RCA VICTOR MODEL M-109

"De Luxe," Seven-Tube Superheterodyne Automobile Receiver

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Power Supply	6.3 Volts (Battery)
Current Consumption	7.2 Amperes
Tuning Range	540 KC. to 1600 KC.
Maximum Power Output	6.0 Watts (Audio)
Undistorted Power Output	3.5 Watts (Audio)
Loudspeaker	8 inch, Electrodynamic
Pilot Lamp	Mazda No. 50, 6–8 Volts
Radiotron Complement	(1) RCA-6D6 R.F. Amplifier (2) RCA-6A7 Oscillator and First Detector (3) RCA-6D6 I.F. Amplifier (4) RCA-6B7 Second Detector, A.F. Amplifier and A.V.C. (5) RCA-76 A.F. Amplifier (6) RCA-6A6 Power Output (7) RCA-84 Rectifier
Alignment Frequencies	175 KC. (i-f), 1400 KC. (r-f and osc.), 600 KC. (osc.)

PHYSICAL SPECIFICATIONS

	Receiver	*Loudspeaker*
Height	6⅛ Inches	8⅝ Inches
Width	7⅜ Inches	8⅝ Inches
Depth	7 Inches	5⅝ Inches

This "De Luxe" Auto Receiver is a ruggedly constructed, two-unit assembly. The six-tube receiver chassis is contained in a substantial case which is separate from that housing the large electro-dynamic loudspeaker and power unit. Each unit is constructed very compactly to simplify mounting. The compactness is engineered in such a manner as to maintain efficiency of electrical performance.

A newly designed control unit is attached by the usual method through flexible drive shafts to the receiver chassis. No external wiring other than the pilot light supply connects to the remote-control. The principal drive shafts are easily adaptable to practically any location chosen for the receiver unit. A combination volume control-power switch and the tuning control appear on the remote-control unit. A continuously variable high-frequency tone control is mounted on the speaker unit.

Equipment provided for inversion of the regular storage-battery supply to the high voltage required for plate and grid potentials consists of a combination vibrator and tube-rectifier unit. The assembly is installed within the loudspeaker housing, and its output conducted to the receiver chassis through a double shielded cable. This separated layout of power-supply unit and receiver chassis minimizes disturbances likely to be introduced from proximity of the two, in combined assemblies.

The necessity for use of suppressor resistors on the ignition system of modern cars has been eliminated in the design of this receiver. A selective "noise filter" system at the receiver input and a systematic wiring layout account for the reduction of ignition noise without the use of the suppressors.

DESCRIPTION OF ELECTRICAL CIRCUIT

The electrical arrangement of the receiver is shown in the schematic of Figure 3. A corresponding wiring layout is shown in Figure 4, where the actual physical relations and coding of conductors are given.

The tube line-up in the superheterodyne circuit consists of seven Radiotrons. In sequence, there is an r-f stage, a dual first detector and oscillator stage, a single i-f stage, a combined second detector-audio amplifier-a.v.c. stage, an audio driver stage, a push-pull power output stage, and a full-wave rectifier. There are five circuits which are tuned to the signal desired, to strengthen its magnitude and reject undesired signals and interference.

The following describes the functions of the various stages of the receiver: Beginning at the antenna circuit, there is a special transmission line and "noise filter" circuit, which, in conjunction with the tuned input system, acts selectively to the entire broadcast range and drastically attenuates signals and interference outside the limits of the band (540–1600 kc.). These properties of the filter circuit and minimizing of primary to secondary capacity coupling in first r-f transformer cause a very great reduction of the ignition noise present when the car is in operation. The ground of the input coil does not appear at the usual point on the chassis frame, but instead is extended as part of the antenna transmission line lead-in to the outer termination of the shield, where it grounds to the frame of the car. This arrangement prevents r-f disturbances which are circulating in the car frame (ground) from becoming mutual to the receiver input. The characteristics of the transmission line section of the antenna lead-in are such as to favor the operation of the noise filter. Its distributed capacitance due to length, conductor sizes, insulation, etc., is of such value as to operate with the inductance and capacitance elements of the input system to obtain a "band-pass" filtering effect. The filter has an acceptance band between 540 kc. and 1600 kc., and sharply defined cut-off below and above these two limits. It is generally possible, because of this input arrangement, to dispense with the usual spark-plug and distributor suppressors without encountering substantial ignition interference on latest types of cars.

After passing through the input filter the signal is applied by transformer action to the control grid of the r-f stage. An RCA-6D6 at this point performs the function of an r-f amplifier, its super-control property being adapted as means of preventing cross-modulation and securing a wide range of volume control. The first (front) section of the tuning condenser is connected to sharply tune the secondary of the antenna coupling transformer.

A second r-f coupling transformer transmits the signal to the following receiver stage, which comprises a combination first detector and local oscillator. The secondary inductance of this transformer is tuned by the second (center) section of the variable capacitor and connects to the detector grid of the RCA-6A7 Radiotron. The local oscillator circuit is established by mutual arrangement of the several elements within this tube. Here the incoming signal is mixed with the local oscillator frequency. The difference frequency beat (i. f.) of these two combined signals is detected by the tube and transferred by a closely coupled transformer to the intermediate-frequency amplifier tube, an RCA-6D6. Both windings of this i-f transformer are tuned by trimmers. The second i-f transformer which joins the RCA-6D6 to the second detector stage has only one trimmer, that being in shunt with its primary winding.

The RCA-6B7 second detector stage receives the i-f signal on its diode plates. Detection takes place as a result of the rectifying action of the diodes and develops a current through the resistors R7 and R10. The d-c voltage drop across the resistance R7 plus R10 is used for automatically regulating the control grid bias of the r-f and first detector stages. The amplification thus becomes dependent upon the signal strength. This process (a.v.c.) compensates for fading signals and tendency toward reduction of signals due to change of antenna direction and shielding effect of buildings, etc. A smaller portion of the d-c voltage obtained by detection is tapped from the juncture of R7 and R10 and is carried to the control grid of the i-f stage. This likewise furnishes automatic volume control, but in a smaller degree.

The audio and d-c components of the detected signal are selected from the resistor R10 by its movable arm and applied to the control grid of the RCA-6B7. The d-c obtained from the signal and applied to the grid prevents overload as the volume control is advanced. Amplification results and the signal passes on to the audio-driver stage. The RCA-76 Radiotron used as an a-f amplifier is resistance-capacitance coupled to the detector stage output. Its plate is matched to the power output stage by a transformer.

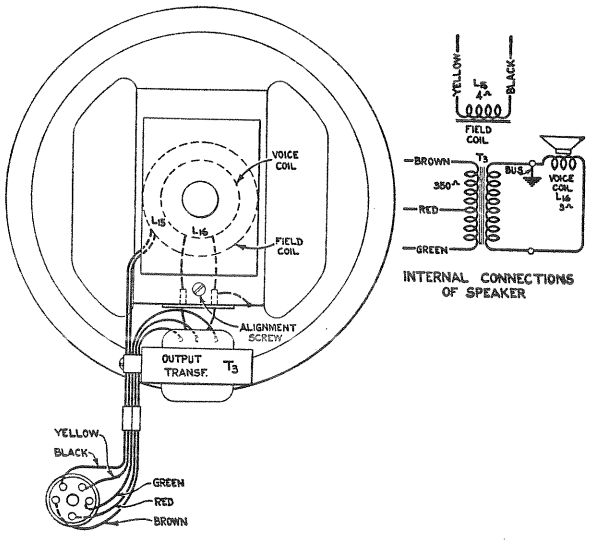

Figure 1—Loudspeaker Wiring

The output stage utilizes an RCA-6A6 tube which performs as a push-pull type. It delivers a high level-high quality signal to the remote loudspeaker unit.

The power supply system consists of a mechanical vibrator for interrupting the d-c from the battery in order to transform the current to high voltage, which in turn is rectified by a full-wave tube, an RCA-84. The vibrator used is adapted for convenient removability by having its base constructed for "plug-in" mounting.

SERVICE DATA

The general mechanical layout of this receiver is judiciously arranged to facilitate any tests, repairs or adjustments that may become necessary. All information needed for proper servicing is presented by the schematics, wiring diagrams and text of this booklet.

LINE-UP ADJUSTMENTS

Maximum efficiency and best quality of performance can only be obtained when the receiver circuits are in correct alignment. The circuits should be realigned after each major service operation and whenever there are positive indications that the adjustments have deviated from normal by ordinary usage.

A definite procedure must be adhered to in readjusting the line-up trimmers. Proper oscillator and indication equipment are also required. Certain standard service instruments, useful for receiver adjusting, have been devised and made available by the manufacturer of this receiver. These are illustrated and described on Page 2.

Preparatory Details

(a) **Dial Calibration**—The tuning condenser flexible shaft engages a gear system within the control unit which actuates the dial pointer. To adjust the mechanical relations of the variable condenser and the dial pointer so that accurate calibration is obtained:—rotate the station selector knob until the variable capacitor is at full mesh, which will carry the dial pointer to its minimum frequency position; then remove the tuning knob, loosen the set screw in the bushing and rotate the bushing until the pointer sets exactly opposite the last radial line at the low-frequency end of the scale. (The line referred to is the second one counter-clockwise of the 550 kc. marking.)

(b) **General Procedure**—The "Output Indicator" should be attached to the voice coil or speaker input circuit; and for each adjustment, the oscillator output increased until a noticeable registration or glow occurs on the indicator. The signal from the oscillator should be held as low as possible consistent with getting a good indication, with the receiver volume control at its maximum position. This method of procedure prevents the automatic volume control from affecting the adjustments.

I-F Adjustments

Three trimmers are provided in the i-f system. Two are located on the first i-f transformer, and one on the second i-f transformer. Their physical positions are

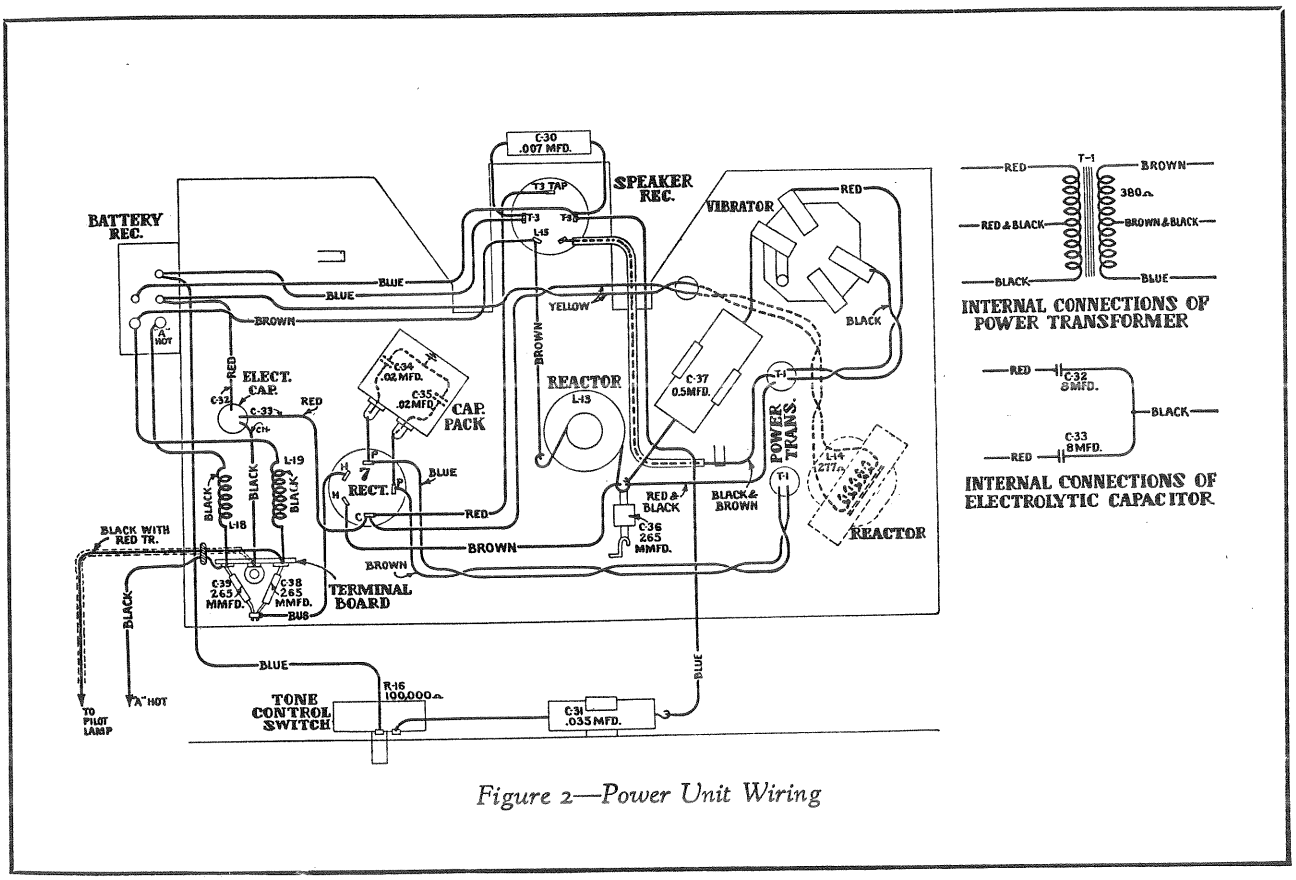

Figure 2—Power Unit Wiring

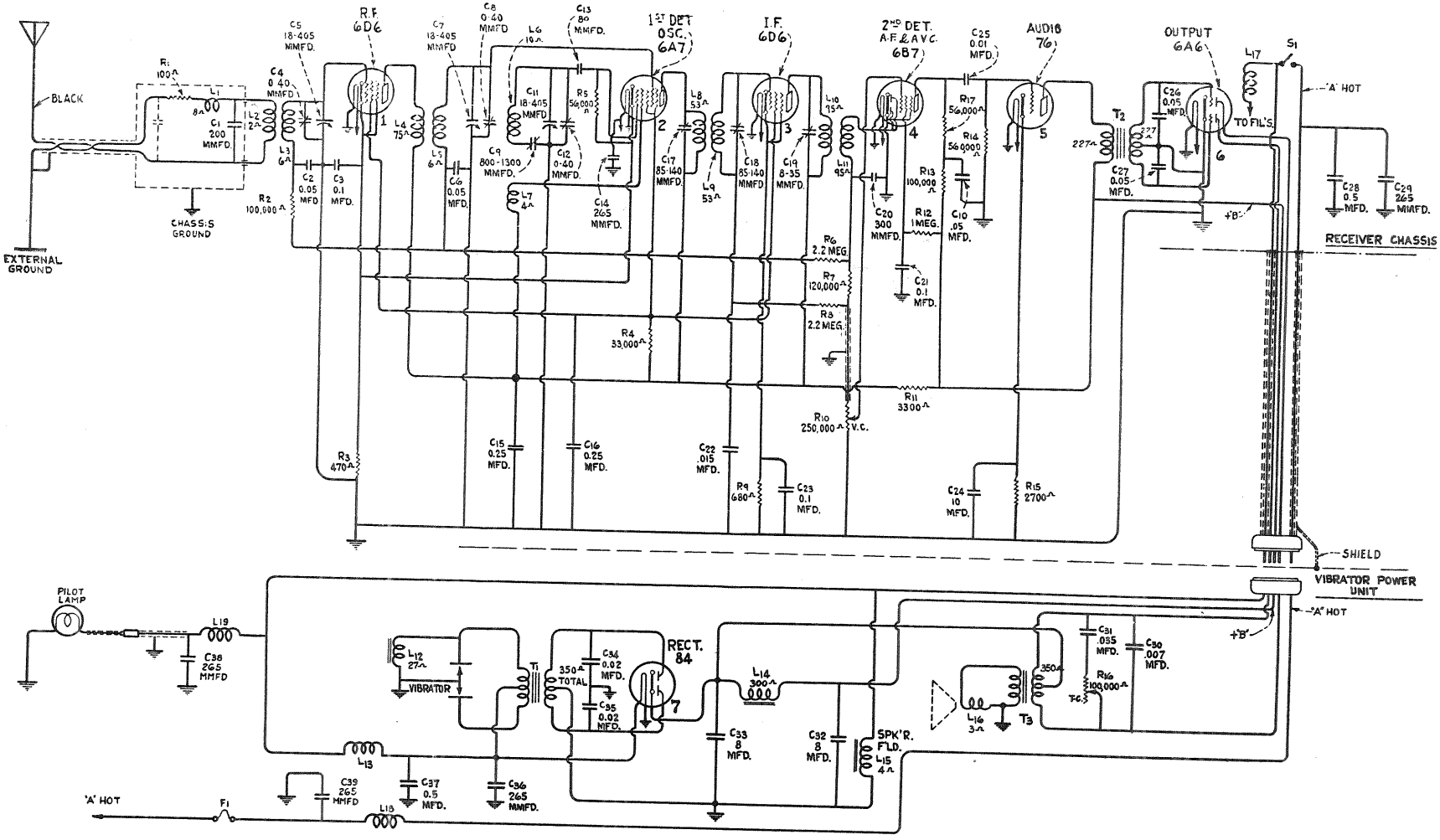

Figure 3—Schematic Circuit Diagram

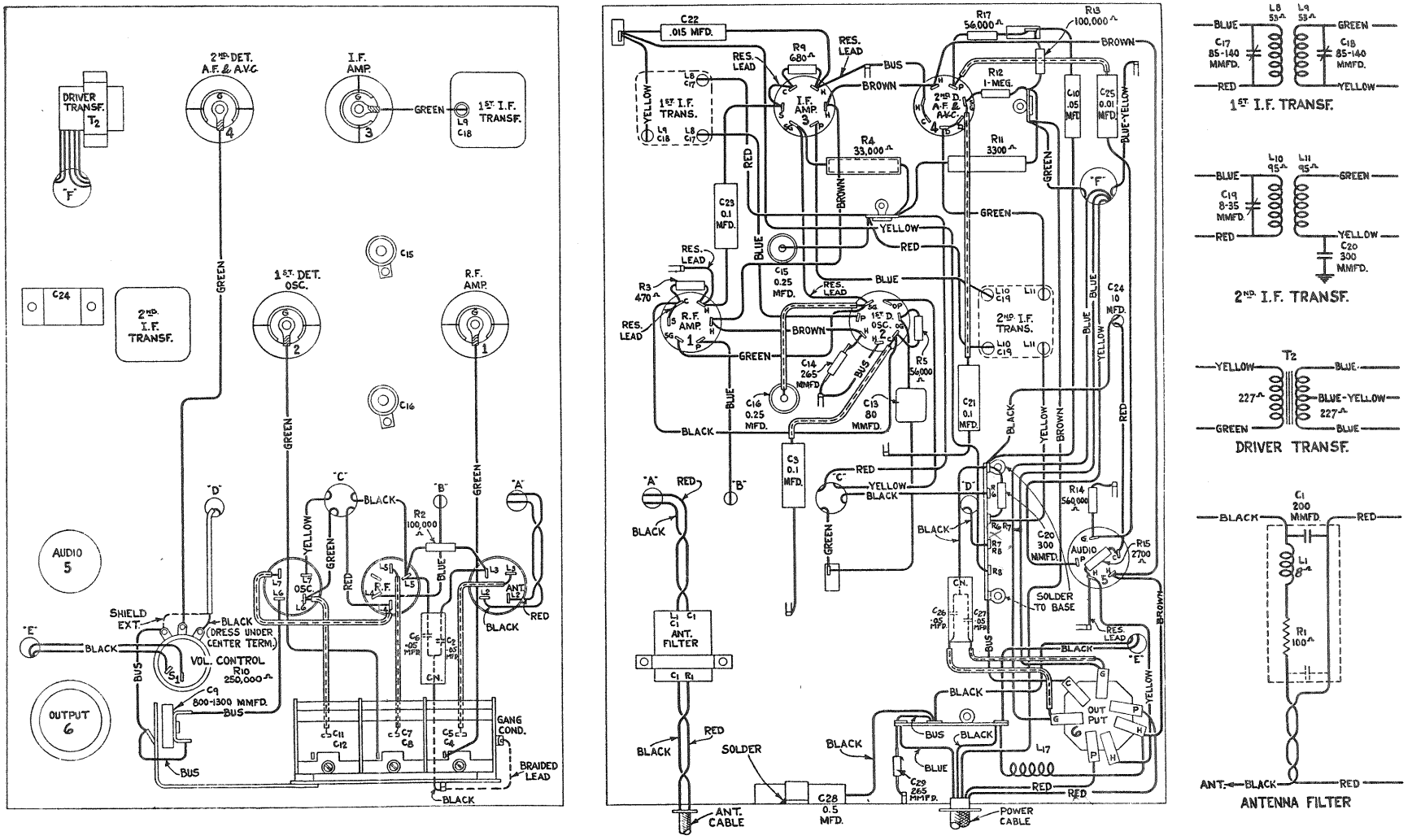

Figure 4—Chassis Wiring Diagram

shown in Figure 5. To correct their alignment proceed as follows:

(a) Connect the output of the "Full Range Oscillator" to the first detector grid and ground, and adjust its frequency to 175 kc. Tune the station selector to a point where no signals are received.

(b) Tune each of the trimmer capacitors C19, C18 and C17 in order. C19 should be set for maximum (peak) output. C18 and C17 should be roughly adjusted for maximum output and then carefully "trimmed" so that a flat-topped response is obtained. This may be checked by shifting the external oscillator frequency through a range two kilocycles each side of the 175 kc. and noting whether or not the receiver output remains substantially constant.

R. F., Detector and Oscillator Adjustments

Three adjustments are used at the high-frequency end of the tuning range. They are located on the gang condenser as shown by the diagram of Figure 5. One trimmer (C9) is used in the oscillator circuit for alignment at 600 kc., it being located as shown in Figure 5.

The external oscillator should be connected to the antenna-ground input at the outer end of the lead-in shield through a 300-ohm resistor in the antenna side. Tuning should be done as follows:

(a) Adjust the frequency of the external oscillator to 1400 kc. and turn the station selector until the dial pointer is at the 1400 kc. marking.

(b) Tune the oscillator high-frequency trimmer, C12, the detector trimmer C8 and the r-f trimmer C4 for maximum receiver output.

(c) Set the external oscillator to a frequency of 600 kc. and rotate the station selector until this signal is accurately tuned. Then adjust the oscillator trimmer C9, simultaneously rocking the tuning condenser slowly through the signal until maximum obtainable output results from the two combined operations. This adjustment should be made irrespective of dial calibration.

(d) Recheck the adjustment of the 1400 kc. oscillator trimmer (C12) as in (b) to correct any reflective errors caused by the procedure of (c).

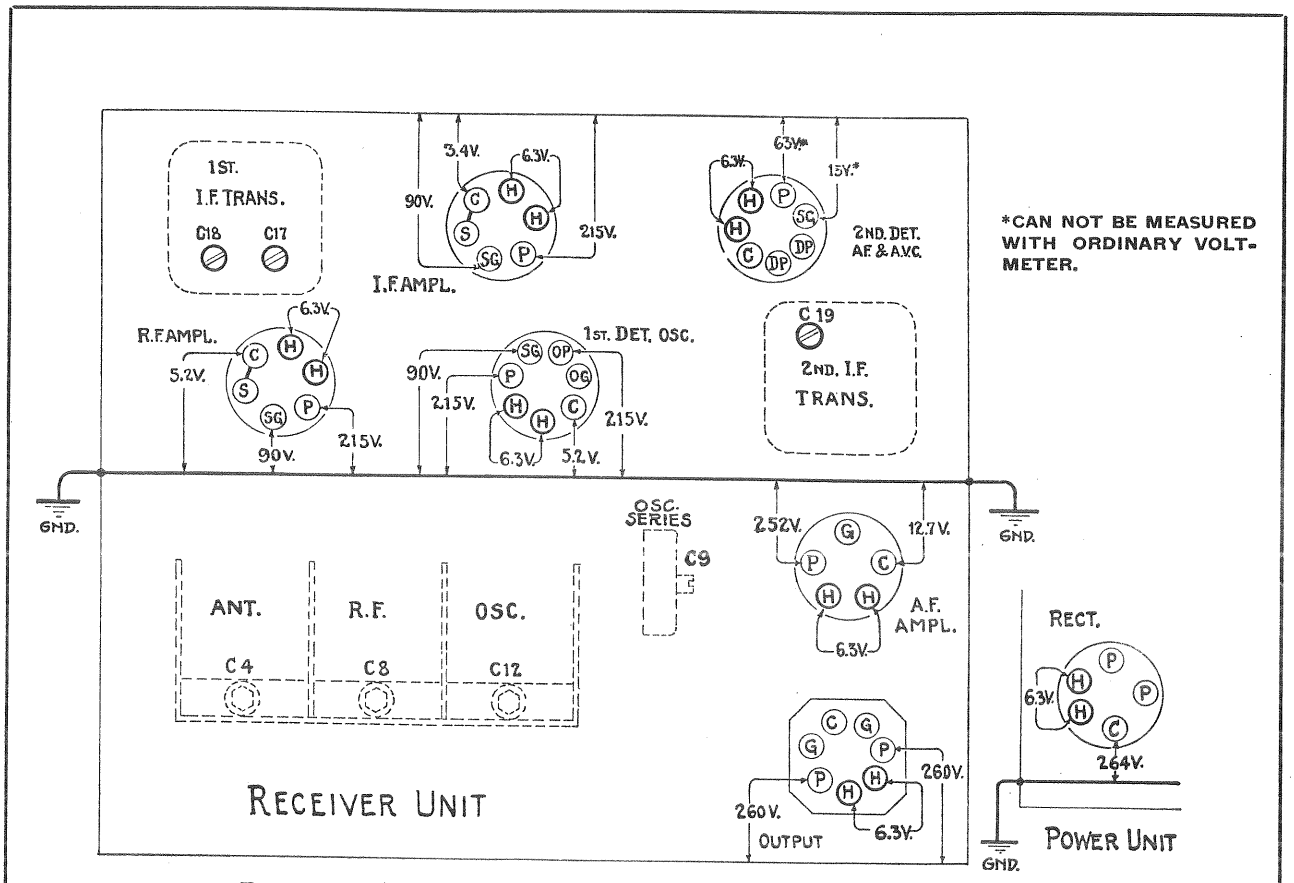

Figure 5—Trimmer Locations and Radiotron Socket Voltages to Ground (Measured at 6.6 volts battery—Volume Control Maximum—No Signal)

Radiotrons

Under ordinary usage within the ratings specified for voltage supply tube life will be consistent with that obtained in other applications. Their deterioration and approach to failure is usually evidenced by noisy or intermittent operation, loss of sensitivity and distorted tone quality.

It is not feasible to test the Radiotrons in the receiver sockets due to likelihood of errors being caused by the associated circuits. Their removal and check with standard tube testing apparatus is therefore advisable.

Tuning Condenser Drive

The coupling of the flexible drive shaft to the variable tuning condenser is through a worm-gear arrangement. Figure 6 shows the two gears and their

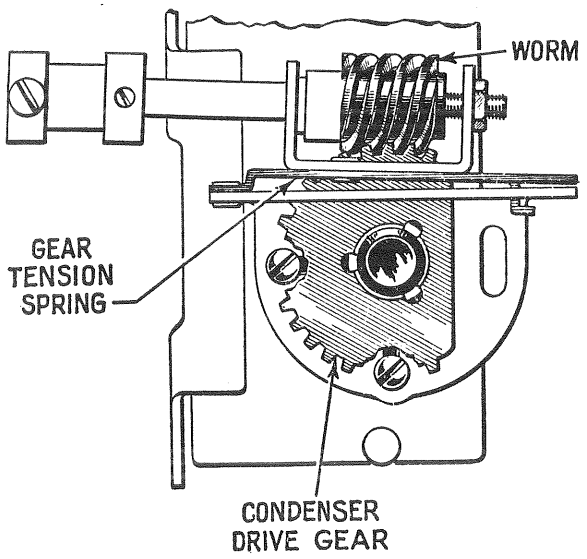

Figure 6—Condenser Drive Mechanism

positions. Smooth operation should be obtained over the entire tuning range. The presence of binding or backlash may cause irregularity in the tuning. To correct these conditions, it will be necessary to remove the chassis from the case and the following procedure applied:—Loosen the two screws behind the condenser drive gear which clamp the worm-gear support plate, and shift the plate upward or downward to change the degree of gear mesh and tension of the spring as required for smooth operation. The screws should then be carefully re-tightened.

Pilot Lamp

A novel type of mounting is provided for the pilot lamp. It consists of a miniature socket attached to a heavy screw which threads into the case of the control unit. The head of this screw is accessible from the underside of the control unit and may be removed with a large screwdriver whenever it becomes necessary to replace the pilot lamp. The power switch should be turned to "off" in order to prevent blowing the fuse if the lamp socket should come in contact with the grounded control case.

Power Unit Interrupter

The mechanical interrupter used in combination with a tube rectifier in the power unit is constructed so as to be conveniently exchanged. Its base is of the "plug-in" type. The adjustments of this device have been correctly set during manufacture by means of special equipment. They should therefore be left undisturbed. In cases of faulty operation, a renewal should be installed.

Speaker Cone Alignment

In the event the cone coil becomes mis-aligned, it will be necessary to correct its centering by an adjustment provided on the speaker assembly. The coil is supported by an external spider. Two round-head brass screws secure its mounting. To center the cone, loosen these two screws and insert a small rod or nail into the hole adjacent to one of these screws and pry the cone mounting into the position which gives normal operation.

Miscellaneous Service Hints

1. The grounding of the outer end of the antenna lead shield is quite critical in that ignition interference may be minimized by selecting the proper point of attachment to the car frame, determined by experiment for each individual installation.

2. In some cars, ignition interference may be introduced through lack of sufficient shielding on the antenna lead-in. In such cases, a shield should be placed over the exposed section of lead and carried as near to the antenna as possible. It should be solidly grounded.

3. Interference in the form of a grating scratch may arise from static collecting on the front wheels of the car due to road surface friction in dry weather. The insulation caused by the grease of the wheel hub enables this action to develop. A number of devices are available through automotive supply dealers which are designed to eliminate this type of trouble. They all serve to form a solid grounding tie between the hub and the axle, and thus drain the static to the frame of the car (ground).

4. The screws holding the chassis to the case must all be in place and tightly installed, inasmuch as they appreciably affect the ground resistance of the assembly and will consequantly have a bearing on the amount of ignition noise received.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4993	Bumper — Rubber bumper for condenser mounting bracket—Package of 5	$0.25
4955	Capacitor — Adjustable trimmer capacitor (C9)	.48
4246	Capacitor—80 mmfd. (C13)	.24
5078	Capacitor—200 mmfd. (C14, C29)	.24
4248	Capacitor—300 mmfd. (C20)	.22
4792	Capacitor—0.015 mfd. (C22)	.22
4882	Capacitor—0.01 mfd. (C25)	.20
4886	Capacitor—0.05 mfd. (C10)	.20
4885	Capacitor—0.1 mfd. (C21)	.28
4841	Capacitor—0.1 mfd. (C3, C23)	.22
4967	Capacitor—0.25 mfd. (C15, C16)	.46
4011	Capacitor—0.5 mfd. generator capacitor	.60
5054	Capacitor—10 mfd. (C24)	1.80
4243	Capacitor pack—Comprising two 0.05 mfd. capacitors (C2, C6, C26, C27)	.35
5074	Clamp—Radiotron shield clamp	.14
4950	Coil—Antenna coil (L3, L4)	.74
5142	Coil—Choke coil (L17)	.15
6967	Coil—Oscillator coil (L6, L7)	.52
6966	Coil—R.F. coil (L4, L5)	.80
5061	Condenser—3-gang variable tuning condenser (C4, C5, C7, C8, C11, C12)	3.68
5018	Volume control (R10)	1.00
5163	Filter—Antenna filter (R1, C1, L1)	1.45
5062	Gear—Condenser drive gear—Located on condenser drive shaft	.12
5030	Resistor—Carbon type—¼ watt—470 ohms (R3)—Package of 5	1.00
5031	Resistor—680 ohms—Carbon type—¼ watt (R9)—Package of 5	1.00
5144	Resistor — 2700 ohms — Carbon type — ¼ watt (R15)—Package of 5	1.00
5147	Resistor — 3300 ohms — Carbon type — 1 watt (R11)	.22
5033	Resistor — 33,000 ohms — Carbon type — 1 watt (R4)—Package of 5	1.10
5029	Resistor—56,000 ohms—Carbon type—¼ watt (R5, R17)—Package of 5	1.00
3118	Resistor—100,000 ohms—Carbon type—¼ watt (R2, R13)—Package of 5	1.00
5035	Resistor—560,000 ohms—Carbon type—¼ watt (R14)—Package of 5	1.00
3033	Resistor—1 megohm—Carbon type—¼ watt (R12)—Package of 5	1.00
3584	Ring—Antenna, r-f, or oscillator coil retaining ring—Package of 5	$0.40
5129	Ring—Radiotron shield ring—Package of 5	.10
4953	Shield—First intermediate frequency transformer shield	.24
4956	Shield—Second intermediate frequency transformer shield	.30
5037	Shield—Radiotron shield	.15
5058	Socket—5-contact Radiotron socket	.18
4946	Socket—6-contact Radiotron socket	.18
4947	Socket—7-contact Radiotron socket	.18
5060	Socket—7-prong Radiotron output socket	.20
5064	Stud—Variable condenser bracket mounting assembly—Comprising one stud, one bushing, one washer and one lockwasher	.12
5057	Transformer—Driver transformer (T2)	1.00
5055	Transformer—First intermediate frequency transformer (L8, L9, C17, C18)	1.32
5056	Transformer—Second intermediate frequency transformer (L10, L11, C19)	1.42
5063	Worm—Condenser drive worm gear	.54
	POWER UNIT ASSEMBLIES	
5078	Capacitor—200 mmfd. (C36, C38, C39)	.24
5148	Capacitor—0.007 mfd. (C30)	.20
5073	Capacitor—0.035 mfd. high-frequency tone control capacitor (C31)	.44
4490	Capacitor—0.5 mfd. (C37)	.62
5070	Capacitor pack—Comprising two 0.02 mfd. capacitors (C34, C35)	.74
5069	Capacitor pack—Comprising two 8 mfd. capacitors (C32, C33)	1.76
5075	Clamp—Mounting clamp for capacitor—Stock No. 4490	.08
5068	Cup—Grounding cup	.10
4693	Clamp—Mounting clamp for capacitor—Stock No. 5069	.15
5143	Coil—Choke coil (L18, L19)	.15
5072	Tone control (R16)	.82
4132	Knob—Tone control knob—Package of 5	.55
7778	Reactor—Filter reactor (L13)	.45
5066	Reactor—Filter reactor (L14)	.88
5071	Receptacle—Power cable plug female receptacle—5-contact—Female section	.20
6980	Socket—4-contact vibrator socket	.20

REPLACEMENT PARTS (Continued)

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
5058	Socket—5-contact Radiotron socket or reproducer plug receptacle	$0.18
5065	Transformer—Power transformer (T1)	2.48
5067	Vibrator—Complete (L12)	3.66
	CABLE ASSEMBLIES	
4976	Cable—Antenna lead assembly—Single-conductor with male section of antenna connector	.16
7766	Cable—Power lead with clip and female section of fuse connector—To ammeter	.30
5059	Cable—Main power cable—Complete—With male section of connector plug, fuse connector and fuse, ammeter clip and female section of pilot light cable connector	1.50
5150	Cap—Cap for power cable plug	.22
5149	Plug—Power cable plug—Less cap	.20
	FLEXIBLE SHAFT ASSEMBLIES	
5000	Bracket—Flexible drive shaft connection bracket—Mounted on housing	.30
4973	Coupling—Tuning condenser flexible drive shaft coupling	.30
5141	Coupling—Volume control flexible drive shaft coupling	.36
3903	Screw—No. 8–32–3/16" headless set screw for flexible drive shaft coupling—Package of 20	.36
7855	Shaft—Tuning condenser or volume control flexible drive shaft—Approximately 28 7/8" long	1.00
	CONTROL BOX ASSEMBLIES	
4987	Bezel—Station selector dial bezel	.42
7865	Box—Control box—Complete	3.86
7864	Bracket—Mounting bracket and rear section of control box housing	.30
4988	Crystal—Station selector dial crystal	.38
4989	Dial—Station selector dial	.20
4981	Gear—18-tooth intermediate drive gear	.15
4978	Gear—Indicator drive gear and shaft	.42
7862	Housing—Front section of control box housing	.28
7863	Housing—Center section of control box housing	.32
4990	Indicator—Station selector (pointer) indicator	.10
4985	Knob—Station selector or volume control knob—Package of 5	.62
4991	Lamp—Dial lamp—Package of 5	$0.74
7866	Plate—Bearing plate assembly—Comprising plate, gear and shaft, volume control shaft, station selector shaft, pinion and spring	1.22
4986	Screw—Oval fillister head machine screw—Fastens bracket and center section of control box housing	.25
5042	Screw—No. 8–32–1/8" headless set screw for station selector or volume control shaft—Package of 10	.25
4983	Shaft—Station selector drive shaft	.16
4979	Shaft—Volume control drive shaft	.16
4984	Socket—Dial lamp socket	.16
4982	Spring—Holding spring for station selector or volume control knob—Package of 10	.26
4980	Spring—Tension spring—Package of 5	.15
5011	Strap—Control box mounting strap	.25
	REPRODUCER ASSEMBLIES	
9597	Coil—Field coil (L15)	2.62
9598	Cone—Reproducer cone (L16)—Package of 5	3.90
9596	Reproducer—Complete	8.00
4995	Screw—Reproducer mounting screw—Package of 10	.15
5090	Transformer—Output transformer (T3)	2.62
	MISCELLANEOUS ASSEMBLIES	
4244	Cap—Grid contact cap—Package of 5	.20
4293	Capacitor—0.5 mfd. ammeter capacitor	.60
5025	Capacitor—0.5 mfd. generator capacitor	.40
7871	Case—Complete—With top and bottom cover—Less screws	3.28
7952	Cover—Bottom cover of receiver case—Less screws	.35
7953	Cover—Top cover of receiving case—Less screws	.35
5023	Fuse—15-ampere—Package of 5	.40
4985	Knob—Station selector or volume control knob—Package of 5	.62
4999	Screw—No. 8–1/4" slotted hex-head self-tapping screw—Package of 5	.12
5037	Shield—Radiotron shield	.15
4992	Stud—Receiver mounting stud, nut and washer—Package of 3	.22
5024	Suppressor—Distributor suppressor	.38
5067	Vibrator—Complete	3.66