FEBRUARY—MARCH 1956
Vol. 8, No. 1

Electronic TUBES
Techni-talk
on AM, FM, TV Servicing

TRANSISTORS

The term transistor, derived from two words, transfer and resistor, is used today for semiconductor devices capable of power gain. Transistors are different from germanium diodes which pass current in one direction only and are not capable of amplification.

The basic elements of semiconductor devices, which include both diodes and transistors, are "barriers." A barrier may be formed in a number of ways. Two of the most common ways are (1) by placing a phosphor bronze wire on a small block of germanium and welding the two together (point contact), and (2) by placing a dot of indium on germanium and heating the indium so that it forms an alloy with some of the germanium (alloy junction). Both types are illustrated in Fig. 1.

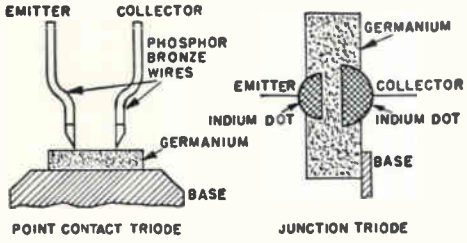

Fig. 1. Cross section of point contact and junction triode type transistors.

N-P-N AND P-N-P TYPES

Transistors are available in two different forms—N-P-N and P-N-P. They are almost identical except that the direction of current flow and voltage polarity is reversed. If the N-P-N transistor corresponds to an electron tube with ordinary (negative) electrons as charge carriers, then the P-N-P will correspond to a tube with positive instead of negative electrons. Obviously such a tube cannot be built. The availability of both P-N-P and N-P-N transistors is, therefore, one of their unique features.

The symbols used for N-P-N and P-N-P transistors are shown in Fig. 2. It will be noted that the emitter arrow points "out" on the N-P-N type and "in" on the P-N-P type. This arrow indicates the direction of current flow and is the only difference between the two transistor symbols. N-P-N transistor circuits normally have the emitter biased negative with respect to the base and the collector positive in respect to the base. P-N-P transistor circuits normally are just the reverse with the emitter biased positive and the collector negative with respect to the base.

GERMANIUM CHARACTERISTICS

The letters "N" and "P" indicate the electrical characteristics of the germanium in the transistor. Pure germanium is in effect an insulator and therefore a very poor conductor of electricity. When specific quantities of certain impurities are present in the germanium, it becomes a semi-conductor. Some impurities when combined with germanium will produce "N" type germanium whereas other impurities will produce "P" type germanium. When these two types of germanium are used in a transistor, the transistor becomes either an N-P-N or a P-N-P type as illustrated in Fig. 3. The N-P-N type

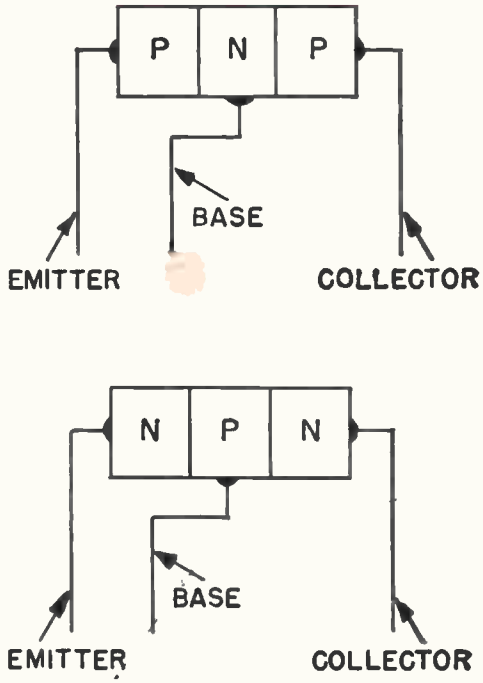

Fig. 3. Arrangement of elements in junction type transistors.

allows electrons to flow in the same manner as an electronic tube, whereas the P-N-P type allows current to flow in the opposite direction.

It may be found that P-N-P type transistors are used more frequently at the present time than N-P-N types. The reason for this has been availability and price. Generally speaking, either type may

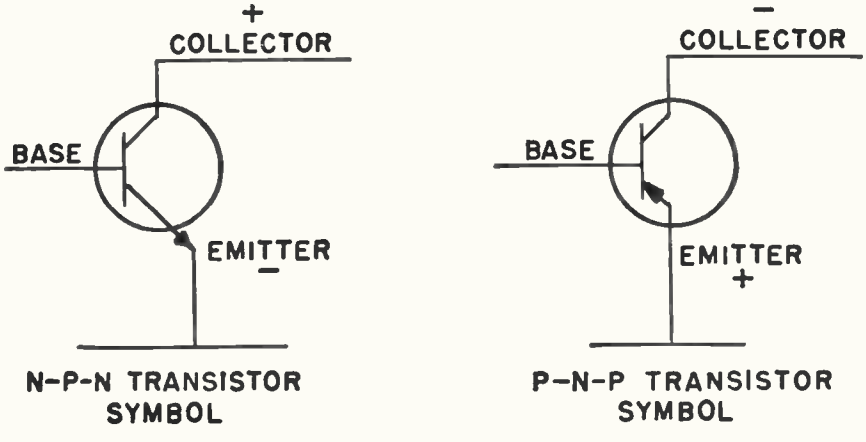

Fig. 2. N-P-N and P-N-P transistor symbols.

(Continued on page 2)

Vol. 8 No. 1
TECHNI-TALK
on AM, FM, TV Servicing
Published by
TUBE DEPARTMENT
GENERAL ELECTRIC
SCHENECTADY 5, N. Y.
R. G. KEMPTON, Editor

TRANSISTORS (continued)

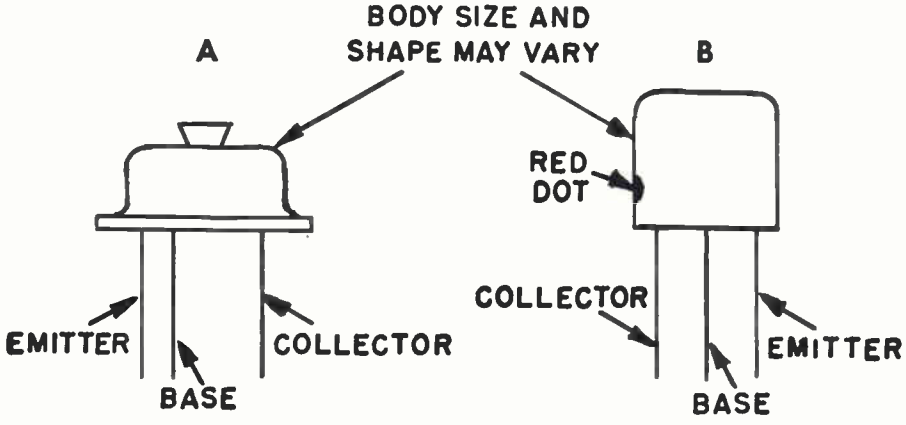

Fig. 4. Transistor basing and placement of leads.

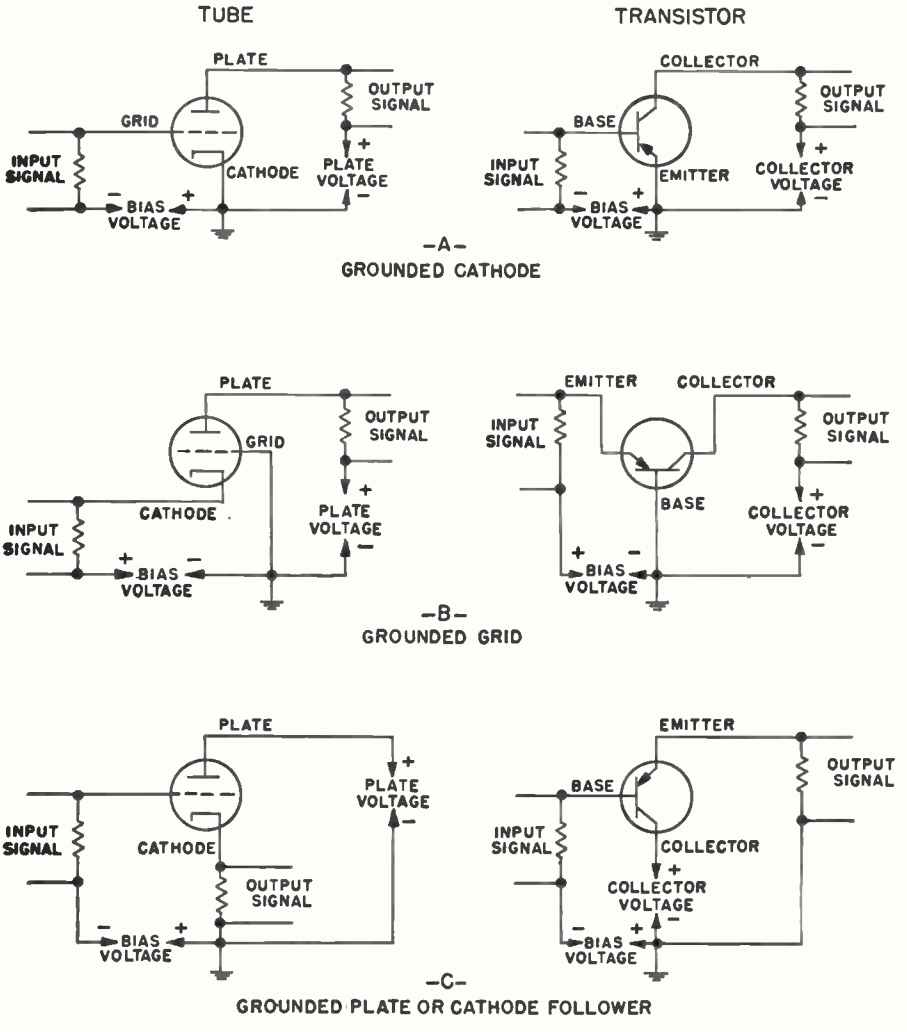

Fig. 5. Three typical tube circuits with comparable transistor circuits.

be used in most circuits. It will be necessary, therefore, to refer to the schematic diagram or transistor specifications in order to determine whether the transistor is a P-N-P or an N-P-N type.

TRANSISTOR PERFORMANCE

The performance of a transistor may deteriorate if its surface becomes contaminated with only a minute quantity of any foreign material. One of the worst offenders, perhaps, is ordinary water vapor which is always present in the atmosphere. One of the best ways to prevent contamination is to hermetically seal the transistor. This is the method used in the manufacture of all General Electric junction triode transistors.

Transistors may be made in various shapes and sizes. In most cases it will be found that the leads are not equally spaced as shown in Fig. 4A. Other types of transistors may have the leads equally spaced as shown in Fig. 4B. The leads on these transistors can be identified by the red dot which is adjacent to the collector as illustrated.

TRANSISTOR CIRCUITS

The base electrode of a transistor corresponds approximately to the grid of a vacuum tube, the emitter to the cathode and the collector to the plate. Figs. 5A, B and C illustrate three basic vacuum tube circuits and similar transistor circuits.

Transistors are different from vacuum tubes, however, in that they are current amplifiers rather than voltage amplifiers. In order to obtain maximum current amplification, it is desirable to have low input impedances. It is not practical, therefore, to substitute a transistor in a circuit designed for a vacuum tube or vice versa. Several circuits designed to use the low priced General Electric Type 2N107 transistor are shown in Fig. 6.

SERVICING TRANSISTOR CIRCUITS

It should be pointed out that excessive heat can damage a transistor. The type of wire used in General Electric transistors is a very poor conductor of heat. In spite of this fact, it is advisable to exercise reasonable care to prevent heat damage when soldering transistor leads.

A number of transistor type radios as well as other equipment using transistors are now available and sooner or later will require service. The schematic diagram of a transistor radio is similar in many respects to a conventional battery-operated radio. A schematic for General Electric Models 675 and 676 is shown in Fig. 7. It will be noted that a 13.5-volt battery is used to supply power. Obviously when servicing one of these receivers the voltages at the battery terminals as well as at the transistor terminals should be checked first.

Before removing or replacing any parts on these compact transistorized receivers, it is advisable to have on hand some

Tele-Clues

FILE IN BACK OF YOUR TELE-CLUE BINDER

Preliminary diagram for "S" line General Electric receivers. These receivers use 90 degree electrostatic focus aluminized picture tubes.

Models	
21C110	21T038
111	39
112	41
113	42
123	43
124	24T070
24C180	71
181	

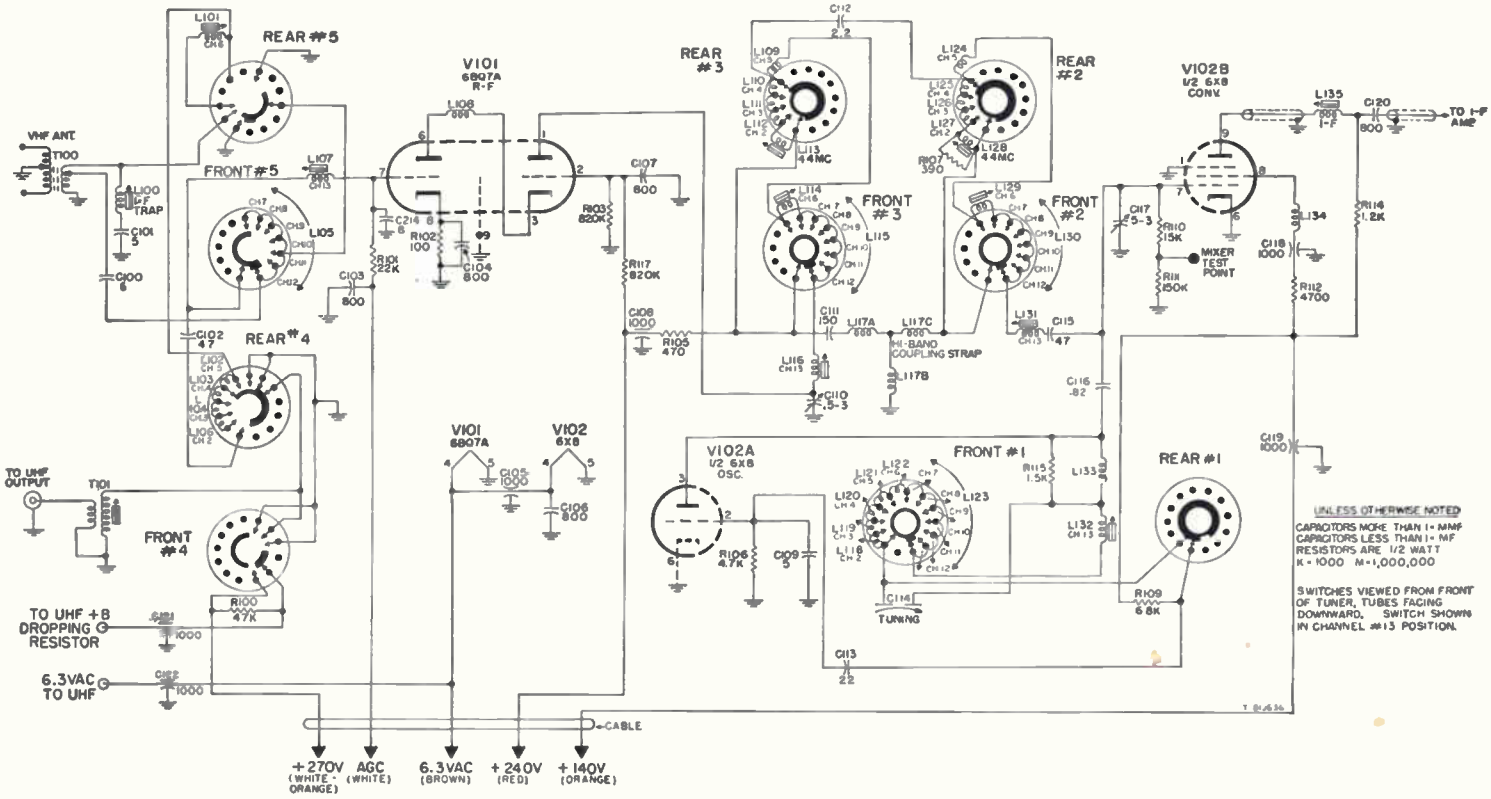

Fig. 1. Schematic diagram for VHF tuner RJX-080 used on "S" chassis.

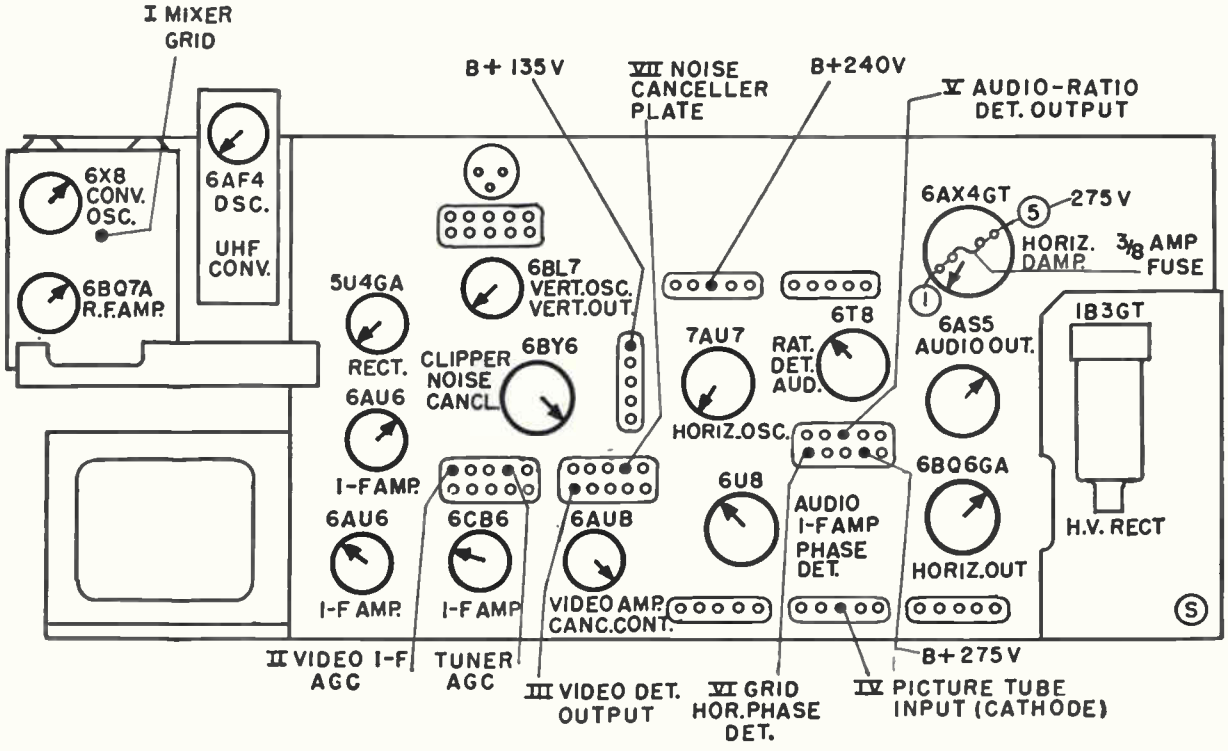

Fig. 2. Test point diagram for "S" chassis shown on page 4.

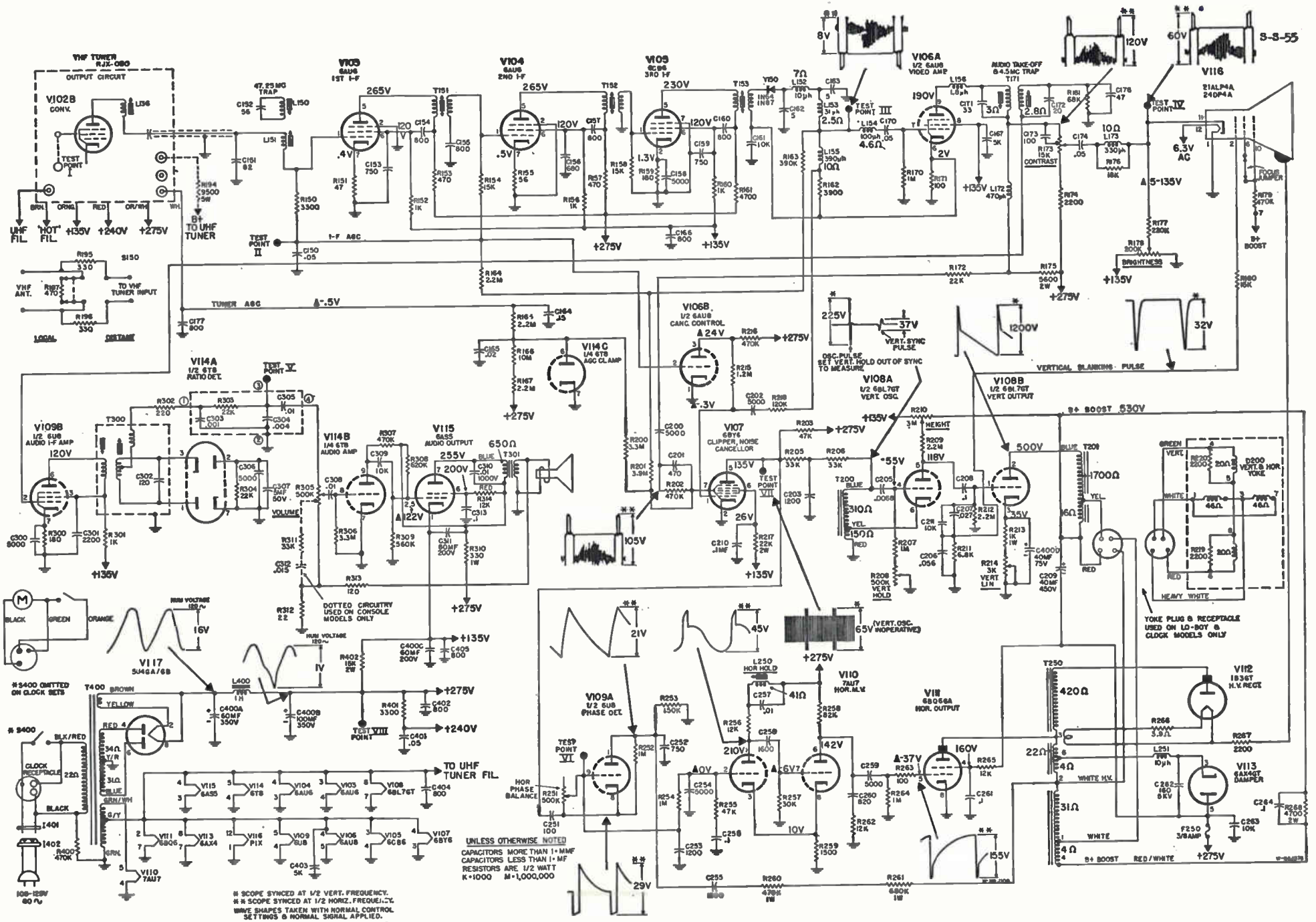

Fig. 3. "S" chassis schematic.

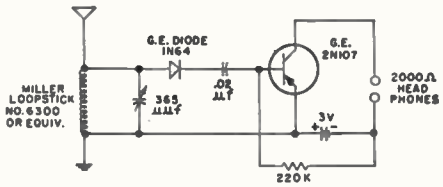

FIG. 6A. SIMPLE RADIO RECEIVER

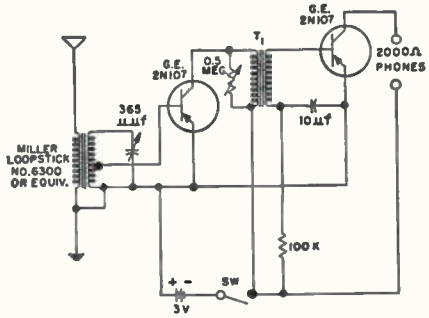

FIG. 6B. TWO TRANSISTOR RADIO RECEIVER

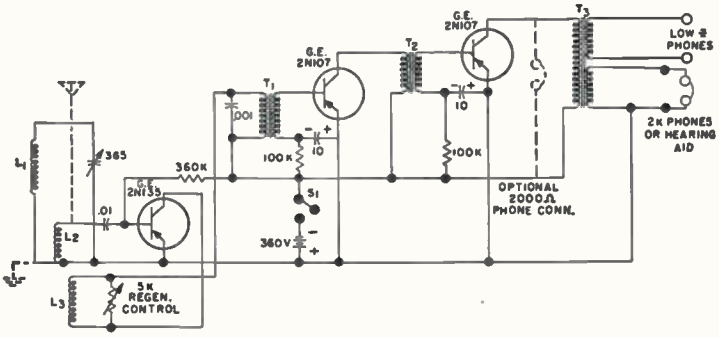

FIG. 6C. THREE TRANSISTOR BROADCAST RADIO

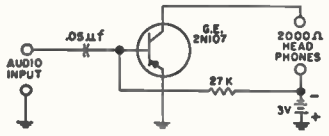

FIG. 6D. SIMPLE AUDIO AMPLIFIER

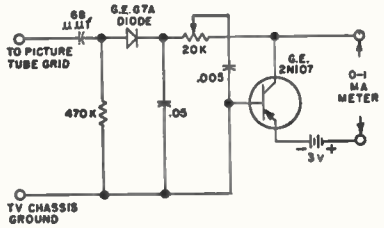

FIG. 6F. TV ANTENNA ORIENTATION METER

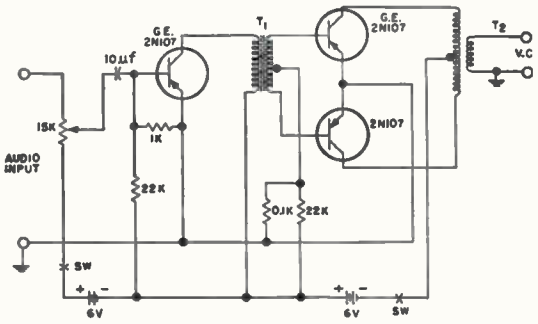

FIG. 6E. LOUDSPEAKER AUDIO AMPLIFIER

Fig. 6. General Electric Type 2N107 transistor circuits.

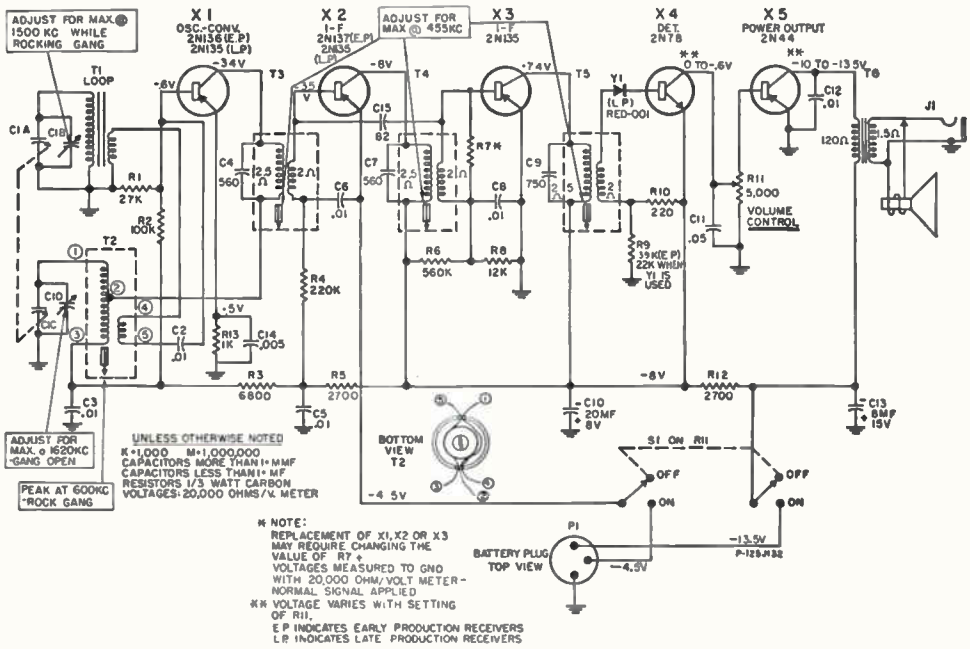

Fig. 7. Schematic diagram of General Electric transistor radio models 675 and 676.

smaller servicing tools than are normally required, such as: tweezers, a small soldering iron (pencil type) having a rating of not more than 35 watts, a small wire brush for removing excessive solder, and a jeweler's lens or magnifying glass. The latter will prove to be a valuable aid when reconnecting damaged transformer leads and other miniature parts.

TESTING TRANSISTORS

If a transistor is suspected it will be necessary to unsolder all three leads. Transistor removal would be simplified considerably if all three leads could be heated simultaneously. Since this is not possible without a special type of soldering iron, one lead at a time should be unsoldered. The transistor can be checked with the transistor tester shown on page 6 of this issue, or by substituting another transistor of the same type in the circuit. It is not advisable to check transistors with an ohmmeter, as damage to the transistors may result.

General Electric transistors are interchangeable with transistors manufactured by other companies. Interchangeability information for three transistorized radios is shown below.

RAYTHEON MODEL 8TP1

USE	RAYTHEON TYPE	GENERAL ELECTRIC REPLACEMENT
Oscillator	CK-760	PNP 2N136 PNP
Converter	CK-759	PNP 2N135 PNP
IF	CK-760	PNP 2N136 PNP
1st Audio	CK-721	PNP 2N45 PNP
2nd Audio	CK-721	PNP 2N45 PNP
Audio Output	CK-721	PNP 2N44 PNP
Audio Output	CK-721	PNP 2N44 PNP

EMERSON MODEL 838

USE	EMERSON TYPE	GENERAL ELECTRIC REPLACEMENT
Audio Output	815003 PNP	2N44 PNP
Audio Output	815003 PNP	2N44 PNP

EMERSON MODEL 842

USE	TEXAS INSTRUMENT TYPE	GENERAL ELECTRIC REPLACEMENT
Converter-Oscillator	830 NPN	2N78 NPN
1st IF	2N146 NPN	2N78 NPN
2nd IF	2N146 NPN	2N78 NPN
Driver	310 PNP	2N44 PNP
Push-Pull Output	353 PNP	2N44 PNP
Push-Pull Output	353 PNP	2N44 PNP

Transistors are very stable and have exceptionally long life. Too much heat applied to transistor leads, mechanical damage, or application of improper voltages are the usual causes of transistor failure. Improper voltage and resistance measurements which are found at the transistor leads are normally the result of a faulty component other than the transistor. Before any component (especially the transistor) is changed, the entire associated circuit should be checked thoroughly to determine which component is faulty.

BENCH NOTES

Contributions to this column are solicted. For each question, short-cut or chronic-trouble note selected for publication, you will receive $10.00 worth of electronic tubes. In the event of duplicate or similar items, selection will be made by the editor and his decision will be final. The Company shall have the right without obligation beyond the obove to publish and use any suggestion submitted to this column. Send contributions to The Editor, Techni-talk, Tube Department, General Electric Company, Schenectody 5, New York.

PORTABLE TABLE

After lugging numerous TV chassis from the front of the store to the workbench in back, I finally got smart and built a table 2 feet square, the same height as the workbench and put casters on the legs. Now when a chassis is brought into the shop, the table stands near the door. Whenever a set comes in, it is placed on the table and wheeled to the workbench. This saves a lot of arm and back work.

Fred W. Rivette
Rivette Radio-TV Service
102 Grand Ave.
Syracuse, N. Y.

FALSE ALARM CALLBACK

Symptom: Picture is OK for many hours and then fades to a blank screen. The serviceman is called in and upon switching the set on, everything is normal. The horizontal oscillator output, damper and rectifier tubes all check OK.

Cure: I have as a general practice removed the socket from the picture tube and tightened the contacts for pins 1 and 12. The same pins on the picture tube base are also resoldered, which enlarges the pins due to the extra coating of solder. This results in a better contact when the socket is replaced.

This procedure is also good preventative maintenance since it takes only a few minutes and may eliminate nuisance calls.

John Dawgila
4 Helen Ave.
Freehold, N. J.

What's new!

General Electric Transistor Tester

With the increased use of transistors in radios, computers and other commercial and military equipment, a means of testing these devices is badly needed. At the present time, there is no assembled instrument on the market which fills the need of the radio serviceman for a low priced, simply operated, rugged and dependable transistor tester.

Recognizing the need for such an instrument, the General Electric Company has released a Transistor Tester which is more than adequate for the testing requirements of the radio serviceman. The tester checks I_{co} (or leakage current) upon insertion of the transistor into the tester and will then test DC or (large signal) Beta when the gain button is pressed. The circuit components of the tester have been chosen so that if the needle advances one division on the gain signal when the red (gain) button is pressed, the transistor has satisfactory gain. The battery potential can be checked by placing a resistor between two of the transistor socket connections as described in the instructions located on the bottom of the instrument.

The G-E transistor tester will be marketed in a display which contains five of the most popular portable radio transistors (the 2N137, 2N136, 2N135, 2N78 and 2N44).

The display package will also include interchangeability information by equipment type. That is, several transistor radios, regardless of manufacture, will have their transistor complements listed on an interchangeability chart with the appropriate G-E replacement. Interchangeability information on new models will be made available as new models come on the market and each transistor tester owner will receive the latest information. The transistor tester is available from G-E franchised tube distributors.

TUBE DEPARTMENT
GENERAL ELECTRIC
Schenectady 5, N. Y.

BULK RATE
U. S. POSTAGE
PAID
Schenectady, N.Y.
Permit No. 148

Mr. Ed Carr, TV Service
Box 248
Beach City, Ohio

E-222

6-24-54

Form 3547 Requested