMMUNICATIONS SYSTEMS* — Form 715 depicts the new Touch/Dial multi-station communications system.
110. *COMCO* — Complete communications systems brochures available on request.
111. *MOSLEY ELECTRONICS* — Catalog covering complete 1966 line of Citizens-band equipment.
112. *PEARCE-SIMPSON* — Specification brochure on 1BC 301 business-band two-way radio, *Companion II, Director, Escort II, Guardian 23,* and *Sentry* Citizens-band transceivers. "The Modern Approach to Business Communications" concerning land mobile radio service for businessman.

COMPONENTS

113. *BUSSMANN* — New 1966, 16-page car and truck fuse list. Shows proper fuse to use and where it is located. Covers foreign as well as domestic cars and trucks. Buss form AWC.*
114. *CORNELL-DUBILIER* — 96-page reference catalog about Twist-prong Electrolytic capacitors.*
115. *OAK* — Catalog and supplement describes Oak line of rotary and lever switches.*
116. *SONOTONE* — Spec sheet on 19T and 1ST stereo and mono cartridges.
117. *SPRAGUE* — Catalog K-508 is a large 64-page replacement manual cross-referencing electrolytic capacitors from manufacturers part number to Sprague number. Covers TV, tape recorders, radios, etc. Includes list prices.*
118. *TRIAD* — 12-page replacement guide on transformers. Manufacturer's number to Triad number.
119. *WORKMAN* — Form X-47 describes noninductive ceramic resistors used in color TV sets.*

SERVICE AIDS

120. *CASTLE* — How to get fast overhaul service on all makes and models of television tuners is described in leaflet. Shipping instructions, labels, and tags are also included.*
121. *CLEVELAND INSTITUTE OF ELECTRONICS* — New pocket-sized, plastic "Electronics Data Guide" of formulas and tables, including frequency and wavelength, db formulas and table, antenna lengths, and color code.*
122. *ELECTRONIC CHEMICAL* — Brochure of aerosol chemicals for controls, tuners, and tape heads.*
123. *G.C.* — New 300-page catalog FR 67 covers *GC, Walsco, Audiotex, Telco,* and *Electrocraft* brands of service aids and components.
124. *PRECISION TUNER* — Literature supplying information on complete low-cost repair and alignment service for any TV tuner.
125. *RAWN* — Instruction bulletin on how to make knobs in minutes with *Plas-T-Pair.**
126. *WALDOM NYLON AND BUTYRATE HARDWARE* — 4-page brochure about Nylon and Butyrate hardware.
127. *YEATS* — The new "back-saving" appliance dolly Model 7 is featured in a four-page booklet describing featherweight aluminum construction.

SPECIAL EQUIPMENT

128. *AMPROBE INSTRUMENT* — Catalog sheet REC 1007 about the *Direct-O-Log* strip-chart recorder.
129. *PERMA-POWER* — New catalog LCG-680- describes *Electro-Lift* garage door opener.
130. *SAMPSON* — Flyer sheet about the new *Waltham* Micro-8 vest pocket size transistor radio.
131. *TERADO CORPORATION*—Flyer sheet describes Model 50-160 portable 115VAC supply.

TECHNICAL PUBLICATIONS

132. *CLEVELAND INSTITUTE OF ELECTRONICS* — Free illustrated brochure describing electronics slide rule and four-lesson instruction course and grading service.*
133. *HAYDEN* — New, 64-page catalog listing books published by the Hayden Book Company, Inc. and John F. Rider Publisher, Inc. for the electronics service technician, student, and hobbyist.
134. *HOWARD W. SAMS* — Literature describing popular and informative publications on radio and TV servicing, communications, audio, hi-fi, and industrial electronics, including special new 1966 catalog of technical books on every phase of electronics.*

TEST EQUIPMENT

135. *B & K* — New 1966 catalog featuring test equipment for color TV, auto radio, and transistor radio servicing, including tube testers designed for testing latest receiving tube types.*
136. *EICO* — 1966 short-form catalog is 48 pages long. Describes a complete line of test instruments, CB and ham equipment, hi-fi components, and miscellaneous electronic equipment.*
137. *HICKOK* — New flyer detailing selected items of service test equipment.
138. *JACKSON* — New catalog of "Service Engineered" test equipment.
139. *MERCURY* — All new test-equipment catalog featuring time saving "Service-Man" equipment.*
140. *SECO* — Catalog sheet No. 90065 describing Model 900 color-bar generator and Models 88, 98, and 107B tube testers.
141. *SENCORE* — Latest 4-color catalog plus other information on new developments in the *Econoline* series of test equipment.*
142. *SIMPSON* — Flyer giving specifications of Model 604 Multicorder for measuring and recording volts, amps, milliamps, and microamps.*
143. *TRIPLETT* — New test equipment catalog D-66-I with full line of panel and portable instruments and accessories.*

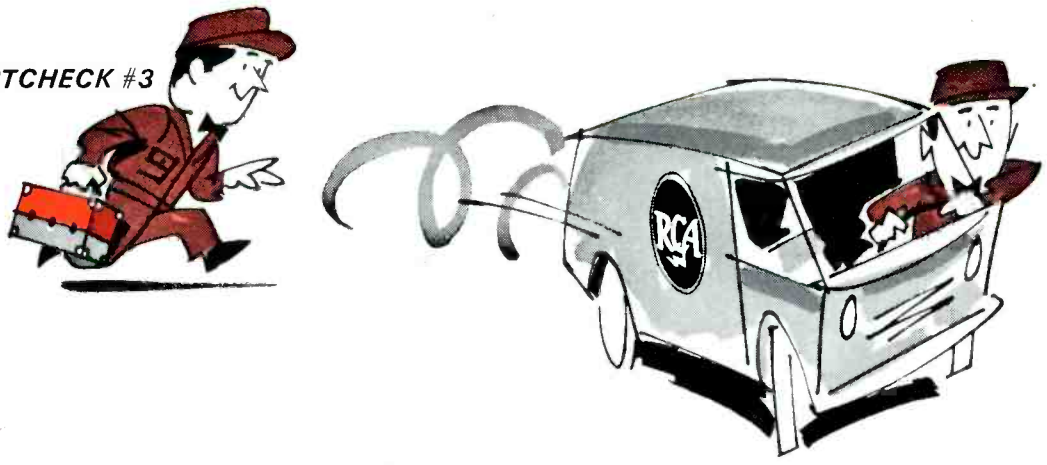
TOOLS

144. *ARROW* — Fly sheet illustrating three staple guns and showing uses.*
145. *ENTERPRISE DEVELOPMENT*—Time-saving techniques in brochure from Endeco demonstrate improved desoldering and resoldering techniques for speeding and simplifying operations on PC boards.
146. *VACO* — New 4-page catalog on Vaco's line of Professional Pliers and wrenches.*

TUBES & TRANSISTORS

147. *GE* — New 18-page "Semiconductor Almanac" for use in servicing radio, TV, and audio sets.
148. *RCA* — 6-page brochure illustrating the full line of dealer aids and promotional material about replacement color picture tubes.*

RCA's COLOR TV FASTCHECK #3



Poor convergence?

...check the horizontal and vertical output stages first

Sometimes the problem of misconvergence can be due to changes of characteristics in the horizontal and vertical output circuits. If the set has poor convergence here's a short check list of preliminary steps that may save you some valuable time. So, take a few moments and follow these easy steps...

1. Check the raster to see that it fills the entire screen. If it does not, check the height and width adjustments, the vertical and horizontal-output tubes, and the high-voltage section.
2. Measure the high voltage with your RCA VTVM or VOM, and high voltage probe. Rotate the brightness control and check voltage at various levels. Voltage should hold at all settings. If it does not, check the high voltage regulator circuit.
3. With your convergence-pattern generator, set up a crosshatch pattern. Then check and adjust linearity, if required. The crosshatch rectangles should be of uniform size. If not, adjust the vertical and horizontal linearity until you get a uniform effect.
4. Re-check items 1, 2, and 3.
5. Check color purity. If required, degauss the set and reset purity.

If these checks do not clear up the misconvergence, then make convergence adjustments as described in the service data.

For more satisfied customers, you'll find your local RCA Distributor your best source for top quality RCA receiving tubes for color TV.

RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.

The Most Trusted Name in Electronics

LOOK WHAT'S HATCHING IN

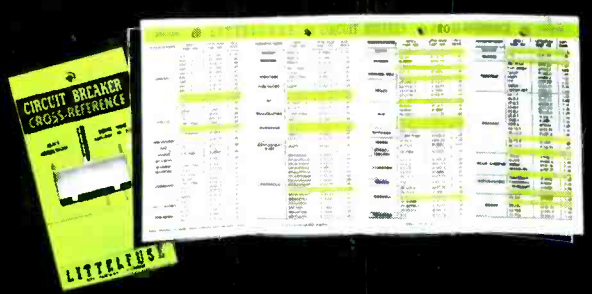
COLOR TV

Assortment #094074
10 BULK BREAKERS

Assortment #094073
10 CARDED BREAKERS

A COMPLETE ASSORTMENT OF CIRCUIT BREAKERS FOR COLOR TV APPLICATIONS

Ten breakers, seven ratings in one handy box for 100% replacement needs. Assortment available consisting of breakers on individual display cards or in bulk.



Included with each assortment: Pocket size cross-reference on color and black/white TV circuit breaker applications. Form No. CBCRP865H.

LITTELFUSE

DES PLAINES, ILLINOIS

Circle 67 on literature card