



# **“His Master’s Voice”**

## **SERVICE MANUAL**

*for*

**SIX-VALVE**

**DUAL-WAVE A.C. RECEIVER**

**Model 410**

**AND**

**DUAL-WAVE A.C. RADIOGRAM**

**Model 420**

# TECHNICAL SPECIFICATION

## VOLTAGE RANGE

200 to 250 volts, 40 to 60 cycles.

It is important that the receiver be operated at the correct voltage; the voltage taps on the mains transformer should be utilized as follows:

Voltage of A.C. Supply	Use Tap Designated
200-220 volts	200
221-240 "	240
241-260 "	260

## CONSUMPTION

	Radio	Gram.
Model 410 .. ..	96 watts	—
„ 420 .. ..	96 „	170 watts

## WAVE-LENGTH RANGE

13.9 metres (21.59 megacycles) to 47 metres (6.38 megacycles).

187 metres (1600 kc.) to 545 metres (550 kc.).

## MAX. UNDISTORTED POWER OUTPUT

6 watts.

## DIMENSIONS

	Height	Width	Depth
Model 410 ..	35 $\frac{3}{4}$ "	31"	13 $\frac{1}{2}$ "
„ 420 ..	34"	34"	19 $\frac{3}{4}$ "

## WEIGHT

	Nett	Gross
Model 410 .. ..	71 lbs.	88 lbs.
„ 420 .. ..	115 „	224 „

## LOUDSPEAKER

These models use a 12" speaker, the field winding acting as filter choke.

D.C. resistance of field coil, cold .. 1200 ohms.

D.C. resistance of voice coil .. 2 „

400 cycle impedance of voice coil .. 2.35 „

## VALVES

6K7GT (2), 6J8G, 6B8G, 6L6G, 5V4G, 6U5/6G5.

## CIRCUIT

These Models are Superheterodyne Receivers, employing 6 valves and a cathode ray type Tuning Indicator, which latter is incorporated in the Dial Assembly. **The R.F. Stage**, which operates on both wave bands, employs a 6K7GT valve, which is transformer-coupled to a 6J8G triode-heptode converter valve. **The oscillator circuit** is a little unusual, and is designed to provide relatively constant oscillation amplitude over the very wide tuning range employed in both wave bands. **The wave-band switching** has been greatly simplified by the elimination of switching in the primary circuits of the aerial and R.F. transformers. **The frequency changer** is followed by a single stage I.F. Amplifier, using a 6K7GT valve, operating at 457.5 kc. and feeding into a 6B8G duo-diode-pentode, whose diodes are used as demodulator and A.V.C. rectifier respectively. The pentode section of this valve is resistance-capacity-coupled to a 6L6G beam type output valve.

**The broadcast band aerial coupling** is through a Litz-wound iron-core coil of exceptionally

high efficiency. All I.F. transformers also employ Litz-wound Iron-core coils and silver-coated titanium dioxide fixed condensers—tuning being accomplished by axial adjustment of the iron cores. Inductive padding of the oscillator circuit is used on both wave bands, through the medium of adjustable iron cores; special close tolerance fixed padding condensers are used.

These Models incorporate the "His Master's Voice" Automatic Expanding Selector, which comprises a special form of I.F. amplifier, whose band width is directly controlled by the strength of the incoming signal, providing broad tuning and consequent high fidelity on powerful signals and giving progressively sharper tuning as signal strength is reduced. Normal 2-circuit input and output transformers are used, but they are more closely coupled than usual, thus giving a broad flat-topped resonance curve of low selectivity, permitting faithful transmission of side bands up to about 5,000 cycles/sec. Feed-back is taken through the condenser CN from the un-by-passed I.F. cathode resistor to the plate of the converter valve; this feed-back is so adjusted that when the I.F. valve is operating at full sensitivity, the coupling between the first I.F. primary and secondary is electrically loosened sufficiently to provide a resonance curve, having a single sharp peak and giving very high selectivity. However, as the bias on the I.F. valve is increased by A.V.C. action on strong signals, its mutual conductance is reduced, allowing the first I.F. transformer to return to its normal tuned condition. The condenser CN is precisely adjusted at the factory and sealed, and its adjustment should **under no circumstances** be interfered with.

A.V.C. voltage is applied to R.F., Converter and I.F. valves on both wave-bands; the maximum Control voltage derived from the A.V.C. diode, which is fed from the I.F. plate, is applied to R.F. and converter states, but the I.F. valve is controlled by the rectified signal voltage from the signal diode; this voltage simultaneously serving the purpose of A.V.C. voltage is also applied to the 6B8G audio frequency valve.

Inverse feed-back is applied to the complete audio frequency system from the Tone Monitor Control, through the secondary of the output transformer to a tap on the Volume Control; in this way the whole of the A.F. circuits benefit from the distortion reducing properties of such feed-back. In addition, the circuits associated with the Tone Monitor Switch provide varying degrees of feed-back differing with frequency, thus ensuring control of tonal balance. Furthermore, the degree of feed-back varies with the setting of the Volume Control in such a way as to automatically provide the best type of response for both local and distant reception and at all volume levels. The speaker field winding is used as a filter choke, in conjunction with two 16mfd. wet electrolytic condensers, one of which is of the regulating type. It is essential that the positions of these condensers in the circuit shall **not** be interchanged. The condensers are mounted on the speaker and are thus isolated from the chassis heat and protected against damage.

Provision is made for the connection of a Gramophone Pick-up to Model 410 by means of two jacks at the back of the chassis. Insertion of the pick-up plugs automatically suppresses radio reception, and converts the diode filter resistor into a load for the pick-up.

### DIAGRAMS

The circuit diagrams of Models 410 and 420, together with all component values are shown on pages 4 and 5.

### WAVE-BAND SWITCHING

This is carried out by a 2-deck switch, having two positions—one for short-wave and one for the broadcast band. The primary windings of all coils are connected permanently in series and are not switched. Additional capacitive feed-back is applied across the padding condenser on the short-wave band, and this is controlled by the Wave-change Switch. Rotation of the switch to the left connects the short-wave circuits, and to the right the broadcast circuits.

### tone MONITOR

This is a 5-position, 2-deck switch. In Model 410 the following effects are secured in the various switch positions:

1st Position (Wide Range): Normal bass and boosted treble, the latter compensating for side band cut. For local reception of high fidelity.

2nd Position (Normal): Normal bass and slight treble cut. For normal and distant reception.

3rd Position (Bass): Bass boost and increased treble cut. For deeper tone and reduction of static and surface noise.

4th Position (Speech): Bass cut and treble boost. For long-distance reception of speech with good intelligibility, or reduced bass response.

5th Position (Overseas): Bass and treble cut. For easy short-wave tuning with reduced background noise and freedom from microphony.

In Model 420 additional bass boost is provided, which is cut in by the Radio-Gram. switch in the "Gram." position and removed in the "Radio" position.

### EXTENSION SPEAKER

Pin-jacks are provided at the back of the chassis for the connection of an extension speaker. They are wired to the secondary of the output transformer, and are suitable for connection to any loud-speaker having a voice coil impedance between 2.5 and 4 ohms. An impedance of 3 ohms at 400 cycles is recommended, and the speaker should preferably be of permanent magnet type and requires no transformer. The "His Master's Voice" Extension Speaker is very suitable, and is fitted with a constant impedance volume control. A switch, marked "REC'R SPKR.", is installed beside the jacks to permit the receiver speaker to be silenced if desired when an extension speaker is in use.

## PRELIMINARY TESTS

1. Switch on receiver and note that dial lights up and changes colour when wave-band switch is operated.
2. If no signals can be tuned in, remove the shield from the 6B8G valve and with the volume control full on and earth wire disconnected, touch the finger to the grid cap of the valve, when a loud hum should be heard; a hum should also be heard when the bottom pick-up jack is touched. This indicates that the A.F. side of the receiver is working, and the fault probably lies in the R.F. or I.F. circuits. Should no hum be heard, a fault exists between first A.F. stage input and the speaker.
3. Check all valves for heater continuity and freedom from internal shorts.
4. To determine if the fault lies in the loud-speaker, connect a high impedance A.C. voltmeter or output meter, range 0-3 volts approx., to the voice coil terminals of the speaker. Switch on receiver, turn volume control fully on, and tune across the broadcast band when stations are known to be transmitting. If meter does not deflect, the fault lies in the receiver circuits or in the field circuit of the speaker. If the meter deflects but no sound is heard, the speaker voice coil is at fault.
5. If the fault is still undiscovered, remove chassis and speaker from cabinet and compare voltages with table given on page 6.

## DISMANTLING

### REMOVAL OF CHASSIS

1. Remove knobs. (Knobs without screws pull straight off shaft.)
2. Disconnect speaker plug and power plug.
3. Remove nuts from two fixing bolts from underside of shelf; the chassis is now free.

### REMOVAL OF LOUDSPEAKER

1. Remove 6-pin plug from back of chassis.
2. Remove screws holding speaker chassis to baffle and withdraw speaker.





## VOLTAGE TABLE

	Wave-band	6K7GT R.F.	6J8G		6K7GT L.F.	6B8G	6L6G	6U5	5V4G
			Amp.	Osc.				6G5	
Plate to Chassis Volts .. ..	B.C.	268	237	148	267	38	250	180	400v. A.C.
	S.W.	253	221	138	252	38	238	170	
Screen to Chassis Volts .. ..	B.C.	46	66		98	10	268	24	
	S.W.	96	96		92	10	255	22	
Plate Current in M/A .. ..	B.C.	1.9	0.5	4.3	4.1	0.35	73.0	1.4	
	S.W.	7.5	1.6	3.9	3.9	0.33	70.0	1.4	
Screen Current in M/A .. ..	B.C.	0.4	0.9		1.0	0.07	6.5		
	S.W.	1.8	2.4		0.9	0.06	6.1		
Cathode to Chassis Volts .. ..	B.C.	0	0		4.8	0	13.0	0	268
	S.W.	0	0		4.2	0	12.2	0	253
Heater Volts (A.C.) .. ..	B.C./S.W.	6.3	6.3		6.3	6.3	6.3	6.3	5.0
Input to Filter .. ..	B.C.	390 volts	} Measured at Speaker Socket						
	S.W.	383 volts							
Output from Filter .. ..	B.C.	268 volts							
	S.W.	253 volts							
Total H.T. Current .. ..	B.C.	95 M/A							
	S.W.	100 M/A							

## RADIO FREQUENCY TESTS AND ADJUSTMENTS

Instability, insensitivity or poor selectivity indicate that the alignment of the tuned circuits is not correct. If a coil or other component associated with the R.F. or I.F. circuits of the receiver has been replaced or repaired, or if the wiring has been disarranged, all circuits must be realigned.

To do this, the following apparatus is required:

1. An oscillator or signal generator capable of tuning to 457.5kc., 1500kc., 600kc., 13.9 metres (21.59mc.), 15 metres (20mc.) and 25 metres (12mc.), suitably screened and having an attenuator.
2. An output meter having a range of 0.2 volts AC approximately.

I.F. alignment should always precede R.F. alignment, and even if only one coil or one range of coils has been serviced, the whole of the realignment should be done in the order given, i.e., broadcast band first, followed by short-wave band.

In carrying out the following operations, it is important that the input to the receiver from the oscillator should be kept low and progressively reduced as the circuits are brought into line, so that the reading on the output meter does not exceed about 1.0 volt.

For all alignment operations, the output meter should be connected directly across the voice coil terminals of the speaker.

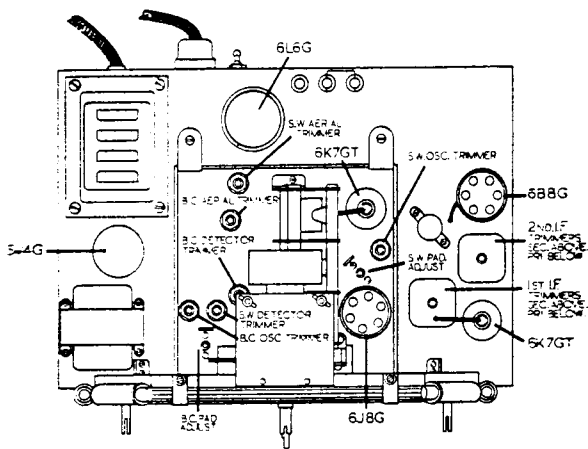
## I.F. ALIGNMENT

The sketch alongside shows the layout of all principal components and adjustments referred to in the following procedure.

Before commencing alignment, it is essential to allow the receiver to warm-up for at least 15 minutes.

Rotate volume control fully clockwise and set wave-change switch to broadcast position; rotate tuning control till dial pointer indicates 550kc., i.e., condenser vanes fully meshed.

1. Connect output leads of signal generator to the grid cap of the 6K7GT I.F. valve through a 0.1 mfd. condenser and to the receiver chassis or



earth terminal. (**Note:** Do not disconnect the clip and lead from the valve grid.)

2. Tune signal generator to exactly 457.5kc.
3. Adjust the trimmer screws of the second I.F. transformer for maximum deflection of the output meter, keeping the meter reading at about 1 volt or less. This alignment must be done **very** accurately.
4. Transfer the signal generator lead to the 6J8G grid, leaving the existing clip and lead connected to the valve.
5. Align the trimmer screws of the **1st I.F. transformer only** for maximum output. On no account touch the 2nd I.F. screws during this process.
6. **Screw out** (i.e., anti-clockwise) the secondary trimmer screw of the 2nd I.F. transformer by  $\frac{1}{2}$  turn (the top screw is the secondary). This completes the I.F. alignment process; it must be carried out strictly as outlined above, and, when this has been done, the trimmer screws must on no account be interfered with further.

(Note.—If trimmer screws are screwed too far in, it is possible to obtain a false peak due to

coupling effects between the moveable iron cores. Any trimmer which appears to require screwing too far in should be screwed out considerably and the true peak will then be found.)

## R.F. ALIGNMENT

With controls set as for I.F. alignment, connect the signal generator output leads through a standard dummy aerial of 200 mmf. capacity to the aerial and earth terminals.

Check that when the ganged condenser is fully meshed, the pointer falls directly over the setting line, marked "S" at the extreme bottom right of the scale; the pointer is a friction fit on the condenser spindle, and can be rotated to bring it to the correct setting.

1. Tune signal generator to 600kc.
2. Rotate tuning knob until dial pointer is exactly over 600kc. mark on scale, and by means of padding adjustment (brass screw to left of ganged condenser) align receiver so that the 600kc. signal is tuned in exactly on 600kc. dial calibration.
3. Tune signal generator to 1500kc.
4. Set pointer exactly over 1500kc. mark on dial and adjust B/c oscillator trimmer until the signal is tuned in with the pointer on the 1500 line.
5. Adjust broadcast aerial and R.F. trimmers for maximum output on output meter, "rocking" ganged condenser slightly during adjustment if necessary.
6. Repeat operations 1 to 5 inclusive. THIS IS IMPORTANT. Note that any stations receivable are tuned in correctly on calibration. (Discrepancies of two or three kilocycles can be tolerated.)

## SHORT-WAVE ALIGNMENT

1. Set wave-change switch to S.W. range (fully anti-clockwise). Remove the standard dummy aerial from the output lead of the signal generator and substitute a 400-ohm non-inductive resistor; connect the aerial terminal as previously.
2. Tune signal generator to 25 metres (12mc.),

setting dial pointer accurately to 25 metres on dial.

3. Adjust short-wave padding screw until generator signal is tuned in to maximum output.
4. Tune signal generator to 13.9 metres (21.59mc.).
5. Set pointer to 13.9 metres on dial and adjust S.W. oscillator trimmer for maximum output. Two settings will be found at which this trimmer will peak; care must be taken that the setting finally selected is that which gives the lower capacity, i.e., plunger further out. Failure to select the correct position of the two will cause serious tracking errors and loss of sensitivity.
6. Tune receiver and signal generator to 15 metres (20mc.).
7. Adjust S.W. aerial and R.F. trimmers for maximum output, while "rocking" the ganged condenser slightly to obtain the true resonant point.
8. Re-tune receiver and signal generator to 13.9 metres and note that signal is still tuned in correctly on dial; if not, re-adjust S.W. oscillator trimmer slightly until dial reads correctly and then repeat tests 6 to 8 inclusive.
9. Tune receiver and signal generator to 25 metres (12mc.), and, if necessary, slightly re-adjust short-wave padding screw for maximum output while "rocking" ganged condenser slightly. This adjustment must be kept small.
10. Check foregoing adjustments carefully to ensure that correct settings have been obtained on all trimmers. Dial should now read correctly throughout.

**Note.**—The R.F. trimmers on these models are of plunger type, with air dielectric, and possess exceptionally high stability and efficiency. A special adjusting tool can be obtained from the factory, incorporating a box spanner for the condenser lock-nut and an adjusting hook for the plunger. After loosening the lock-nut at the top of the condenser, the adjusting hook is inserted in the hole which will be found in the top of the plunger, which can then be easily adjusted by moving up or down as required, with a slight rotary movement. When adjustment is completed, tighten the lock-nut securely.

## Supplementary Service Information for Radiogram Model 420

### TECHNICAL SPECIFICATION

#### PICK-UP

DC resistance, 7400 ohms.

Impedance at 1000 cycles, 19,000 ohms.

One of the pick-up leads, and also the screening over the leads, is to be connected to the black pick-

up socket on the chassis. For service particulars of this pick-up, see below.

#### AUTO BRAKE (Type 324)

Standard friction type, see page 8.

### DISMANTLING

#### REMOVAL OF CHASSIS

1. Remove knobs. The tuning control knobs are a friction fit and can be pulled off. Do not lose small flat spring from inside small tuning knob.
2. Disconnect loudspeaker plug, gramophone motor plug, tuning indicator socket, and pick-up leads. (Socket pulls straight off base of tuning indicator tube.)
3. Unscrew volume control bracket from inside front of cabinet.
4. Remove nut from speaker switch on top of control panel and withdraw switch, noting position so that it may be replaced right way round.

5. Remove two nuts from chassis fixing bolts behind wooden chassis supports; the chassis is now free.

#### THE PICK-UP AND MOTOR

To gain access to the pick-up movement remove the wax covering the two screw-heads in centre (underside) of pick-up head and remove the screws. The four wax-covered screws fixing the pole pieces of the pick-up must not be disturbed. These pole-fixing screws are situated at either side of, and in line with, the needle hole (Fig. 1).

#### ADJUSTING THE ARMATURE

The armature, which should be midway between the two poles of the magnet, may be adjusted by

moving the clamp which holds the rubber damping pad.

See that the slit in the rubber is locating the end of the armature. When properly fitted, the flat end of the armature will be just visible through the slit in the rubber. Carefully remove all dust or filings in and around the gap of the armature. A piece of "plasticine" will be found useful for this work.

## THE MAGNET

Do not remove the magnet unless absolutely necessary.

If it is necessary to remove the magnet, first place a "keeper," consisting of a flat piece of iron, across the poles of the magnet. When replacing, the ground face of the magnet must be in contact with the poles.

## RENEWAL OF COILS

Be careful to connect and position the coils

correctly (see Fig. 1) when renewing. These coils should be firmly held in position with beeswax.

## THE MOTOR

To remove the motor on the radiogram: First disconnect leads, then remove the three fixing screws from the top of the motor-board (underneath turntable), taking care not to lose rubber washers between motor and board.

## LUBRICATION

It is important that only good quality light machine oil and grease, free from acid, should be used for lubrication. It is advisable to lubricate the motor regularly on certain dates, depending on how much it is used; the oiling diagram will be found inside the cabinet.

## THE AUTOMATIC BRAKE

### THE AUTOMATIC BRAKE

**How it Works.** Read carefully before attempting adjustments. (Fig. 3)

The pick-up arm travels across the record until the point is reached when lever L1 slowly commences to push lever L2 (rubber-covered arm). This slight movement is transmitted to the brake lever L3 by the friction bearing BR. Note the correct position of tone arm lever L1 in the fork of lever L2. So long as the needle progresses over the record at the normal rate (obtained only by the actual playing of a record) the movement of the pick-up arm is not enough to move L3 sufficiently for the pawl CW to engage fully with the tooth D on the frictional collar around the turntable bush. The tooth engages with the face A, thus pushing the pawl away at each revolution.

When, however, the end of the record is reached and the spiral "run-in" groove gives the pick-up arm rapid movement, the increase in speed of movement is sufficient to cause the pawl CW to move far enough

towards the turntable spindle for the tooth D to strike the face B, thus actuating the brake and operating switch of the motor.

A faint regular click is normal with this type of brake.

### ADJUSTMENT OF BRAKE

If at any time the spring SPI on the hand brake is renewed or replaced, make sure that the axis of the spring lies as far distant as possible from the centre of the pivot of the HB lever, otherwise the friction brake may fail to operate in conjunction with the automatic stop. If auto brake does not function, increase the friction at BR by removing the Isle-o'-Man washer and bending the arms in order to increase the effective thickness. Too much friction at BR may cause a hollow knocking sound to be transmitted to the pick-up, and may also cause undue record wear. If a knocking sound is heard from speaker, slightly decrease the friction at BR, but do not apply oil.

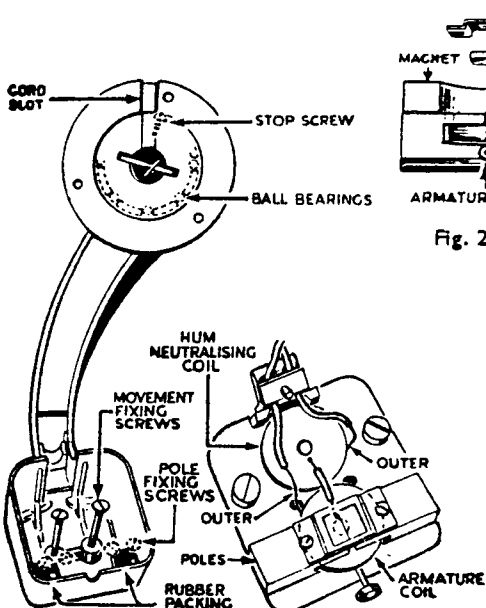


Fig. 1

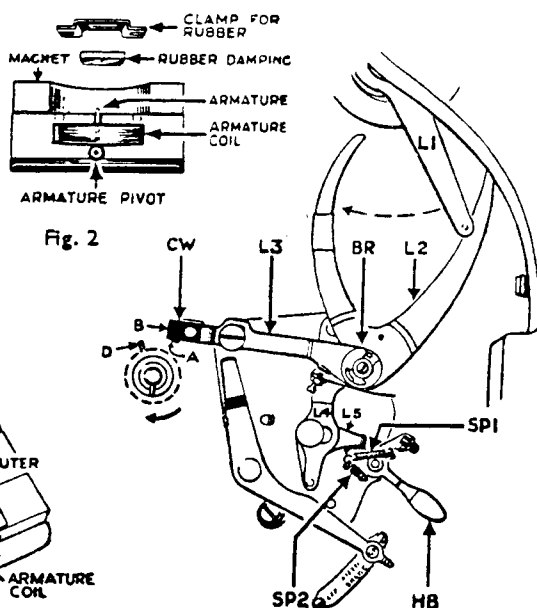
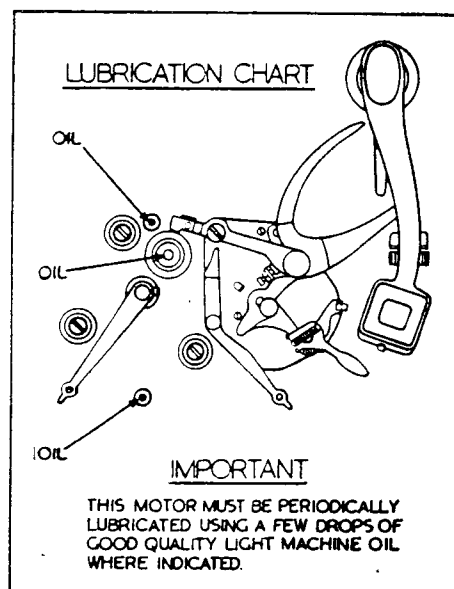


Fig. 2



**ADDITIONAL DATA.**—Any further Service Information desired can be obtained by addressing an inquiry to The Service Department, The Gramophone Co. Ltd., 2 Parramatta Road, Homebush, N.S.W.

This Company reserves the right to make any modifications without notice.