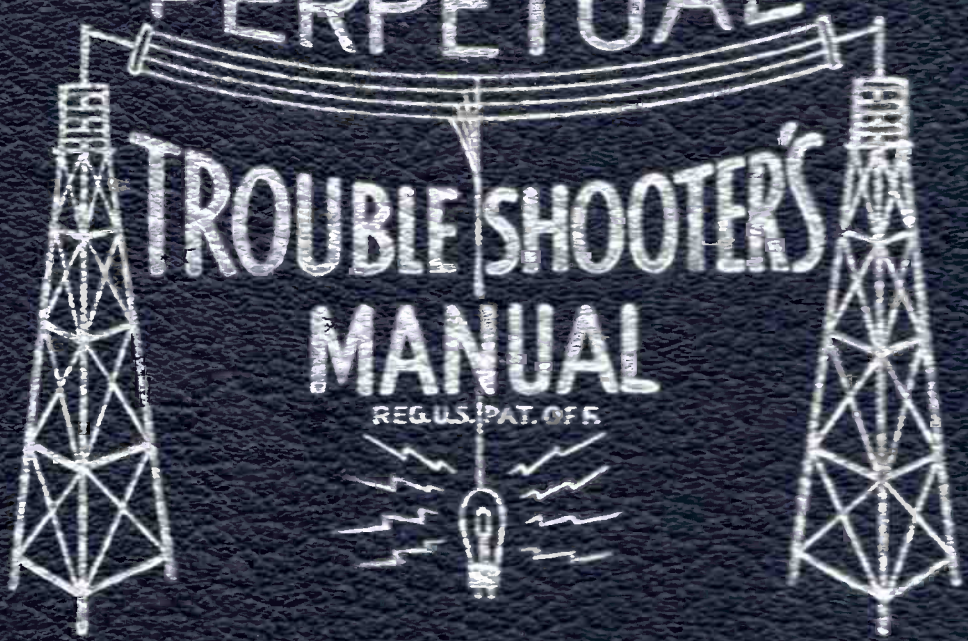
VOLUME XV

PERPETUAL TROUBLE SHOOTER'S MANUAL

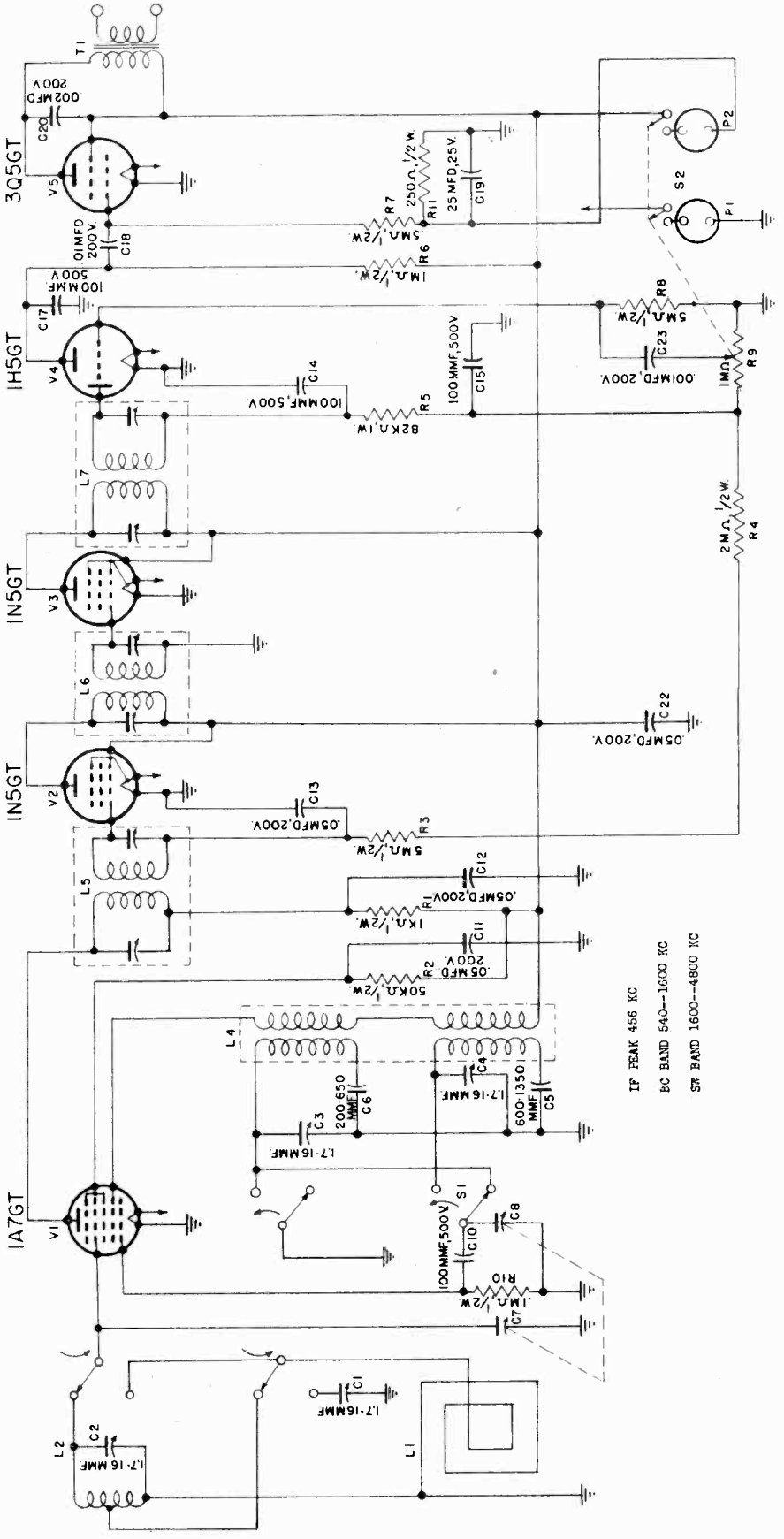
REG. U.S. PAT. OFF.



JOHN F. RIDER

JEFFERSON-TRAVIS CORP.

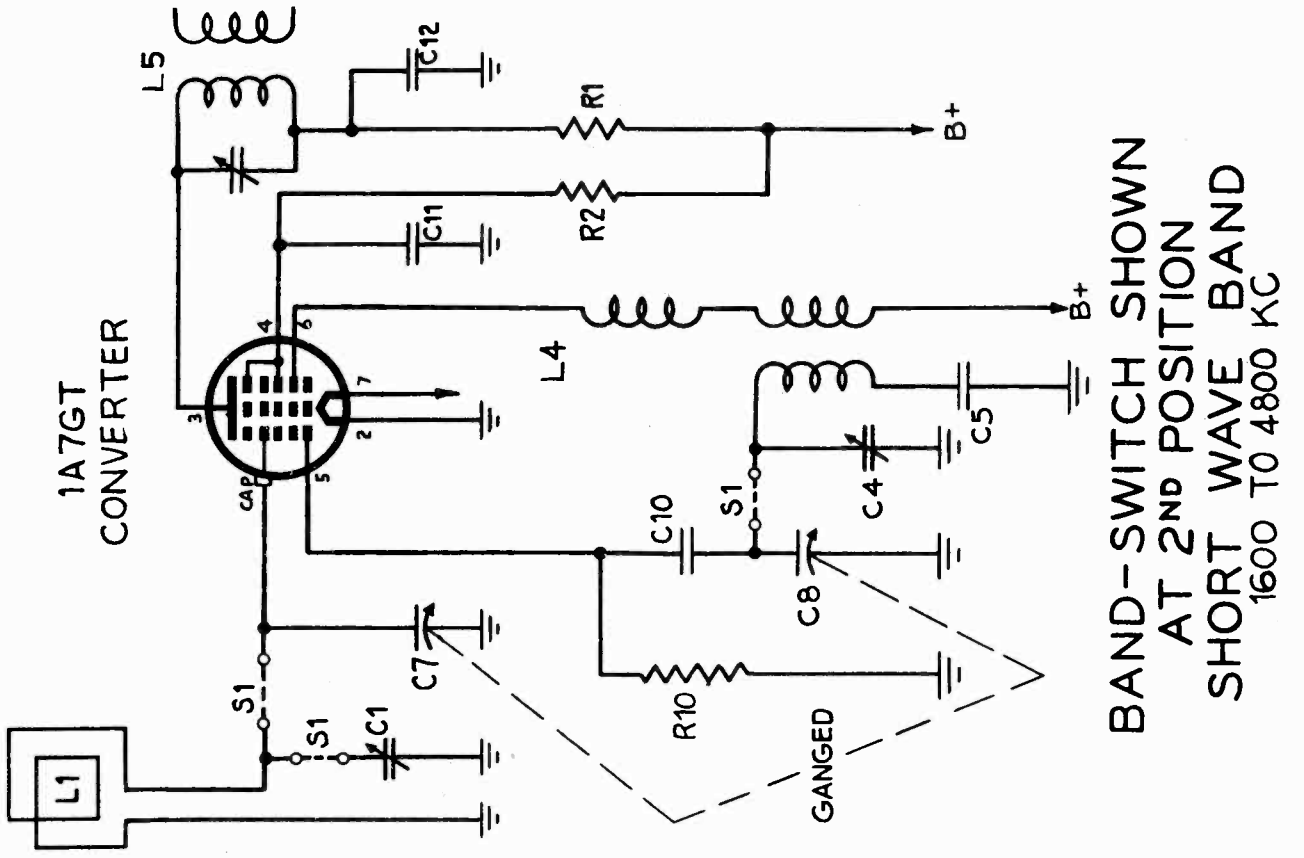
MODEL MR2B

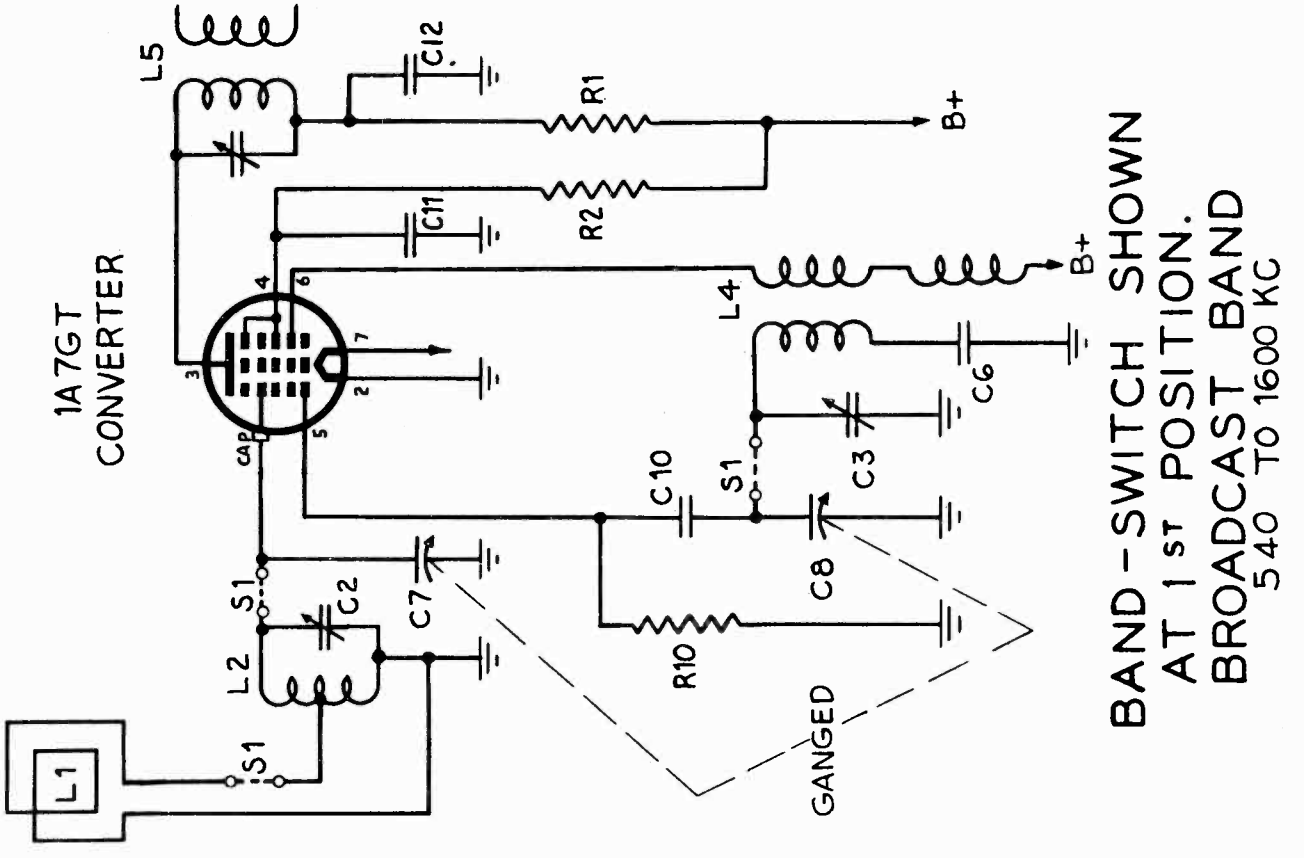


"clarified schematics"

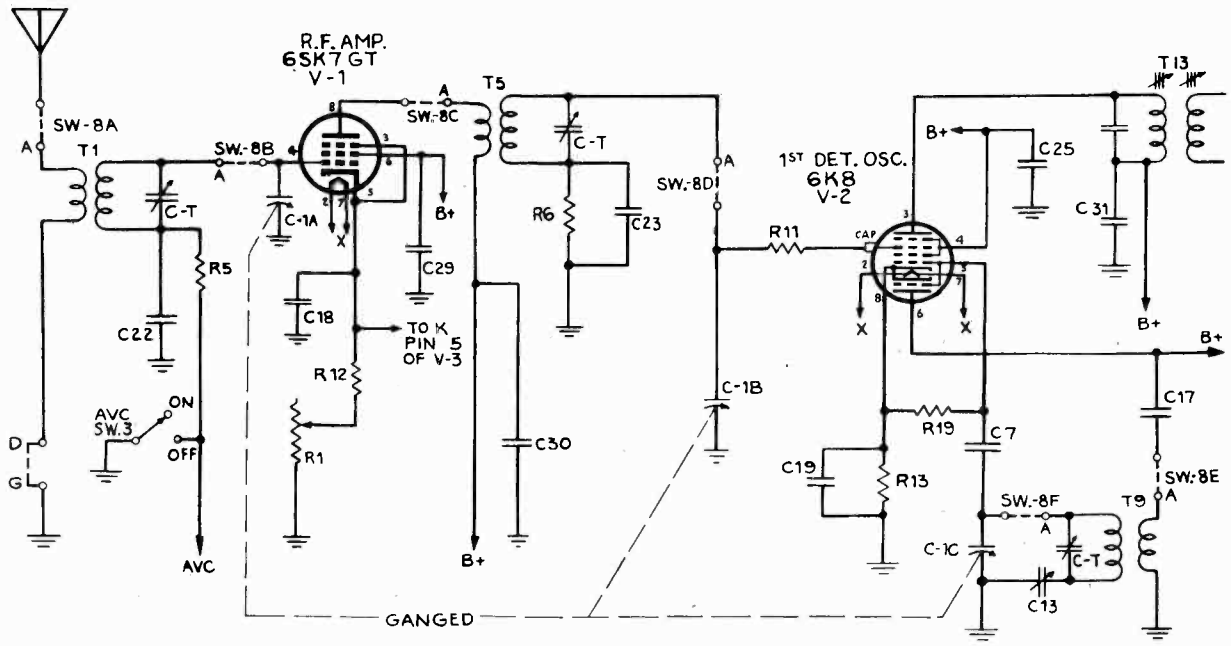
MODEL MR2B

JEFFERSON-TRAVIS CORP.

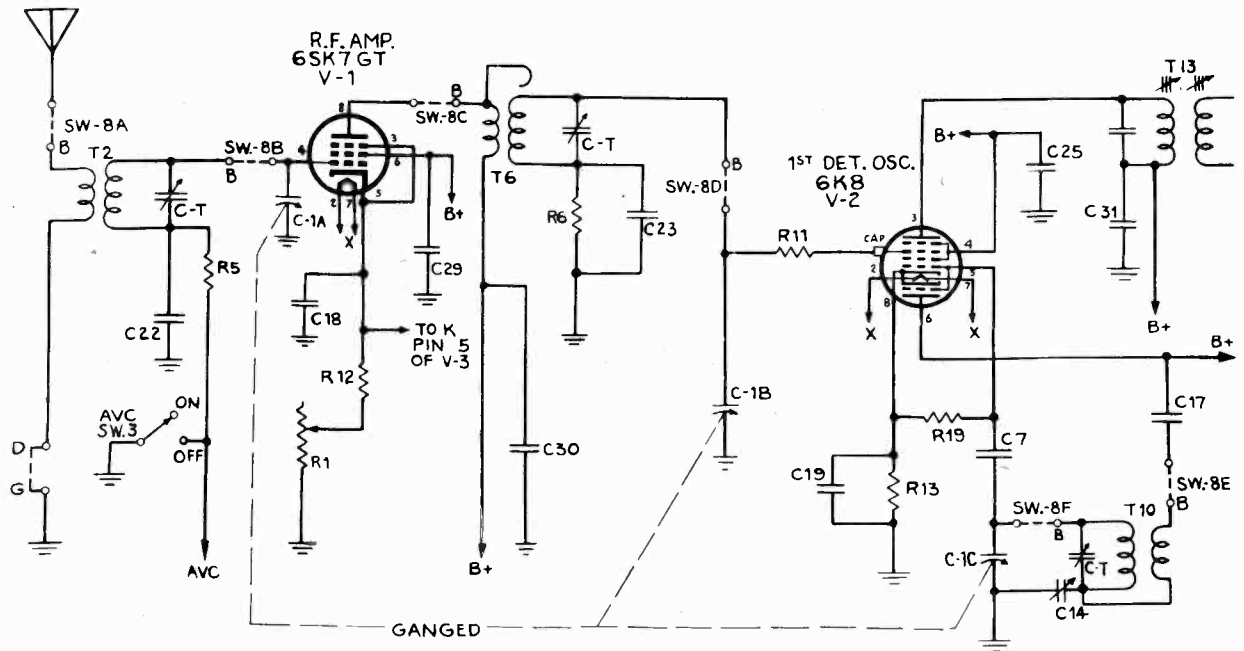




KAAR ENGINEERING CO.



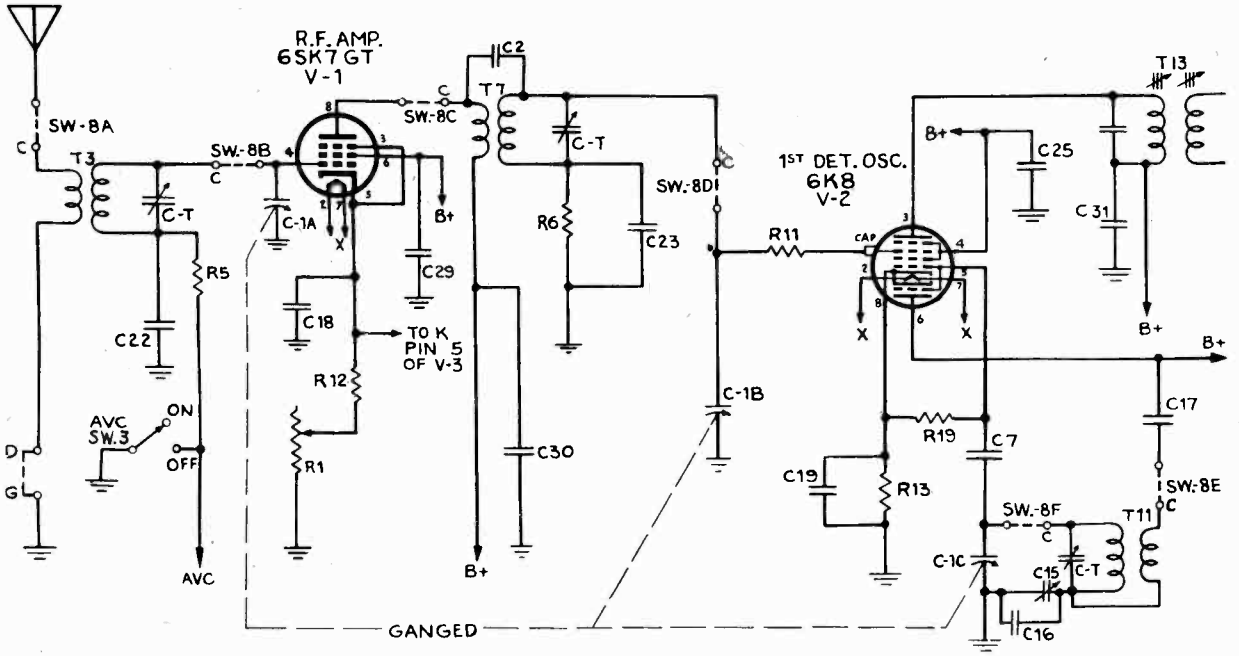
BAND-SWITCH SHOWN
AT 1ST POSITION.
BROADCAST BAND A
500 TO 1600 KC.



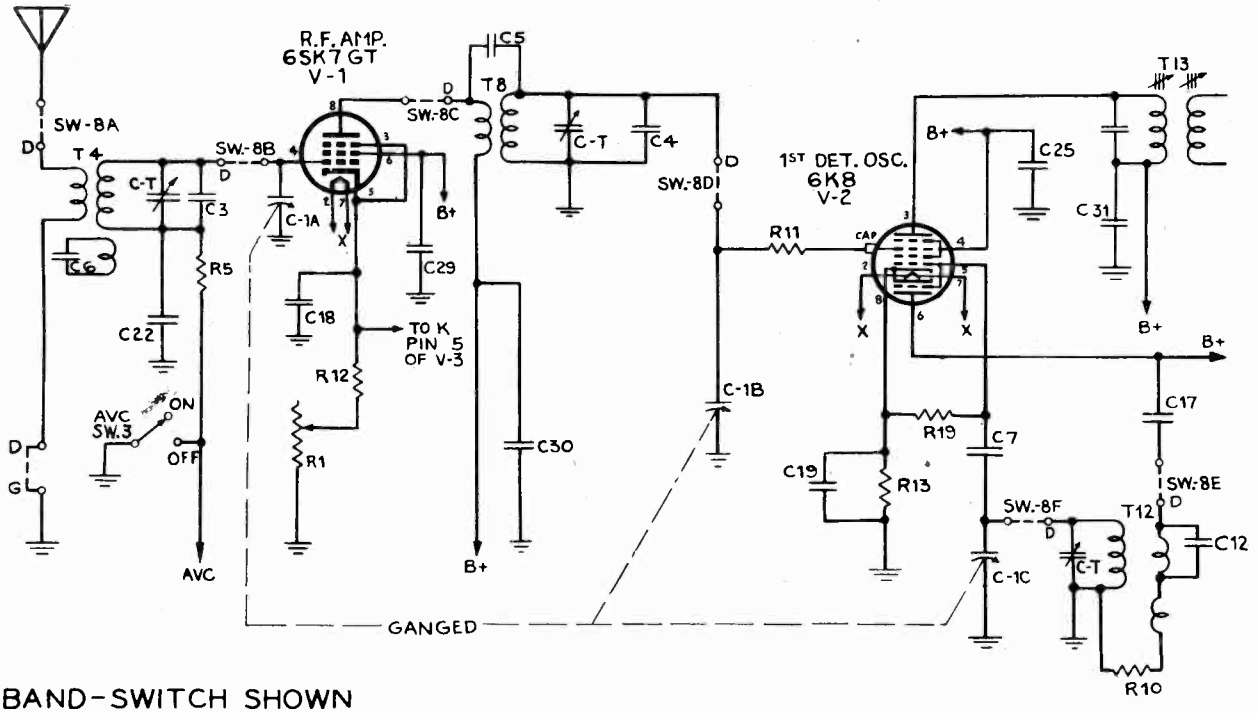
BAND-SWITCH SHOWN
AT 2ND POSITION
BAND B
1600 - 5000 KC.

MODEL KE-23AT

KAAR ENGINEERING CO.



BAND-SWITCH SHOWN
AT 3RD POSITION
BAND C
5-16 MC.



BAND-SWITCH SHOWN
AT 4TH POSITION
BAND D
16-42 MC.

1. DESCRIPTION

.1 GENERAL: The Kaar Engineering Company Model KE-23AT is a nine-tube general purpose communications receiver covering a frequency range from 500 KC to 42 MC, the most commonly used radio communications bands. This receiver provides a high degree of selectivity and sensitivity which should provide reception under the most difficult conditions.

1.2 POWER SUPPLY: The KE-23AT receiver is designed for operation from AC power from its built-in AC power supply An auxiliary 24" power cable terminating in a miniature 5 prong plug provides operation from a 6 volt battery through an external power pack.

1.21 The built-in power supply provides operation from 40 - 60 cycle AC power at 100, 120, 150, 210 and 230 volts. A switch is provided for selecting any one of these voltages as necessary. The receiver will also operate satisfactorily under substantial overvoltage or undervoltage conditions, and satisfactory operation can be expected on any voltage between 90 and 250 volts.

1.22 Operation from a 6 volt battery is provided by removing the power plug from its socket and inserting it into an external power supply capable of furnishing 460 volts at 65 MA and 6 V. DC for the heaters. By making a minor circuit change underneath the chassis, the high voltage power requirement can be reduced to 230 - 250 volts at 65 MA.

1.3 SPEAKER: The 8" PM model 23ST loud speaker as furnished with this receiver is recommended for general use. Much larger speakers to provide better tone quality or very small speakers for monitoring purposes may be used satisfactorily. A 4 ohm output is provided for direct loud speaker operation. 500 ohms is also provided for feeding the output into a 500 ohm line.

1.4 DIMENSIONS: The KE-23AT receiver is mounted on a 8 3/4" x 19", 16 gage steel panel of relay rack mounting dimensions. It is housed in an 18 gage steel cabinet, with hinged lid in the top, 19" long, 9" high and 11" deep.

The model 23ST speaker cabinet is 9" high (excluding handle), 10" wide and 6" deep.

Both the receiver and speaker are finished in gray, baked enamel wrinkle with black trim and knobs.

1.5 FREQUENCY COVERAGES: The tuning range of the receiver is covered in four bands:

Band A	500 KC to 1600 KC
Band B	1600 KC to 5000 KC
Band C	5 MC to 16 MC
Band D	16 MC to 42 MC

The frequencies are calibrated directly on the main dial. The VERNIER dial in the center provides a means for fine tuning adjustments and accurate logging. One complete rotation of this dial covers one division on the 0 - 50 logging scale on the main dial. The tuning ratio is approximately 100 to 1.

1.6 TUBE COMPLEMENTS:

V-1	6SK7GT	Tuned R.F. Amplifier.	
V-2	6K8	First Det. Osc.	
V-3	6SK7GT	455 KC I.F. Amplifier	
V-4	6H6	Automatic Noise Limiter.	
V-5	6SQ7GT	Second Det. and Squelch Control.	
V-6	6SQ7GT	First Audio Amplifier.	
V-7	6SK7GT	Beat Frequency Oscillator.	
V-8	6V6GT	Power Output Tube.	
V-9	5Y3GT	Rectifier.	

Glass "GT" tubes or even "G" tubes can be used if the metal tubes indicated above are not available. Metal tubes can be substituted in all cases where glass tubes are indicated. However, if such substitutions are made for V-1, V-2 or V-3, it is quite probable that the receiver would have to be re-aligned, particularly on the higher frequency bands.

.7 CIRCUIT:

1.71 The circuit is a standard superhetrodyne with a high degree of stability Permeability tuned intermediate frequency transformers and ceramic trimming condensers across the R.F. coils are incorporated to assure permanancy of adjustment.

1.72 A special feature of the KE-23AT is the NO-SIGNAL SQUELCH CIRCUIT. This SQUELCH (or "Q") CIRCUIT may be used in two-way communication work where "standby" operation is desirable and where the background noise with the station off would be objectionable. The SQUELCH CIRCUIT automatically silences the receiver except when a station is actually being received. This feature can also be used as a between-station quieting device preventing the roar of static between stations when tuning from one to another.

1.73 There is also provided an AUTOMATIC NOISE SILENCER which limits the noise produced by gasoline engine ignition systems or other electrical equipment, including ordinary static, that may exceed the level of the signal being received.

1.74 A BEAT FREQUENCY OSCILLATOR is provided for receiving CW (code) signals.

1.8 PERFORMANCE: For a receiver built as simply as the KE-23AT with as few tubes and component parts, the general performance is excellent.

1.81 SENSITIVITY: When measured with a standard dummy antenna input, the sensitivity of the receiver will be approximately between 1 and 5 microvolts over the range 500 KC to 16 MC, and between 3 and 15 microvolts in the 16 to 42 MC range.

1.82 SELECTIVITY: The average selectivity is approximately as follows:

Ratio: Input Voltage off Resonance to Voltage at Resonance	Kilocycles off Resonance
10 (20 DB)	7 KC
100 (40 DB)	14 KC
1000 (60 DB)	25 KC

1.83 AUDIO RESPONSE: The audio frequency response is essentially flat between 100 and 3500 cycles. The power output is approximately 2 watts with a total harmonic distortion of not over 10%.

2. INSTALLATION

2.1 A radio receiver is only as good as its installation. Reception obviously will not be as good with a poor, fluctuating or noisy power source; or a make-shift antenna; as it would be under proper conditions. Generally speaking the KE-23AT receiver should be installed according to good and acceptable practice. A filter is provided in the AC line to help minimize noise from that source. The automatic noise limiter will help reduce noise entering by way of the antenna. Two voltage regulating neon lamps are in the oscillator voltage supply circuit to minimize the effect of voltage fluctuations. The receiver has been moisture-proofed and the parts on the under side of the chassis have been sprayed with fungus resisting lacquer as an aid to operation in damp and humid climates.

2.2 ANTENNA AND GROUND: The importance of a good antenna cannot be over stressed. It is essential for satisfactory reception of weak signals.

2.21 The antenna input circuit of the KE-23AT provides for the use of a Marconi or doublet antenna. The Marconi type is usually recommended for ordinary reception and should prove satisfactory in most instances. It consists of an ordinary antenna wire of approximately #12 or 14 B&S gage strung between insulators as high as possible. The over-all length is not critical and may be some 50 to 100 feet long including the lead-in to the set. When using this type of antenna, the terminals on the rear of the set, "E" and "G", must be connected together and the antenna lead-in connected to "A".

2.22 The receiver will usually work fairly satisfactorily without a ground connection but a good ground connection is to be highly recommended. In many instances it will increase the signal strength and reduce noise. A six-foot rod driven in moist earth will make a satisfactory ground, or as an alternate, a cold water pipe. The lead-in from the ground should be of heavy wire, at least #12 or 14, and should be connected to "G" at the rear of the receiver.

2.23 Under special conditions when a doublet antenna may be used, the 400 ohm transmission line will then be connected between "A" and "D" with the ground connected to "G". In this case "D" and "G" are not connected together. The doublet antenna performs excellently in a direction at right angles to its length but only on the rather narrow group of frequencies for which it was designed.

2.3 SETTING UP THE RECEIVER FOR AC OPERATION:

2.31 Unpack the KE-23AT receiver and loud speaker from the shipping case and examine for possible damage. There are no loose accessories other than the instruction book.

2.32 Make sure that the tubes are firmly seated in their sockets and the grid cap is in place on the 6K8 tube.

2.33 Make sure that the power plug, P-3, on the end of the 24" power cable is firmly inserted in the power socket, P-2, at the rear of the chassis for AC operation.

2.34 Attach the 23ST speaker to the two terminals marked "4-8Ω" at the rear of the receiver.

Ordinarily the loud speaker will be placed at the side of the receiver. It is not desirable to place it on top of the cabinet since vibration from it might possibly introduce microphonic noises which would not otherwise be noticeable.

2.35 Connect the antenna lead-in or antenna transmission line in accordance with instructions in Paragraph 2.2.

2.36 Determine the voltage of the AC source which is to operate the receiver by measurement with a voltmeter. Then set the voltage selector switch, SW-14, to the nearest voltage indicated. This switch is located just behind the tuning meter, M-1. It will be necessary to loosen the set screw with a small screw driver in order to turn the switch.

CAUTION: Never turn the voltage selector switch with the receiver turned "ON". An accidental wrong setting may damage the receiver and accidental contact with the terminals at the rear of the tuning meter may cause shock.

If no voltmeter is available to test the line voltage, in cases of emergency the voltage selector switch can be turned first to the 230 volt position, the brilliancy of the pilot lamps observed, and then the switch tried in the consecutively lower positions until the brilliancy of the pilot lamps appears to be about normal. Care should be exercised in operating the receiver with this estimated setting, and at the first opportunity it should be checked with a voltmeter. Also, at the correct setting when the receiver is turned off and then on again, the two neon lamps located just in front of the 6K8, V-2, should ignite.

2.4 BATTERY OPERATION: The KE-23AT may be operated from a 6 volt storage battery with a proper vibrator power supply. It can be operated from other battery sources if the proper voltages are applied to the correct prongs of the power plug, P-3.

To set up and operate the receiver from the vibrator power supply, proceed as follows:

2.41 Proceed as directed in Paragraphs 2.31 - 2.35. Be sure the AC line cord is not plugged into an AC outlet, (in case AC power should accidentally be applied).

2.42 Remove the power plug, P-3, in the end of the 24" power cable from the power socket, P-2, at the rear of the chassis. If operation is to be from a type of vibrator power supply furnishing approximately 460 volts at 65 MA from the same type of 5 prong power socket with the correct connections, simply plug P-3 into the socket.

Although the high voltage required for the receiver is only 250 volts, a dropping resistor, R-35 (3500 ohms, 25 watts), is installed in the receiver in order to drop the 460 volts to the correct value.

2.43 If operation is to be from other power supplies, make sure that the proper voltages are applied to the proper pins on P-3 as shown in the schematic diagram. The easiest way to do this is to connect the output terminals or leads from the power supply unit used to a 5 prong female cable socket such as an Amphenol Type MPF5L. If the output is approximately 240 - 250 volts at 65 MA, such as would be obtained from the Kaar Type 647X Vibrator Power Supply, then the resistor, R-35, should be shorted out by soldering a piece of wire around its terminals. (This resistor is located under the chassis at the rear near the fuse extractor post.) For power supplies furnishing voltages between 250 and 460 volts, a 10 watt resistor of the proper resistance value as calculated, or determined by experiment, may be connected across the terminals of R-35. The correct value should provide approximately 250 volts at the low potential end of the resistor when the receiver is operating.

2.44 Connect the heavy battery leads from the power supply to the 6 volt battery, the RED lead to the positive (+) and the BLACK lead to the negative (-) terminal.

2.45 When operating from a battery power source, the operation of the receiver is the same as before except that the switch, S-1, on the Volume Control does not now turn the receiver off and on. To turn the receiver off, it will be necessary to remove one of the battery leads from the storage battery. A special high current, low resistance switch may be installed in one of the battery leads if desired.

2.5 BREAK-IN CONNECTION: The KE-23AT may be used with a transmitter to form a two-way radio communication system. When the transmitter has break-in facilities, it is only necessary to run wires to the two BREAK-IN terminals on the rear of the chassis. When the STANDBY-RECEIVE switch is in the "STANDBY" position, every time the transmitter is turned off the receiver will automatically be turned on, and the receiver will be silenced while transmitting. This system will only work when the receiver is operated from its internal AC power supply. When operating from batteries with an external power supply, these BREAK-IN CONNECTIONS can not be used, and if break-in operation is desired, it will be necessary to provide for breaking the high voltage supply lead by other means, such as by a special relay operated by the transmitter.

3. OPERATING INSTRUCTIONS

3.1 The various controls for operating the KE-23AT receiver are located across the bottom of the panel and are appropriately marked. The main tuning knob is located in the center of the panel just underneath the Vernier dial. To put the KE-23AT receiver into operation, proceed as follows.

3.11 Plug the line cord into a source of AC power as outlined in Paragraph 2.3 or connect for battery operation with an external power supply as per Paragraph 2.4.

3.12 If operating from an AC source, the receiver is turned on by rotating the VOLUME control from its "OFF" position to the right. A click will be felt and heard. As the switch connected to this control closes, the dials should light up. It will take 30 seconds or so for the tubes to heat up. If operating from a 6 volt storage battery, the receiver is turned off and on by disconnecting one of the battery leads as described in Paragraph 2.45.

3.13 Set the SELECTOR switch on position "A" for receiving broadcast stations, as they are usually the easiest to receive initially and will enable one to become accustomed to the operation of the set. In remote locations it may be that there are no near-by stations on Band A, in which case the SELECTOR switch should be set on position "C" and short wave broadcast stations tuned in instead.

3.14 The R.F. GAIN control should be turned completely to the right (clockwise) as far as it will go to position "10".

3.15 The SQUELCH control should be turned off by rotating it as far as it will go to the right (clockwise) until the switch snaps in the "OFF" position.

3.16 The AUTOMATIC NOISE LIMITER, A.N.L., and BEAT FREQUENCY OSCILLATOR, B.F.O. should be "OFF"; and the AUTOMATIC VOLUME CONTROL, A.V.C., switch "ON". Put the STANDBY-RECEIVE switch in the "RECEIVE" position.

3.17 Advance the VOLUME control to the right to a point where background noise is heard. In quiet locations it may be desirable to turn the VOLUME control full on, and when a station is turned to too loudly, reduce it to the desired volume level.

3.18 Rotate the main tuning knob until a fairly strong station is heard. The operator should then familiarize himself with the operation of each of the various controls in turn. Tune for maximum reading on Tuning Meter.

3.2 The function of each of the controls is herewith explained.

3.21 R.F. GAIN CONTROL: This control adjusts the sensitivity of the receiver and is used when the signal strength of a powerful nearby station is too great and reception is distorted. Normally, however, with the AUTOMATIC VOLUME CONTROL (A.V.C.) "ON", there will be very little use for this control when receiving voice and it is usually left turned completely to the right to position "10". The A.V.C. switch should be turned "OFF" when listening to code with the BEAT FREQUENCY OSCILLATOR (B.F.O.) "ON". With the A.V.C. "OFF", even medium powerful stations will overload the receiver and it will be necessary to reduce the sensitivity with the R.F. GAIN CONTROL for best results. The Tuning Meter operates only when the A.V.C. is turned on.

3.22 SELECTOR SWITCH: The SELECTOR switch, or "BAND CHANGE" switch as it is sometimes called, allows selection of the various frequency ranges, "A", "B" "C" or "D", as desired. Simply turn the pointer knob to the desired range.

3.23 SQUELCH CONTROL: The SQUELCH CONTROL (or "C" control) can be used to silence the receiver except when a signal is actually being received. Its use is particularly adapted to two-way communication work where the KE-23AT may be standing by and where a considerable amount of background noise would be present when no station is being received. The squelch circuit allows the receiver to be actually inoperative until the station to which it is tuned comes on the air, when it is automatically turned on. By adjusting the SQUELCH knob, the receiver can be made to operate only on signals of a definite minimum volume. As the control is turned to the left (counter-clockwise) it takes a stronger and stronger signal to trip the squelch circuit. For instance, in position "8" a reasonably strong signal will operate the receiver, while in position "2" it would take a powerful transmitter located just a few blocks away to operate it and any weaker station on the same frequency would not then come in.

To properly set the SQUELCH for a given condition, tune in the station it is desired to receive in the ordinary manner while it is transmitting. Then when it goes off the air, turn the SQUELCH control knob to the left until the background and static noises just disappear. Then check and see if, when the transmitter again comes on the air, it can be heard.

Another way would be to turn the control knob to the left when the transmitter is on the air until it just disappears; then advance the knob slightly to the right until the station just sounds normal, but no further. This latter method is satisfactory for close-by stations, but for more distant stations which are subject to fading, it is possible that at some other time of day the signal would become weaker than it was when the control was set and then might not trip the SQUELCH circuit.

To use the SQUELCH control for a between-station quieting device, it is only necessary to set the knob at the position where average static noise just disappears when not tuned to a station. Then, when the set is tuned across the dial, only the stations stronger than the static noises will come in. This use of the control does not work too satisfactorily on the short wave bands, as the short wave stations are usually subject to so much fading that it is possible to tune right by them as they are fading and consequently miss them altogether.

3.24 VOLUME CONTROL: The main receiver "On-Off" switch is combined with the VOLUME control. To turn the receiver "On", turn the control to the right, and to turn it "Off", turn it to the left until the switch clicks and the dial lights go out. The VOLUME control is used to adjust the volume level of the received signals. When operating the receiver with the A.V.C. "OFF", best results will be obtained by advancing the VOLUME control a little further than normal and then reducing the volume to the desired level by turning the R.F. GAIN control to the left.

3.25 TONE CONTROL: The TONE control serves to reduce the intensity of the higher audio-frequencies which some listeners find desirable in assisting to reduce static or to make the tone quality "bassy". In the "HIGH" position, the receiver operates normally as there is no attenuation of the high frequencies and music, and especially voice, will be most natural. For the greatest

intelligibility of the speaking voice, this control should always be in the "HIGH" position. When in the "LOW" position, most of the treble tones are lost. Since electrical and atmospheric noises are more or less of a high pitch, there will be a marked reduction in background noise when the TONE control is in the "LOW" position, but often this advantage is lost as the excessive "drummy" or "boomy" tone of the voice is not clear and crisp. The center point provides a position half way between the high and low settings.

3.26 PITCH CONTROL AND BEAT FREQUENCY OSCILLATOR: The BEAT FREQUENCY OSCILLATOR (B.F.O.) is turned on by snapping the "B.F.O." switch to "ON". The Beat Frequency Oscillator is a miniature radio transmitter built into the receiver for producing a signal which will "beat" with the received carrier to create an audible tone or whistle. CW (code) signals are produced by virtually turning a transmitter off and on to make the dots and dashes. If it were not for the Beat Frequency Oscillator, nothing could be heard but some thumping sounds as the transmitter went off and on. By beating this oscillator with the transmitter, a tone is produced which can be read as code. The pitch of the beat note should be adjusted by the PITCH CONTROL Ordinarily the receiver is properly tuned when, with the PITCH CONTROL in the center "O" position, the tone is so low that it is inaudible. Then the control may be turned to the right or left until a tone of the desired pitch results. The pitch selected will depend upon the listener's preference, the background noises present, etc.

When listening to code signals with the B.F.O. on, the A.V.C. switch should be "OFF" and the volume controlled by turning the R.F. GAIN control to the left. The regular volume control can be left set at a comfortable listening level.

3.27 AUTOMATIC NOISE LIMITER: The AUTOMATIC NOISE LIMITER (A.N.L.) is a device for short-circuiting noises and interference which are stronger than the signal being received. It works best on noises of short duration such as spark discharge noises and the like. It is operative when the A.N.L. switch is "ON". Since the device removes a portion of the sounds coming through the receiver, there will be a certain amount of distortion, which is of much less consequence than heavy background noise when receiving a weak signal. However, when listening to stronger stations not requiring this feature, the A.N.L. should be turned "OFF" as the speech and music will then tend to be clearer.

3.28 STANDBY-RECEIVE SWITCH: Located at the center of the designation plate is the STANDBY-RECEIVE switch. This switch must always be in the "RECEIVE" position in order for the receiver to operate. When the receiver is used in conjunction with a transmitter, it is desirable to turn the receiver off while transmitting, leaving the tubes still lit in order that it can be instantly turned on without the usual delay in waiting for the tubes to warm up. This switch is used for that purpose.

At the rear of the receiver is a BREAK-IN connection which parallels this front panel switch. In using a transmitter with break-in facilities, it is only necessary to run wires from these two BREAK-IN terminals to the proper terminals on the transmitter. Then the STANDBY-RECEIVE switch should be left in the "STANDBY" position, and every time the transmitter is turned off the receiver will automatically be turned on. Complete Two-Way Radiotelephone communication can be carried on in this fashion very easily.

3.29 PHONES: A phone jack is located on the front panel for using headphones when desired. Ordinary high impedance crystal or magnetic phones can be used.

3.210 OUTPUT TERMINALS: There are two output circuits in the KE-23AT receiver, 4 Ohms and 500 Ohms. When using the Model 23ST speaker, connections should be made to the "4 Ω" terminals. For 500 Ohm output, connections should be made to the "500 Ω" terminals.

4. MAINTENANCE

4.1 The parts used in the KE-23AT Receiver are of more than adequate rating and the maintenance required ordinarily will be limited to the occasional checking of the tubes.

4.2 If the receiver is used in extremely dirty and dusty locations, it will be advisable to blow out the dust, preferably with compressed air, every few weeks. If compressed air is not available, a soft paint brush may be used although care should be exercised in dusting around the various adjusting screws in order that their settings will not be altered.

4.3 It may be desirable every few months to oil the gear train mechanism. A drop of light machine oil on the end of a tooth pick may be applied to the various bearings.

CAUTION: Do not use too much oil. One small drop only should be applied at each point.

It also may be desirable to apply vaseline or other light grease to the gears themselves. However, in very dirty locations this may not be desirable as the grease would collect abrasive dust and cause premature wear.

4.4 Should the failure of some part occur, regular servicing technique by one familiar with this work is suggested. If parts replacement be required, standard parts of any reputable manufacturer, of the same value and voltage rating as the originals, may be used without adversely affecting the performance of the equipment.

5. ALIGNMENT PROCEDURE

5.1 GENERAL: Due to continual temperature changes, ageing of the parts and tubes, etc., it may be necessary to align the KE-23AT from time to time. Even under severe operating conditions this should seldom be necessary more than once a year. It is suggested that only someone entirely familiar with the theory of alignment of superhetrodyne receivers be permitted to make these adjustments.

Ordinarily the alignment will need only to be "touched up", and no more than a very small fraction of a turn of any of the adjusting screws should be required. This procedure is not particularly difficult. However, if certain coils and condensers are replaced, or through tampering the receiver should get badly out of alignment, trouble may be experienced in getting it correctly aligned again unless one is very thoroughly familiar with the correct procedure, as a number of apparent settings, images and the like may prove to be confusing, particularly on the higher frequency bands "C" and "D".

NOTE: Since individual receivers may vary slightly one from the other, the dial calibration may not be exact in all cases, and alignment should not be attempted merely for making the dial calibration exact as performance may be sacrificed. Under no conditions bend the plates of the tuning condenser C-1.

To properly align the KE-23AT Receiver, certain apparatus will be required.

A very accurately calibrated source of RF signals is necessary. This may be an ordinary Test Oscillator for aligning the I.F. Amplifier, provided that 455 KC has been accurately calibrated by recent comparison with a secondary frequency standard. For properly aligning the R.F. section on the various bands, a regular laboratory type Standard Signal Generator is recommended. The frequencies that will be required will be: 455, 550, 1,400, 1,800 and 4,400 KC; and 5.5, 14, 16 and 38 MC. It is also desirable, but not essential, to have a series of frequencies lying near the mid-point of each band, such as 900 and 3,000 KC and 9 and 25 MC. It is also desirable to have provision for modulating the signal with a 400 or 1,000 cycle tone.

In order to visually observe the correct alignment, an Electronic Voltmeter or a regular rectifier type AC Voltmeter is used. If neither of these is available, then the regular tuning meter, M-1, may be used, but the small scale will make accurate adjustment difficult.

If the Electronic Voltmeter is used, connect the positive (+) lead to the chassis and insert the negative (-) lead-prong in the "ALIGNMENT JACK", the red tip-jack on the rear of the chassis. If the AC Voltmeter is used, it is connected as an output meter across the "500 Ω" terminals at the rear of the receiver. When aligning the receiver, the "A.V.C." switch should be On when using the Electronic Voltmeter or the Tuning Meter of the receiver, and Off when using the AC Voltmeter as an output meter.

It is preferable to use an insulated screw driver for adjusting the various trimmers. The receiver may be left in or removed from the cabinet when aligning the R. F. section, but it must be removed when aligning the I. F. Amplifier.

5.2 ALIGNMENT OF THE I. F. AMPLIFIER: Correct alignment of the Intermediate Frequency Amplifier is perhaps most important, as all signals being received are converted to the 455 KC I.F. frequency. If the Amplifier is incorrectly aligned, it may cause the dial calibration to be excessively off or cause mis-tracking.

To align the I. F. Amplifier, proceed as follows:

5.21 To gain access to the adjusting screws, it will be necessary to remove the receiver from the cabinet. This is done by removing the four screws in the panel and then pulling the receiver forward out of the cabinet.

5.22 Connect the loud speaker. If the Electronic Voltmeter is used, turn the A.V.C. switch On. If the AC Voltmeter is used, turn the A.V.C. switch Off. The R.F. GAIN control should be turned completely On to the right, the A.N.L. switch Off, and the STANDBY-RECEIVE switch in the "RECEIVE" position. The VOLUME control may be turned about 1/2 way on just so the signal can be comfortably heard in order to give an aural indication, partly for convenience and also so that one can get the "feel" of the receiver. The B.F.O. switch should be turned off.

5.23 Remove the grid cap of the 6K8 mixer tube, V-2, and connect the Test Oscillator output to the 6K8 grid and the chassis. It may be most convenient to clip the grounded side to the variable condenser frame.

5.24 Turn on the receiver and the Test Oscillator and allow several minutes for the equipment to warm up and become stable. Since it is best to align the receiver at its normal operating temperature, in extremely cold climates it is recommended to let it run for an hour or two before proceeding with the alignment.

5.25 Apply the 455 KC signal to the 6K8 tube. If the I.F. Amplifier is considerably out of alignment, such as might be the case if a new transformer had been installed, then a fairly strong signal will have to be used in order to force it through the system. Otherwise, set the level of the Test Oscillator until some two or three volts are read on the Electronic Voltmeter, or five volts with the Volume Control turned full On on the AC Voltmeter.

5.26 Then, with a screw driver, adjust the four screws on the rear side of the I.F. transformers, T-13 and T-14, one at a time, until maximum reading on the meter is obtained. If the alignment is occasioned by the replacement of one of the transformers, then adjust the two screws on this one first and follow up with the minor adjustment of the transformer that was not replaced.

After the adjustment appears to be completed and the meter reading is at a maximum, then go back over the adjusting screws in reverse order trying for a slightly higher reading. As the meter reading increases appreciably, reduce the output of the Test Oscillator as necessary.

5.3 ALIGNMENT OF THE BEAT FREQUENCY OSCILLATOR: The Beat Frequency Oscillator oscillates at the same frequency to which the I.F. Amplifier is tuned. Its adjustment is correct if, when a station is accurately tuned in, "zero beat" occurs when the B.F.O. pitch control is at zero or mid-point. Should it be required to adjust for this condition, proceed as follows:

5.31 If the I.F. Amplifier has just been aligned, leave the setup intact. Otherwise, set up in the same manner as described above, and apply the 455 KC signal. It is preferable that the modulation be removed from the signal.

5.32 With the B.F.O. PITCH control set at the mid-point, "0", with a screw driver turn the adjusting screw of T-15 until the beat-note between the Beat Frequency Oscillator and the Test Oscillator becomes lower and lower in pitch and finally zero beats.

5.33 Check the adjustment by turning the B.F.O. pitch control to the right or left and see that the pitch increases as the control is turned either way.

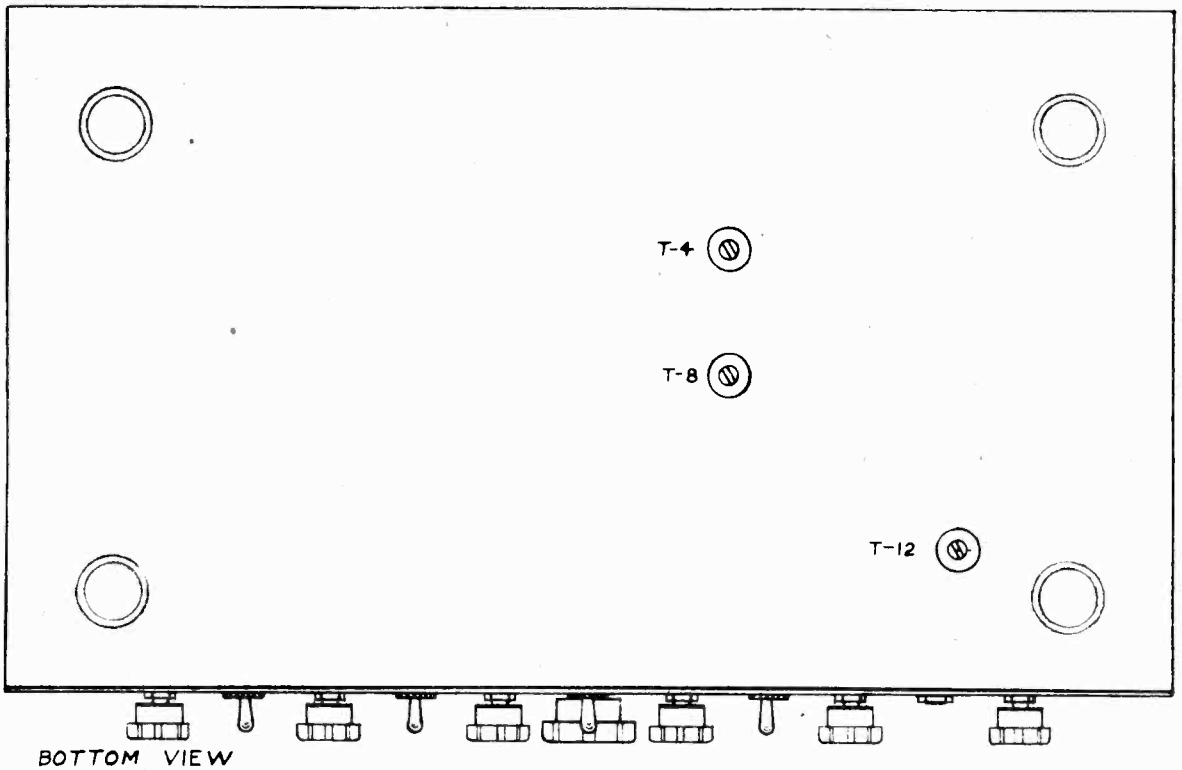
5.34 Remove the leads and replace the grid cap on the 6K8 tube.

5.4 ALIGNMENT OF THE RADIO FREQUENCY SECTION: This procedure is much more difficult than that of aligning the I.F. Amplifier. It is suggested that care be exercised if only "touching up" the trimmers not to get the receiver too far out of alignment, as difficulty may be experienced in getting it realigned correctly, particularly on Bands "C" and "D". The positions of the various trimming and padding adjusting screws are shown in the Plan View and Bottom View diagrams.

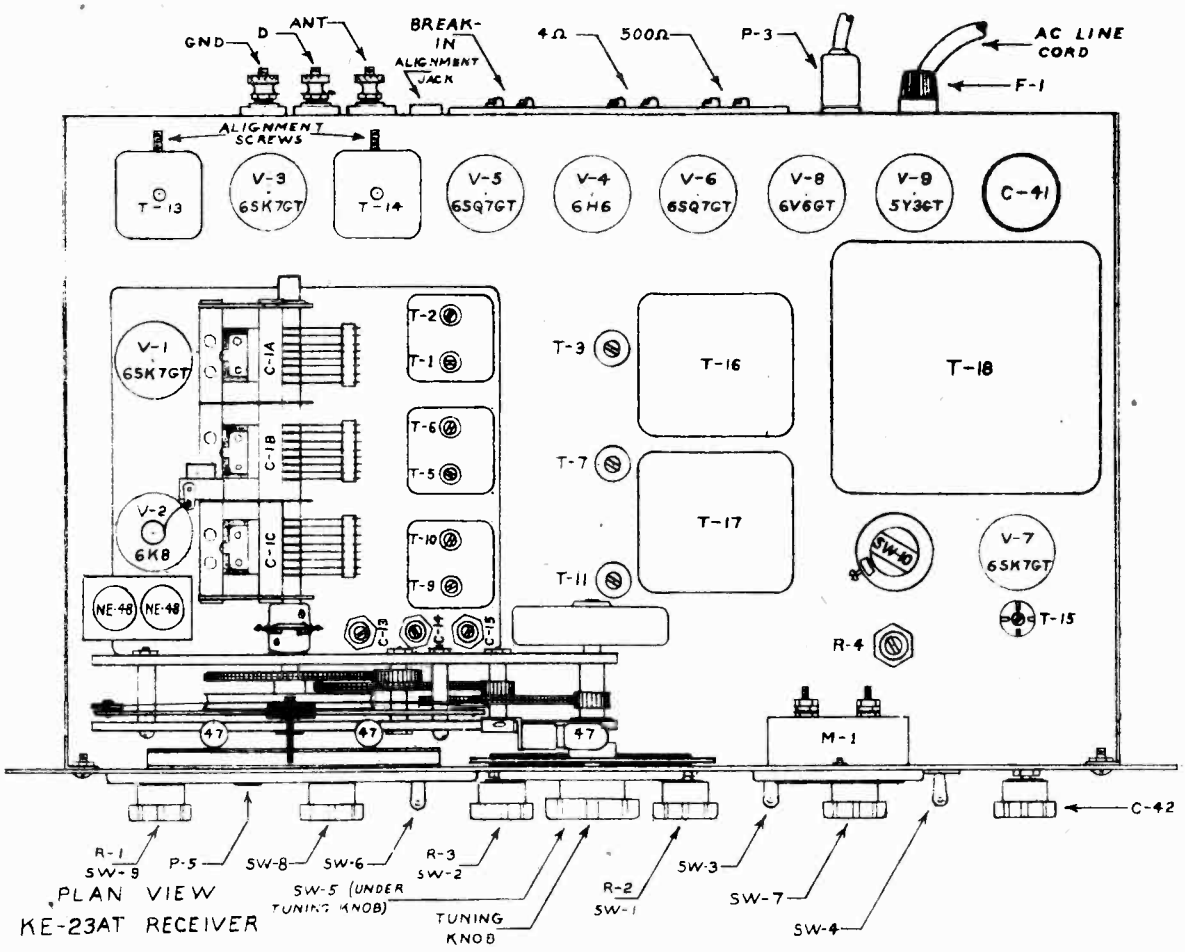
5.41 Connect the Signal Generator through a standard dummy antenna to the input terminals, A and D, (be sure D and G are connected together). If a dummy antenna is not available, a 400 Ohm resistor can be connected between the hot side of the output of the Signal Generator and the antenna terminal, A.

MODEL KE-23AT

KAAR ENGINEERING CO.



BOTTOM VIEW
KE-23AT RECEIVER



PLAN VIEW
KE-23AT RECEIVER

5.42 Set the various switches and controls in the same position as outlined in Paragraph No. 5.22.

5.43 To align the A Band, 500 - 1,600 KC, proceed in the following order:

(1) Turn the SELECTOR switch to "A".

(2) Apply the 1,400 KC signal and tune the dial to approximately 1,400 KC. In other words, tune in the signal to be sure it is getting through. If the set is badly out of alignment, then a very strong signal may have to be used and T-9 turned to locate it.

(3) If the dial does not read exactly 1,400, then turn it so that it does. VERY CAREFULLY "trim" by turning the trimmer T-9 until the signal is again heard. Do not attempt to too accurately tune by means of the trimmer alone, instead slightly rotate the tuning dial for the maximum reading on the meter after T-9 has been approximately set. This movement should be so slight that the pointer will still point to 1,400.

(4) Trim further by adjusting T-5 and T-1 for maximum reading on the output meter, reducing the output from the Signal Generator if necessary.

(5) Apply a signal of 550 KC and tune it in on the dial.

(6) Proceed to "pad" by adjusting the padding condenser, C-13, and the dial in connection with each other. There is somewhat of a "trick" to doing this properly and one who is inexperienced in padding a superhetrodyne may find it difficult.

To properly pad, VERY CAREFULLY turn the adjusting screw of the padding condenser, C-13, to the right, clockwise, 1/8 or 1/4 turn. This should detune the receiver slightly. Then retune with the dial and observe the reading on the output meter.

If the meter reading is higher, it shows the procedure is in the right direction. Then give C-13 another 1/8 or 1/4 turn and observe the reading again. Continue until the meter ceases to read higher. If one too many fractional turns is made and the meter starts to read lower, then go back 1/8 or 1/4 turn as necessary.

If, instead of the output meter reading higher when C-13 is turned 1/8 or 1/4 of a turn it reads lower, then, instead, turn it 1/8 or 1/4 turn to the left, counter-clockwise, and proceed as above until the maximum meter reading is reached.

(7) The receiver is now correctly padded on Band A and if the intention was to "touch up" the adjustments only, no further alignment on Band A will be necessary.
However, if the receiver was considerably out of line, then it may be that the dial will not read 550 when a 550 KC signal is applied. If such is the case the pointer may be bent slightly until it reads correctly. This may make the pointer read incorrectly at 1,400 KC, and if so, it will be necessary to trim over again as outlined in (3) and (4) above.

(8) If Band A has required more adjustment than merely a "touch up" of the trimmers, then, regardless of whether the dial reads 550 at 550 KC or not, the padding procedure may have been enough to throw the trimmers out of alignment. This can be checked by returning to 1,400 KC, and see if the dial still reads 1,400. If it does not, repeat (3). Even if it does, check the adjustments T-5 and T-1 again. If T-9 requires further adjustment then repeat the entire trimming procedure, then repad again, retrim again and repad as necessary until the result of further adjustment in both cases is indiscernable.

(9) In cases of extreme misalignment it is possible to inadvertently turn T-9 an excessive amount to such a position that would cause the oscillator to oscillate at a frequency 455 KC lower than the signal frequency, 1,400 KC, instead of higher. If this happens, the apparent performance of the receiver at and around 1,400 KC will seem to be the same as with the oscillator adjusted correctly, and the receiver will pad just as it should. However, if this mistake is made, the set will not perform satisfactorily in the middle of the band, appearing insensitive or dead, and it may even whistle when tuning in stations.

A quick check for this is to attach a fairly long outside antenna to the antenna terminal, A, instead of the Signal Generator, and tune the dial from 1,400 to 550 KC. The noise in the center of the band around 900 KC should be somewhat higher than at 550 KC and possibly a little lower than at 1,400 KC, but the set should sound definitely live in the center of the band. This can also be checked with the Signal Generator, and the output should read as good as or better at 900 KC as at 550.

Should it be found that the set is dead in the middle of a band, then apply 1,400 KC to the input as before and tune in the signal, then turn the trimmer of T-9 approximately 1/4 to 3/4 turn in either direction until the signal is tuned in again with a new adjustment. Then trim and pad several times as described above and again check the performance at the center of the band.

5.44 To align the B Band, 1,600 - 5,000 KC.

(1) Turn the SELECTOR switch to position "B". The Signal Generator and output meter are left connected as before.

(2) Proceed in the same manner as outlined in Paragraph 5.43 (3) to (9) above, but trimming at 4,400 KC and padding at 1,800.

On this higher frequency range it will be found that the trimming of T-10 is somewhat more critical than T-9 was on Band A, but the padding with C-14 is less critical.

(3) It will be noted that by properly trimming T-10, the dial can be made to read correctly at 4,400 KC, and T-6 and T-2 can be easily adjusted. However, the dial reading at 1,800 KC is dependent upon the coils which are not adjustable, and it is possible that when the receiver is correctly padded on Band B that the dial will not read exactly 1,80C. If such should be the case the pointer may be bent slightly to "split the difference", so to speak, between the 550 KC reading of Band A and the 1,800 KC reading of Band B. Sometimes one may wish to "split the difference" between the correct padding position and the correct dial reading, in which case the receiver may be purposely mis-padded slightly in order that the dial may read more correctly. If this is done, some performance will naturally be sacrificed.

5.45 To align the C Band, 5 - 14 MC.

(1) Turn the SELECTOR switch to "C" and proceed as before, using 14 Megacycles for trimming and 5.5 Megacycles for padding.

(2) On this higher frequency band it is extremely easy to incorrectly adjust the trimming condenser of T-11 in such a manner that the oscillator is lower in frequency than the signal, as the two settings of the trimmers fall so close together, and sometimes in merely "touching up" the adjustments, the wrong oscillator frequency may result. Therefore, it is most important when aligning the C Band to check the performance in the center of the band, around 8 - 9 MC.

NOTE: Because of an inherent characteristic of the receiver the sensitivity between 9.5 and 10 MC is somewhat less than over the rest of the range. This slightly "dead" spot is rather sharply defined and should not be confused with a general lack of sensitivity over the middle portion of the band which would be due to the trimmers being incorrectly set.

It will be found that the padding adjustment of C-15 will not be critical.

5.46 To align the D Band, 16 - 42 MC.

(1) Turn the SELECTOR switch to "D".

(2) It is to be noted that on the D Band only, the oscillator frequency is 455 KC Lower than the signal frequency, and the method of determining the correct setting is different from that used on the other bands.

(3) Apply a 38 MC signal to the receiver, adjust the trimming condenser of T-12 and obtain the correct dial reading as before. Adjust T-8 and T-4 for maximum reading on the meter. It will be noted in this case that all the adjustments are very, very critical. In adjusting T-12 it may be necessary to turn the trimmer a very small amount to an estimated setting, and then find the signal by tuning the dial, this adjustment is so critical.

(4) After T-12, T-8 and T-4 are adjusted, then check to see if the oscillator frequency is lower than the signal frequency. To do this, find the image by tuning the dial to approximately 39 MC where the signal should again be heard a little weaker than before. If the signal is heard on 39 MC the adjustment of T-12 is correct. However, if it should be heard on 37 MC and not on 39, the adjustment is incorrect and T-12 should be completely reset.

(5) It must be pointed out that in trimming the D Band it is possible to get false settings. At a false setting all of the adjustments seem to proceed normally except that the receiver lacks sensitivity generally and the performance is very poor. If this condition is suspected, the 38 MC signal should again be applied only possibly stronger, and T-12 and T-8 and T-4 arbitrarily readjusted until the 38 MC signal can be located with an entirely different set of adjustments. Then proceed to carry through the trimming procedure from the beginning.

(6) There is no padding adjustment for the D Band. Instead, the turns on the oscillator coil are moved back and forth to change the inductance, which accomplishes the same result.

It is suggested that no attempt be made to pad the D Band under a touch-up procedure. Only if one of the D Band coils has been replaced should this adjustment be attempted. The results of padding will vary from set to set but, in general, if one of the coils has been replaced it is suggested that an attempt be made to move the turns on it only, leaving the other two alone.

(7) The general padding procedure is much the same as that used with a padding condenser. A 16 MC signal is applied, the output meter reading observed as before, and one of the turns of heavy wire on T-12 moved backwards or forwards by pushing with a screw driver. Follow the signal by retuning the dial and observing if the output has gone up or gone down, repeating or reversing the procedure as necessary. After the correct point has been found, it will be necessary to retrim, much more so in this case than when aligning Bands A, B or C. Then, repad and retrim, repad and retrim as many times as necessary until the performance seems satisfactory. It is not uncommon to have to repeat as many as ten times before satisfactory performance is achieved.

(8) When the best padding seems to have been obtained, then heavy wire of the secondary of T-4 may be moved back and forth to try and better the results. It will seldom be necessary to adjust T-8.

The final check may be made at 25 MC in the center of the band. Ordinarily the sensitivity of the set at 25 MC will be greater than at 38 or 16 MC.

(9) Apply a little Duco Cement, or equivalent, to the turns of wire that have been moved in order to secure them in place.

5.47 Remove the meter and Signal Generator and replace the set in the cabinet.

PARTS LIST

KAAR TYPE KE-23AR COMMUNICATIONS RECEIVER

Circuit Symbol	Function	Description	Type	Mfgr.
C-T	Trimming condensers, 12 units mounted across secondaries of T-1 to T-12.	7-45 mmf. variable ceramic.	CTS-2	TEL
C-1A	Antenna coil secondary tuning.	Rear section, 3 gang variable air condenser. 442 mmf. (Effective capacity.)	23	RC
C-1B	R.F. coil secondary tuning.	Center section, 3 gang variable air condenser. 442 mmf. (Effective capacity.)		
C-1C	Oscillator grid coil tuning.	Front section, 3 gang variable air condenser. 442 mmf. (Effective capacity.)		
C-2	High frequency coupling for T-7.	5 mmf. ceramic, 400 V. DC, or Two 10 mmf. mica in series.	N-750E-5 5R5Q1	E CD
C-3	Compensating capacitance for secondary of T-4.	25 mmf. ceramic, 400V. DC.	N-750K-25	E
C-4	Compensating capacitance for secondary of T-8.	Same as C-3.		
C-5	High frequency coupling for T-8.	50 mmf. ceramic, 400 V. DC.	N-750K-50	E
C-6	Tuning condenser for compensating coil of T-4.	Same as C-5.		
C-7	V-2 oscillator grid.	100 mmf. ceramic, 400 V. DC.	N-750L-100	E
C-8	V-5 diode, R.F. filter.	Same as C-7.		
C-9	Tuning condenser for T-15.	Same as C-7.		
C-10	V-7 grid.	Same as C-7.		
C-11	V-5 diode, R.F. by-pass.	250 mmf. ceramic, 400 V. DC.	N-750K-250	E
C-12	Low frequency tickler tuning of T-12.	150 mmf. mica, 500 V. DC.	FO	MC
C-13	A Band oscillator padding condenser.	250 - 525 mmf., mica compression.	HC-41	SI
C-14	B Band oscillator padding condenser.	850 - 1500 mmf., mica compression.	HC-71	SI
C-15	C Band oscillator padding condenser.	Same as C-14.		
C-16	C Band oscillator padding condenser. Fixed portion.	.001 mfd. mica, 500 V. DC.	1-W5D1	CD
C-17	V-2 oscillator plate coupling.	.002 mfd. mica, 500 V. DC.	1-W5D2	CD
C-18	V-1 cathode by-pass.	.1 mfd. 200 V. DC., moulded paper.	MPW-5157	SOL
C-19	V-2 cathode by-pass.	Same as C-18.		
C-20	V-3 cathode by-pass.	Same as C-18.		
C-21	Coupling, volume control to V-6 grid.	.01 mfd., 400 V. DC., moulded paper.	340-21	MC
C-22	V-1 grid return by-pass.	.02 mfd., 400 V. DC., moulded paper.	342-12	MC
C-23	V-2 mixer grid return by-pass.	Same as C-22.		
C-24	V-3 grid return by-pass.	Same as C-22.		
C-25	V-2 screen by-pass.	.02 mfd., 400 V. DC., moulded paper.	MPW-5143	SOL
C-26	V-7 plate by-pass.	Same as C-25.		
C-27	Power line filter	Same as C-25.		
C-28	Power line filter.	Same as C-25.		
C-29	V-1 and V-3 screen by-pass.	.1 mfd., 400 V. DC., moulded paper.	MPW-5147A	SOL
C-30	V-1 and V-3 plate return by-pass.	Same as C-29.		
C-31	V-2 plate return by-pass.	Same as C-29.		
C-32	V-6 grid return by-pass.	Same as C-29.		
C-33	V-8 plate filter.	.005 mfd., 600 V. DC., moulded paper.	340-25	MC
C-34	Coupling V-6 plate to V-8 grid.	.01 mfd., 600 V. DC., moulded paper.	342-17	MC

Circuit Symbol	Function	Description	Type	Mfgr.
C-35	Coupling V-8 plate to phones.	Same as C-34.		
C-36	V-4 plate by-pass.	.05 mfd., 600 V. DC., moulded paper.	345-22	MC
C-37	Tone control.	.05 mfd., 600 V. DC., moulded paper.	MFW-5639	SCL
C-38	V-8 cathode by-pass.	10 mfd., 25 V. DC., tubular electrolytic.	BR-102A	CD
C-39	V-6 cathode by-pass.	10 mfd., 50 V. DC., tubular electrolytic.	BR-105	CD
C-40	Filter for V-2 plate and screen supply voltage.	12 mfd., 450 V. DC., tubular electrolytic.	BR-1245	CD
C-41	Plate supply filter condensers. One section at input of filter, other section at output.	20-20 mfd., 450 V. DC., dual section aluminum can type electrolytic.	UP-6B-J38	CD
C-42	B.F.C. pitch control. Across T-15.	13 mmf. variable air trimmer.	KZ-1300	ASP
C-43	Phase correction capacitance for C Band.	Two loops of wire around grid bus of T-7.		
C-44	B.F.O. coupling, V-7 to V-5.	1 1/2 loops of wire around diode plate lead of T-14.		
R-1	R.F. Gain Control.	1,000 Ohm wire wound variable resistor. Combined with meter switch SW-9.	X-2015	CTT
R-2	Volume Control.	250,000 Ohm potentiometer. Combined with power switch SW-1.	WC-8586	ST
R-3	Squelch Control.	1 Megohm potentiometer. Combined with SW-2.	WC-8585	ST
R-4	Meter Zero-Set Control.	1500 Ohm potentiometer.	WC-8975	ST
R-5	A.V.C. filter, V-1 grid return.	500,000 Ohm, 1/4 W., insulated carbon.	CM-1/2	ST
R-6	V-2 grid return isolation.	Same as R-5.		
R-7	Squelch dropping.	Same as R-5.		
R-8	V-6 plate.	Same as R-5.		
R-9	V-8 grid leak.	Same as R-5.		
R-10	Stabilizing resistance for T-12 oscillator coil.	5 Ohm, 1/2 W., insulated carbon.	504	E
R-11	Supressor for Control Grid, V-2.	30 Ohm, 1/2 W., insulated carbon.	504	E
R-12	V-1 and V-3 cathode.	150 Ohm, 1/2 W., insulated carbon.	504	E
R-13	V-2 cathode.	300 Ohm, 1/2 W., insulated carbon.	504	E
R-14	Voltage divider.	600 Ohm., 1/2 W., insulated carbon.	504	E
R-15	Meter compensating.	27,000 Ohm, 1/2 W., insulated carbon.	CM-1	ST
R-16	Voltage divider.	10,000 Ohm, 1/2 W., insulated carbon.	504	E
R-17	R.F. filter from diode detector, V-5.	25,000 Ohm, 1/2 W., insulated carbon.	504	E
R-18	V-7 grid leak.	Same as R-17.		
R-19	V-2 oscillator grid leak.	50,000 Ohm, 1/2 W., insulated carbon.	504	E
R-20	Audio dropping for A.N.L. tube, V-4.	100,000 Ohm, 1/2 W., insulated carbon.	504	E
R-21	Audio dropping for A.N.L. tube, V-4.	250,000 Ohm, 1/2 W., insulated carbon.	504	E
R-22	V-4 plate filter.	1 Megohm, 1/2 W., insulated carbon.	504	E
R-23	V-6 grid leak.	Same as R-22.		
R-24	A.V.C. filter.	2 Megohm, 1/2 W., insulated carbon.	504	E
R-25	Protective load across 4 Ohm winding of T-16.	10 Ohm, 1 W., insulated carbon.	518	E

Circuit Symbol	Function	Description	Type	Mfgr.
R-26	V-8 cathode.	300 Ohm, 1 W., insulated carbon.	518	E
R-27	Meter dropping, in plate supply for V-1 and V-3.	500 Ohm, 1 W., insulated carbon.	518	E
R-28	V-2 plate and screen dropping.	5,000 Ohm, 1 W., insulated carbon.	518	E
R-29	Tone Control dropping.	Same as R-28.		
R-30	V-2 screen dropping.	20,000 Ohm, 1 W., insulated carbon.	518	E
R-31	Voltage regulator dropping in plate circuit of V-2.	10,000 Ohm, 1 W., insulated carbon.	CM-1	ST
R-31A	V-2 plate.	Same as R-31.		
R-32	V-7 plate.	25,000 Ohm, 1 W., insulated carbon.	518	E
R-33	Voltage divider.	40,000 Ohm, 1 W., insulated carbon.	518	E
R-34	Voltage divider.	30,000 Ohm, 10 W., wire wound.	10F	WL
R-35	High voltage supply dropping from external power supply.	3,500 Ohm, 25 W., wire wound.	25F	WL
SW-1	Power Switch.	SPST on R-2.		
SW-2	Squelch ON-OFF Switch.	SPST on R-3.		
SW-3	A.V.C. ON-OFF Switch.	SPST toggle.	20994	HH
SW-4	B.F.O. Switch.	Same as SW-3.		
SW-5	Stand-By Switch.	Same as SW-3.		
SW-6	A.N.L. Switch.	DPDT toggle.	20905BJ	HH
SW-7	Tone Control Switch.	Single Pole, 3 Position.	1461	CE
SW-8A to SW-8F	Band Selector Switch.	6 Pole, 4 Position, 3 gang, Isolantite.	K-23SWT	CE
SW-9	Meter Switch.	SPST on R-1.		
SW-10	Line Voltage Selector.	Single Pole, 5 Position.	36	AMT

Circuit Symbol	Function	Description	Type	Mfgr.
T-1	A Band. Antenna to V-1 grid.	Antenna coil in common shield with T-2.	AB-23AT	ML
T-2	B Band. Antenna to V-1 grid.			
T-3	C Band. Antenna to V-1 grid.	Antenna coil in shield.	C-23AT	ML
T-4	D Band. Antenna to V-1 grid.	Unshielded antenna coil.	D-23AT	KE
T-5	V-1 plate to V-2 grid, A Band.	R.F. coil in common shield with T-6.	AB-23RFT	ML
T-6	V-1 plate to V-2 grid, B Band.			
T-7	V-1 plate to V-2 grid, C Band.	R.F. coil mounted in shield.	C-23RFT	ML
T-8	V-1 plate to V-2 grid, D Band.	Unshielded R.F. Coil.	D-23RFT	KE
T-9	Oscillator coil, A Band.	Oscillator coil in common shield with T-10.	AB-23SCT	ML
T-10	Oscillator coil, B Band.			
T-11	Oscillator coil, C Band.	Oscillator coil mounted in shield.	C-23SCT	ML
T-12	Oscillator coil, D Band.	Unshielded oscillator coil.	D-23SCT	KE
T-13	V-2 plate to V-3 grid.	455 Kc. permeability tuned I.F. transformer.	912CT	ML
T-14	V-3 plate to V-5 diode plates.	Same as T-13.		
T-15	Beat frequency oscillator coil.	455 KC permeability tuned oscillator coil.	K-23-BFOT	ML
T-16	V-8 plate to 4 Ohm and 500 Ohm output terminals.	Output transformer, 8,000 Ohm plate to 500 Ohm line and 4 Ohm speaker voice coil.	4259Q	P
T-17	Smoothing choke.	15 Henry, iron core choke.	K-303Q	P
T-18	Power transformer.	Primary 100, 120, 150, 210 and 230 Volts, to 5 V. at 2 A., 6.3 V. at 3.5 A., and 520 V. CT at 75 MA.	5351Q	P

Circuit Symbol	Function	Description	Type	Mfgr.
V-1	R.F. Amplifier.	Vacuum tube.	6SK7GT	TS
V-2	Oscillator and First Detector-Mixer.	Vacuum tube.	6X8	RCA
V-3	I.F. Amplifier.	Vacuum tube.	6SK7GT	TS
V-4	Automatic Noise Limiter.	Vacuum tube.	6H6	RCA
V-5	Diode Second Detector and Squelch Control.	Vacuum tube.	6SQ7GT	HY
V-6	First Audio Amplifier.	Vacuum tube.	6SQ7GT	HY
V-7	Beat Frequency Oscillator.	Vacuum tube.	6SK7GT	TS
V-8	Audio Output Amplifier.	Vacuum tube.	6V6GT	RCA
V-9	Rectifier.	Vacuum tube.	5Y3GT	TS
2 #NE-48	Voltage regulator for V-2.	Two neon lamps in series.	NE-48	GE
3 #47	Illumination of dials.	Three bayonet base miniature pilot lamps.	47	GE
M-1	Signal strength meter.	0 - 1 MA 3-1/2 inch milliammeter.	DW-51	GE
F-1	Fuse.	2 amp. small glass.	3AG	BS
P-1	External connection to A.V.C. for receiver alignment.	Single contact tip jack.	889R	RCA
P-2	AC supply for heaters.	5 prong miniature socket.	S5S	AMP
P-3	Plate and heater input for DC operation.	5 prong miniature cable plug.	MPM5S	AMP
P-4	Input from AC line.	Rubber AC, spring action line plug.	102	ALL
P-5	Output connection for phones.	Open circuit phone jack.	IJ-101	U

OTHER PARTS AND ACCESSORIES

Description of Part	Type	Mfgr.
Ceramic octal tube sockets for V-1 to V-9.	25-8437	UC
Miniature bayonet pilot lamp sockets.	3171	CI
2 contact neon lamp sockets.	1012 (Sockets ONLY)	GC
Fuse extractor post for 3AG fuse.	HKM	BS
Ceramic thru panel insulators for antenna and ground connections, A, D, and G.	55	EFJ
Terminal strip for 500 Ohm and 4 Ohm output connections and break-in, 6 terminals.	Special 5C	J
Small pointer knobs.	S-3C8-3P	KK
Large tuning knob.	S-3C9-3	KK
Round Vernier dial assembly.	VS-23T-2	KE
Main tuning dial scale.	TS-23T	KE
Gear-train tuning mechanism.	GT-23T	GR

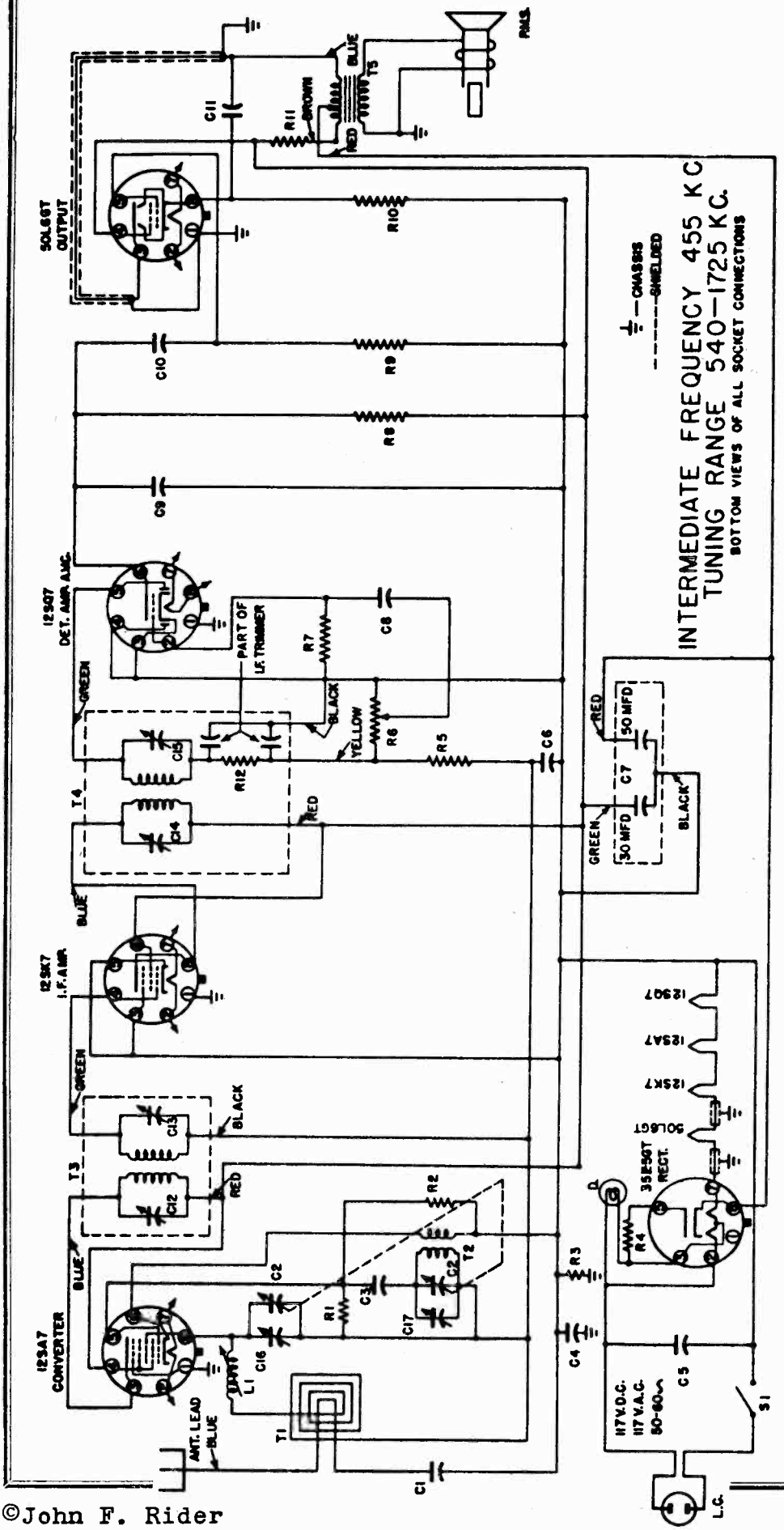
The KAAR ENGINEERING COMPANY reserves the right to make parts substitutions as necessary, changes or improvements on its products from time to time without incurring obligation to install the same on equipment previously sold.

LIST OF PARTS MANUFACTURERS AND ADDRESSES

Mfgr. Symbol	Manufacturer	Address
ALL	Allied Electric Products, Inc.	82 Coit St., Irvington, N. J.
AMP	American Phenolic Corp.	1832 So. 54th Ave., Chicago, Ill.
ASP	American Steel Package Co.	Defiance, Ohio
BS	Bussman Mfg. Co.	University at Jefferson, St. Louis, Mo.
CE	Centralab	900 E. Keefe Ave., Milwaukee, Wis.
CTT	Chicago Telephone Supply Co.	Elkhart, Indiana
CI	Cinch Mfg. Corp.	2335 W. Van Buren St., Chicago, Ill.
CD	Cornell-Dubilier Electric Corp.	So. Plainfield, New Jersey
CR	Crowe Name Plate and Mfg. Co.	3701 Ravenswood Ave., Chicago, Ill.
E	Erie Resistor Corp.	644 W. 12th St., Erie, Pennsylvania
GE	General Electric Company	Bridgeport, Connecticut
GC	Gothard Mfg. Co.	Springfield, Illinois
HH	Hart & Hegeman Division (The Arrow-Hart & Hegeman Co.)	Hartford, Connecticut
EFJ	E. F. Johnson Co.	Waseca, Minnesota
HY	Hytron Corporation	76 Lafayette St., Salem, Mass.
IC	Insuline Corp. of America	36-02 35th Ave., Long Island City, N. Y.
J	Howard B. Jones	2300 Wabansia Ave., Chicago, Ill.
KE	Kaar Engineering Company	619 Emerson St., Palo Alto, Calif.
KR	Ken-Rad Tube & Lamp Corp.	Owensboro, Kentucky
KK	Kurtz Kasch, Inc.	1415 So. Broadway, Dayton, Ohio
MC	Micamold Radio Corp.	1087 Flushing, Brooklyn, New York
ML	J. W. Miller Co.	5917 So. Main St., Los Angeles, Calif.
P	Peerless Electrical Products Co.	6920 McKinley St., Los Angeles, Calif.
RC	Radio Condenser Co.	Camden New Jersey.
RCA	R.C.A. Mfg. Co., Inc.	Camden, New Jersey.
SI	F. W. Sickles Co.	Springfield, Mass.
SOL	Solar Mfg. Corp.	Bayonne, New Jersey
ST	Stackpole Carbon Company	St. Marys, Pennsylvania
TEL	Teleradio Engineering Co.	Wilkes-Barre, Pennsylvania
TS	Tung-Sol Lamp Works	95 8th Avenue, Newark, New Jersey
UC	United Carr Fastener Co.	31 Ames St., Cambridge, Mass.
U	Utah Radio Products Co.	812 Orleans St., Chicago, Ill.
WL	Ward Leonard Co.	Mt. Vernon, New York

LEAR INC.

MODELS 561, 562, 563

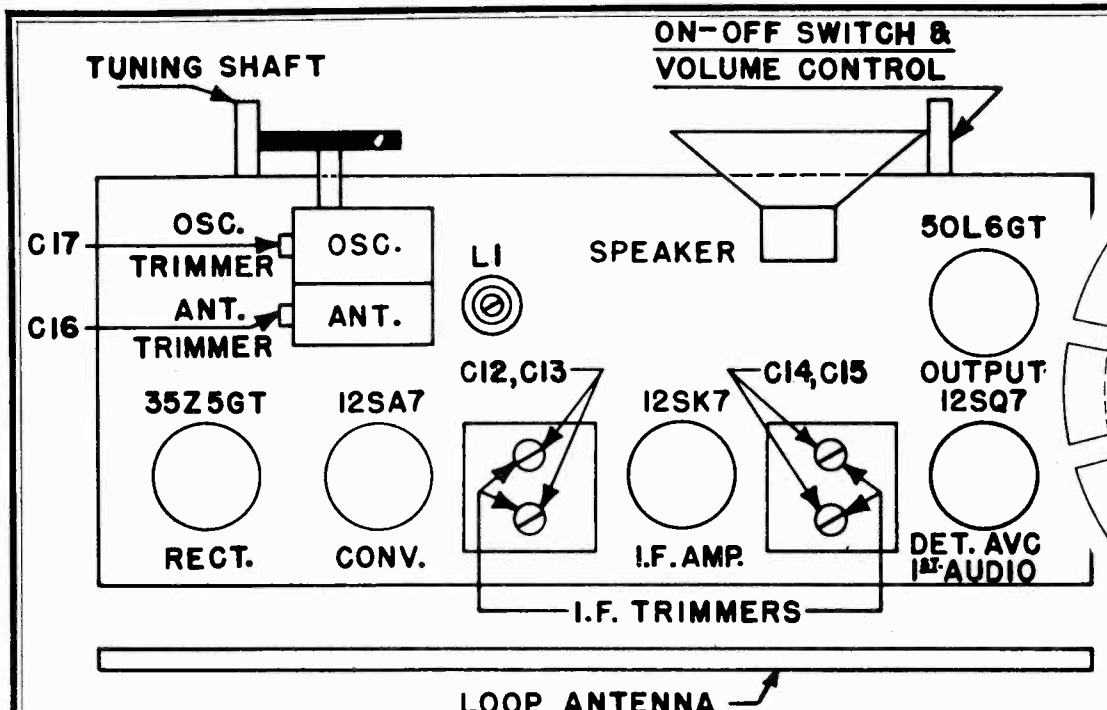


DWG. SYM.	PART NO.	DESCRIPTION
T1	852870	LOOP ANTENNA ASSEMBLY
T2	863015	OSCILLATOR COIL "
T3	853350	NO.1 I.F. TRANSFORMER "
T4	853381	" 2 " " "
T5	852831	OUTPUT " "
L1	A82897	ANT. LOAD COIL
C1	C56585	.001 MFD. 200V. PAPER CAPACITOR
C2	A82452	2 GANG VARIABLE "
C3	B56065	47 MMFD. MICA "
C4	C56831	0.1 MFD. 400V. PAPER "
C5	C56866	.05 " 600V. " "
C6	C56800	" " 200V. " "
C7	B52826	30-30 MFD. 150V. ELECTROLYTIC

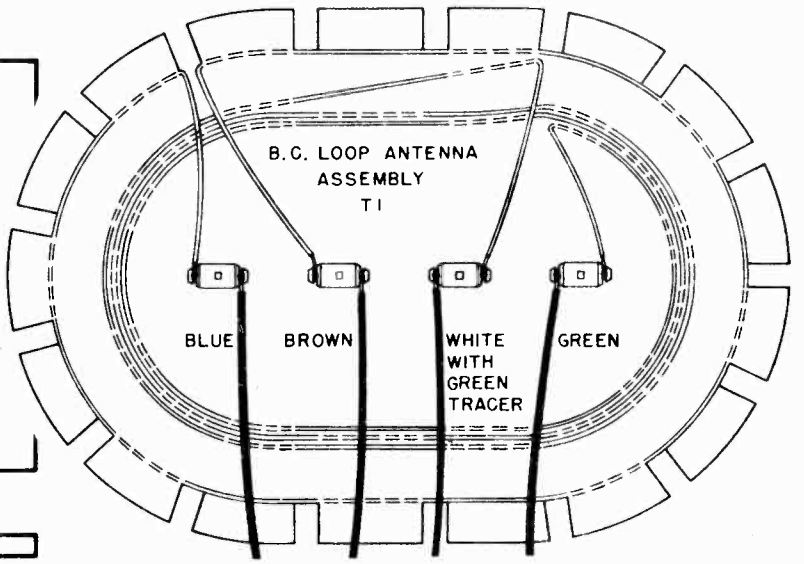
DWG. SYM.	PART NO.	DESCRIPTION
C8	C56596	.02 MFD. 200V. PAPER CAPACITOR
C9	B56059	220 MMFD. MICA "
C10	C56568	.004 MFD. 200V. PAPER "
C11	C56626	.05 " 400V. " "
C12,C13		NO.1 I.F. TRIMMERS (PART OF ASS'Y.)
C14,C15		NO.2 " " (" " ")
C16		ANT. TRIMMER ON VARIABLE CAPACITOR
C17		OSC. " " " "
R1	B56496	18 MEG. 1/2W. CARBON RESISTOR
R2	B56479	22,000 OHMS " " "
R3	B56485	220,000 " " " "
R4	B56460	18 " " " "
R5	B56491	2.2 MEG. " " " "

DWG. SYM.	PART NO.	DESCRIPTION
R6,R1	D56340	500,000 OHM VOL. CONTROL & LINE SW.
R7	B56494	5.6 MEG. 1/2W. CARBON RESISTOR
R8	B56467	470,000 OHMS " " "
R9	B56487	470,000 " " " "
R10	B56466	150 " " " "
R11	B56474	1200 " 1 W. " "
R12		47,000 " 1/2W. " "
P.M.S.	D53450	5" PERMANENT MAGNET SPEAKER
L.C.	A63091	LINE CORD
D.L.	A70536	DIAL LIGHT, TYPE 47

OCT. 25, 1945



LOOP WIRING DIAGRAM



OPERATION	ALIGNMENT OF	GENERATOR CONNECTED TO	DUMMY ANTENNA	GENERATOR FREQUENCY	DIAL AND CONDENSER SETTING	TRIMMER	REMARKS
1	Set dial pointer to last mark at low frequency end of dial with gang condenser closed.						
2	2nd. IF	12SA7 grid and B-	.05 mfd.	455 KC	open	C14 & C15	Max. Output
3	1st. IF					C12 & C13	Max. Output
4	Broadcast	Ant. lead and B-	200 mmfd.	1500 KC	1500 KC	C16 & C17	Max. Output
5				600 KC	600 KC	Slug in L1	Max. Output
6	Repeat operations 4 and 5 until no further improvement in output is obtained.						

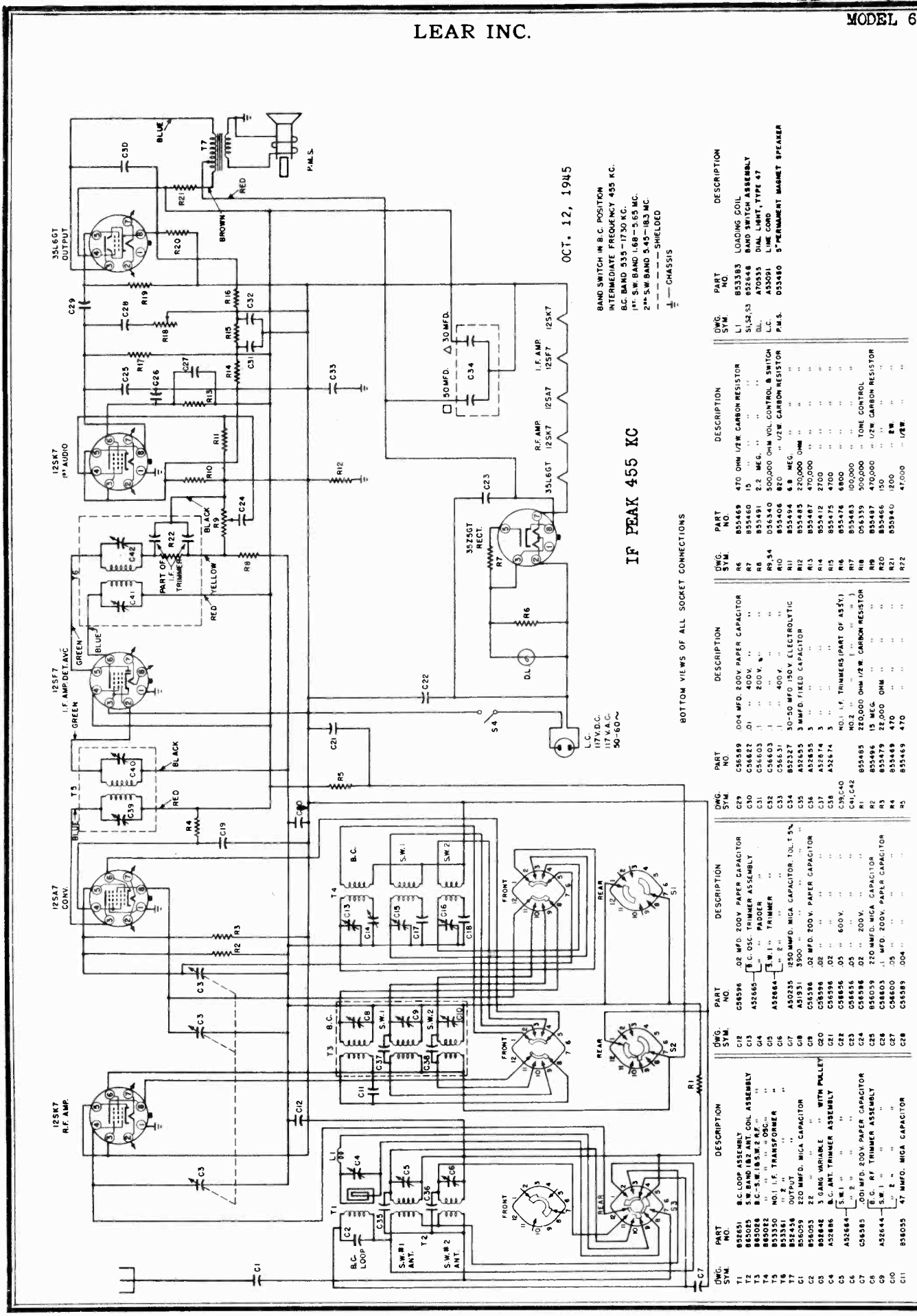
TUBE	FUNCTION	Voltage of each socket prong to B- (Prong No. 3 of 12SK7)							
		No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8
12SA7	Oscillator - Converter	0	-	90	90	0	0	-	0
12SK7	I-F Amplifier	0	-	0	0	0	90	-	90
12SQ7	Detector - AVC - 1st. Audio	0	0	0	0	0	28	-	-
50L6	Beam Power Amplifier	0	-	115	90	0	0	-	6
35Z5	Rectifier	-	-	-	-	110 AC	-	-	117

Notes: Voltage readings are for schematic diagram in this bulletin. Allow 10% ± on all measurements.
Always use meter scale which will give greatest deflection within scale limits
All DC measurements made with 1000 ohms per volt voltmeter. Position of volume control: On full (with no signal)
Voltages are DC unless otherwise specified. Line voltage: 117 volts, 60 cycles (AC)
All voltages measured from prong No. 3 of 12SK7 tube socket, or B-.

LEAR INC.

MODEL 661

LEAR INC.



DWG. SYM.	PART NO.	DESCRIPTION
T1	852651	B.C. LOOP ASSEMBLY
T2	852025	S.W. BAND 1&2 ANT. COIL ASSEMBLY
T3	852028	B.C.-S.W. 1&S.W. 2 R.F. "
T4	852052	" " " " " OSC. "
T5	853350	NO. 1 I.F. TRANSFORMER "
T6	853361	" 2 " " " "
T7	852436	OUTPUT "
C1	856059	220 MMFD. MICA CAPACITOR
C2	856053	22 " " " "
C3	852642	3 GANG VARIABLE " WITH PULLEY
C4	A52686	B.C. ANT. TRIMMER ASSEMBLY
C5	A52664	S.W. 1 " "
C6		" 2 " "
C7	C56585	.001 MFD. 200 V. PAPER CAPACITOR
C8		B.C. RF TRIMMER ASSEMBLY
C9	A52644	S.W. 1 " "
C10		" 2 " "
C11	856035	47 MMFD. MICA CAPACITOR

DWG. SYM.	PART NO.	DESCRIPTION
C12	C56596	.02 MFD. 200 V. PAPER CAPACITOR
C13	A52665	B.C. OSC. TRIMMER ASSEMBLY
C14		" PADDER "
C15	A52664	S.W. 1 " TRIMMER "
C16		" 2 " " "
C17	A50235	1250 MMFD. MICA CAPACITOR. TOL. ± 5%
C18	A51951	3900 " " " " " " "
C19	C56596	.02 MFD. 200 V. PAPER CAPACITOR
C20	C56596	.02 " " " " "
C21	C56596	.02 " " " " "
C22	C56856	.05 " 600 V. " "
C23	C56856	.05 " " " "
C24	C56596	.02 " 200 V. " "
C25	856059	220 MMFD. MICA CAPACITOR
C26	C56603	.1 MFD. 200 V. PAPER CAPACITOR
C27	C56600	.05 " " " "
C28	C56589	.004 " " " "

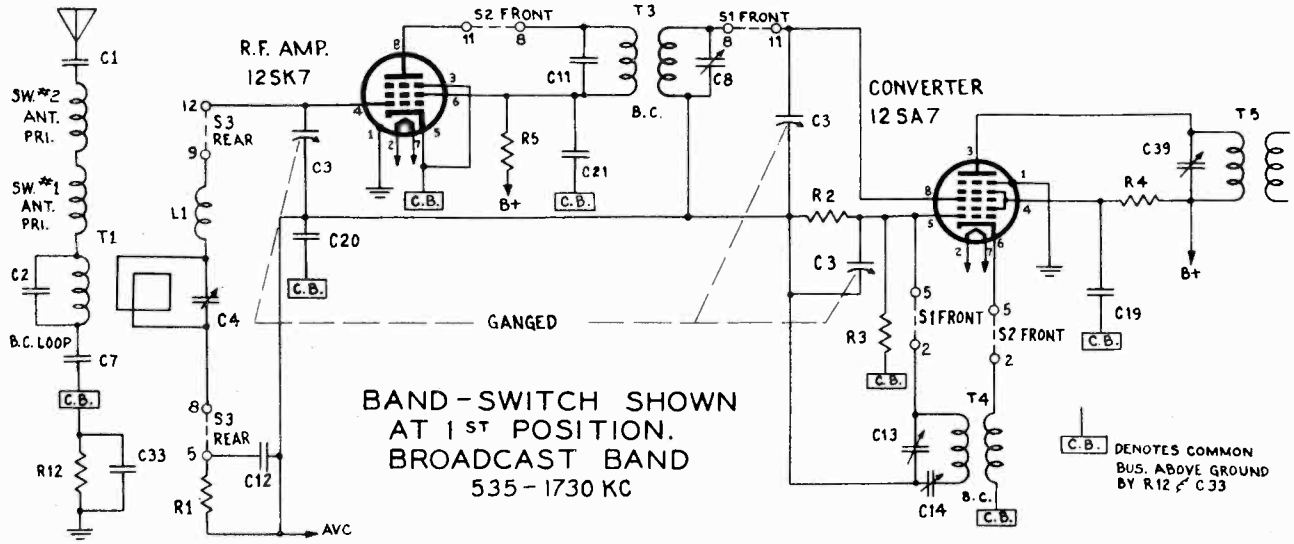
DWG. SYM.	PART NO.	DESCRIPTION
C29	C56589	.004 MFD. 200 V. PAPER CAPACITOR
C30	C56622	.01 " 400 V. " "
C31	C56603	.1 " 200 V. " "
C32	C56603	.1 " " " "
C33	C56631	.1 " 400 V. " "
C34	852327	30-30 MFD. 150 V. ELECTROLYTIC
C35	A52655	3 MMFD. FIXED CAPACITOR
C36	A52655	3 " " "
C37	A52674	3 " " "
C38	A52674	3 " " "
C39, C40		NO. 1 I.F. TRIMMERS (PART OF ASS'Y.)
C41, C42		NO. 2 " " " " " " " "
R1	855485	220,000 OHM 1/2 W. CARBON RESISTOR
R2	855496	15 MEG. " " "
R3	855479	22,000 OHM " " "
R4	855468	470 " " " "
R5	855469	470 " " " "

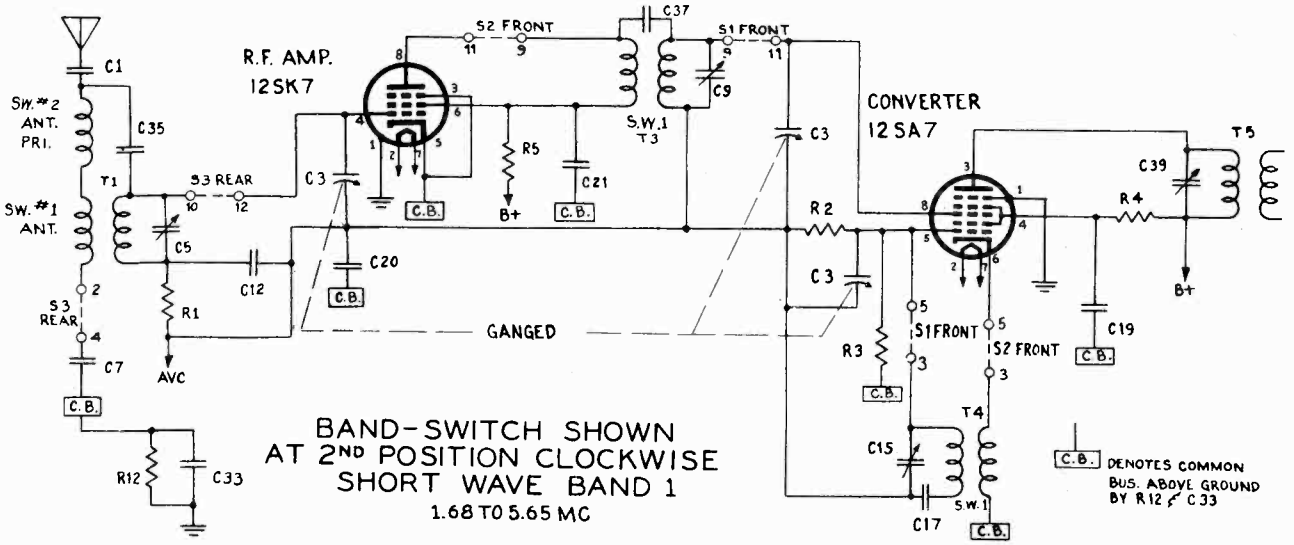
DWG. SYM.	PART NO.	DESCRIPTION
R6	855469	470 OHM 1/2 W. CARBON RESISTOR
R7	855460	15 " " " "
R8	855491	2.2 MEG. " " "
R9, 34	D56340	500,000 OHM VOL. CONTROL & SWITCH
R10	855468	820 " 1/2 W. CARBON RESISTOR
R11	855494	6.8 MEG. " " "
R12	855485	220,000 OHM " " "
R13	855487	470,000 " " " "
R14	855412	2700 " " " "
R15	855475	4700 " " " "
R16	855476	6800 " " " "
R17	855483	100,000 " " " "
R18	D56339	300,000 " TONE CONTROL
R19	855487	470,000 " 1/2 W. CARBON RESISTOR
R20	855466	150 " " " "
R21	855940	1200 " 2 W. "
R22		47,000 " 1/2 W. "

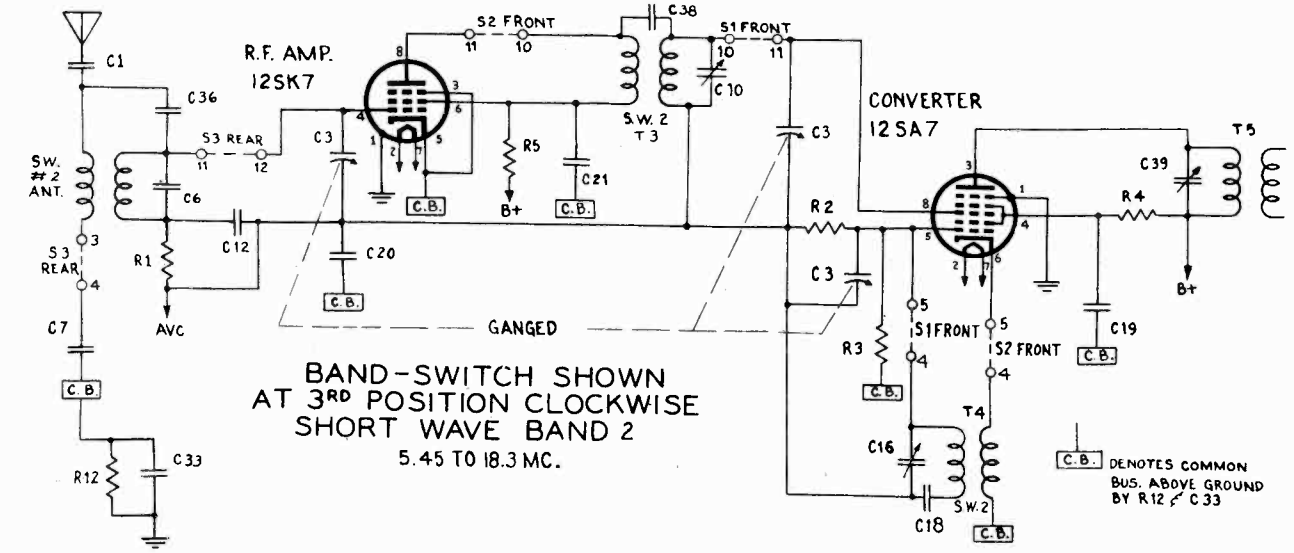
DWG. SYM.	PART NO.	DESCRIPTION
L1	853383	LOADING COIL
S1, S2, S3	852648	BAND SWITCH ASSEMBLY
DL.	A70535	DIAL LIGHT, TYPE 47
L.C.	A53091	LINE CORD
P.M.S.	D53480	5" PERMANENT MAGNET SPEAKER

MODEL 661

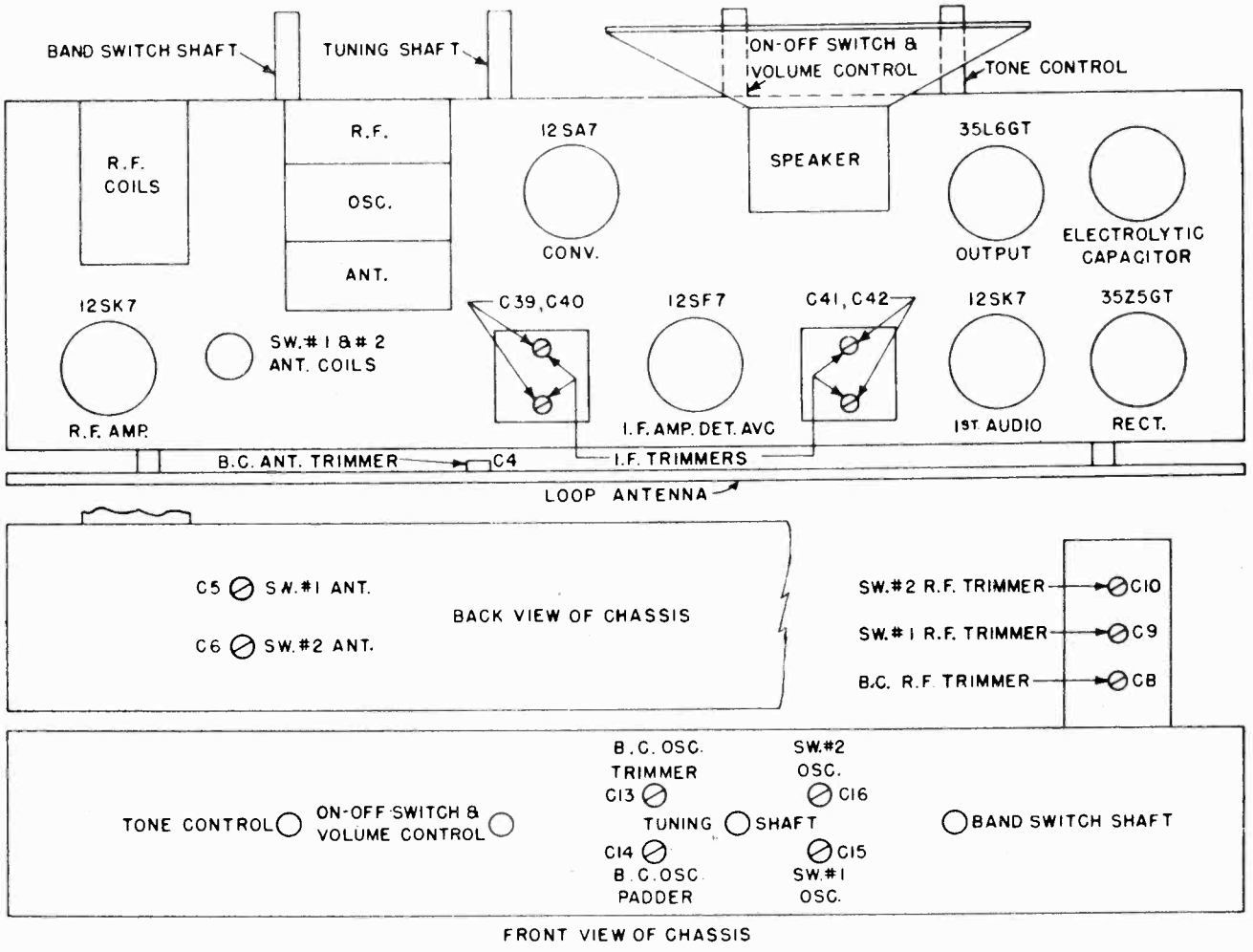
LEAR INC.







LEAR INC.



ALIGNMENT CHART

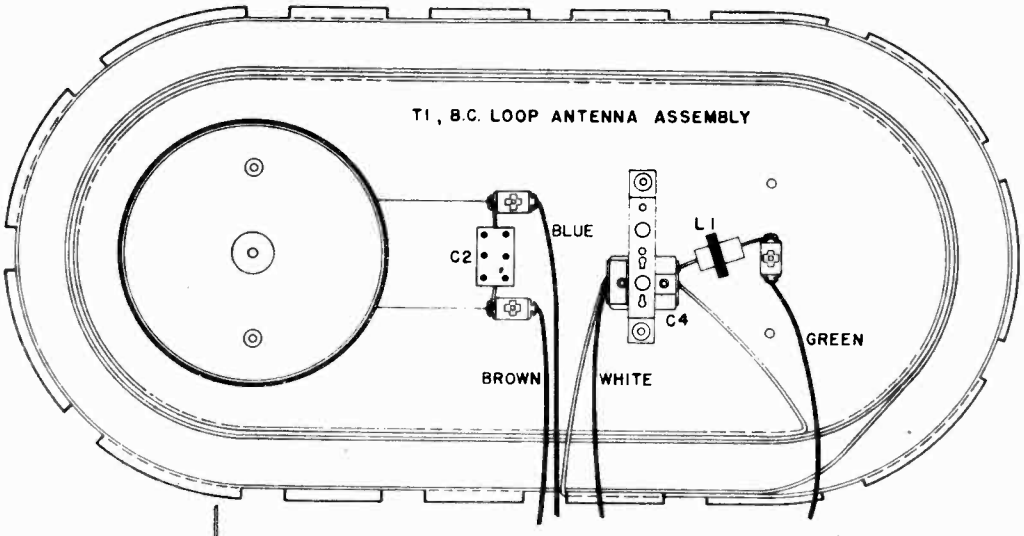
OPERATION	ALIGNMENT OF	GENERATOR CONNECTED TO	DUMMY ANTENNA	GENERATOR FREQUENCY	BAND SWITCH SETTING	DIAL AND CONDENSER SETTING	TRIMMER	REMARKS
1.	Set dial pointer to last mark at low frequency end of dial with gang condenser closed.							
2.	2nd. IF	12SA7 Grid & B–	.05 mf	455 KC	BC	open	C41 & C42	Max. Output
3.	1st. IF						C39 & C40	Max. Output
4.	BC	Ant. lead and B–	200 mmf.	1500 KC	BC	1500 KC	C13, C8, C4	Max. Output
5.				600 KC		600 KC	C14	Osc. Padder
6.	Repeat operations 4 and 5 until alignment frequencies fall on correct calibration points.							
7.	SW 1	Ant. lead and B–	400 ohms (res.)	5 MC	1	5 MC	C15, C9, C5	Max. Output
8.				1800 KC		1800 KC		**
9.	SW 2	Ant. lead and B–	400 ohms (res.)	16 MC	2	16 MC	C16*, C10, C6	Max. Output
10.				6 MC		6 MC		**

* Rock dial while trimming C16 at 16 MC

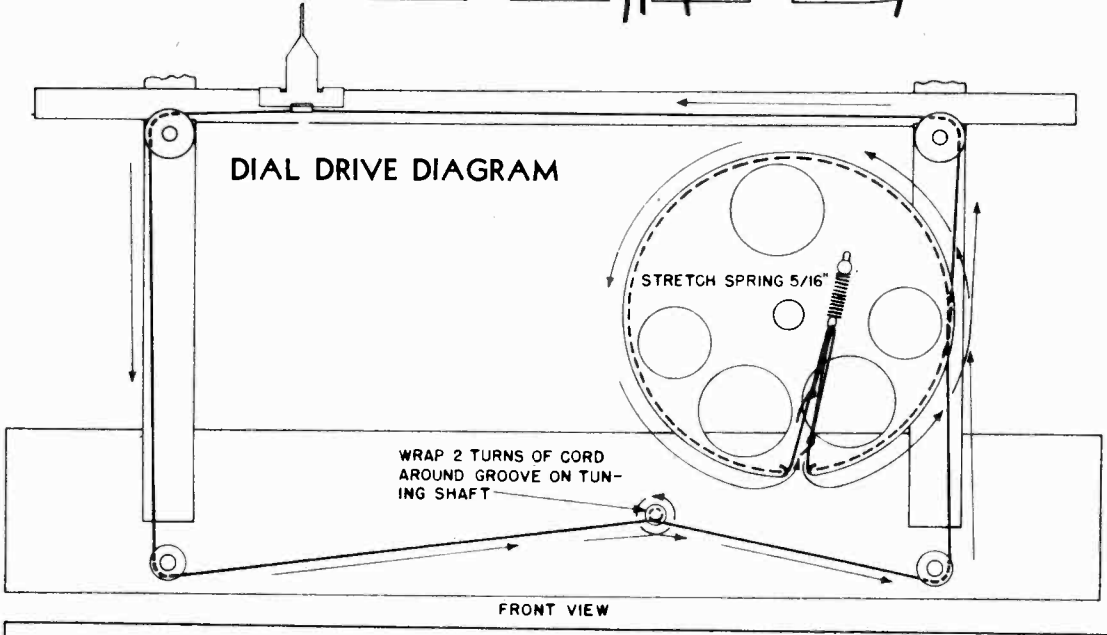
** Check sensitivity and dial calibration

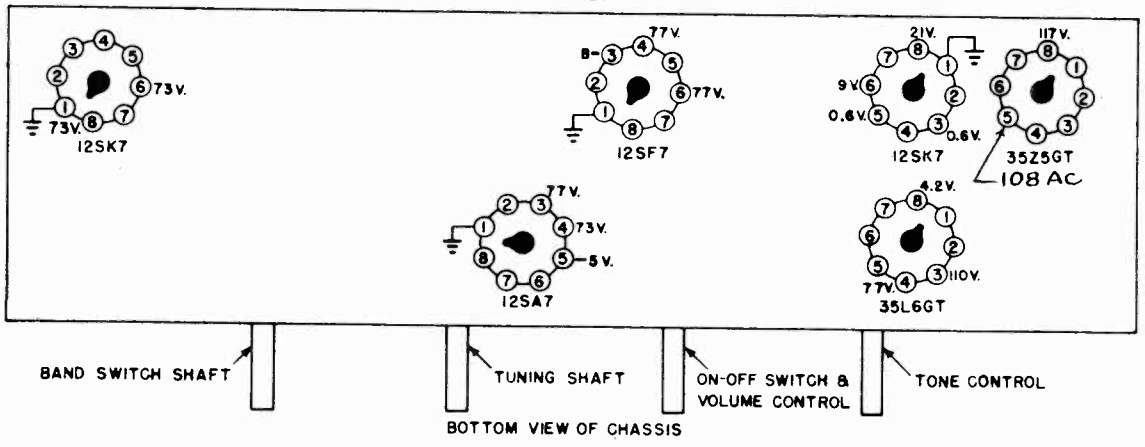
LEAR INC.

LOOP WIRING DIAGRAM

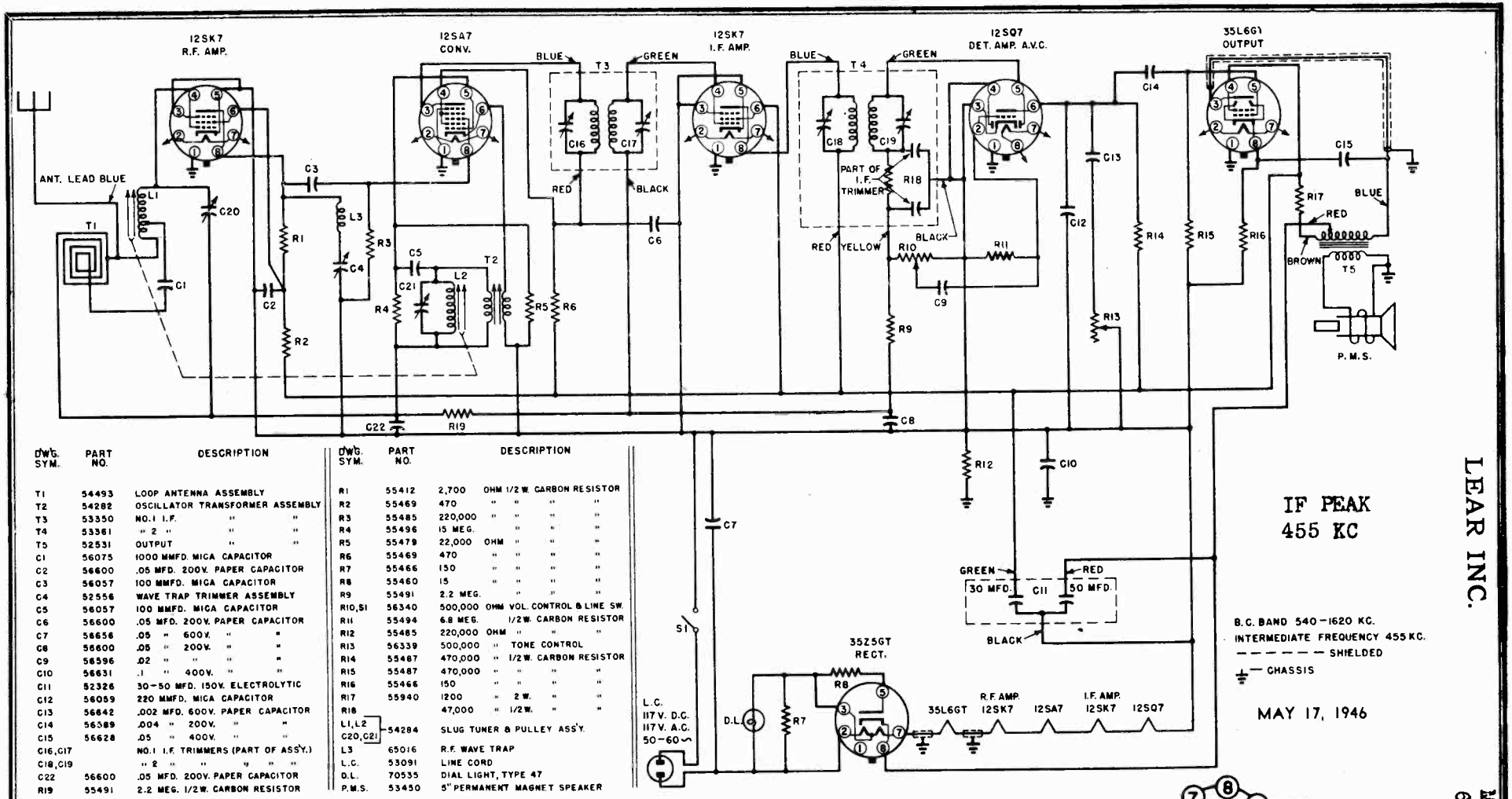


DIAL DRIVE DIAGRAM





Notes: Voltage readings are for schematic diagram in this bulletin, Allow 10% ± on all measurements.
Always use meter scale which will give greatest deflection within scale limits.
All DC measurements made with 1000 ohms per volt voltmeter.
Voltages are DC unless otherwise specified.
All voltages measured from prong No. 3 of 12SF7 tube socket, or B-.



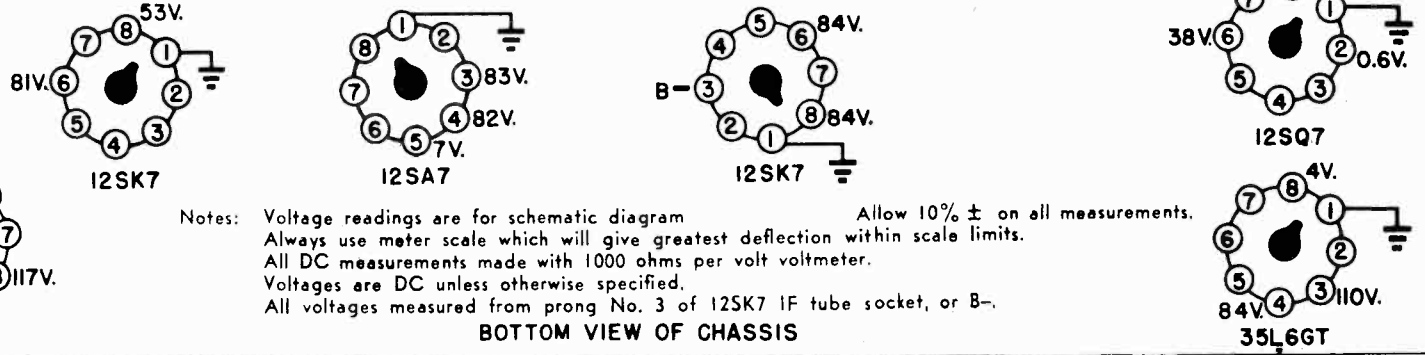
DWG. SYM.	PART NO.	DESCRIPTION
T1	54493	LOOP ANTENNA ASSEMBLY
T2	54282	OSCILLATOR TRANSFORMER ASSEMBLY
T3	53350	NO.1 I.F. " "
T4	53361	" 2 " " "
T5	52531	OUTPUT " "
C1	56075	1000 MMFD. MICA CAPACITOR
C2	56600	.05 MFD. 200V. PAPER CAPACITOR
C3	56057	100 MMFD. MICA CAPACITOR
C4	52556	WAVE TRAP TRIMMER ASSEMBLY
C5	56057	100 MMFD. MICA CAPACITOR
C6	56600	.05 MFD. 200V. PAPER CAPACITOR
C7	56656	.05 " 600V. " "
C8	56600	.05 " 200V. " "
C9	56596	.02 " " " "
C10	56631	.1 " 400V. " "
C11	52326	30-50 MFD. 150V. ELECTROLYTIC
C12	56059	220 MMFD. MICA CAPACITOR
C13	56642	.002 MFD. 600V. PAPER CAPACITOR
C14	56589	.004 " 200V. " "
C15	56628	.05 " 400V. " "
C16,C17		NO.1 I.F. TRIMMERS (PART OF ASS'Y.)
C18,C19		" 2 " " " " "
C22	56600	.05 MFD. 200V. PAPER CAPACITOR
R19	55491	2.2 MEG. 1/2W. CARBON RESISTOR

DWG. SYM.	PART NO.	DESCRIPTION
R1	55412	2,700 OHM 1/2 W. CARBON RESISTOR
R2	55469	470 " " " "
R3	55485	220,000 " " " "
R4	55496	15 MEG. " " "
R5	55479	22,000 OHM " " "
R6	55469	470 " " " "
R7	55466	150 " " " "
R8	55460	15 " " " "
R9	55491	2.2 MEG. " " "
R10,S1	56340	500,000 OHM VOL. CONTROL & LINE SW.
R11	55494	6.8 MEG. 1/2W. CARBON RESISTOR
R12	55485	220,000 OHM " " "
R13	56339	500,000 " TONE CONTROL
R14	55487	470,000 " 1/2W. CARBON RESISTOR
R15	55487	470,000 " " " "
R16	55466	150 " " " "
R17	55940	1200 " 2 W. " "
R18		47,000 " 1/2W. " "
L1,L2 C20,C21	54284	SLUG TUNER & PULLEY ASS'Y.
L3	65016	R.F. WAVE TRAP
L.C.	53091	LINE CORD
D.L.	70535	DIAL LIGHT, TYPE 47
P.M.S.	53450	5" PERMANENT MAGNET SPEAKER

IF PEAK
455 KC

B.C. BAND 540-1620 KC.
INTERMEDIATE FREQUENCY 455 KC.
- - - - - - SHIELDED
⏚ — CHASSIS

MAY 17, 1946

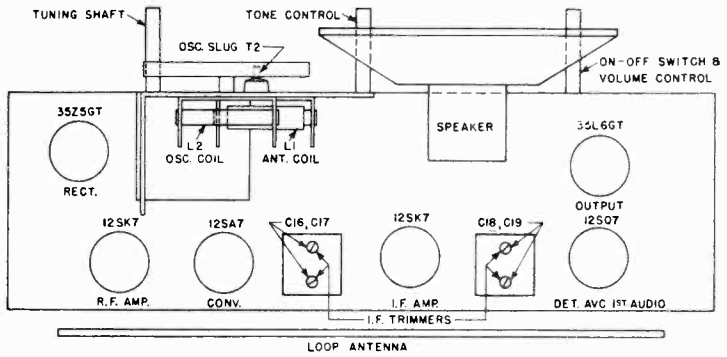


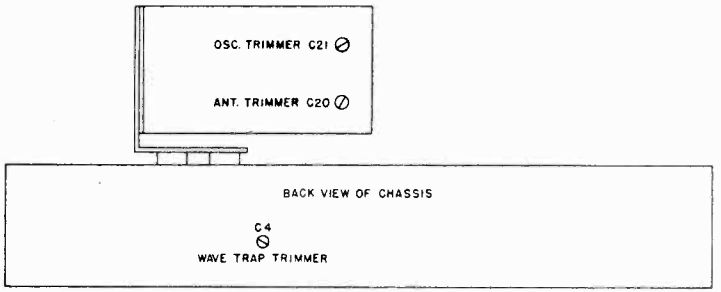
Notes: Voltage readings are for schematic diagram. Allow 10% ± on all measurements.
Always use meter scale which will give greatest deflection within scale limits.
All DC measurements made with 1000 ohms per volt voltmeter.
Voltages are DC unless otherwise specified.
All voltages measured from prong No. 3 of 12SK7 IF tube socket, or B-.

BOTTOM VIEW OF CHASSIS

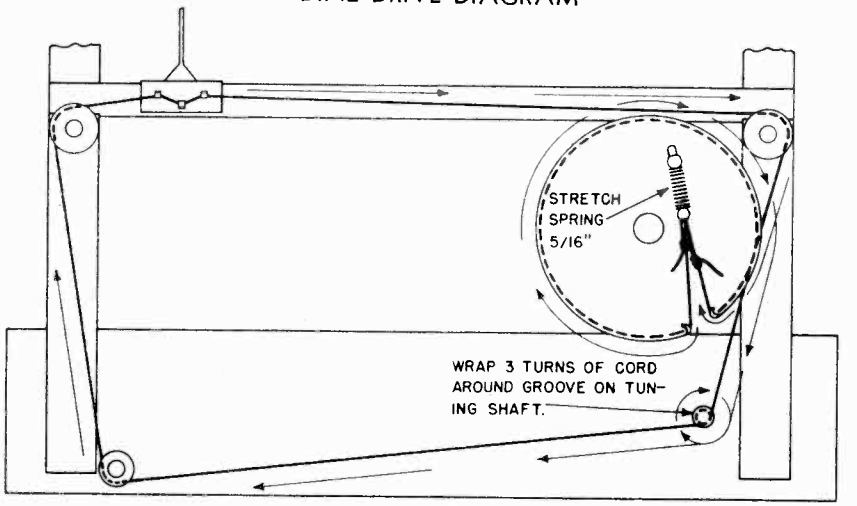
LEAR INC.
MODELS 6614, 6615, 6616, 6619

LEAR PAGE 15-7



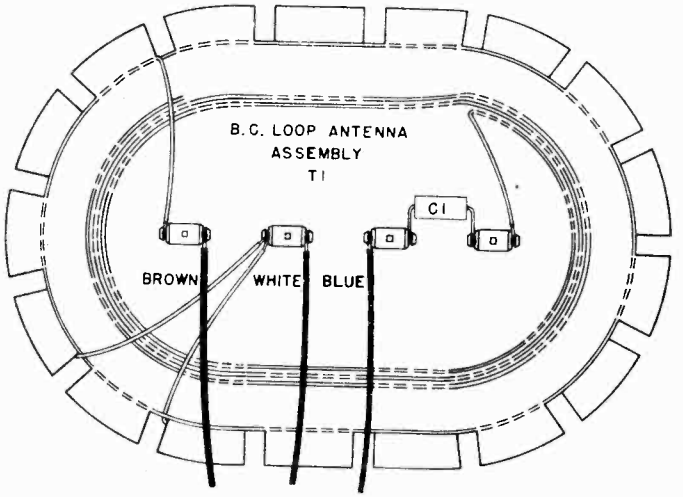


DIAL DRIVE DIAGRAM



FRONT VIEW

LOOP WIRING DIAGRAM



ALIGNMENT CHART

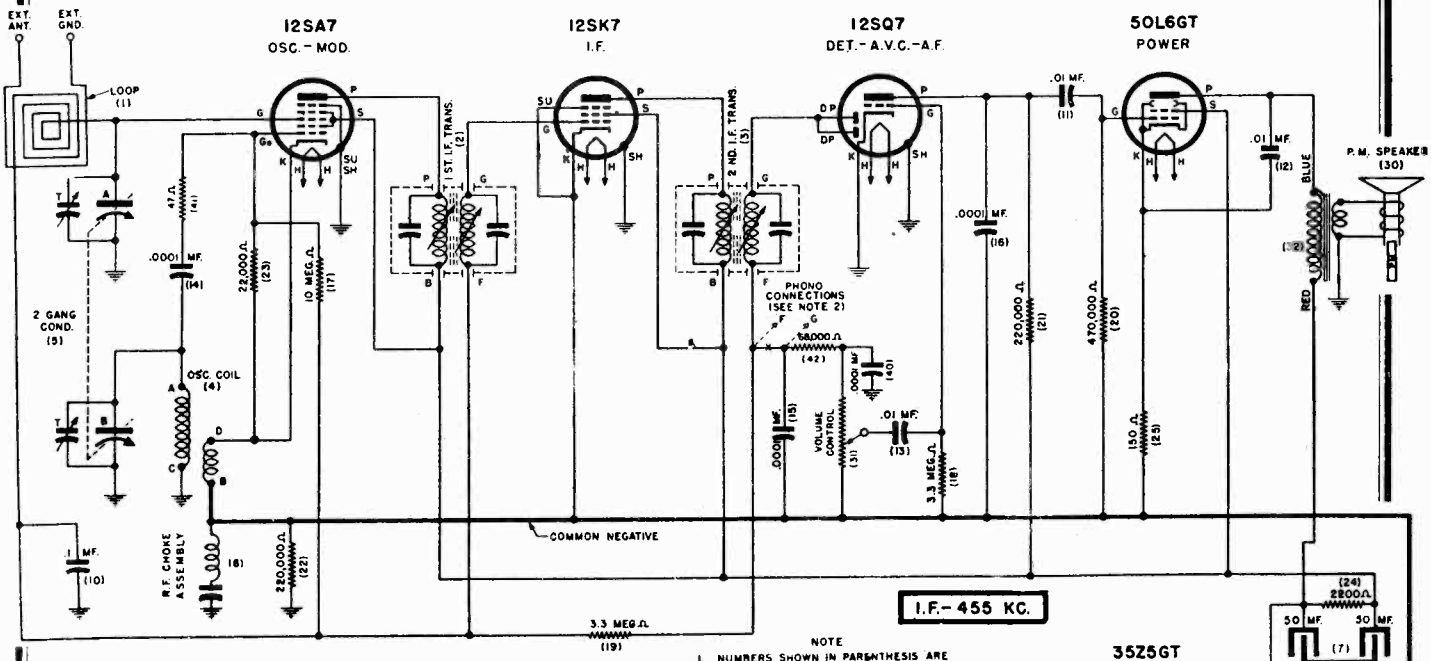
OPERATION	ALIGNMENT OF	GENERATOR CONNECTED TO	DUMMY ANTENNA	GENERATOR FREQUENCY	DIAL SETTING	TRIMMER	REMARKS
1	Set dial pointer at 1620 KC with tuning unit drive turned fully clockwise against stop.						
2	2nd IF	Pin No. 8 of 12SA7 and B–	.05 mf.	455 KC	1620 KC	C18, C19	Max. Output
3	1st IF					C16, C17	Max. Output
4	Wave Trap	Antenna lead (blue wire) and B–	200 mmf.	455 KC	1620 KC	C4	Min. Output
5	Osc. Trim			1620 KC	1620 KC	C21	Max. Output
6	Ant. Trim			1500 KC	1500 KC	C22	Max. Output
7	Osc. Slug			600 KC	600 KC	T2	Max. Output*
8	Repeat adjustments in operations 5 and 6 until no further increase in output is obtained.						

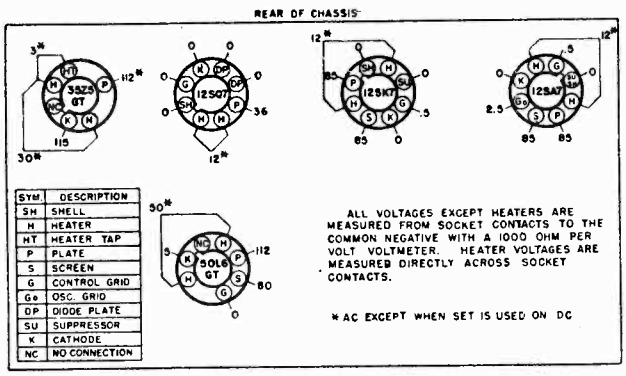
* Rock dial tuner slightly while adjusting T2.

Notes: Connect output meter to voice coil circuit.
Volume control on full for all adjustments.
Signal generator gain control at minimum for satisfactory output meter reading.

LINCOLN RADIO & TELEV. CORP.

MODEL 5A-110





ALL VOLTAGES EXCEPT HEATERS ARE MEASURED FROM SOCKET CONTACTS TO THE COMMON NEGATIVE WITH A 1000 OHM PER VOLT VOLTMETER. HEATER VOLTAGES ARE MEASURED DIRECTLY ACROSS SOCKET CONTACTS.

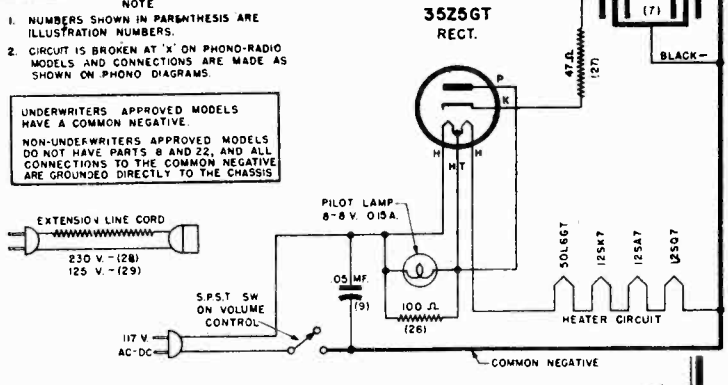
* AC EXCEPT WHEN SET IS USED ON DC

VOLTAGE TABLE
(BOTTOM VIEW OF CHASSIS)

NOTE
1. NUMBERS SHOWN IN PARENTHESIS ARE ILLUSTRATION NUMBERS.
2. CIRCUIT IS BROKEN AT 'X' ON PHONO-RADIO MODELS AND CONNECTIONS ARE MADE AS SHOWN ON PHONO DIAGRAMS.

UNDERWRITERS APPROVED MODELS HAVE A COMMON NEGATIVE.

NON-UNDERWRITERS APPROVED MODELS DO NOT HAVE PARTS 8 AND 22, AND ALL CONNECTIONS TO THE COMMON NEGATIVE ARE GROUNDED DIRECTLY TO THE CHASSIS



—7-46—

PART NO 284-8

Ill. No.	Part No.	Part Name	Description
1	20E24	Antenna	Loop
2	20E21	Coil	1st I.F. Transformer
3	20E22	Coil	2nd I.F. Transformer
4	20E162	Coil	Oscillator
5	24E2	Condenser	Tuning, 2 Gang (3 Hole Mtg.)
5	24E18	Condenser	Tuning, 2 Gang (2 Hole Mtg.)
7	25E1	Condenser	Dry Electrolytic, 50-50 Mfd. 150 V.
8	20E75	Choke	R.F. Choke Assembly (Und. Appd. Only)
9	23E416	Condenser	Tubular, .05 Mfd. 400 Volts
10	23E218	Condenser	Tubular, .1 Mfd. 200 Volts
11	23E211	Condenser	Tubular, .01 Mfd. 200 Volts
12	23E211	Condenser	Tubular, .01 Mfd. 200 Volts
13	23E211	Condenser	Tubular, .01 Mfd. 200 Volts
14	23E39	Condenser	Mica, .0001 Mfd.
15	23E39	Condenser	Mica, .0001 Mfd.
16	23E39	Condenser	Mica, .0001 Mfd.
17	27E106	Resistor	Carbon, 10 Megohm 1/3 Watt
18	27E335	Resistor	Carbon, 3.3 Megohm 1/3 Watt
19	27E335	Resistor	Carbon, 3.3 Megohm 1/3 Watt
20	27E474	Resistor	Carbon, 470,000 Ohm 1/3 Watt
21	27E224	Resistor	Carbon, 220,000 Ohm 1/3 Watt
22	27E224	Resistor	Carbon, 220,000 Ohm 1/3 Watt (Und. Appd. Only)
23	27E223	Resistor	Carbon, 22,000 Ohm 1/3 Watt
24	27E222-2	Resistor	Carbon, 2,200 Ohm 1 Watt
25	27E151	Resistor	Carbon, 150 Ohm 1/3 Watt
26	27E101	Resistor	Carbon, 100 Ohm 1/3 Watt
27	27E470-2	Resistor	Carbon, 47 Ohm 1/2 Watt
28		Resistor	230 Volt Extension Line Cord. Used in models not Underwriters Apprd.
29		Resistor	125 Volt Extension Line Cord. Used in models not Underwriters Apprd.
30	1E9	Speaker	5" PM
31	28E1	Volume Control	With S.P.S.T. Switch
32	22E2	Transformer	Output for Speaker
40	23E39	Condenser	Mica, .001 Mfd.
42	27E683	Resistor	Carbon, 68,000 Ohm, 1/3 W.

Part No.	Part Name	Description
7E85	Cabinet	Wood
7E86	Cabinet Back	
41E1	Cord	6 Ft. Rubber Line Cord
5E14-1	Dial Plate	Dial Back Plate Less Scale
4E1	Dial Cord	30" of 18 Lb. Dial Drive Cord
9E2	Dial Crystal	Acetate Dial Crystal
36E24-1	Dial Scale	Calibrated Scale
68E1	Dial Shaft	Drive Shaft

Part No.	Part Name	Description
19E3	Dial Shaft Bearing	Bearing For Drive Shaft
35E8	Dial Pointer	Dial Indicator
65E2	Dial Spring	Tension Spring For Drive Cord
37E27-1	Knob	
20E43	Pilot Lamp Socket	Pilot Lamp Socket Assembly
40E1	Pilot Lamp	6-8 Volt .150 Amp. Type 47 Lamp

For alignment procedure read tabulations from left to right, and make the adjustment marked (1) first, (2) next, (3) third.

Before starting alignment:

(a) Check tuning dial adjustment by tuning gang condenser until plates touch maximum capacity stop (completely in mesh) at which point the dial needle must be exactly even with the last line at the low frequency end of the dial calibration. If dial needle does not point exactly to last line move to correct position.

(b) Use an accurately calibrated test oscillator with some type of output measuring device.

(c) PLACE LOOP ANTENNA IN THE SAME POSITION IT WILL BE IN WHEN THE SET IS IN THE CABINET.

Steps	Set receiver dial to:	TEST OSCILLATOR: Adjust test oscillator frequency to:	TEST OSCILLATOR: Use dummy antenna in series with output of test oscillator consisting of:	TEST OSCILLATOR: Attach output of test oscillator to:	Refer to parts layout diagram for location of trimmers mentioned below:
1	Any point where no interfering signal is received.	455 K. C.	.02 MFD. condenser	High side to rear stator plates of tuning condenser. Low side to frame of condenser through a .02 Mfd. blocking condenser.	Adjust each of the second I. F. transformer trimmers for maximum output—then adjust each of the first I. F. trimmers for maximum output.
2	Exactly 1730 K. C.	Exactly 1730 K. C.	.00025 MFD. condenser	Receiver blue antenna lead Receiver black ground lead	Adjust 1730 K. C. oscillator trimmer for maximum output.
3	Approx. 1400 K. C.	Exactly 1400 K. C.	.00025 MFD. condenser	Receiver blue antenna lead Receiver black ground lead	While rocking gang condenser adjust 1400 K. C. antenna trimmer for maximum output.