MAIN PINION GEAR.

Arm "G" must be adjusted for correct mesh with motor shaft drive pin "F." With the motor shaft completely forward and pinion "E" tight against its front bearing, the pinion mounting stud "J" should be adjusted so that pin "F" meshes its full thickness with the rotating arm "G." An increase of this mesh will increase over travel on tuning, while a decrease in mesh will decrease the over travel. Clearance between the small high speed pinion gear "E" and the intermediate gear "K" determines the amount of mechanical noise produced. Correct adjustment will give approximately 1/32 of an inch movement of back-lash at the end of pinion arm "G" when gear "K" is held stationary. The elongated hole in the front bracket allows sufficient movement of the mounting stud "K" to permit above-mentioned gear mesh adjustment. Adjust drive gear-arm mount strip by moving to right or left until there is practically 1/64 inch backlash of gear "K" when gear "KI" is held stationary. While this adjustment is being made, maintain stud "J" in correct vertical alignment with motor shaft.

MANUAL — AUTOMATIC — REMOTE CHANGEOVER.

1. THROW OUT GEAR ADJUSTMENT.— To obtain smooth operation on "Automatic" or "Remote" position it is important that the proper clearance is maintained between the throw out gear "M" and the intermediate gear "L." With the Manual-Automatic-Remote control thrown to "Remote" position, adjust the mesh between these gears by means of the eccentric screw "O" and the lock nut "P" on the throw-out gear bracket "MM" until there is practically 1/64 of an inch backlash of gear "L" when gear "M" is held stationary.

2. LINK AND LEVER ADJUSTMENT.

To correctly adjust the mechanical link between the switch shaft and throw-out gear bracket "MM," switch to "Manual" and loosen screw "N" which connects the two sections of the link. Point "Q" on the throw-out control arm should fall on an imaginary line between the points shown in fig. 4, namely, the pivoting point of the control arm and the centre of the manual vernier drive shaft. Tighten screw "N." If point "Q" is above centre line the throwout gear "M" will not disengage when switched to "Manual." On the other hand, if point "Q" is below centre line the throw-out control arm spring will throw an unnecessary load on the Scanning Button movement.

3. SCANNING BUTTON ADJUSTMENT.

Loosen nut and adjust the length of stud so that when the button is pressed the throw-out gear meshes in the gear train before the scanning button switch closes, setting the mechanism in motion. If the switch were to close before the throw-out gear meshed in the train, serious damage to the gears would result.

MANUAL VERNIER.

In case it becomes necessary to remove the manual vernier drive shaft "T," it should be replaced by sliding anti-backlash gear "R" on condenser shaft apart so that compression amounting to three teeth on the gear is obtained in the spring. Adjust mesh of gear "R" with pinion gear "U" on vernier shaft before tightening screws "S" so that smooth tuning is obtained throughout the range.

STATION SELECTOR DRUM.

1. BEARING ADJUSTMENT.—The selector drum may be removed by unscrewing the two bearing adjusting screws "X" on the front and rear bearings and sliding shaft out of slots on frame. To replace drum, the reverse procedure should be followed holding bearing adjusting plates "Y" firmly against the shaft and tightening adjusting screws.

2. CONTACT ADJUSTMENT: The contact strip should be adjusted to the selector drum by placing the selector adjusting key in the station adjustment strip in positions 1 and 8, simultaneously bringing the insulated segments into line, loosening contact strip adjusting nuts "Z" and shifting the contact strip until the end contacts are exactly centred on the respective disc insulating segments. Adjustment will be facilitated by removing complete assembly from rear of variable condenser by unscrewing the four mounting screws. Contacts and discs must be kept free of dirt, filings, and other extraneous matter.

LUBRICATION.

The dial pointer slide and all gear faces should be greased with vaseline. This same lubrication should be applied sparingly with a cloth to the station selector discs. Sewing machine oil is suitable for the motor shaft bearings and a light grade engine oil for all gear bearings. Medium viscosity engine oil should be applied between the thrust washers on the motor shaft. A colloidal graphite and oil mixture is recommended for use at the selector drum end bearing slots and cable pulley bearings.

RESISTANCE MEASUREMENTS.

The resistance values shown in fig. 5 have been carefully prepared to facilitate a rapid check of the circuit for irregularities. To obtain the full benefit from this diagram it is advisable to consult the circuit and layout diagrams when conducting the check. Each value should hold within ±20%. Variations greater than this limit will usually be a pointer to trouble in the circuit.

THE FISK RADIOLA, MODEL 264

Nine Valve, Three Band, A.C. Operated, Superheterodyne

TECHNICAL INFORMATION

Electrical Specifications

TUNING RANGES.		ALIGNMENT FREQUENCIES.	
Standard Medium Wave (A)	1500-550 K.C.	Standard Medium Wave (A)	1400 K.C. 600 K.C.
Short Wave (B)	35-105 metres	Short Wave (B)	38 metres
Short Wave (C)	13-39 metres	Short Wave (C)	14 metres

Intermediate Frequency..460 K.C.

Power Supply Rating..200-260V., 40-60 cycles

Power Consumption..(a) Tuning Motor operating—132 watts
............(b) „ „ inoperative—96 watts

(Special instruments made for other voltage and frequency ratings)

VALVE COMPLEMENT.

(1)	6K7	R.F. Amplifier	(6)	6H6	Second Detector A.VC. and A.F.C.
(2)	6L7	1st Detector	(7)	6J7	Audio Amplifier
(3)	6J7	Heterodyne Oscillator	(8)	6V6G	Power Output
(4)	6J7	Oscillator Control	(9)	5Z3	Full Wave Rectifier
(5)	6K7	I.F. Amplifier	(10)	6U5	Visual Tuning Indicator

Dial Lamps (2)..6.3 volts, 0.25 amps.

Loudspeaker, 10 inch..................Type AN9 Loudspeaker Transformer..............T.S. 4169A

Loudspeaker Field Coil Resistance..1000 ohms

Power Output..Undistorted 3 watts, Maximum 3.5 watts

General Description

The Radiola employs a nine valve, three band superheterodyne circuit, operated from A.C. power supply.

Features of design include "Automatic Tuning" with push-button station selection in conjunction with automatic frequency control; alternative

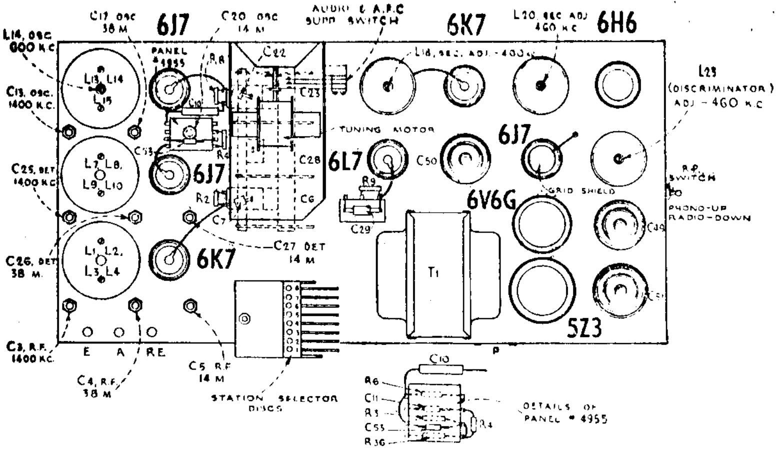

Fig. 1.—Lay-out Diagram (top view).

scanning button control to speed-up manual tuning; tuned R.F. amplifier; inductance tuned I.F. transformers and "A" band oscillator tracking; plunger type air dielectric trimming capacitors; automatic volume control; phonograph terminal panel; "Magic Eye" visual tuning indicator; ten inch electrodynamic loudspeaker; aural compensated volume control; high frequency tone control; low frequency ("Music Speech") tone control.

The circuit consists of an R.F. amplifier stage, first detector (converter) stage, separate heterodyne oscillator stage, diode detector (A.V.C. and A.F.C.) stage, audio amplifier stage, beam power output tetrode stage, "Magic Eye" visual tuning indicator, and a full wave rectifier stage.

Signals are fed from the aerial via the primary into the secondary of the aerial tuned R.F. circuit to the grid of the R.F. amplifier 6K7. The latter feeds the signal through the primary into the secondary of the detector tuned R.F. circuit, across which is connected the first (super control) grid circuit of the 6L7 first detector. Amplification at the frequency of the received signal is completed at this point.

The intermediate frequency amplifier is transformer coupled from the output of the first detector to the grid of the 6K7 I.F. Amplifier, and from the output of the latter to the 6H6 second detector. The windings of all I.F. transformers are resonated with fixed capacitors and are inductance tuned to 460 K.C.

The function of the automatic frequency control circuit is to automatically change the frequency of the heterodyne oscillator so that the correct intermediate frequency is formed for the I.F. amplifier. The circuit consists essentially of an I.F. discriminator which furnishes control voltage of the correct polarity to an oscillator frequency control tube for generated intermediate carrier frequencies slightly above and below 460 K.C. or the frequency to which the I.F. amplifier is tuned.

The plate circuit of the 6J7 oscillator control tube is caused to act as an apparent variable inductance in parallel with the "A" band oscillator tuned circuit, of which coil L14 is a part. The series combination of R4 and C53 shunted by a second series combination of R36 and the oscillator control tube grid to cathode capacitance is also in parallel with the oscillator tuned circuit. The resistance of R4 is many times greater than the impedance of the rest of the circuit, and hence the R.F. current through R4 is practically in phase with voltage across the oscillator circuit. In the absence of R36, the R.F. voltage impressed across C53 and the parallel grid —cathode capacitance would lag 90 degrees behind the current in R4, and rather less than 90 degrees behind the voltage across the oscillator circuit. The phase angle of the plate current of the oscillator control tube is the same as that of the applied grid voltage, and hence the R.F. current fed back into the oscillator circuit lags approximately 90 degrees with respect to the voltage across it. In other words, the control tube is acting as an equivalent shunt inductance. When the angle of lag is less than 90 degrees, positive resistance is also shunted across the oscillator tuned circuit, the damping being heavier at the 550 K.C. end of the band where the oscillation is ordinarily weaker. The introduction of R36 between C53 and the grid of the control tube produces a further phase shift, so that the R.F. current fed back to the oscillator tuned circuit lags more than 90 degrees all over the tuning range, thus reflecting negative resistance in addition to inductance, and so assisting oscillation. The amount of this combined action is determined by the amplification of the tube, which in turn is governed by the grid-cathode bias voltage. In operation a residual bias is developed across R24. The D.C. control voltage is fed to the control grid from the discriminator circuit through resistors R6, R3 and R36. If this voltage is negative with respect to ground, the amplification of the control tube will be decreased and the apparent plate circuit inductance of the tube increased, which will lower the frequency of the oscillator circuit. The converse will occur when the grid voltage is positive with respect to ground.

The action of the discriminator circuit depends upon the fact that a 90 degree phase difference exists between the primary and secondary potentials of a double tuned loosely coupled transformer when the resonant frequency is applied, and that this phase difference varies as the applied frequency varies. That is, the maximum resultant response voltage across the primary and secondary windings connected in series will occur at a frequency to one side of that to which the individual windings are resonated, respectively depending upon whether the windings are connected in series aiding or opposing.

The discriminator, or third I.F. transformer consists of a primary winding L22, which is part of the second I.F. Transformer secondary tuned circuit (tuned to 460 K.C.), and the centre-tapped secondary L21. The upper and lower halves of L21 may be considered as two secondary coils, the upper series aiding and the lower series opposing the primary L22. The core in L21 is inserted to inductively balance the two halves. The function of coil L23 in parallel with L21 is to tune L21, L23 and C39 to 460 K.C. It is arranged that the maximum rectified voltage will appear across R18, R19 and R20 in series when the intermediate signal frequency is above 460 K.C. and across R17 when below 460 K.C. The resistors R17, R18, R19 and R20 are connected in series between ground and a point leading to the oscillator control tube grid.

D.C. voltages across R17 are always in opposition to those across R18, R19 and R20. Consequently the oscillator control tube grid bias voltage is always a differential amount depending upon the I.F. signal strength and its frequency deviation from the nominal value of 460 K.C. The polarity

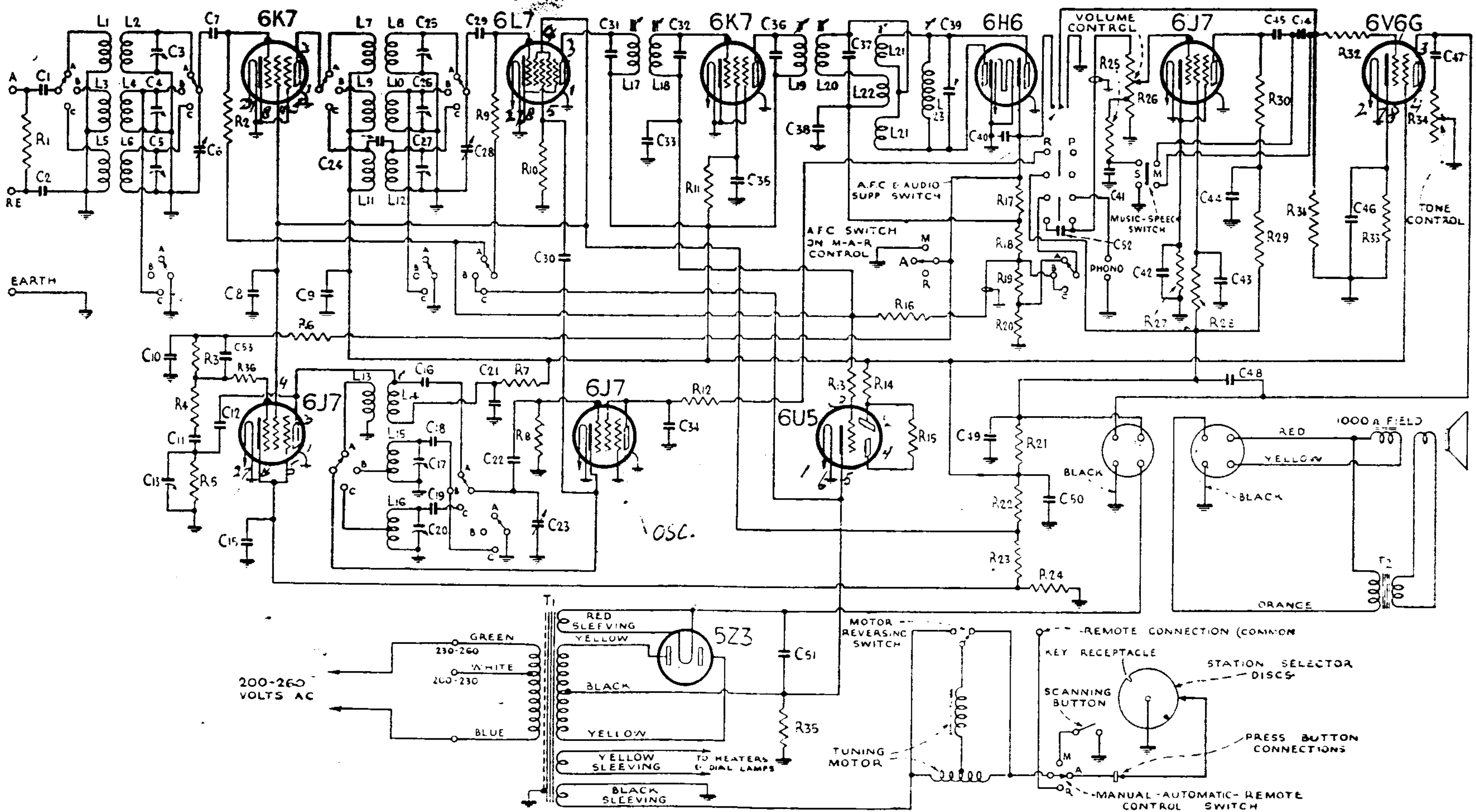

Fig. 2.—Circuit Diagram.

Code	Part No.	COILS
L1, L2	4807	Aerial Coil, 1500-550 K.C.
L3, L4	4807	Aerial Coil, 35-105 metres.
L5, L6	4818	Aerial Coil, 13-39 metres.
L7, L8	4809	R.F. Coil, 1500-550 K.C.
L9, L10	4809	R.F. Coil, 35-105 metres
L11, L12	4819	R.F. Coil, 13-39 metres
L13, L14	4943	Osc. Coil, 1500-550 K.C.
L15	4943	Osc. Coil, 35-105 metres
L16	4944	Osc. Coil, 13-39 metres
L17, L18	4946	1st I.F. Transformer
L19, L20	4948	2nd I.F. Transformer
L21, L22	4950	Discriminator Transformer
L23		
		TRANSFORMERS
T1	4939	Power Transformer, 40-60C.
T1	4941	Power Transformer, 110V.
T2	TS4169A	Loudspeaker Transformer
		RESISTORS
R1		100,000 ohms, ⅓ watt
R2		500,000 ohms, ⅓ watt
R3		1¾ Megohms, ⅓ watt
R4		100,000 ohms, ⅓ watt
R5		100,000 ohms, ⅓ watt
R6		500,000 ohms, ⅓ watt
R7		10,000 ohms, 1 watt
R8		50,000 ohms, ⅓ watt
R9		500,000 ohms, ⅓ watt
R10		50,000 ohms, ⅓ watt
R11		100,000 ohms, 1 watt
R12		25,000 ohms, 1 watt
R13		250,000 ohms, 1 watt
R14		20,000 ohms, 1 watt

Code	Part No.	RESISTORS
R15		1 megohm, 1 watt
R16		1¾ megohms, ⅓ watt
R17		500,000 ohms, 1 watt
R18		200,000 ohms, 1 watt
R19		200,000 ohms, 1 watt
R20		100,000 ohms, 1 watt
R21		300 ohms, 3 watts
R22		9000 ohms, 3 watts
R23		11,000 ohms, 3 watts
R24		450 ohms, 3 watts
R25		50,000 ohms, ⅓ watt
R26	4785	1 megohm, Vol. Control
R27		2000 ohms, ⅓ watt
R28		1 megohm, 1 watt
R29		50,000 ohms, ⅓ watt
R30		200,000 ohms, 1 watt
R31		500,000 ohms, ⅓ watt
R32		50 ohms, ⅓ watt
R33		250 ohms, 3 watts
R34	2762	100,000 ohms, Tone Control
R35		26 ohms, 3 watts
R36		10,000 ohms, ⅓ watt
		CONDENSERS
C1		500 mmfd. Mica
C2		500 mmfd. Mica
C3	3661	2-20 mmfd. Air Trimmer
C4	3661	2-20 mmfd. Air Trimmer
C5	3661	2-20 mmfd. Air Trimmer
C6	4937	Variable Condenser
C7		350 mmfd. Mica
C8		.1 mfd. Paper
C9		.1 mfd. Paper
C10		.05 mfd. Paper
C11		200 mmfd. Mica (J)
C12		350 mmfd. Mica
C13	3661	2-20 mmfd. Air Trimmer

Code	Part No.	CONDENSERS
C14		.0025 mfd. Paper
C15		.05 mfd. Paper
C16		505 mmfd. Mica (Padder)
C17	3658	2-10 mmfd. Air Trimmer
C18		2250 mmfd. Mica (Padder)
C19		5400 mmfd. Mica (Padder)
C20	3658	2-10 mmfd. Air Trimmer
C21		.05 mfd. Paper
C22		110 mmfd. Mica (L).
C23	4937	Variable Condenser
C24		4 mmfd. Mica (I)
C25	3661	2-20 mmfd. Air Trimmer
C26	3658	2-10 mmfd. Air Trimmer
C27	3658	2-10 mmfd. Air Trimmer
C28	4937	Variable Condenser
C29		350 mmfd. Mica
C30		110 mmfd. Mica (L)
C31		115 mmfd. Mica (A)
C32		115 mmfd. Mica (A)
C33		.05 mfd. Paper
C34		.005 mfd. Paper
C35		.1 mfd. Paper
C36		180 mmfd. Mica (P)
C37		180 mmfd. Mica (P)
C38		110 mmfd. Mica (L)
C39		115 mmfd. Mica (A)
C40		.5 mfd. Paper
C41		.02 mfd. Paper
C42		25 mfd. 25V. Electrolytic
C43		.1 mfd. Paper
C44		.5 mfd. Paper
C45		.05 mfd. Paper
C46		25 mfd. 25V. Electrolytic
C47		.035 mfd. Paper
C48		.0025 mfd. Paper
C49		8 mfd. 500V. Electrolytic
C50		8 mfd. 500V. Electrolytic
C51		16 mfd. 500V. Electrolytic
C52		.01 mfd. Paper
C53		6 mmfd. Mica (F)

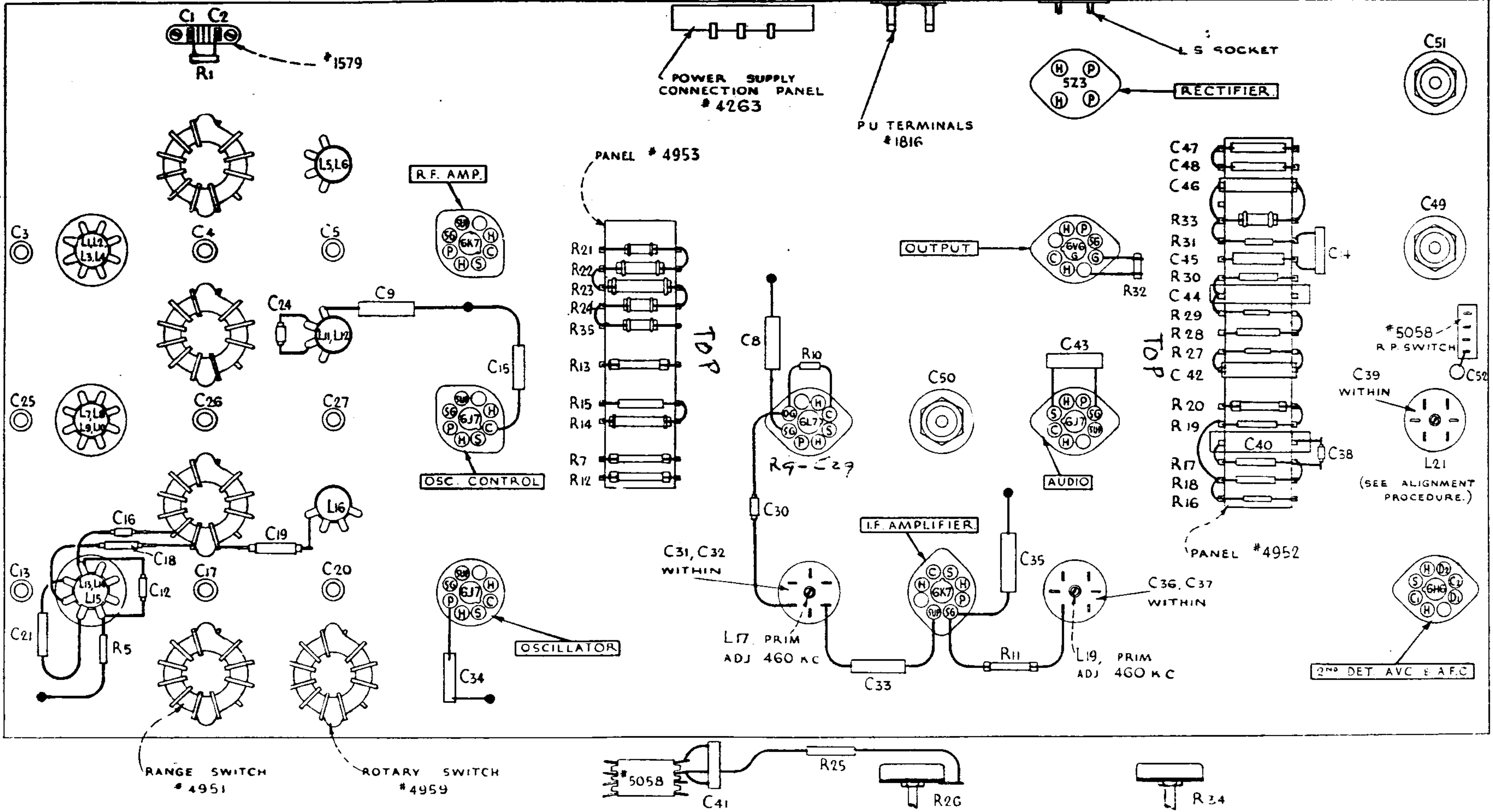

Fig. 3.—Lay-out Diagram (underneath view).

of this differential bias, with respect to ground, depends upon whether the intermediate signal frequency is above or below 460 K.C., but is always in the direction which will bring the generated intermediate frequency nearer to 460 K.C.: A.F.C is automatically eliminated from "manual" tuning by grounding the diode cathode to which R17 is connected through the "M-A-R" ("Manual-Automatic-Remote") switch.

The visual tuning indicator 6U5 has its cathode connected to ground through resistor R35 across which the minimum bias for the R.F. first detector and I.F. amplifier tubes is developed. The grid of the 6U5 is connected through R13 to the A.V.C. line which is fed with A.V.C. voltage through R16 from the rectified voltage appearing across R19 and R20 in series. When there is no signal present, the junction voltages of R17, R18, R19 and R20 tend towards ground potential; the grid of the 6U5 draws current and holds the potential of the A.V.C. line at a value of -3 volts, which is the sum of the voltage drop in R35 and the grid to cathode contact voltage of the 6U5.

The volume control R26 controls the audio signal level reaching the grid of the 6J7 audio amplifier stage, and on the "A" band is coupled across R20 only, but on "B" and "C" bands across R19 and R20 in series. When the "phono-radio" switch is in the "phono" position, the volume control is shunted directly across the phono terminals, and the high tension supply to plate circuit of the 6J7 oscillator is broken.

The "Music-Speech" or low frequency tone control in the "Music" position short-circuits the smaller condenser C14 of the series pair C45 and C14, which couple the plate circuit of the 6J7 audio amplifier to the grid circuit of the 6V6G output, giving full amplification of the low frequencies. At the same time the series combination R25 and C41 from the tap on the volume control to ground is in operation and serves to boost the low frequencies by raising the impedance from the tap to ground for those frequencies. In the "Speech" position C41 is short circuited, removing the bass boosting action, and C14 is now active in series with C45, reducing further the low frequency amplification.

The high frequency tone control is formed by the series combination of condenser C47 and variable resistor R34 in series across the output of the 6V6G to ground.

The loudspeaker is connected to the chassis by a four pin plug and cable. Matching between the voice coil and output stage is accomplished by the transformer T.S.4169A.

Voltages for the Radiola are supplied by a circuit comprising a transformer and full-wave rectifier with the loudspeaker field utilised as a filter reactor in conjunction with two electrolytic capacitors C49 and C51.

Alignment Procedure

Unless it is felt certain that the alignment of the Radiola is incorrect it is not desirable to alter the adjustments from the factory setting. However, when repairs have been made to I.F. or R.F. circuits or tampering is suspected, alignment becomes necessary.

When aligning the tuned circuits, it is important to apply a definite procedure, as tabulated below, and to use adequate and reliable test equipment. An A.W.A. Modulated Oscillator, Type C1070, is ideal for the purpose. Visual indication of the output from the Radiola is also necessary, any output meter of conventional design being suitable.

Connect the ground connection of the Modulated Oscillator to the Radiola chassis, and for I.F. alignment remove the grid clip from the 6L7 before connecting the oscillator. See that a 250,000 ohms resistor is connected between the output terminals of the Modulated Oscillator.

During alignment set the Volume and "Music-Speech" controls in the maximum clockwise position and the tone control and "Manual-Automatic-Remote" (M-A-R) switch in the maximum anti-clockwise position for minimum noise interference and manual operation respectively. It is most important that the M-A-R switch be set at "Manual," unless otherwise specified, so that the A.F.C. circuits will be rendered inoperative.

Regulate the output of the Modulated Oscillator so that a minimum signal is applied to the Radiola to obtain an observable indication. This will avoid A.V.C. action and overloading.

The I.F. adjustments are approached from above and below the chassis—see figs. 1 and 3, and should be adjusted with a non-metallic screwdriver, since the self-capacity of a metallic screwdriver would upset the adjustment.

CAUTION.

The iron core screw L21 on the bottom of the third I.F. transformer has been accurately adjusted for an exact electrical balance of coil L21 to the centre tap during manufacture, and should not be disturbed. However, if for any reason the adjustment has been moved from its original position it will be necessary to mechanically adjust this screw until the end of the stud protrudes exactly 1/16 in. (two threads exposed) above the brass bushing, prior to any alignment operations.

The padding adjustment, referred to in chart, is situated on top of the oscillator coil — see fig. 1. The R.F. circuits are align plunger type air trimmers. It will be found advantageous in adjusting the air trimmers to rotate the plunger during the operation in addition to using a steady pressure. As soon as the correct capacity is obtained, lock the air trimmer to make the setting permanent.

"No signal 550-750 K.C." means that the Radiola should be tuned to a point between 550 and 750 K.C. where no signal or interference is received from a station or local (heterodyne) oscillator.

The term "dummy aerial" means the device which should be connected between the output cable of the modulated oscillator and the aerial terminal of the Radiola, on short waves only, to simulate the characteristics of the average aerial. The "dummy aerial" in this case is a 400 ohms non-inductive resistor.

	Test Oscillator			Radiola			
Alignment Order	Connection to Radiola	Dummy Aerial	Frequency or Wave Length Setting	Dial and Range Setting	Circuit to Adjust	Adjustment Symbols	Adjust to obtain
1					3rd I.F. Transf.	L23	Turn extreme counter clockwise
2	6L7 1st Det. Grid Cap		460 K.C.	No Signal 550-750 K.C.	2nd I.F. Transf.	L19 & L20	Max. (Peak)
3	6L7 1st Det. Grid Cap		460 K.C.	No signal 550-750 K.C.	1st I.F. Transf.	L17 & L18	Max. (Peak)
4	Repeat adjustments 2 and 3 before proceeding.						
5	Aerial Terminal		600 K.C.	600 K.C.	Oscillator	L14 ‡	Max. (Peak)
6	Aerial Terminal		1400 K.C.	1400 K.C.	Oscillator	C13	Max. (Peak)
7	Aerial Terminal		1400 K.C.	1400 K.C.	Detector & Aerial	C25 & C3	Max. (Peak)
8	Repeat adjustment 5.						
9	Connect an aerial in place of test oscillator and check Radiola dial calibration by tuning in a station between 550 and 750 K.C. If there is an error, loosen pointer and reset. Now tune a station between 1350 and 1500 K.C. If there is an error, adjust station selector until pointer lies on station calibration, and then use C13 to retune the station.						
10	Repeat adjustments 7 and 5 in this order.						
11	Aerial Terminal	400 ohms	38 M.	38 M. on 35/105 M. Range	Oscillator	C17	Max. (Peak) *
12	Aerial Terminal	400 ohms	38 M.	38 M. on 35/105 M. Range	Detector & Aerial	C26 & C4 ‡	Max. (Peak) ** †
13	Aerial Terminal	400 ohms	42 M	14 M.	Oscillator	C20	Max. (Peak) *
14	Aerial Terminal	400 ohms	42 M.	14 M.	Detector & Aerial	C27 & C5 ‡	Max. (Peak) ** ††
15	Proceed to A.F.C. Discriminator Adjustments outlined below.						

Note: To align the Radiola at 14 metres with a Type C1070 Modulated Oscillator, set the oscillator to 42 metres and use the third harmonic.

‡ Rock the station selector back and forth through the signal.
* Use minimum capacity peak if two peaks can be obtained.
** Use maximum capacity peak if two peaks can be obtained.
† After this adjustment, check for image signal by tuning the Radiola to approx. 42.5 metres.
†† After this adjustment, check for image signal by tuning the Radiola to approx. 14.6 metres.

A.F.C. DISCRIMINATOR ADJUSTMENTS.

These adjustments are rather critical and should be performed with extreme care. Improper adjustment may result in complete failure of the oscillator control tube to function, or else may cause it to detune the oscillator circuit instead of tuning it to the signal.

It is assumed that the iron core adjusting screw L23 (top of third I.F. transformer) has been turned all the way out (extreme counterclockwise) prior to the preceding tabulated adjustments.

The adjustments are as follows:—

1. Turn the M-A-R control to "Manual" and loosen the grub screw which secures the actuating arm of the throw-out gear mechanism until the latter cannot be disturbed when the M-A-R control is operated.
2. Connect the test oscillator to the grid cap of the 6L7 first detector and adjust the R.F. input (unmodulated) at 460 K.C. to obtain half to two-thirds closure of the tuning indicator. Carefully adjust the tuning of the

test oscillator for maximum response of the tuning indicator, keeping the M-A-R control at Manual. The most accurate adjustment will be obtained by adjusting the tuning control mid-way between the two points where the eye just appears to start to open. *The tuning adjustment of the test oscillator must remain perfectly undisturbed throughout the remainder of the procedure.*

3. Replace the grid connector of the 6L7 first detector and place the "high" test oscillator lead near thhe grid lead of the 6K7 I.F. amplifier, but not wrapped around it, or the tuning of that circuit will be upset. Advance the R.F. output of the test oscillator to about 100 millivolts, which should cause no more than a barely perceptible response in the tuning indicator if the coupling to the grid lead of the 6K7 is not too close.

4. Take another receiver of the Superheterodyne type and set its dial pointer to 550 K.C., when its local oscillator should radiate at 1000 K.C. if the intermediate frequency is 460 K.C. Connect a wire to the aerial terminal of the Radiola and place the other end of it near enough to the oscillator circuits of the other receiver to obtain half to two-thirds closure of the tuning indicator, as in 2 above, when the 1000 K.C. signal is tuned in. Simultaneously a heterodyne beat-note will be heard which is reduced to zero-beat at exact tune and maximum deflection of the Magic Eye.

5. Turn the M-A-R control to "Automatic" and commence turning the iron core adjusting screw L23 clockwise until the high beat note which is heard is reduced to zero-beat Switch to "Manual," re-adjust the zero-beat if drift has occurred, then back to "Automatic" to finish accurately the L23 adjustment. The signals should remain at zero-beat as the M-A-R control is thrown back and forth from "Manual" to "Automatic." Adjustment of the discriminator circuit is then complete.

NOTE.—With the M-A-R switch at "Automatic," operation of the tuning control of the Radiola will cause the above-mentioned beat note to slowly rise in frequency to about 2000 or 3000 cycles per second and then suddenly disappear after the dial pointer has moved through an interval of 15-25 K.C. in either direction from exact tune. The two points at which the A.F.C. circuits lose control should be roughly equidistant from the point of exact resonance; the intervals at which control is regained are about two-thirds of those at which control is lost. The interval over which control is effective is directly proportional to the amount of A.V.C. generated by the received signal.

If the ratio of the two intervals on either side of resonance at which control is lost is greater than 1.5:1 the oscillator control 6J7 bias requires adjustment to centre the control action. The necessary procedure is described later.

6. Tighten the grub screw that was released in 1.

NOTE.—In adjustment 4 a second test oscillator set to 1000 K.C. and unmodulated may be used if available in place of the second receiver. Failing either, the signal from a local station (preferably 550-1000 K.C.) may be used, but the presence of programme modulation causes a little difficulty in accurate determination of the zero-beat points.

OSCILLATOR CONTROL CIRCUIT ADJUSTMENTS.

This circuit should only seldom require attention, having been carefully adjusted in manufacture.

A 4.5 volt bias battery is required.

1. Set the M-A-R switch at "Automatic" and volume control full on; other controls as before.

2. Connect a test oscillator at 1000 K.C. (30% modulated) to the grid cap of the 6L7 first detector and adjust input to a low level so that just comfortable response is obtained when the signal is tuned-in. Note carefully the dial reading of the Radiola.

3. Connect two leads to resistor R6 (500,000 ohms on panel No. 4955 fixed to the side of the variable condenser), and join them to the 4.5v. bias battery. Retune the Radiola to the signal and note the dial reading. Reverse the battery and take a third reading.

   The first reading should be midway between the two last, which should have a total separation of 30 to 50 K.C. If the ratio of the frequency differences between the first reading and each of the other two is greater than 1.5 to 1, say, for example, 25 K.C. on one side and 15 K.C. the other, further adjustment is necessary.

4. If the first reading is on the low frequency side of the mid-point between the two taken with the battery in circuit, shunt R24 (450 ohms cathode bias resistor of 6J7 oscillator control tube) with 5000 ohms or 2000 ohms as may be required. If the first reading is on the high frequency side, replace R24 with a larger value such as 500 ohms.

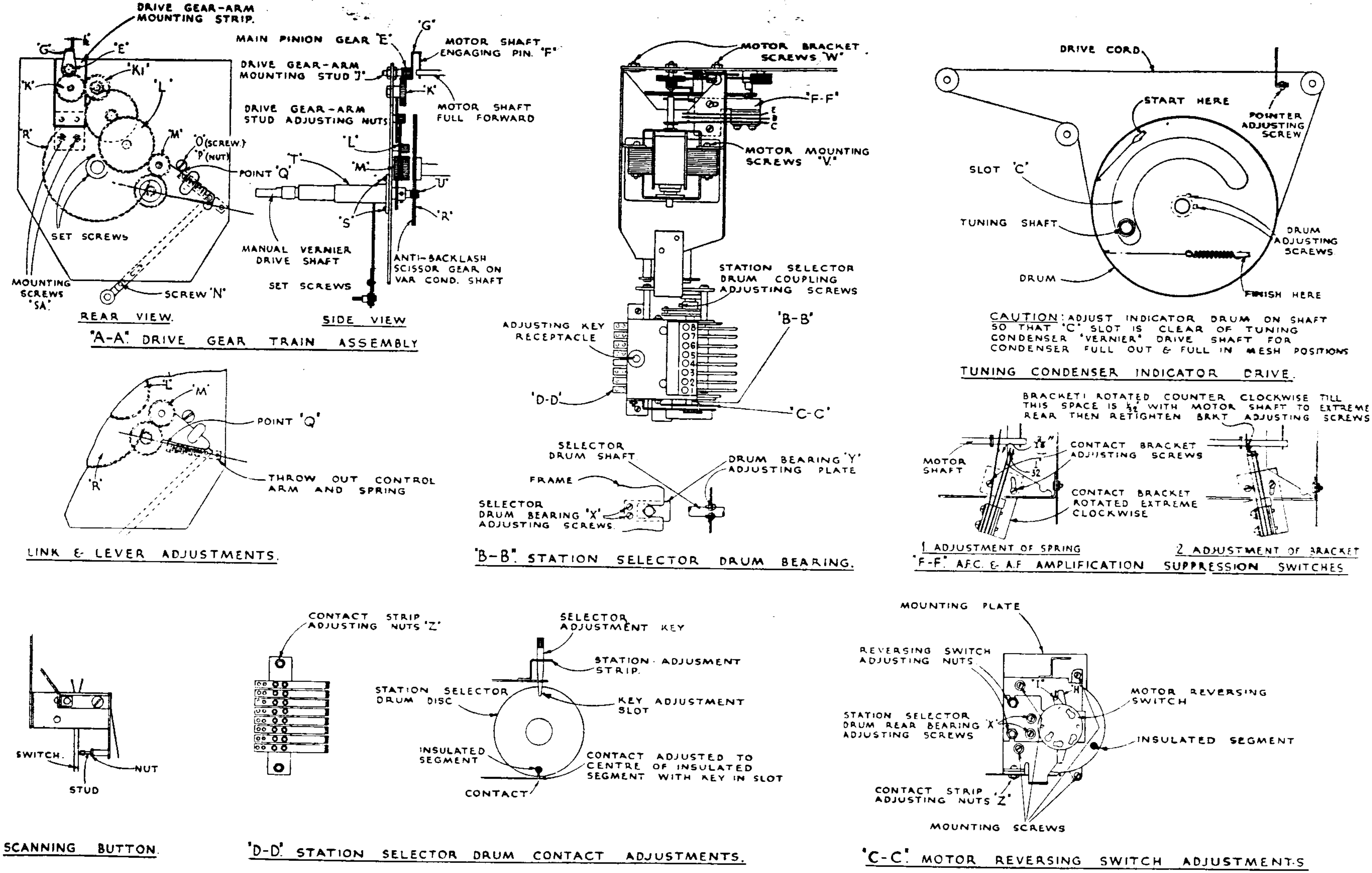

Fig. 4.—"Automatic Tuning" Mechanism Adjustments.

Automatic Tuning

PRINCIPLE OF OPERATION.

The automatic tuning mechanism consists essentially of a quick engaging and dis-engaging reversible electric motor, tuning condenser gear train, and eight automatically interlocked Station Selector buttons (pushing one button releases all others) respectively wired to eight adjustable station selector discs (each with a motor stopping insulated segment) mounted on a drum which is directly coupled to the variable condenser shaft. The arrangement permits any one of the eight predetermined stations to be automatically tuned by merely pressing the correct push-button.

The operation may be more readily understood by reference to fig. 4. When the motor is not energised, the armature is pushed to the rear or slightly out of the magnetic centre by tension of contact spring "C" and the motor shaft is disengaged from the driving gear train. Pressing any one of the eight push-buttons will complete the motor circuit through a station selector contact disc, assuming that the Manual-Automatic-Remote control is in the "Automatic" position and that the insulated segment in the contactor disc is not opposite its contactor. As the motor starts, the armature will be drawn forward, due to solenoid action, and the pin "F" on the end of the shaft will engage with the arm "G" on the small main pinion gear, thereby driving the tuning mechanism; at the same time contact springs "E" and "D" will be grounded, causing suppression of audio amplification and automatic frequency control during the tuning cycle.The motor will continue to operate until the insulated segment in the selector disc breaks the motor circuit, whereupon spring "C" will instantly dis-engage the motor pin "F" from the arm "G" on the small pinion driving gear and open contacts "E" and "D." Pushing another button will cause the above-mentioned cycle to be repeated, except that the motor will be interrupted by the insulated segment on a corresponding disc. The discs are individually adjustable on a drum mechanism, providing a choice of eight "Medium Wave" broadcasting stations. The arrangement of the motor is such that its rotation will continue in the same direction regardless of the number of "Automatic" tuning cycles until the variable condenser approaches full-out or full-in of mesh, whereupon lever "H" trips the reversing switch, which reverses the direction of rotation. A throw-out idler gear is link-coupled to the Manual-Automatic-Remote control to disconnect the motor drive gear train when the control is thrown to "Manual" position.

MECHANISM ADJUSTMENTS.

The automatic tuning mechanism is designed to be as simple in construction and as fool-proof in operation as possible. In order to maintain the accurate results possible with the instrument, care must be taken in effecting any repairs or adjustments. Reference should be made to fig. 4 when making the following adjustments.

A.F.C. AND A.F. AMPLIFICATION SUPPRESSION SWITCHES.

This switch assembly is located on the motor bracket and closes due to solenoid action of the motor armature. The tension of the long contact spring "C" is important in bringing about quick disengagement of the motor and in permitting the motor to pull into mesh with the drive mechanism. Normal adjustment is attained when the short springs "D" and "E" are aligned exactly straight with contact points separated approximately 1/32 of an inch and with the spring "C" spaced approximately 3/16 of an inch from spring "D" at the point of contact. Contacts of the switch must be kept clean. A relay burnisher or a piece of "00" glass paper may be used for this purpose. Only a light cleaning is necessary to free the contact points of any foreign substance.

MOTOR REVERSING SWITCH.

It is necessary to automatically stop and reverse the drive before the tuning condenser reaches the ends of its travel. The reversal should take place slightly above 550 K.C. and below 1500 K.C. Turn the moving plates of the tuning condenser full-in mesh and then 1/16 of an inch out from full-in mesh with the manual vernier control. Loosen the station selector drum coupling screws. Using the trip lever "H", turn the station selector drum discs in a clockwise direction for approximately a quarter of a turn and throw the reversing switch pin "I" to the right. Grasp the lower section of trip lever "H" in the fingers and turn the station selector discs anticlockwise **very slowly** until the reversing switch snaps. Tighten the station selector drum coupling screws and make certain that the moving plates of the tuning condenser are 1/16 of an inch out of full-mesh when the reversing switch operates.

MOTOR ALIGNMENT.

The motor shaft must be exactly aligned with the axis of the pinion gear with which it engages. This may be adjusted by loosening the mounting screws "V" of the motor and aligning the shaft by sight. Correct alignment may be tested by slowly rotating motor and observing the relation between the pin "F" on the motor shaft and the arm "G" on the pinion. The relation of the two should remain the same throughout the revolution. Additional horizontal movement for adjustment may be obtained by the motor bracket screws "W" if necessary. Additional vertical movement for adjustment may be obtained by mounting screws "S.A."

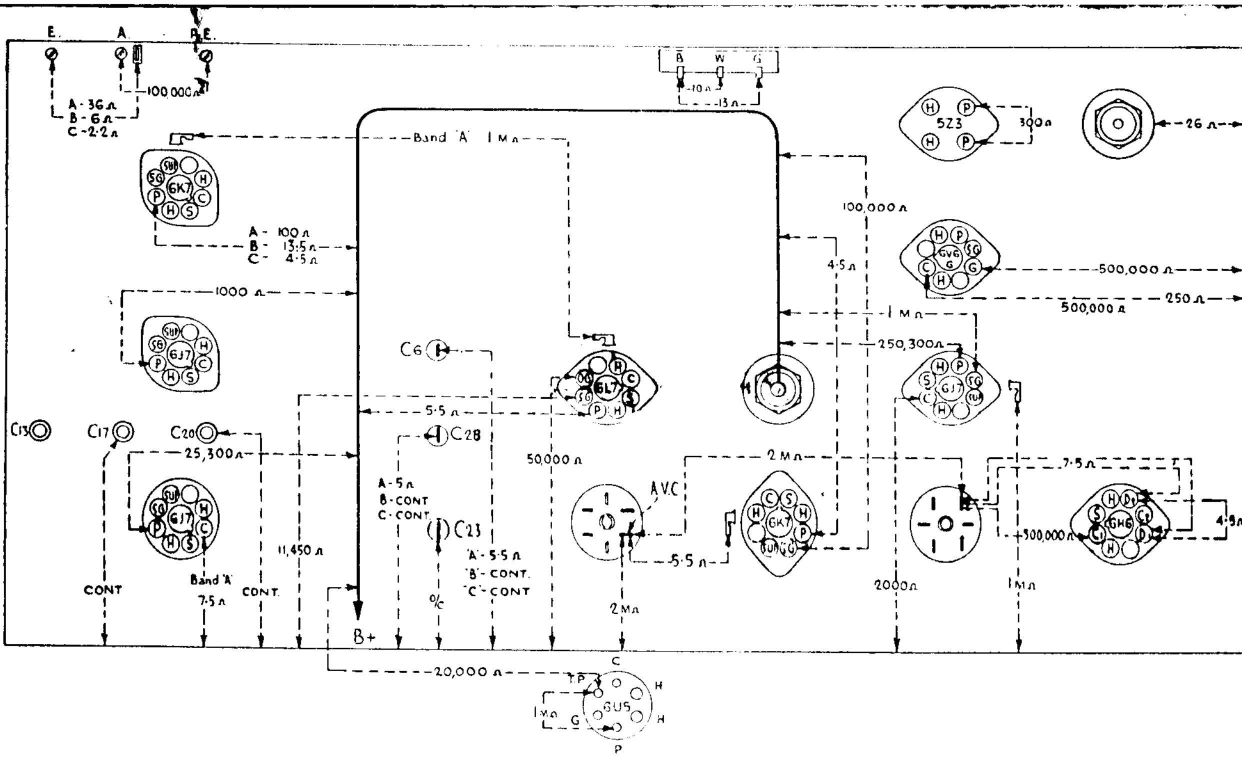

Fig. 5.—Resistance Diagram.

Resistance values were taken with valves removed, power supply disconnected, variable condenser in full-me and volume control in maximum clockwise position.

SOCKET VOLTAGES.

VALVES	Cathode to Chassis Volts	Screen Grid to Chassis Volts	Plate to Chassis Volts	Plate Current M.A.	Heater Volts
6K7 R.F. Amplifier	0	100	270	7.0	6.3
6L7 1st Detector ...	0	100	270	3.3	6.3
6J7 Oscillator					
Band (A)	0	150	150	5.5	6.3
,, (B)	0	155	155	5.0	—
,, (C)	0	155	155	5.0	—
6J7 Osc. Control					
Band (A)	4.4	100	260	1.1	6.3
,, (B)	4.1	100	-260	0.3	—
,, (C)	4.1	100	260	0.3	—
6K7 I.F. Amplifier ..	0	100	270	7.0	6.3
6H6 2nd Det.					
A.V.C. & A.F.C.	0	--	0	..	6.3
6J7 Audio.	1.8	45	60	0.8	6.3
6V6G Output	12.5	270	270	48	6.3
5Z3 Rectifier	800/400 volts, 100 M.A. total current				5.0

Tuning Motor Voltage no load 25.0 volts

Tuning Motor Voltage on load 22.0 volts

Voltage across loudspeaker field, 100 volts D.C.

Measured at 240 volts A.C. supply. No signal input. Controls in maximum clockwise position excepting range switch which is set as desired.