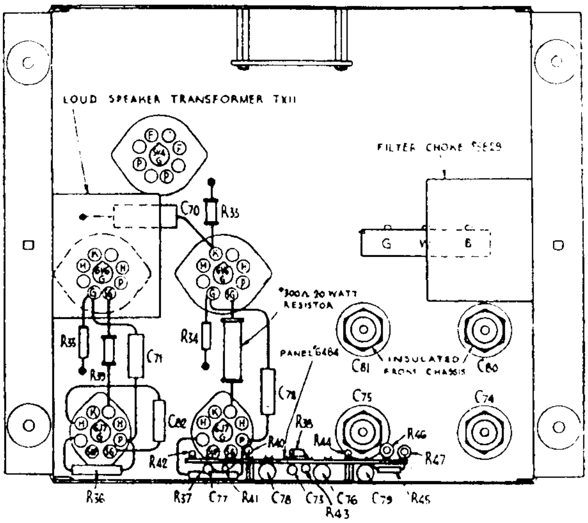


Fig. 3.—A.F. Amplifier Chassis (Underneath View).

SOCKET VOLTAGES.

Valve	Cathode to Chass Volts	Control Grid to Chass. Volts	Screen Grid to Chass. Volts	Plate to Chass. Volts	Plate Current M.A.	Heater Volts
6U7G R.F. Amplifier	0	—3.5*	98	250	7.2	6.3
6K8G Mixer, Band A	4.5	—3.5*	100	250	1.0	6.3
,, B	2.5	—3.5*	100	250	1.0	6.3
,, C	2.5	0	100	250	1.5	6.3
6J7G Oscil., Band A	0	0	135	145	3.5	6.3
,, B	0	0	140	170	3.0	6.3
,, C	0	0	145	160	3.2	6.3
6J7G Oscil. Control Band A	4.4	0	100	235	1.1	6.3
,, B	4.2	0	100	240	0.8	6.3
,, C	4.2	0	100	240	0.8	6.3
6U7G 1st I.F. Amplifier	0	—3.5*	98	170	7.2	6.3
6U7G 2nd I.F. Amplifier	0	—3.5*	100	250	7.2	6.3
6H6G 2nd Detector, A.V.C. and A.F.C.	0	—	—	0	—	6.3
6R7G 1st Audio Amp	0	—5.5*	-	100*	1.5	6.3
6J7G 2nd Audio Amp	0	—5.5*	†	125*	1.25	6.3
6J7G Phase Inverter	0	—5.5*	†	125*	1.25	6.3
6V6G Output	20.0	0	300	290	36.0	6.3
6V6G Output	20.0	0	300	290	36.0	6.3
5V4G Rectifier	370/385 volts A.C. 130 M.A. total current					5.0

Tuning Motor Voltage (no load), 27.0 volts A.C.
Tuning Motor Voltage (on load), 24.0 volts A.C.
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.

* Cannot be measured with ordinary voltmeter.
† Connected to Plate.

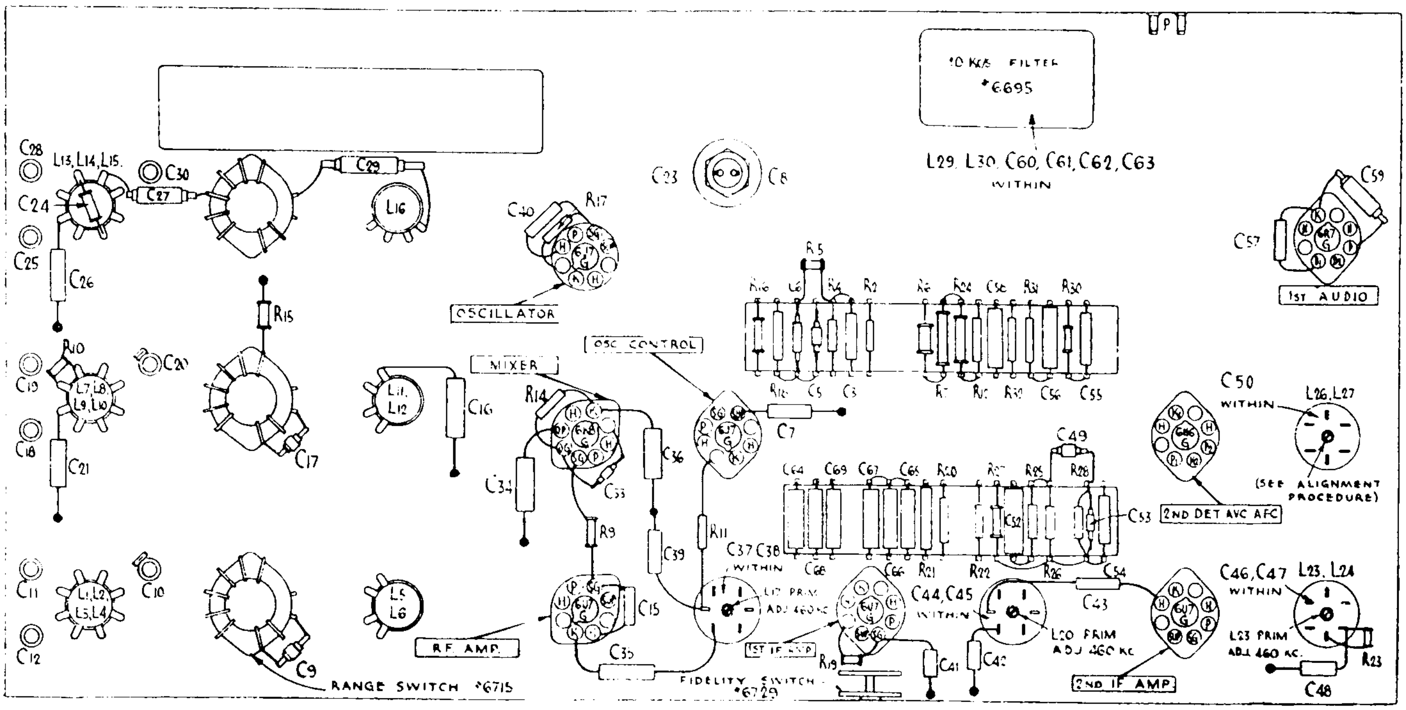


Fig. 4.—R.F. Unit Chassis (Underneath View).

THE FISK RADIOLA

MODEL 281

THIRTEEN VALVE, THREE BAND, AUTOMATIC TUNING, A.C. OPERATED SUPERHETERODYNE

Technical Information & Service Data

ELECTRICAL SPECIFICATIONS.

TUNING RANGES.
"Standard Medium Wave" .... (A) 1600-550 K.C.
"Short Wave" .... (B) 35-105M.
"Short Wave" .... (C) 13-39M.

R.F. ALIGNMENT SETTINGS.
"A" Band—600 K.C. (Osc.), 1500 K.C. (Osc., R.F., Aer.).
"B" Band—38 metres (Osc., R.F., Aer.).
"C" Band—14 metres (Osc., R.F., Aer.).

INTERMEDIATE FREQUENCY .... 460 K.C.
POWER SUPPLY RATING .... 200-260V., 40-60 cycles
POWER CONSUMPTION (Tuning Motor Inoperative) .... 135 watts

VALVE COMPLEMENT.
(1) 6U7G R.F. Amplifier.
(2) 6K8G Mixer.
(3) 6J7G Oscillator.
(4) 6J7G Oscillator Control.
(5) 6U7G 1st I.F. Amplifier.
(6) 6U7G 2nd I.F. Amplifier.
(7) 6H6G 2nd Det., A.V.C., and A.F.C.
(8) 6R7G 1st Audio Amplifier.
(9) 6J7G 2nd Audio Amplifier.
(10) 6J7G Phase Inverter.
(11) 6V6G Output.
(12) 6V6G Output.
(13) 5V4G Rectifier.
6U5 Visual Tuning Indicator.

UNDISTORTED POWER OUTPUT .... 13 watts
LOUDSPEAKER .... Type AS3, 12 inch electro-dynamic (dustproof).
Transformer (mounted on A.F. Amp. chassis) TX11
Field Coil Resistance .... 600 ohms
Voice Coil Impedance .... 12.5 ohms at 400 cycles
DIAL LAMPS (2) .... 6.3V., .25 amp.
AUTOMATIC TUNING ADJUSTMENT LAMP .... 6.3V., .25 amp.

MECHANICAL SPECIFICATIONS.

Height (inches)	38¼	Amp. Chassis dimensions (inches)	4 x 8½ x 11
Width (inches)	32¾	Weight (shipping lbs.)	170
Depth (inches)	15	Max. Chassis height (inches)	11½
Chassis dimensions (inches)	4 x 8½ x 20	Max. Amp. Chassis height (inches)	8½

GENERAL INFORMATION.

The Receiver is a thirteen valve "World Range" superheterodyne built in two units. The audio amplifier is separate from the R.F. unit, and is mounted in the lower compartment of the cabinet. Connection between the two is effected by two cables fitted with plugs and sockets. Features of design include: "Automatic Keyboard Tuning" for eight broadcast stations; "Scanning," by which the dial pointer may be shifted, automatically, to any position on the dial, controlled from the keyboard; phono. switch operated from the keyboard; magnetite core tuned I.F. transformers and oscillator coil; temperature compensated circuits; two short wave ranges, tuning continuously from 13 to 105 metres, and medium wave band tuning from 1600-550 kilocycles; "local," "distance," seven point high fidelity, and high frequency tone control; 12 inch, welded, dustproof, high fidelity loudspeaker; provision for attachment of Armchair Control Unit; automatic frequency control with "Automatic Tuning" and manual tuning; "Magic eye" visual tuning indicator; audio phase inverter; push-pull beam power output valves; inverse feed-back.

With the unique features embodied in this instrument, naturally, proper operation is important for maximum entertainment. The proper use of the fidelity and tuning controls is most important. The fidelity control has seven positions, the purposes of which are fully explained in the table. In the "Wide Range" position, that is, extreme clockwise, the reproduction is faithful from 40 to 7,500 cycles.

In the majority of cases, the high fidelity positions of the control, positions 5, 6, and 7, may be used on local stations to give true response of the broadcast programme. Positions 1 and 2 should always be used for tuning short wave or distant stations. The first position provides maximum selectivity, with a reduction in "Treble" response, and the second medium selectivity with increased "Treble" response.

Positions 3 and 4 are selective settings for the reception of local or medium distant stations with reduced "Treble" response in 3 and normal tonal balance in 4. If interference from powerful local stations is experienced in these settings—use position 1.

The tuning control has a special function used in conjunction with the fidelity control. When the tuning knob is pushed in, and the fidelity control is in position 2, the I.F. response of the receiver will return to its maximum selectivity condition. Releasing the tuning knob will broaden the I.F. channel, as shown in the table. When the fidelity control is in position 3 or 4, and the tuning control is pushed in, the A.F.C. system will be rendered inoperative. With the fidelity control in position 5, 6, or 7, pushing in the tuning control improves the selectivity of the I.F. channel, and renders the A.F.C. system inoperative. This function of the tuning control should be used when tuning local or medium distant stations, manually. Before it is possible to tune the receiver manually, the key labelled "Manual" must first be pressed. This also applies when it is desired to "Scan" on the medium wave band. "Scanning" on the short wave bands can be carried out regardless of the manual key. The scanning keys are those situated at the extreme ends of the keyboard labelled "Scan," and also marked with an arrow to show the direction in which the dial pointer will travel when a key is pressed.

Position of Fidelity Control	Selectivity 1st I.F. Trans.	Selectivity 2nd I.F. Trans.	Audio Response	A.F.C.	Automatic Station Selection	Use
1	Normal	Normal	Reduced High Frequencies	Inoperative	Inoperative	*Short Wave and Distance tuning, with reduced "Treble" response
2	½ Broad	Normal	Normal	Inoperative	Inoperative	*Short Wave and Distance tuning, with increased "Treble" response
3	Normal	Normal	Reduced High Frequencies	Operative	Operative	Local and Med. Distance tuning, with reduced "Treble" response
4	Normal	Normal	Normal	Operative	Operative	Local and Med. Distance tuning, with "Normal" response
5	½ Broad	Normal	Normal	Operative	Operative	Local tuning, with increased "Treble" response
6	½ Broad	½ Broad	Normal	Operative	Operative	Local tuning with further increased "Treble" response
7	Broad	Broad	Normal	Operative	Operative	Local tuning with "Wide Range" response

* Automatic tuning is not provided in these settings, but "Scanning" is available.

CIRCUIT ARRANGEMENT.

The circuit consists of an R.F. amplifier stage, first detector (convertor) stage, separate heterodyne oscillator stage, two I.F. amplifier stages, diode detector (A.V.C. and A.F.C.) stage, first audio amplifier and muting rectifier stage, second audio stage, phase invertor stage, push pull beam power output tetrode stage, "Magic Eye" visual tuning indicator, and a full wave rectifier stage.

The I.F. amplifier channel is of the variable selectivity type, in which variation of selectivity is obtained by switching in overcoupling windings (L19 and L22). These windings are in close proximity to their respective primary windings and are arranged to be switched in series with their respective secondary windings to give the desired increases in coupling and to produce the required changes in selectivity.

Each overcoupling winding is centre tapped so that two degrees of overcoupling are available on each of the two I.F. transformers, and combinations of these are used to obtain the desired effect. The switching of these windings is performed primarily by the fidelity switch, but the action of this switch, in regard to selectivity, is modified by the switch operating on the main tuning control knob.

The function of the switch on the main tuning control knob is to remove the overcoupling from the first I.F. transformer when pushed in, so that tuning can be satisfactorily performed, even though the fidelity switch be in a position which would normally give wide band width and consequent difficulty in tuning.

For the actual combinations of selectivity, which are associated with the different positions of the fidelity switch, reference should be made to the accompanying chart.

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 a control voltage of the correct polarity to an oscillator frequency control valve for generated intermediate frequency carriers slightly above and below 460 K/cs, the frequency to which the I.F. amplifier is tuned.

The action of the discriminator circuit depends on 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. Whether the frequency at which this maximum response occurs, is at a higher or lower frequency than that to which the individual circuits are tuned, depends on whether the windings are connected in series aiding or opposing.

The discriminator, or fourth I.F. transformer, consists of a primary winding L25, which is part of the third I.F. transformer secondary tuned circuit (tuned to 460 K/cs), and the centre tapped secondary L26, L27 may be considered as two secondary coils, the upper L26 series opposing, and the lower L27 series aiding the primary L25.

The core in L26, L27 is inserted to inductively balance the two halves.

The function of the coil L28, in parallel with L26, L27 is to tune L26, L27, L28 and C50 to 460 K/cs. It is arranged that the maximum rectified voltage will appear across R25, when the intermediate signal frequency is above 460 K/cs, and across R26 and R28 in series, when below 460 K/cs. The resistors R25, R26 and R28 are connected in series, between ground and a point leading to the oscillator control valve grid.

D.C. voltages across R25 are always in opposition to those across R26 and R28. Consequently, the oscillator control valve 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/cs. The polarity of this differential bias, with respect to ground, depends upon whether the intermediate frequency signal is above or below 460 Kc/s, but is always in the direction which will bring the generated intermediate frequency nearer to 460 K/cs.

The automatic frequency control is governed from three points. Firstly, in the first two positions of the fidelity switch, the D.C. control voltage appearing at the cathode of the 6H6G (connected to R25), is shorted to ground to remove the automatic frequency control action, which is not required in these two positions, as they are intended for use when distance stations are being received. Secondly, the switch on the main tuning control spindle is so arranged that the same point will be shorted to ground, when this knob is pushed in, so that manual tuning may be possible, as the operation of the automatic frequency control would prevent accurate manual tuning, unless the fidelity switch was in position 1 or 2. Thirdly, a switch on the motor spindle is arranged to short this same point to ground, while the motor is running, to eliminate the possibility of the receiver remaining on a strong station, when it is desired to select an adjacent weaker station.

Then, to automatically change the frequency of the oscillator circuit, in accordance with the polarity and magnitude of the D.C. voltages from the discriminator, the plate circuit of the 6J7G oscillator control valve is caused to act as a variable apparent negative inductance in parallel with the "A" band oscillator tuned circuit, of which coil L14 is part. The current in the plate circuit of the oscillator valve is in phase with the voltage in the grid circuit, and produces in the plate circuit of the oscillator valve (combination of R18 in parallel with C6 and R5 in series), a voltage, which leads the current causing it by more than 90 degrees. This voltage, applied to the grid of the oscillator control valve, through the network C5, R4, C4 and R3, which has negligible phase shift at the frequencies concerned, produces in the plate circuit of the oscillator control valve, which is also the grid circuit of the oscillator valve, a current, which is in phase with the oscillator control valve grid voltage, and which, therefore, leads the oscillator grid voltage by more than 90 degrees.

Then, assuming a small increase in frequency of the voltage at the grid of the oscillator valve, without change in magnitude, the voltage appearing in its plate circuit will be smaller, due to the capacitive reactance of C6 decreasing with increase in frequency. Consequently, the voltage applied to the grid of the oscillator control valve will be smaller, and this, in turn, will produce a smaller signal plate current in the oscillator control valve.

Then, as this oscillator control valve signal plate current flows in the grid circuit of the oscillator valve, it means that for an increase in frequency in this circuit, the current decreased; a condition which is satisfied when the reflected reactance is inductive.

Then, for an inductance to cause the current to lead the voltage by more than 90 degrees, it must be negative in sign, and associated with negative resistance. Therefore, the effect of the oscillator control valve is to cause an apparent negative inductance, and a negative resistance to appear in parallel with the oscillator tuned circuit.

The effect of the negative resistance is to assist the oscillator by reducing the damping on the tuned circuit.

The amount of negative inductance is determined by the amplification of the oscillator control valve, which, in turn, is governed by the grid cathode bias voltage. In operation, a residual bias is developed across R6. The D.C. control voltage from the discriminator circuit is fed to the control grid of the oscillator control valve, through the resistors R2 and R3.

If this voltage is negative with respect to ground, the amplification of the control valve will be decreased, and consequently, the apparent negative inductance, appearing in parallel with the oscillator tuned circuit, will be increased. Then, as an increase in negative inductance in parallel, has the same effect as a decrease in positive inductance in parallel, the frequency of the oscillator circuit will be increased. The converse will occur when the grid voltage is positive with respect to ground.

The visual tuning indicator 6U5 has its cathode connected to ground, through resistor R46, across which the minimum bias for the R.F. amplifier, first detector and I.F. amplifier valves is developed. The grid of the 6U5 is connected through R22 to the A.V.C. line, which is fed with A.V.C. voltage through R27, from the rectified voltage appearing across R26. When there is no signal present, the junction voltages of R25, R26 and R28, 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 −3.5 volts, which is the sum of the voltage drop across R46, and the grid to cathode contact voltage of the 6U5.

The fidelity switch, besides varying the selectivity of the I.F. channel, and controlling the operation of the A.F.C., also operates on the automatic station selection circuit and the audio frequency amplifying circuit.

In the motor circuit, the fidelity switch is arranged to open-circuit the 24-volt supply in the first two positions, as these two positions are intended for distant reception, and automatic station selection is, therefore, not required. This, however, does not affect the operation of the scanning buttons, which will still operate if the manual tuning button is pressed, or if the wave change switch is turned to either of the short wave bands.

In the audio frequency circuit, the fidelity switch operates in positions 1 and 3 to connect the condenser C64 to ground from the plate of the 6R7G, thus reducing the high frequency response in these positions.

In the other positions, when the receiver is being operated on radio, the audio frequency response remains constant, and further variations in response are obtained by variations in selectivity as outlined previously.

Provision is made for the use of a gramophone pickup with this receiver, and the necessary switch is in the same group as the station selection keys, and is marked "Phono". When this key is pressed, the receiver is connected for gramophone pickup operation, and the switch, in the circuit diagram, is in position "P." In this position, the volume control is shunted directly across the pickup terminals, and the audio input from the diode detector is grounded. Further, when in this position, the condensers C65, C66, C67, C68, and C69, associated with the fidelity control, are placed in circuit, and the fidelity control then acts to give a gradually increasing high frequency response, as it is turned in a clockwise direction. When the "Phono" key is returned to its normal "out" position, the audio input from the diode detector is again connected to the volume control, the input from the "phono" terminals is grounded, and the fidelity switch circuit reverts to its original form, as described in the previous paragraph.

A special two-section filter is used in the plate circuit of the 6R7G first audio amplifier, and this filter, consisting of L29, C60, C61, L30, C62 and C63, is of the low pass type with cut-off frequency commencing at a frequency of 7 Kc/s and having maximum suppression at 10 Kc/s. This operates to materially reduce 10 Kc/s heterodyne whistles and all frequencies above 10 Kc/s, which are generally associated with background noise.

Inverse feedback is used with this audio amplifier circuit, and it is essential that correct phase relationship be maintained, so that in the event of the output transformer being removed, it is essential that it be replaced with identical connections.

The out-of-phase voltage for the push pull output stage is obtained by the use of a separate valve, 6J7G, as a phase inverter, wherein a small part of the audio frequency voltage, appearing in the plate circuit of the second audio amplifier 6J7G, is fed to the grid of the 6J7G phase inverter, and due to the phase reversal through the valve, appears in the plate circuit with the correct phase relationship to the voltage in the plate circuit of second audio amplifier.

In order that noise be avoided, when tuning the receiver by motor, provision has been made to completely silence the audio end of the receiver, when the automatic tuning motor is running. This is accomplished by connecting one side of the motor winding to ground, and the other, through a condenser C58, to the diodes of the 6R7G. When the motor is running, a voltage appears on the diodes, and is rectified to appear as a D.C. voltage across R32, R45, R47 and R46. Portion of this voltage appearing across R45, R47 and R46 is used, after being suitably filtered, to bias the first audio amplifier 6R7G, the second audio amplifier 6J7G, and the phase inverter 6J7G, to a point where their plate current is cut off, and where, consequently, no signal can be transmitted. This voltage is applied only while the motor is running, and disappears shortly after the motor circuit is broken. The slight delay is due to the time constants of the necessary resistance capacity filter circuits.

ALIGNMENT PROCEDURE.

Alignment should only be necessary when adjustments have been altered from the factory setting, or when repairs have been made to the tuned circuits. Climatic conditions should not seriously affect the performance of the receiver.

It is important to apply a definite procedure, as tabulated, and to use adequate and reliable test equipment. Instruments ideally suited to the requirements are the A.W.A. Junior Signal Generator Type 2R3911, or the A.W.A. Modulated Oscillator, Type C1070. An output meter is necessary in conjunction with both these instruments.

Alignment of the R.F. stages at the high frequency end of each band is by air trimmers of the plunger type. Adjustment of the Medium Wave Oscillator coil at the low frequency end of the band (600 Kc/s) is by a magnetite core, the adjusting screw being located at the top of the coil shield. A special tool should be used for adjusting the air trimmers. It is constructed for the purpose with a hook at one end to grasp the plunger and a tubular spanner at the other for locking the trimmer. Such a tool, Part No. 5371, may be obtained from the Service Department of the Company. It will be found advantageous to use a twisting motion when adjusting the trimmer.

The I.F. stages are adjusted by magnetite cores. The adjusting screws are approached from above and below the chassis, see Figs. 1 and 4, and should be adjusted with a non-metallic screwdriver. A special tool, part No. 5372, is obtainable for this purpose from the Company. This tool should also be used for the 600 Kc/s oscillator adjustment mentioned above.

Perform alignment in the proper order, starting with No. 1 and following all operations across, then No. 2, etc. Adjustment locations are shown in Figs. 2 and 5. "No Signal 550-750 K.C." means that the receiver should be tuned to a point between 550 and 750 Kc/s where no signal or interference is received from a station or local (heterodyne) oscillator. The term "Dummy Aerial" should be disregarded, if a Type 2R3911 Signal Generator is employed, as a suitable dummy aerial is included in the output cable of the instrument. If a Type C1070 Modulated oscillator is used, a dummy aerial should be used for short wave alignment. It is simply a 400 ohms non-inductive resistor, connected between the output cable of the test oscillator and the aerial terminal of the receiver, the purpose being to simulate the characteristics of the average aerial.

Connect the ground connection of the test oscillator to the Receiver chassis, and for I.F. alignment remove the grid clip from the 6K8G, before connecting the oscillator. See that a 250,000 ohms resistor is connected between the output terminals of the test oscillator.

During alignment, set the volume and fidelity controls in the maximum clockwise and anti-clockwise positions respectively. It is most important that the fidelity control be set anti-clockwise, unless otherwise specified, so that the A.F.C. circuits will be rendered inoperative, and the selectivity will be normal.

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

CAUTION.

The iron core screw L26, L27, on the bottom of the fourth I.F. transformer, has been accurately adjusted for an exact electrical balance of coil L26, L27, 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 $\frac{1}{16}$in. (two threads exposed) above the brass bushing, prior to any alignment operations.

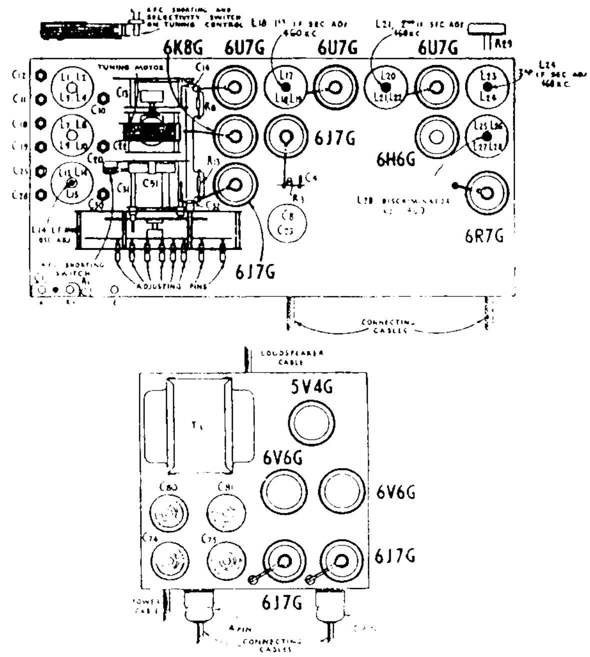


Fig. 1.—Layout Diagram (Top View).

	TEST OSCILLATOR.				RECEIVER.		
Alignment Order	Connection to Radiola	Dummy Aerial	Frequency or Wavelength Setting	Dial and Range Setting	Circuit to Adjust	Adjustment Symbol	Adjust to Obtain
1					4th I.F. Trans.	L28	Turn extreme counter clockwise
2	6K8G 1st Det. Grid Cap		460 Kc/s	No Signal 550-750 Kc/s	3rd I.F. Trans.	L23 & L24	Max. (Peak)
3	6K8G 1st Det. Grid Cap		460 Kc/s	No Signal 550-750 Kc/s	2nd I.F. Trans.	L20 & L21	Max. (Peak)
4	6K8G 1st Det. Grid Cap		460 Kc/s	No Signal 550-750 Kc/s	1st I.F. Trans.	L17 & L18	Max. (Peak)
5	Repeat adjustments 2, 3 and 4 before proceeding						
6	Aerial Term.		600 Kc/s	600 Kc/s	Oscillator	L14‡	Max. (Peak)
7	Aerial Term.		1500 Kc/s	1500 Kc/s	Oscillator	C25	Max. (Peak)
8	Aerial Term.		1500 Kc/s	1500 Kc/s	Detector and Aerial	C18 & C12	Max. (Peak)
9	Repeat Adjustment 6						
10	Connect an aerial in place of test oscillator and check Radiola dial calibration by tuning in a station between 550 and 750 Kc/s. If there is an error, loosen pointer and reset. Now tune a station between 1350 and 1600 Kc/s. If there is an error, adjust station selector until pointer lies on station calibration and then use C25 to retune the station.						
11	Repeat adjustments 8 and 6 in this order.						
12	Aerial Term.	400 ohms	38 M.	38 M.	Oscillator	C28	Max. (Peak)*
13	Aerial Term.	400 ohms	38 M.	38 M.	Detector and Aerial	C19 & C11‡	Max. (Peak)**†
14	Aerial Term.	400 ohms	14 M.	14 M.	Oscillator	C30	Max. (Peak)*
15	Aerial Term.	400 ohms	14 M.	14 M.	Detector and Aerial	C20 & C10‡	Max. (Peak)**††

Proceed to A.F.C. Discriminator Adjustments outlined below.

Note:—To align the Receiver 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 Receiver to approx. 42.5 metres.

†† After this adjustment, check for image signal by tuning the Receiver 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 the oscillator control tube failing 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 L28 (top of fourth I.F. transformer) has been turned all the way out (extreme anti-clockwise), prior to the preceding tabulated adjustments.

The adjustments are as follows:—

1. Set Fidelity Control in maximum anti-clockwise position.
2. Connect the test oscillator to the grid cap of the 6K8G 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. The most accurate adjustment will be obtained by adjusting the tuning control midway 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 6K8G first detector, and place the "high" test oscillator lead near the grid lead of the 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 6U7G is not too close.
4. Take another receiver of the Superheterodyne type, and set its dial pointer to 550 Kc/s., when its local oscillator should radiate at 1000 Kc/s., if the intermediate frequency is 460 Kc/s. Connect a wire to the aerial terminal of the Receiver, 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 Fidelity control to Position 3, and commence turning the iron core adjusting screw L28 clockwise, until the high beat note, which is heard, is reduced to zero-beat. Reset the fidelity control to maximum anti-clockwise position. Re-adjust the zero-beat as the control is thrown back and forth from "maximum anti-clockwise" to "third position." Adjustment of the discriminator circuit is then complete.

NOTE:—With the Fidelity control at position 3, operation of the tuning control of the Receiver 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 15-20 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 6J7G bias requires adjustment to centre the control action. The necessary procedure is described later.

NOTE:—In adjustment 4, a second test oscillator set to 1000 Kc/s. 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 Fidelity control at position 3, 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 6K8G 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 Receiver.
3. Connect two leads to resistor R2 (500,000 ohms on panel No. 6684) and join them to the 4.5 v. bias battery. Retune the receiver 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 20 to 30 Kc/s. 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, 20 K.C. on one side and 12 Kc/s. the other, further adjustment is necessary.
4. If the first reading is on the high frequency side of the mid-point, between the two taken with the battery in circuit, shunt R6 (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 low frequency side, replace R6 with a larger value, such as 500 ohms.

ADJUSTMENTS FOR AUTOMATIC TUNING.

Any eight stations in the Medium Wave band may be selected for Automatic tuning. The stations are identified by means of the call-sign tabs supplied for insertion in the recesses on the keys. A sheet of tabs, on which are printed the call-signs of all Australasian stations accompanies the set. Call-signs of the eight stations selected should be neatly cut from the sheet.

The stations should be adjusted in order of their frequency in kilocycles. This order is used in the following example:—

(1)	2SM	1270 K.C.	(5)	2UE	950 K.C.
(2)	2CH	1190 K.C.	(6)	2GB	870 K.C.
(3)	2UW	1110 K.C.	(7)	2BL	740 K.C.
(4)	2KY	1020 K.C.	(8)	2FC	610 K.C.

Accompanying the call-sign sheet will be found several celluloid tab covers. Insert a call sign tab and a celluloid cover in each key. This is easily done by curving the tabs upwards lengthwise and sliding the two ends in the ends of the recesses.

Turn the receiver ON and allow it to operate for at least five minutes before making adjustments.

Proceed to set up for Automatic tuning as follows:—

(1) Press the key labelled "Manual", and set the Fidelity Control in No. 1 position.

(2) Manually tune station No. 1. Be sure to tune accurately by watching the Tuning Indicator. Tune till the darkened sector of the Indicator's screen is at the narrowest possible width.

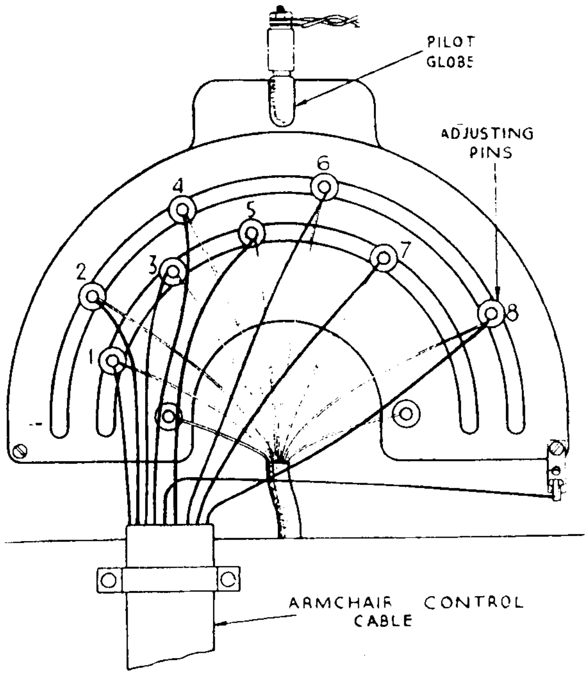


Fig. 2.—Automatic adjusting pins and Armchair Control connections.

(3) Look in the back of the receiver and two semi-circular slots in which are eight adjusting pins, as shown, numbered 1 to 8 in Fig 2, will be seen. These correspond to the keys on the keyboard, numbered 1 to 8, from left to right.

(4) Hold the "Manual" key down and press key No 1 on the keyboard. Both keys will stay down. Then move adjusting pin No. 1 along the semi-circular slot, either clockwise or anti-clockwise, until the pilot globe situated above the adjusting pin goes out. It will be noticed that when the adjusting pin is moved to the right past this position the globe will light brightly and to the left dimly.

This is normal and care should be taken in making this adjustment to see that the globe does go completely out.

(5) Press another key and key No. 1 and the "Manual" key will then be released.

(6) Press key No. 1 again. The pilot globe will stay out and the station will be heard. If reproduction is not normal, repeat the above procedure, as the adjustments were probably not carried out with great enough accuracy.

Proceed similarly for the other seven keys, and then any one of the eight stations may then be obtained by simply pressing the key on which is the call-sign of the desired station.

To change a station at any time, simply follow the same procedure and remember to replace the call-sign tab in the key with the new one.

AUTOMATIC TUNING MECHANISM.

The circuit of the automatic tuning mechanism is shown in the schematic diagram. The action can be understood by following a cycle of operation:

When a station key is pressed, it completes the 24-volt circuit through the corresponding station-setting contact and one-half of the brass selector disc, which is connected to one side of the motor field coil. This energises the motor, and the rotor is pulled forward engaging with the gear train that drives the tuning condenser and selector disc. The condenser and disc rotate until the insulation line comes under the particular station-setting contact, and the motor circuit is broken. Inertia carries the insulation line past the station-setting contact, which then makes contact to the other half of the disc: This completes the circuit to the other side of the motor field coil, causing the motor to reverse. The floating flywheel is still turning in the original direction and therefore slows down the reversal movement of the motor; as a result, the selector disc is moved slowly back until the insulation line is under the station-setting contact, when the circuit is broken and the mechanism stops.

MUTING CIRCUIT.

When the automatic tuning mechanism is in action, the motor-supply voltage is fed into a diode rectifier circuit, which applies a high bias to 1st audio, 2nd audio and inverter tubes. This prevents audio amplification and makes the set quiet or "mute" while the mechanism is operating.

ADJUSTMENT OF FLYWHEEL FRICTION.

In normal operation, the motor drives the tuning condenser and selector disc until the insulation line just passes the particular station-setting contact: The motor then reverses and moves the disc slowly in the opposite direction until the insulation line is under the contact, and the mechanism stops.

In some cases, particularly with high line-voltage, the disc may make two or three reversals before stopping.

The flywheel friction adjustment spring washer should be set to give the least number of reversals with the chassis in normal operating position.

ADJUSTMENT OF SELECTOR DISC.

The brass selector disc is fastened to the rear shaft of the tuning condenser by means of two set-screws. When the condenser is at maximum (plates fully meshed) the insulation line should be horizontal, with the operating-end at the right (viewed from rear). The operating-end has red insulating material and the brass is bevelled at this end.

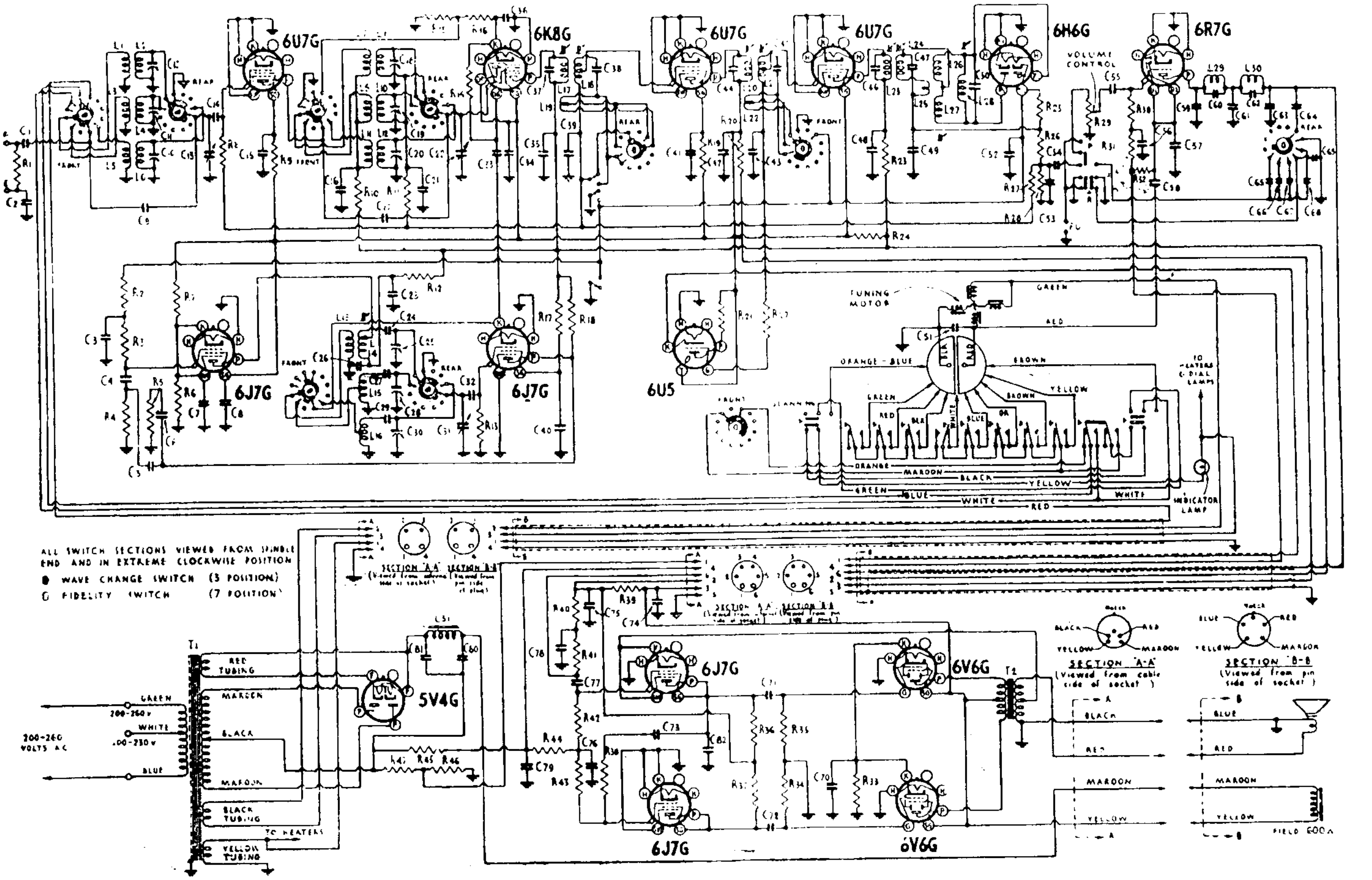
The selector disc should be set so that the contact-tip plungers in the station-setting contacts project not more than 1/16-in. from the body of the contacts.

ARMCHAIR CONTROL UNIT.

When an Armchair Control Unit is connected to the receiver, as shown in Fig. 2, it duplicates the action of the eight station selector keys on the receiver's keyboard. That is, after pressing the "Manual" key on the receiver, eight broadcast stations may be tuned automatically at any distance up to the length of the connecting cable from the instrument (25 feet).

The unit is supplied fitted with a 9 wire flat cable. Take the central wire and solder it to a lug attached to the lower right-hand corner of the selector mechanism frame. The remaining eight wires are then soldered to the eight adjusting pins. The first, or right-hand wire, looking towards the unit, to No. 1 pin, the second to No. 2 pin and so on. The call-signs of the eight selected stations, which must correspond to those for which the receiver is set, should be removed from the sheet supplied and fitted beneath the windows of the unit.

Before operating the receiver from the unit, the "Manual" key on the receiver's keyboard must first be pressed. Then, press the push-button on the Unit for the desired station and hold the button down until the station is tuned. Care must be taken not to hold two push-buttons down at one time, as both windings of the motor may be engaged simultaneously, causing the motor to be inoperative and overheated.



Code No.	Part No.	COILS
L1, L2 } L3, L4 }	6665	Aerial Coil, Med. Wave, 1600-550 K.C. Aer. Coil, Short Wave, 35-105 metres
L5, L6	6692	Aer. Coil, Short Wave, 13-39 metres.
L7, L8 } L9, L10 }	6667	R.F. Coil, Med. Wave, 1600-550 K.C. R.F. Coil, Short Wave, 35-105 metres
L11, L12	6693	R.F. Coil, Short Wave, 13-39 metres
L13, L14 } L15 }	6669	Osc. Coil, Med. Wave, 1600-550 K.C. Osc. Coil, Short Wave, 35-105 metres
L16	4944A	Osc. Coil, Short Wave, 13-39 metres
L17, L18 } L19 }	6671	1st I.F. Transformer
L20, L21 } L22 }	6671	2nd I.F. Transformer
L23, L24	6673	3rd I.F. Transformer
L25, L26 } L27, L28 }	6674	4th I.F. Transformer
L29, C60 } C63, L30 } C61, C62 }	6695	10 Kc/s Filter
L31	5829	Filter Choke

Code No.	Part No.	TRANSFORMERS
T1	6482A	Power Transformer, 40-60C.
T1	6631A	Power Transformer, 110V., 100C.
T2	TX11	Loudspeaker Transformer

Code No.	Part No.	RESISTORS
R1		100,000 ohms, 1/3 watt
R2		500,000 ohms, 1/3 watt
R3		1.75 megohms, 1/3 watt
R4		100,000 ohms, 1/3 watt
R5		100 ohms, 1/3 watt
R6		450 ohms, 3 watt
R7		11,000 ohms, 3 watt
R8		500,000 ohms, 1/3 watt
R9		900 ohms, 1/3 watt
R10		600 ohms, 1/3 watt
R11		100,000 ohms, 1/3 watt
R12		10,000 ohms, 1 watt
R13		50,000 ohms, 1/3 watt
R14		50,000 ohms, 1/3 watt
R15		300 ohms, 1/3 watt
R16		300 ohms, 1/3 watt
R17		70,000 ohms, 1 watt
R18		30,000 ohms, 1 watt
R19		900 ohms, 1/3 watt
R20		15,000 ohms, 2 watts
R21		1.0 megohm, 1 watt
R22		250,000 ohms, 1/3 watt
R23		600 ohms, 1/3 watt
R24		7,000 ohms, 5 watts
R25		500,000 ohms, 1/3 watt
R26		200,000 ohms, 1/3 watt
R27		1.75 megohms, 1/3 watt
R28		300,000 ohms, 1/3 watt
R29	6370	1.0 megohm, Vol. Cntrl.
R30		1.75 megohms, 1/3 watt
R31		250,000 ohms, 1/3 watt
R32		100,000 ohms, 1/3 watt
R33		240 ohms, 3 watt
R34		250,000 ohms, 1/3 watt
R35		250,000 ohms, 1/3 watt
R36		100,000 ohms, 1 watt
R37		100,000 ohms, 1 watt
R38		500,000 ohms, 1/3 watt
R39		1,000 ohms, 3 watt
R40		50,000 ohms, 1 watt
R41		50,000 ohms, 1 watt
R42		1 megohm, 1/3 watt
R43		35,000 ohms, 1/3 watt
R44		250,000 ohms, 1/3 watt
R45		500,000 ohms, 1/3 watt
R46		20 ohms, 3 watt
R47		20 ohms, 3 watt

Code No.	Part No.	CONDENSERS
C1		500 mmfd., Mica
C2		500 mmfd., Mica
C3		0.05 mfd., Paper
C4		200 mmfd., Mica (J)
C5		200 mmfd., Mica (J)
C6		350 mmfd., Mica
C7		0.1 mfd., Paper
C8		8 mfd., 450V., Electrolytic
C9		4 mmfd., Mica
C10	3411	11-29 mmfd., Air Trim.
C11	3661	2-20 mmfd., Air Trim.
C12	3661	2-20 mmfd., Air Trim.
C13	6690	Tuning Condenser
C14		350 mmfd., Mica
C15		0.1 mfd., Paper
C16		0.1 mfd., Paper
C17		4 mmfd., Mica
C18	3661	2-20 mmfd., Air Trim.
C19	3661	2-20 mmfd., Air Trim.
C20	3411	11-29 mmfd., Air Trim.
C21		0.05 mfd., Paper
C22	6690	Tuning Condenser
C23		8 mfd., 450V., Electrolytic
C24		450 mmfd. (Padder temp. comp.)
C25	3661	2-20 mmfd., Air Trim.
C26		0.5 mfd., Paper
C27		2,250 mmfd., Mica (Padder)
C28	3661	2-20 mmfd., Air Trim.
C29		5,400 mmfd., Mica (Padder)
C30	3411	9-29 mmfd., Air Trim.
C31	6690	Tuning Condenser
C32		110 mmfd., Mica (L)
C33		110 mmfd., Mica (L)
C34		0.25 mfd., Paper
C35		0.05 mfd., Paper
C36		0.1 mfd., Paper
C37		250 mmfd., Mica
C38		250 mmfd., Mica
C39		0.05 mfd., Paper
C40		0.05 mfd., Paper
C41		0.1 mfd., Paper
C42		0.1 mfd., Paper
C43		0.05 mfd., Paper
C44		250 mmfd., Mica
C45		250 mmfd., Mica
C46		100 mmfd., Mica
C47		100 mmfd., Mica
C48		0.05 mfd., Paper
C49		110 mmfd., Mica (L)
C50		100 mmfd., Mica
C51		60 mfd., Non-Polarised Elect.
C52		0.5 mfd., Paper
C53		110 mmfd., Mica (L)
C54		0.025 mfd., Paper
C55		0.025 mfd., Paper
C56		0.25 mfd., Paper
C57		0.01 mfd., Paper
C58		0.25 mfd., Paper
C59		1500 mmfd., Mica
C60		680 mmfd., Mica
C61		1500 mmfd., Mica
C62		990 mmfd., Mica
C63		680 mmfd., Mica
C64		0.025 mfd., Paper
C65		0.003 mfd., Paper
C66		0.006 mfd., Paper
C67		0.01 mfd., Paper
C68		0.05 mfd., Paper
C69		0.02 mfd., Paper
C70		25 mfd., 25v., Electrolytic
C71		0.1 mfd., Paper
C72		0.025 mfd., Paper
C73		0.01 mfd., Paper Condenser
C74		16 mfd., 550V., Electrolytic
C75		8 mfd., 500V., Electrolytic
C76		0.25 mfd., Paper
C77		0.0025 mfd., Paper
C78		0.25 mfd., Paper
C79		0.25 mfd., Paper
C80		16 mfd., 550V., Electrolytic
C81		16 mfd., 550V., Electrolytic
C82		0.005 mfd., Paper