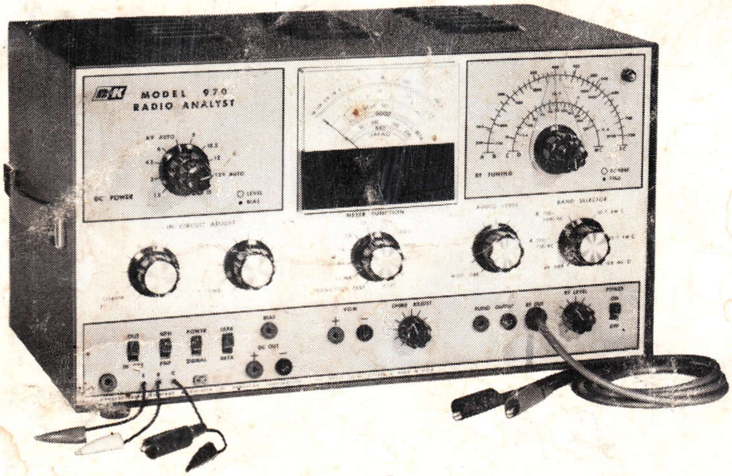
RADIO ANALYST

Model 970

B&K

INSTRUCTION MANUAL



B & K MANUFACTURING COMPANY

DIVISION OF DYNASCAN CORPORATION

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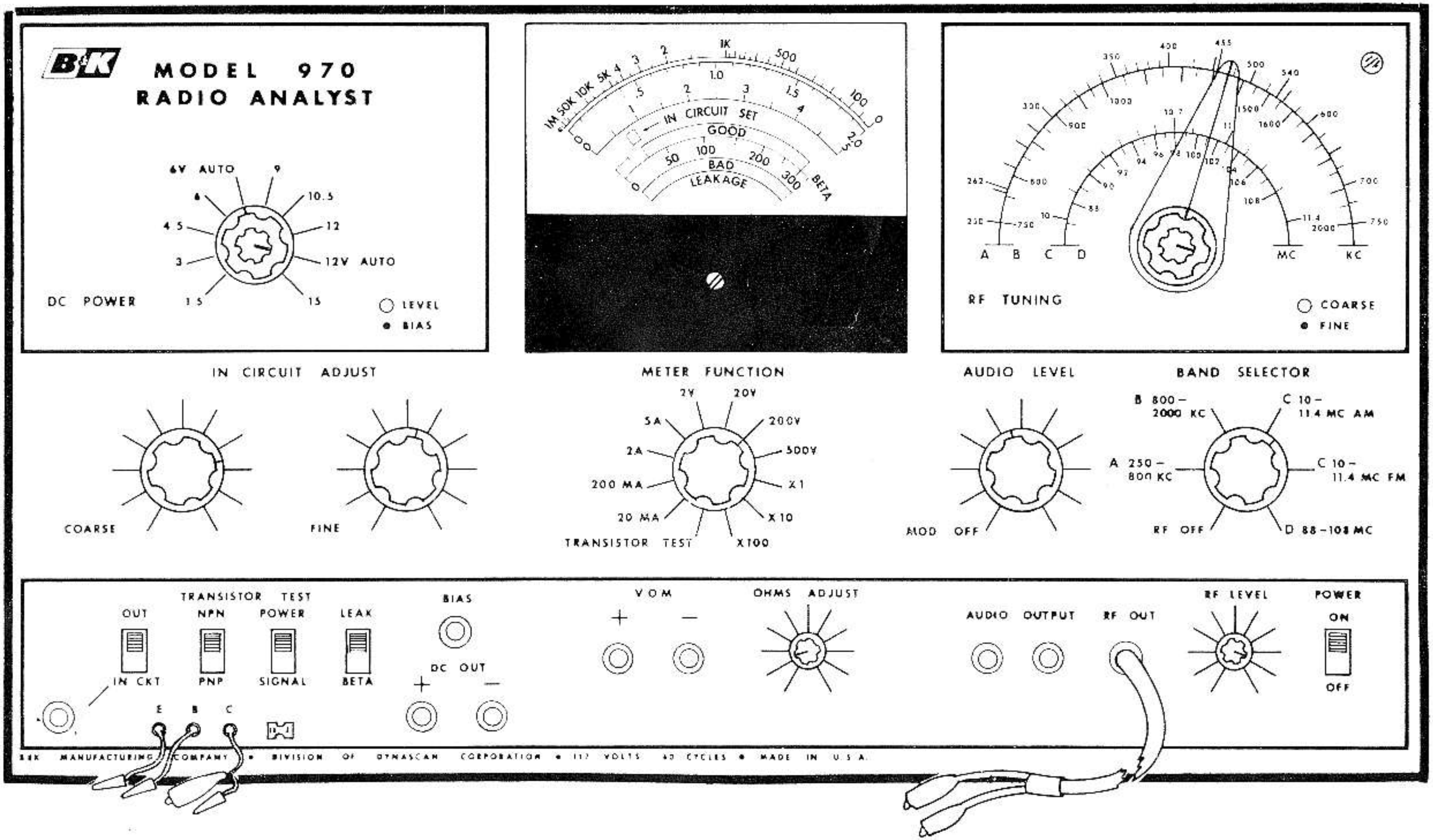
B&K
MODEL 970
RADIO ANALYST
6V AUTO
9
10.5
12
12V AUTO
15
1.5
3
4.5
6
DC POWER
LEVEL
BIAS
1K
500
100
1.0
1.5
IN CIRCUIT SET
GOOD
BAD
LEAKAGE
BETA
RF TUNING
COARSE
FINE
A B C D
MC
KC
IN CIRCUIT ADJUST
COARSE
FINE
METER FUNCTION
2V
20V
200V
500V
X1
X10
X100
5A
2A
200 MA
20 MA
TRANSISTOR TEST
AUDIO LEVEL
MOD OFF
BAND SELECTOR
B 800 - 2000 KC
C 10 - 11.4 MC AM
A 250 - 800 KC
C 10 - 11.4 MC FM
RF OFF
D 88 - 108 MC
TRANSISTOR TEST
OUT
IN CKT
NPN
PNP
POWER
SIGNAL
LEAK
BETA
E B C
BIAS
DC OUT
+
—
V O M
+
—
OHMS ADJUST
AUDIO OUTPUT
RF OUT
RF LEVEL
POWER
ON
OFF
B&K MANUFACTURING COMPANY • DIVISION OF DYNASCAN CORPORATION • 117 VOLTS • MADE IN U.S.A.

INSTRUCTION MANUAL

FOR

MODEL 970

Radio Analyst

B & K MANUFACTURING COMPANY

DIVISION OF DYNASCAN CORPORATION

1801 West Belle Plaine Avenue

Chicago, Illinois 60613

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MODEL 970 RADIO ANALYST

What the Model 970 Radio Analyst Will Do

Some idea of the inherent versatility of the Model 970 can be gained by an examination of its features.

The Model 970 provides:

1. DC power supply for powering the radio under test. This unique power supply provides voltages from zero to 15 volts. Even radios employing tapped power supplies may be fully operated from this built-in bias source. The available current is 5 amperes at all DC POWER switch positions, 5 amperes calibrated at 6 V AUTO, and 12 V AUTO, and 1 ampere calibrated at all other non-automotive DC POWER voltages.

2. Volt-ohm-milliammeter (VOM). The meter measures voltage, current, and resistance, transistor Beta or transistor leakage as selected by the function switch. There are four ranges for measuring voltage and current, and three ranges for measuring resistance. The meter is fully protected against accidental overloading.

3. Accurate "Out of Circuit" test for transistors. Leakage and Beta are individually tested and read on special scales on the face of VOM. Leakage is read on the LEAKAGE scale. Beta is read directly on a 0-300 BETA scale. Clip leads and a socket are available on the front panel for transistor testing. An NPN-PNP switch selects connections for transistor polarity. For the first time in a low cost tester, a switch position is provided for testing power transistors at working currents.

4. Built in "In Circuit" transistor tester. This section may be used as a D.C. Signal Tracer for rapidly localizing a dead stage. The test is made by using the Dyna Trace which is single probe.

5. Signal generator that tunes from 250 to 2000 kc, 10 to 11.4 mc, and 88 to 108 mc in four bands. The output level from the generator is variable and may be used for Signal Injection or RF and IF alignment. The generator operates with an internal 400 cycle modulation or unmodulated. Band A provides 250 to 750 kc AM modulated. Band B provides 750 to 2000 kc AM modulated. Band C provides 10 mc AM or FM modulated. Band D provides 88 to 108 mc FM modulated.

6. 400 cycle signal at the front panel for Signal Injection into the Audio section of a radio. The signal level is adjustable by a front panel control.

CONTROLS AND JACKS

Identification and Function

The Model 970 Radio Analyst is a complete instrument for use in the servicing of transistor radios, but is equally applicable to battery powered vibrator type or 115V AC/DC tube types. When using this new instrument for the first time, the best way to become familiar with the controls and signals is to make a "dry run" on a known radio. Carefully observe the effects of the controls and signals. It is the purpose of this section to familiarize the technician with all of the operating controls of the Analyst.

PANEL MARKING *(Schematic Symbol)*	DESCRIPTION AND FUNCTION
POWER ON-OFF (SW-4)	Two position switch which applies AC line power to the various circuits and turns on pilot light.
DC POWER (SW-5)	Ten position switch which enables operator to select output voltage of the DC Power Supply in 1½ volt steps from 1½ to 15 volts.
BIAS (R-49)	Variable resistor which provides a variable output from zero to the voltage selected by the DC POWER selector switch. This bias control is concentric with the DC POWER selector switch, but only controls the voltage accessible at the BIAS jack.
OUT-IN CKT (SW-6)	Two position switch which operates in conjunction with other TRANSISTOR TEST switches. OUT position is for testing a transistor independently. IN CKT position is for testing a transistor while it is connected in a circuit.
NPN-PNP (SW-8)	Two position switch which applies proper bias polarity to the emitter, base and collector of a transistor under test for both OUT and IN CKT testing.
POWER-SIGNAL (SW-7)	Two position switch which in POWER TRANSISTOR TEST position applies higher operating currents and in SIGNAL TRANSISTOR TEST position applies lower operating currents to transistor under test. This switch is used with the OUT of circuit transistor test.
IN CIRCUIT ADJUST COARSE-FINE (R-47)-(R-44)	Two variable resistors used to position the meter pointer to IN CIRCUIT SET position on meter face.
IN CIRCUIT TEST JACK	Red jack at lower left corner which supplies current for application to the base of a transistor in the IN CKT test.

PANEL MARKING *(Schematic Symbol)*	DESCRIPTION AND FUNCTION
LEAK-BETA (SW-9)	Two position switch which selects type of OUT of circuit transistor test. In LEAK position, high leakage between collector and emitter (I_{ceo}) reads BAD (red) on meter. In Beta position, true value of Beta is read on the 0-300 scale.
(Transistor Socket)	Socket accepts the leads of a transistor OUT-of-circuit test.
E, B, C (Red, Yellow, and Blue Clip Leads)	Clip leads for connecting to a transistor for OUT-of-circuit test; red clip lead—emitter, yellow clip lead—base, blue clip lead—collector.
BIAS (Jack)	Blue jack which supplies controlled DC bias voltage from power supply.
DC OUT + — (Jacks)	Red and black jacks which supply DC voltage selected from the power supply.
METER FUNCTION (SW-3)	Twelve position switch which enables operator to select function of the VOM.
OHMS ADJUST (R-39)	Variable resistor which controls meter current for adjusting zero reading of resistance scale.
(Screwdriver Adjustment) (R-36)	Factory set, requires no further adjustment.
VOM + — (Jacks)	Red and black jacks which provide input connections to VOM.
BAND SELECTOR (SW-1)	Six position switch which enables operator to turn off signal generator or select desired signal band output.
RF TUNING (C-6)	Variable ganged capacitors with pointer and dial for selecting specific frequency in any one of four bands. COARSE control sets approximate frequency and concentric FINE control gives a vernier adjustment.
RF LEVEL (R-15)	Variable resistor which controls strength of signal appearing at RF OUT probe.
RF OUT (Probe)	Two connection probe which provides connections from RF signal generator.
AUDIO LEVEL (R-21 and SW-2)	Variable resistor and on-off switch which control audio output and RF modulation level.
AUDIO OUTPUT (Jacks)	Red and black jacks which provide output connections from audio oscillator.

POWER SUPPLY

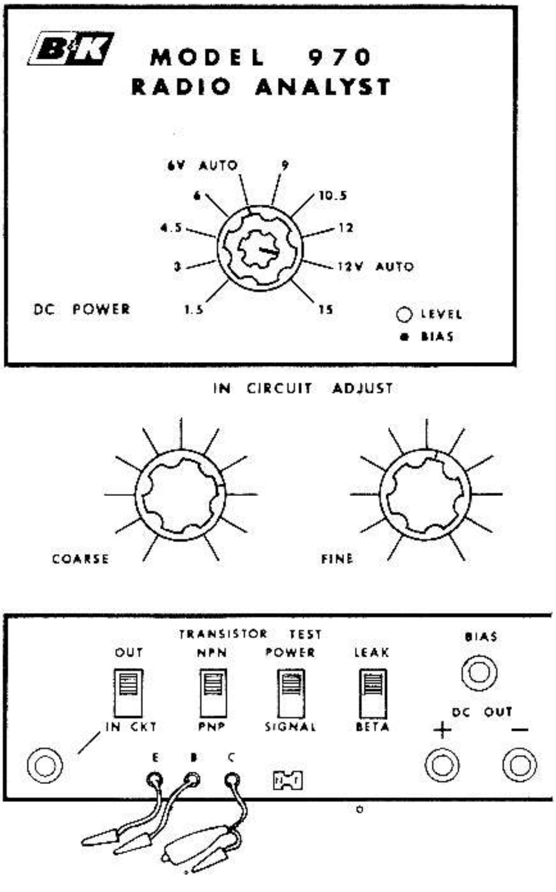

Fig. 2—Power Supply Section, Front Panel.

Specifications

OUTPUT: The DC POWER supply is adjustable in steps of 1.5 volts from 1.5 to 15 volts. Five amperes is available at all settings of the DC POWER supply. At settings of 6 V AUTO, and 12 V AUTO, the current is 5 amperes calibrated. At all non-automotive voltage settings the current is 1 ampere calibrated. Across the DC OUT terminals is a BIAS control which provides a biasing voltage that can be varied from 0 to 100% of the value indicated on the DC POWER selector switch by rotating the control counterclockwise. Clockwise rotation varies the BIAS from 100 to 0% of the DC POWER switch setting.

RIPPLE: Maximum ripple does not exceed 5%.

FUSE: A 3 ampere fuse protects the circuits at the primary of the power transformer. A 5 ampere fuse protects the diodes in the power supply.

Description

The power supply section of Radio Analyst 970 provides the dc voltages for transistor testing and complete operating and bias voltages for a radio under test. For car radios use the 6 V AUTO or 12 V AUTO positions of the DC POWER selector switch, depending on the electrical system used in the car. In some cases the drain of the car radio may be lower or higher than average. The DC POWER selector switch can be used to change the voltage either up or down.

VOLT-OHM-METER

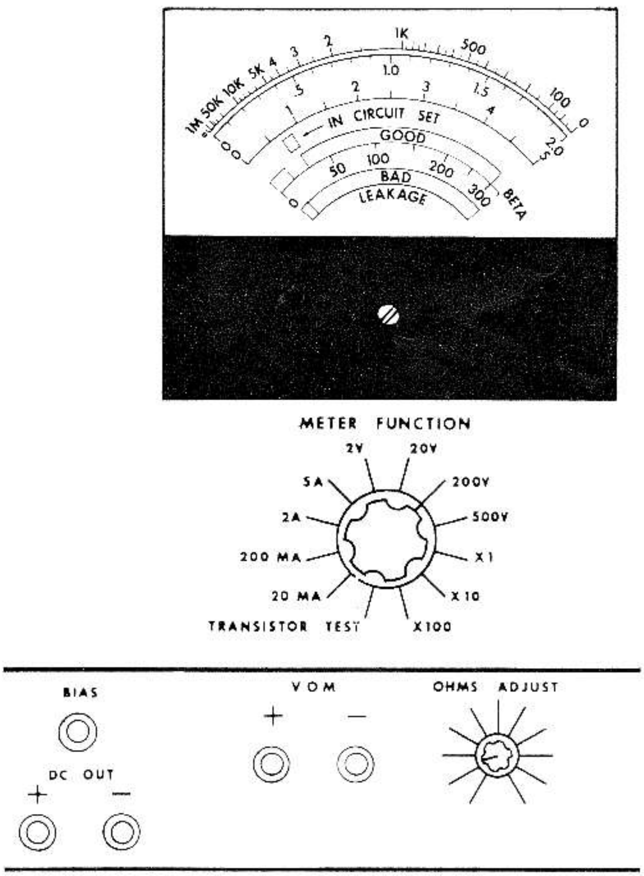

Fig. 3—VOM Section, Front Panel.

Specifications

SENSITIVITY:	5.5K ohms/volt.
DC VOLT RANGES:	2V, 20V, 200V, 500V.
VOLT ACCURACY:	Within 5% of full scale.
DC CURRENT RANGES:	20 ma, 200 ma, 2 amp, 5 amp.
CURRENT ACCURACY:	Within 7% of full scale.
RESISTANCE RANGES:	X 1, X 10, X 100.
RESISTANCE ACCURACY:	Within 20% of midscale.
OHMS ADJUST:	For zeroing meter on resistance ranges.
TRANSISTOR TEST:	Transfers meter for transistor testing.

Description

The VOM has four switch positions for measuring voltage, four for measuring current, three for measuring resistance, and one for transistor testing. In addition to measuring voltage, current, and resistance in a radio under test, the VOM can be used to check the voltage of the analyst power supply or current supplied to the radio. A 6 inch patch cord is supplied for connecting the VOM to the DC OUT for monitoring the current supplied. (Refer to Current Measurements in the section titled USING THE 970.)

Protection for the meter movement against overloads is built into the instrument.

The test lead jacks are spaced with ¾ inch centers to allow the use of the one-piece General Radio type connector.

RF AND AUDIO SECTION

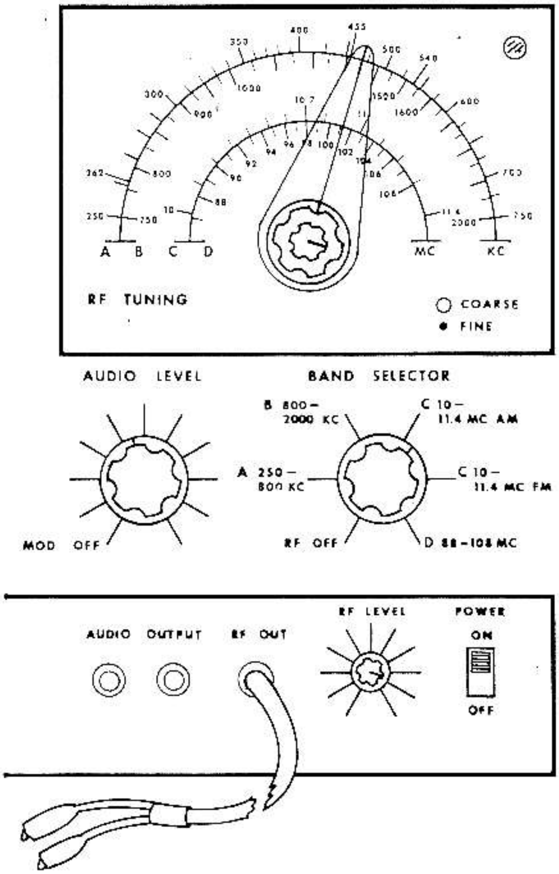

Fig. 4—RF and Audio Section, Front Panel.

Specifications

FREQUENCY:	Four bands of frequencies	
	Band A—250 KC to 750 KC	AM modulated
	Band B—750 KC to 2 MC	AM modulated
	Band C—10.0 MC to 11.4 MC	AM or FM modulated
	Band D—88 MC to 108 MC	FM modulated (70KC dev)
ACCURACY:	Within 2% at 455 KC, 1600 KC and all frequencies on band D.	
	All other frequencies are within 5% of indicated value.	
RF LEVEL:	Minimum output of 0.025 volts rms on Bands A, B, and C.	
	Minimum output of 0.010 volts rms on Band D.	
MODULATION:	400 cycle tone. Supplies a minimum of 30% modulation in AM and 70 kc deviation in FM.	
AUDIO OUTPUT:	A minimum of 50 mv rms at 400 cycles across a 3 ohm load, a minimum of 1.25 volts at 400 cycles across a 72 ohm load.	

Description

The RF and Audio section of the Radio Analyst provides either an unmodulated RF signal at the RF OUT probe, a modulated RF signal at the RF OUT probe, or an audio signal at the AUDIO OUTPUT jacks. The RF level variable resistor controls the strength of the RF signal and the AUDIO LEVEL variable resistor controls the percentage of modulation as well as the strength of the audio signal available at the AUDIO OUTPUT jacks. The BAND SELECTOR switch and the RF TUNING control select the desired frequency. Signal injection is the main use of the RF and AUDIO section. A known signal is injected into the radio to locate a defective stage.

USING THE 970

Using the Power Supply

1. Rotate the power supply range switch to the desired voltage. If you are going to power a car radio, select either the 6 V AUTO or 12 V AUTO position (depending on the voltage requirements of the radio). Sometimes defects are located by raising or lowering the DC POWER supply voltage which is possible since 5 amperes is available at all positions of the DC POWER selector switch.

2. Insert a red and black alligator cable in each of the DC OUT jacks, color to color. Observing proper polarity, connect the alligator clips to the power inputs (or other test points) of the radio under test.

3. Apply the AC power to the Model 970 via the POWER ON-OFF switch at the extreme right of the front panel. The pilot lamp will light.

CAUTION: Do not short the DC output cables together or you will blow the fuse.

4. To feed a bias voltage into the circuit under test, insert a red alligator cable into the blue BIAS jack and rotate the BIAS control completely counterclockwise. Connect the alligator clip to the desired point in the radio and advance the BIAS control for the appropriate voltage.

The magnitude of the voltages and currents delivered by the power and bias supplies can be monitored by using the VOM of the 970.

Voltage Measurements:

1. Insert a red and black alligator cable in each of the VOM jacks, color to color.

2. Rotate the power supply range switch to the desired voltage.

3. Make the necessary power supply connections in accordance with the instructions under Power Supply.

4. Connect the leads from the VOM jacks to the test points in the radio and read the voltage directly from the 2nd or 3rd scale on the meter. If the meter reads down-scale, reverse the leads.

5. Monitor BIAS voltage by connecting the VOM leads between the bias lead and radio chassis ground. Rotation of the BIAS control will alter the voltage.

Current Measurements:

To measure the total current drawn by a battery powered radio, perform the following:

1. In the interest of safety, the 970 POWER switch should be OFF.

2. Connect the 6 inch red patch cord between the red DC OUT jack (+) and the red VOM jack (+).

3. Connect the black VOM lead to the positive input of the radio.

4. Connect the black DC OUT (—) lead to the radio chassis or negative input.

5. Place the METER FUNCTION switch in the 5A position.

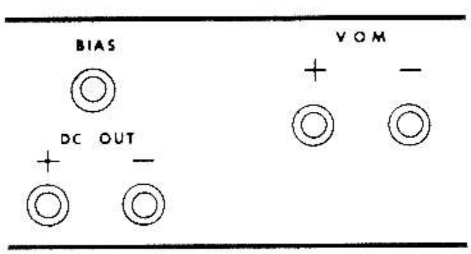

Fig. 5—Current Measurements, Front Panel.

6. Rotate the power supply range switch to the appropriate input voltage and apply power to the 970.

7. Read total current drawn by the radio directly from the correct scale on the VOM meter. If the meter reads down-scale, reverse the VOM leads. By applying a signal to the radio from the signal generator of the 970, the additional current drawn by the radio can be measured at this time.

To measure the current drawn from the BIAS supply, perform the following:

1. Apply power to the radio in the manner prescribed under Power Supply.

2. Rotate the METER FUNCTION switch to the appropriate current range.

3. Connect the 6 inch patch cord between the blue BIAS jack and the red VOM jack (+).

4. Connect the lead from the black VOM jack (—) to the point at which the bias is applied.

5. Read the current directly from the 2nd or 3rd scale of the meter. If meter reads down-scale reverse the VOM leads.

Current measurements without the power supply:

If the radio under test is powered by an independent power supply (battery, generator, etc.), then the VOM of the 970 is used in the same manner as any other VOM.

1. Rotate the METER FUNCTION switch to the appropriate current range.

2. Insert the leads from the VOM jacks in series with the circuit being tested and read the current value directly from the 2nd or 3rd scale on the meter. If the meter reads down-scale, reverse the leads.

Resistance Measurements:

CAUTION: There must be no voltage present in the circuit or component being tested when making resistance measurements.

1. Rotate the METER FUNCTION switch to the appropriate resistance range.

2. Short the VOM leads together and "ZERO" the meter with the OHMS ADJUST control.

NOTE: The meter must be "ZEROED" for every resistance range.

3. Separate the leads and connect them across the component or circuit to be measured. Read the resistance value directly from the top scale of the meter.

Using the low resistance range, test capacitor for leakage or shorts by connecting the test leads across the suspected capacitor. (When testing electrolytics be sure to observe polarity. Reverse polarity across an electrolytic can destroy the capacitor. The red jack on the panel is positive with respect to the black jack.)

The front to back ratio of diodes can also be measured on the Ohmmeter. The resistance in the forward direction should be quite low while in the reverse direction the resistance should be quite high. A front to back ratio of about 100 to 1 is common for a good diode. If the resistance of the diode in both directions is equal, that is very high or very low, then the diode is defective and should be replaced.

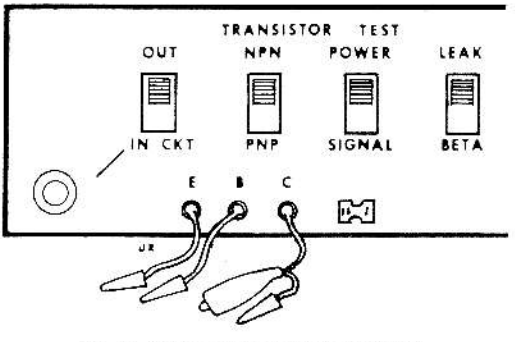

Fig. 6—Transistor Testing, Front Panel.

In Circuit Test—Dyna Trace:

This is perhaps the most useful test. Since only a single probe is needed when this test is used for signal tracing or, in circuit testing of transistors, it is a very rapid method of locating a defective stage or transistor. To use this test the radio must be connected to the Analyst power supply and not to an external battery.

Whenever using the Dyna Trace test turn the volume control on the radio to minimum. Take a piece of bare copper wire and wrap it around the loopstick of the radio and short the ends together.

The purpose of this shorted turn is to load the antenna circuit thereby keeping the radio from picking up a broadcast station and disturbing the test. In the case of a dead radio this would not be necessary.

Perform the following steps for In Circuit Testing:

1. Connect the power supply of the 970 to the radio in accordance with the instructions under Power Supply.

2. Rotate the METER FUNCTION switch to TRANSISTOR TEST.

3. Set the OUT-IN CKT slide switch to IN CKT.

4. Rotate the COARSE and FINE controls until the meter pointer is at the IN CIRCUIT SET mark.

5. Place the NPN-PNP slide switch in the position corresponding to the type transistor being tested.

6. Insert the red test probe in the red jack at the extreme left of the front panel. Touch the probe to the base of the transistor being checked.

7. If the meter swings up-scale, the transistor is good and can amplify a signal. It further indicates that the DC circuitry of the stage is working properly. If the meter indicates no change or swings down-scale, reverse the NPN-PNP switch. If there is still no indication, the transistor or that portion of the circuit is at fault.

Repeat this test on each transistor in the radio. Each time the Dyna Trace is touched to the base of a transistor the pointer will swing up scale and out of the BLUE square. Some stages will cause the pointer to go off scale while others may just barely move the pointer out of the BLUE square. As long as the pointer moves up scale this indicates that the stage is operating and that the DC circuitry is O.K. When a stage is reached that does not make the pointer read up the meter scale, a defective stage or transistor has been located. A few simple voltage readings will quickly isolate the defect to the component or to the transistor itself.

Out of Circuit Test—Transistor Testing:

This test should be used to confirm whether or not a transistor is defective. The test should be made with the transistor out of the circuit. A test for both Leakage and Beta (H_{FE}) is made. The true value of Beta can be read on the 0-300 scale. The Leakage test is the I_{ceo} test which is the leakage between the collector and emitter. High leakage between base and collector is amplified by the transistor and shows up as BAD on the LEAKAGE scale.

The Beta test is a DC test where a fixed amount of current is applied to the base of the transistor and the resultant collector current read on the meter.

A transistor whose beta is less than 20 is generally not considered useful in a radio. Between 20 and 30 is considered questionable. From 30 to 110 is the area into which most transistors will fall and this is considered a good transistor. Since the actual Beta of transistors found in portable radios is rarely known, this GOOD (blue)—bad (red) scale will be extremely helpful in determining the quality of a transistor. As a general rule defective radio transistors usually have high leakage, shorted or open junctions. Low beta units will not normally result in a dead radio, but might result in low gain. In high Beta transistors it is possible that the reading may go off or to full scale and the leakage not be excessive. In that case check the manufacturers specifications. If leakage is again checked after the Beta test allow the leakage reading to go down as the transistor cools.

To perform the OUT of circuit test, connect the transistor to the clip leads marked E (emitter), B (base) and C (collector). If the transistor has stiff wire leads simply plug the transistor into the socket. As an aid in identifying the emitter, base, and collector leads, the more common basings for transistors is shown in Fig. 7A. The location of the E, B and C of the test socket of the Analyst is shown in Fig. 7B.

BASE DIAGRAMS

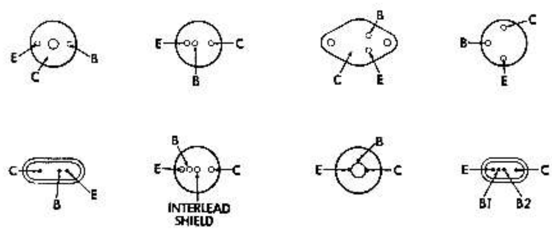

Fig. 7A—Transistor Basing Configurations.

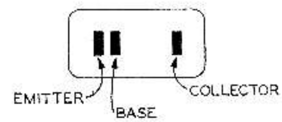

Fig. 7B—Transistor Socket Connections.

Both low signal and power transistors can be tested with the 970. The transistor socket, located beside the DC OUT jacks, will accommodate low signal transistors. Protection is provided to prevent damage if the transistor is inserted improperly in this socket.

Power transistors are connected by means of the E, B, and C leads beside the transistor socket. Use the large blue clip lead for the collector of power transistors. The small blue clip lead is for testing signal transistors.

1. Place the OUT-IN CKT slide switch in the OUT position.

2. Place the NPN-PNP slide switch in the appropriate position.

3. Place the POWER-SIGNAL slide switch in the appropriate position.

CAUTION: This switch must never be in the POWER position when a low signal transistor is being tested. Damage to the transistor could easily result.

4. Place the LEAK-BETA slide switch in the LEAK position and read the leakage scale on the meter. If the meter indicates anywhere in the BAD area, the leakage current is too high and the transistor should be replaced.

5. Place the switch in the BETA position and read the BETA scale on the meter. If the meter indicates anywhere in the GOOD area, the beta of the transistor is acceptable.

If there is no meter indication, reverse the NPN-PNP switch and/or check the transistor connections to the 970.

It is not absolutely necessary that it be known whether the transistor is NPN or PNP. By a process of elimination the transistor can be tested without this information.

Let us test an unknown transistor. Test the transistor with the NPN-PNP switch in the PNP position and the POWER-SIGNAL switch in the SIGNAL position. If the transistor shows low leakage and reads on the Beta scale the transistor is good and is now known to be a PNP. If the transistor shows no leakage and no Beta, switch to the NPN position. If the transistor tests good in this postion, the transistor is now known to be good and of the NPN variety. If the transistor tests BAD (red) in both positions of the NPN-PNP switch the transistor is defective and must be replaced with the same or equivalent type. Certain transistors, those usually found in high frequency circuits of FM sets, etc., may have very high Betas. If you note a high Beta reading check the manufacturers specification.

The Analyst may be used to test power transistors, which may be good or bad, such as shorted or open. Power transistors are tested at high currents. This is the first true power test available in a low cost instrument. It can also be used to balance power transistors in push-pull circuits.

SIGNAL GENERATOR

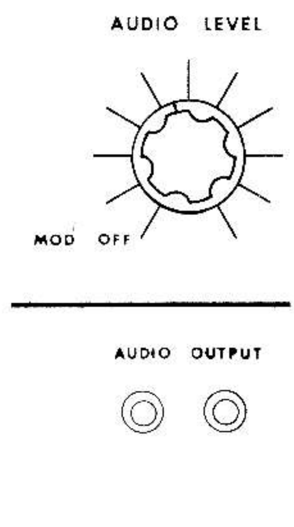

Fig. 8—Audio Section, Front Panel.

Using Audio Signal Injection

Signal Injection is used to test the performance of the various stages of a radio.

In order to become familiar with audio signal injection, practice signal injection on a known good radio and observe the effect of this signal. Signal Injection in transistor devices is similar to that used in vacuum tube circuits. The signal in vacuum tube stages is normally fed into the grid. In transistors it is generally fed into the base. In the vacuum tube circuit the output is usually from the plate. In transistors it is usually from the collector. The main difference of course, is that the vacuum tube is a voltage amplifying device while the transistor is a current amplifying device.

To inject a straight audio signal into a radio, connect the leads from the AUDIO OUTPUT jacks to the circuit being tested. Advance the AUDIO LEVEL control to the desired value. If the RF OUT probe is connected to the radio, the BAND SELECTOR switch should be placed in the RF OFF position. If the RF OUT cable is not connected, the setting of the BAND SELECTOR switch is unimportant.

CAUTION: If the circuit being tested by audio signal injection has a DC component in excess of 400 volts, place a DC blocking capacitor (0.1 mf, 600 V) in series with the red AUDIO OUTPUT lead.

The output level at the AUDIO OUTPUT jack is adjustable by means of the control marked AUDIO LEVEL. When this control is turned fully counterclockwise to the MOD OFF position, the audio signal is turned off. Since the same audio signal that is used for audio injection is also used for modulation of the R.F.-I.F., this is a means of turning the modulation off.

In order to use signal injection the black lead from the AUDIO OUTPUT jack must be connected to the radio common ground. Touch the test prod to the hot side of the loudspeaker voice coil.

The AUDIO LEVEL control should be in any position other than MOD OFF. You should now hear the 400 cycle audio tone in the loudspeaker. This would indicate that the loudspeaker is operating properly, and so are the contacts of the earphone plug.

The next stage to be tested by signal injection is the push-pull output stage. Touch the test prod to the primary of the push-pull driver transformer. Adjust the AUDIO LEVEL control for an audible signal in the loudspeaker. Presence of a signal indicates that the output stage is capable of passing an audio signal and would not be the source of trouble if the receiver were dead. Other troubles may however occur in the output stage. Distortion is one such trouble.

Now shift the test prod to the base of the audio driver transistor. The level of the signal heard in the loudspeaker will increase substantially due to the added gain provided by the driver stage. The signal may be restored to a lower level by reducing the AUDIO LEVEL control of the Analyst. For this and subsequent tests be sure the radio volume control is at maximum gain. Any trouble that might be present in the audio section of the receiver can easily be isolated to the specific stage by means of this signal injection method.

Action of the volume control can be observed by injecting a signal at the output of the detector. Adjustment of the volume control should cause the volume of the signal to change at the loudspeaker.

Another use for signal injection would be to check the effectiveness of the emitter bypass capacitor by touching the test probe to the transistor emitter. If the bypass capacitor is operating properly, very little signal will be heard in the loudspeaker. If the bypass capacitor is open, the signal heard in the loudspeaker will be quite loud, as loud as the signal would be when the probe is brought to the base of the same transistor.

Using RF Signal Injection

RF Signal Injection is accomplished using the calibrated signal generator. The tuning range of the generator is from 250 kc to 108 mc. Four ranges are employed namely Bands A, B, C and D. Band A tunes from 250 kc to 750 kc. This is the upper scale on the panel. See Fig. 4.

Since Band A covers the IF frequency range of an AM radio, the two most common IF frequencies are marked on the dial. These points are 262 kc and 455 kc. Band B tunes from 750 kc to 2000 kc, or 2.0 mc. This range would be used most commonly for signal injection into RF stages. Band C tunes from 10 mc to 11.4 mc in two positions, AM and FM.

For Signal Injection (I.F.) in FM radios, 10.7 mc is marked on Band C. Band D tunes from 88 mc to 108 mc.

The RF signal generator can be turned OFF, or BAND A, BAND B, BAND C, or BAND D can be selected by means of the BAND SELECTOR switch. This switch is located just above the RF LEVEL control and is shown in Fig. 4.

The output from the signal generator is taken from the RF OUT probe. See Fig. 4. No ground connection to the (—) minus VOM jack is necessary and should not be used.

Connect the black probe of R.F. OUT cable to chassis and the red probe to the point of signal injection. The RF level control for the signal generator is located to the right of the RF OUT probe.

The RF oscillator is AM modulated with a 400 cycle audio tone in BANDS A, B and C (AM) and FM modulated (70 KC deviation) in BANDS C (FM) and BAND D.

To supply an unmodulated RF signal to a radio, perform the following:

1. Connect the RF OUT probe to the radio circuit in question.

2. Rotate the BAND SELECTOR and RF TUNING dials to the desired frequency.

3. Adjust the RF LEVEL control for the desired signal strength.

4. Turn the AUDIO LEVEL control to the MOD OFF position.

To supply a modulated RF signal to a radio, perform the first three steps listed above, then rotate the AUDIO LEVEL control to the desired percentage of modulation. For normal RF and IF signal injection the modulation would be left on. In the event that the local oscillator of the receiver is to be replaced with the signal from the Analyst, the modulation would be turned off.

Practice signal injection on a known good AM radio to become familiar with this technique. The BAND SELECTOR switch is set to BAND A. The pointer on the tuning dial is set so that the hairline on the plastic pointer is on 455 kc since this is the I.F. frequency of the radio we are testing.

Before signal injection the radio must be disabled by wrapping a single shorted turn of wire around the loopstick antenna. This will prevent the radio from picking up any broadcast stations that would produce faulty indications.

The BAND SELECTOR switch should be in the Band A position and the R.F. TUNING set to 455 on the A dial. Touch the red RF OUT probe to the input of the detector stage. For injection at this point the level controls would normally be set to maximum. The 400 cycle test tone will now be heard in the loudspeaker. If the sound fails to appear in the loudspeaker be sure to advance the volume control until the sound is heard.

Since the volume control appears between the source of signal and the loudspeaker, it will control the amount of sound heard in the loudspeaker. We would not normally expect the intensity of the test tone in the loudspeaker to be very loud since there is little amplification being provided for the signal.

Move the test prod from the detector input and touch it to the input of the last I.F. transformer. If the signal is again heard in the loudspeaker we have proved that the transformer is operating. If the Signal Generator frequency is changed the signal will get weaker as it is detuned from the proper I.F. frequency.

Reset the generator back to 455 kc. Shift the RF OUT prod from the I.F. transformer to the input of the last stage of the I.F. amplification. We are now feeding the signal into the base of the I.F. amplifier. Since the signal is now being amplified by the I.F. amplifier, the level of the signal heard in the loudspeaker will increase substantially. Reduce the level control on the Analyst to compensate for this increase in gain. Always work with the minimum amount of signal in order to prevent overload of the amplifier stages in the receiver.

We have now demonstrated that from the base of the last I.F. amplifier to the loudspeaker, the radio is operating properly. Shift the test prod to the input of the next I.F. amplifier. With another stage of gain present, the signal should again increase in level at the loudspeaker. Again reduce the level control of the Analyst to compensate for this increase in gain. Since the signal can be heard when injected into the base of the I.F. amplifier transistor, we have demonstrated that the I.F. system and audio system are operating normally.

The input of the converter is the next point for signal injection. This is the base of the converter transistor. Although some I.F. signal will get through, the signal at this point is in the R.F. range and the Signal Generator must be retuned to an R.F. frequency. Let us use 1.0 mc. For this frequency the BAND SELECTOR switch must be set to Band B and the R.F. TUNING dial set to 1.0 mc (1000 kc).

The radio must also be tuned to 1 mc. Touch the test prod to the base of the converter transistor. The signal should now be heard in the loudspeaker at full volume since all of the gain of the radio is now in use.

The oscillator section may be tested by measuring the base to emitter voltage. This voltage should change slightly as the variable tuning capacitor is rotated through its range.

Another technique for testing the oscillator is to tune the radio to a known station. Loose-couple the ANALYST to the oscillator coil or the input converter. Set the R.F. TUNING control of the ANALYST to the known frequency plus the I.F. frequency of the set. If the station can be heard, then the oscillator of the set is defective. This particular approach uses the ANALYST as a replacement oscillator.

R.F. Signal Injection in an FM radio is accomplished by using Bands C and D. For R.F. Signal Injection of I.F. frequencies, use Band C, and position the RF TUNING control to the 10.7 mark on the dial. Set the BAND SELECTOR switch to the 10.7 FM position.

For signal injection of R.F. FM frequencies, use Band D, and set the BAND SELECTOR switch to Band D (88-108 MC). Position the R.F. TUNING control to the frequency desired.

FM RECEIVER ALIGNMENT

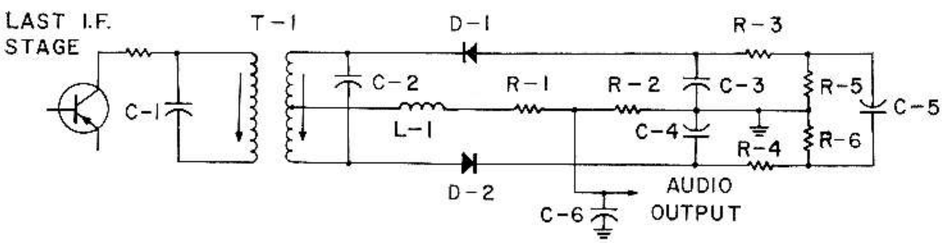

Fig. 9—Typical Ratio Detector Circuit.

Aligning a Ratio Detector

Variations of d-c voltage that take place in different parts of the receiver circuit when the tuning is changed is the basis for this method of alignment. A steady carrier is applied from the signal generator to the circuit under test, and changes in voltage are observed on the VOM while tuning.

For alignment of the ratio detector, use the VOM and Signal Generator of the Radio Analyst. Connect the R.F. OUT probe to the base of the last I.F. amplifier transistor. Turn the BAND SELECTOR switch to the 10.7 FM C position and rotate the R.F. TUNING control to the 10.7 MC mark. Connect the VOM across resistors R5 and R6 of figure 9. Adjust the primary of the transformer for maximum deflection of the meter. This shows that maximum current is flowing through the load resistors (R1 and R2) and the capacitor (C6).

To align the secondary of the transformer, connect the VOM across C6 and tune for maximum deflection towards zero on the VOM. This shows that the secondary is exactly centered in the I-F pass band.

Aligning the I.F. Stages

The alignment of the I.F. stages in a receiver consists of measuring the voltage developed at the detector circuit as the I.F. amplifiers are tuned. In the ratio detector, connect the meter across the load capacitor and connect the signal generator to the input of the first I.F. amplifier. Starting with the last I.F., tune each I.F. for maximum deflection of the meter. If any of the I.F. amplifiers is overcoupled, (two maximum deflections) connect a low value resistor (200 to 500 ohms) with short leads across the secondary of the overcoupled transformer. This reduces the Q of the transformer. The reduced Q suppresses the double-humped charactristic of the overcoupled circuit resulting in a single broad peak. Observe the output meter; carefully tune to the exact center of this peak. Disconnect the loading resistor when the stage has been aligned.

Alignment of R.F., Mixer, and Oscillator

The alignment of R.F. and mixer stages require the adjustment of trimmer capacitors to frequencies in the low, high, and center portions of the receiver range. The mixer and the oscillator must track over the desired range as the receiver is tuned.

The mixer and the oscillator trimmers are adjusted at the high frequency end of the tuning range and the oscillator padder is adjusted at the low. Set the F.M. receiver tuning control to 106 mc. Connect the R.F. generator to the antenna terminal. Set its frequency to 106 mc and AUDIO LEVEL to MOD OFF. Vary the oscillator trimmer until the signal is heard in the output circuit, or until the meter in the detection circuit indicates maximum deflection. Peak the mixer grid-circuit trimmer for maximum output. Tune the FM receiver to 90 mc, and tune the signal generator to 90 mc. Adjust the oscillator padder until the signal is maximum at the detector.

Check the response at 106 mc and readjust the oscillator trimmer, if necessary, to make the dial calibration of the receiver correspond to the frequency of the generator. Repeat these steps until both the low and the high frequencies are on calibration. Set the signal generator to a point midway in the frequency range, and check the calibration. When these steps have been carried out carefully, the calibration should be correct.

To align the R.F. stage, antenna noise or a weak external signal supplied by the leakage from the signal generator or any other source, such as a fluorescent lamp, electric shaver or a mixer will do for the first rough initial alignment. Peak the trimmer for maximum signal at the high end of the frequency range, and apply the noise generator technique at the highest frequency to obtain the maximum signal-to-noise ratio.

Perform the equivalent of plotting an S curve to check the alignment of ratio detector. Use the Analyst Signal Generator and VOM. Insert a 10.7 unmodulated signal into the receiver and connect the VOM across the output of the ratio detector. The VOM should read zero. Increase the signal generator frequency by rotating the FINE control on the R.F. TUNING control clockwise. Notice that the voltage reading increases with the increase of frequency. When the maximum voltage point is found, record the voltage and record the frequency indicated by the R.F. TUNING dial.

Return the R.F. TUNING control to the center frequency. From this null point, decrease the frequency and record the frequency at which the meter again indicates a maximum voltage reading. Record this voltage. The two voltage peaks should be equal in amplitude and occur at the same distance from the center frequency.

The bandwidth curve of the I.F. amplifiers can be found by the same method as was used to find the S curve of the ratio detector. Connect the VOM to the output of the last I.F. amplifier and insert a 10.7 unmodulated signal.

Observe that meter is reading at a null point. Increase the frequency of the R.F. TUNING control slowly and notice that the meter indication increases slightly and then drops off sharply. This is the upper limit of the bandwidth. Record the voltage and frequency at which the peak was reached and also record the frequency at which the voltage dropped suddenly. The lower limit is found in the same way except that the frequency of the RF TUNING control is decreased slowly. The sum of these two frequency deviations is the I.F. bandwidth.

SERVICE INFORMATION

The analyst schematic will aid you in trouble shooting the Radio Analyst. The instrument contains a 3 amp line fuse and a 5 amp power supply fuse, which are located on the rear apron of the chassis. Replacement must be made with identical types in order to retain protection of the circuits components.

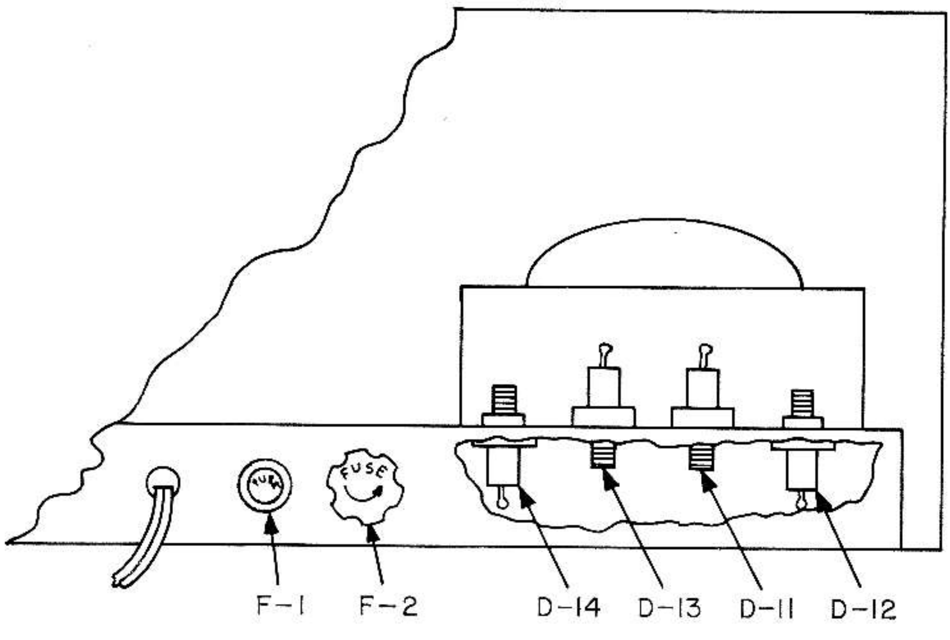

Fig. 10—Rear View of Chassis Apron Showing Two Fuses and 4 Diodes.

Transistors are located above the chassis and are accessible when the chassis is removed from the cabinet. The power transistor is mounted on the chassis. The other transistors are mounted on the printed circuit board above the BAND SELECTOR rotary switch.

To remove the chassis from the cabinet, remove the four screws on the bottom of the cabinet next to the rubber feet and slide chassis forward and out of cabinet.

If R.F. alignment of the ANALYST is needed an AM radio receiver may be used as follows:

1. Turn AUDIO LEVEL knob to MOD OFF (maximum counterclockwise rotation through the click).

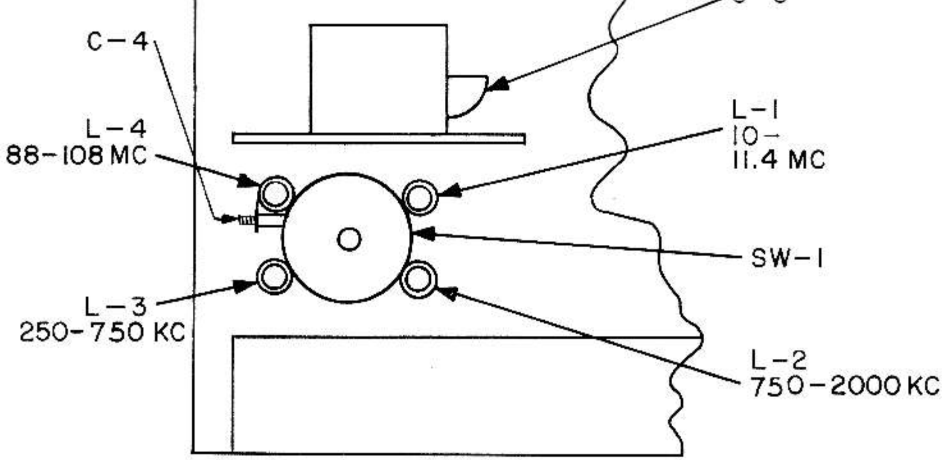

Fig. 11—Slug Tuned Coils, C4, Wafer Switch and Outline of Tuning Capacitor.

2. Place the R.F. OUT probe of the Analyst close to the antenna terminal of the receiver.

3. Switch the R.F. BAND SELECTOR switch to Band B 750-2000 KC.

4. Tune the receiver to a station around 850 kc.

5. Starting at 800 kc rotate the R.F. TUNING control until the signal from the Analyst zero beats with the station. If the reading on Band B is not the same frequency as the station, set the R.F. TUNING knob to the frequency of the station. If the R.F. TUNING knob originally read higher than the station frequency (when zero beat was heard) the iron core of coil L-2 should be rotated out of the coil slightly until another zero beat is heard. If the tuning knob originally read lower than the station frequency, the iron core should be rotated clockwise into the coil. Use a non-metallic hex head alignment wrench.

6. Tune the receiver to a station around 1500 kc. Set the R.F. TUNING knob to the same frequency as the station. Adjust the trimmer on the small variable capacitor for a zero beat.

7. Repeat steps 4 through 6 until no further adjustment is needed.

When Band A alignment is necessary proceed as follows:

1. Repeat Steps 1, 2, 3 and 4 of R.F. alignment except that the R.F. BAND SELECTOR switch is switched to Band A 250-750 KC and a station tuned between 700 kc and 750 kc.

2. Adjust the RF TUNING knob to the same frequency as the station.

3. Adjust the front trimmer (on the variable capacitor closest to the panel) for a zero beat.

4. Without changing the tuning of the radio receiver, rotate the RF TUNING knob to ½ the frequency of the station. Adjust the powdered iron core on coil L-3 until a zero beat is heard.

5. Repeat steps 2 through 4 until no further adjustment is needed.

For Band C and D, an FM radio receiver may be used as follows:

1. Repeat Steps 1, 2, 3 and 4 of R.F. alignment, except that the BAND SELECTOR is switched to Band D 88-108 MC and a station selected between 98-108 mc.

2. Adjust R.F. TUNING knob to the same frequency as the station.

3. Adjust trimmer capacitor C4 (mounted on coil L4) for a zero beat.

4. Without changing the tuning of the radio receiver, rotate the R.F. TUNING knob to ½ the frequency of the station. Adjust the brass slug in coil L-4 until a zero beat is heard on the receiver.

5. Repeat steps 2 through 4 until no further adjustment is needed.

When Band C alignment is necessary, proceed as follows:

1. Repeat steps 1, 2 and 3 of R.F. alignment except that the R.F. BAND SELECTOR is switched to Band C 10.7 MC FM.

2. Select an FM station in the 100 to 108 MC range and set the R.F. TUNING control to one-tenth of the frequency of the radio station. For example, if the station selected is 107 MC set the R.F. TUNING control to 10.7 mc on the dial. Adjust powder iron core in L-1 until a zero beat is heard in the receiver.

WARRANTY SERVICE INSTRUCTIONS

1. Refer to the maintenance section of the instruction manual for adjustments that may be applicable.
2. Check common electronic parts such as tubes, transistors, and batteries. Always check instruction manual for applicable adjustments after such replacement.
3. Defective parts removed from units which are within the warranty period should be sent to the factory prepaid with model and serial number of instrument from which removed and date of instrument purchase. These parts will be exchanged at no charge.
4. If the above mentioned procedures do not correct the difficulty, pack the instrument securely (preferably double packed). A detailed list of troubles encountered must be enclosed as well as your name and address. Forward prepaid (express preferred) to the nearest B & K authorized service agency.

Contact your local B & K Distributor for the name and location of your nearest service agency, or write to

Service Department

B & K MANUFACTURING COMPANY

DIVISION OF DYNASCAN CORPORATION

1801 W. Belle Plaine

Chicago, Ill. 60613

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"B & K warrants that each product manufactured by it will be free from defects in material and workmanship under normal usage and service for a period of ninety days after its purchase new from an authorized B & K distributor. Our obligation under this warranty is limited to repairing, or replacing any product or component which we are satisfied does not conform with the foregoing warranty and which is returned to our factory or our authorized service contractor, transportation prepaid, and we shall not otherwise be liable for any damages, consequential or otherwise. *The foregoing warranty is exclusive and in lieu of all other warranties (including any warranty of merchantability), whether express or implied.* Such warranty shall not apply to any product or component (i) repaired or altered by anyone other than B & K or its authorized service contractor (except normal tube replacement) without B & K's prior written approval; (ii) tampered with or altered in any way or subjected to misuse, negligence or accident; (iii) which has the serial number altered, defaced or removed; or (iv) which has been improperly connected, installed or adjusted otherwise than in accordance with B & K's instructions. B & K reserves the right to discontinue any model at any time or change specifications or design without notice and without incurring any obligation. *The warranty shall be void and there shall be no warranty of any product or component if a B & K warranty registration card is not properly completed and postmarked to the B & K factory within five days after the purchase of the product new from an authorized B & K distributor.*"

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