"TRADER" SERVICE SHEET
915

ULTRA T491

A.C. Superhet with Hood-type Cabinet and 3-unit Hinged Chassis

DESIGNED specially to provide rapid and convenient access for service work, the chassis of the Ultra T491 receiver is divided into three units, two of which are hinged. When fully opened up the receiver is still in working order and every part is accessible. Removal of the cabinet, which is in the form of a cover, is only a matter of a minute or two.

The receiver is a 4-valve (plus rectifier) 3-band superhet designed to operate from A.C. mains of 200-250 V, 40-100 c/s. The waveband ranges are : 16-50 m, 200-550 m and 1,000-2,000 m. Provision is made for connecting a gramophone pick-up and an external speaker.

Release date and original price : October 1947 ; £19 19*s. plus purchase tax.*

CIRCUIT DESCRIPTION

Aerial input from socket **A1,** via series capacitor **C3,** is inductively coupled by **L2** (S.W.), **L3** (M.W.), **L4** (L.W.) to single-tuned circuits **L5, C34** (S.W.), **L6, C34** (M.W.) and **L7, C34** (L.W.) which precede a triode heptode valve **(V1, Mazda metallized TH41)** operating as frequency changer with internal coupling. Input attenuation from socket **A2** is provided by series capacitor **C2;** a filter circuit **L1, C1** suppresses interfering signals at the intermediate frequency; and **C4** is included to prevent image signals on L.W.

Triode oscillator anode coils **L10** (S.W.), **L11** (M.W.), **L12** (L.W.) are tuned by **C38,** with parallel trimming by **C35** (S.W.), **C36** (M.W.), **C13, C37** (L.W.) and series tracking by **C11** (M.W.), **C12** (L.W.). Reaction coupling to C.G. is inductive on S.W. and M.W., due to **L8** and **L9** respectively, and capacitative on L.W. due to the common impedance of tracker **C12.**

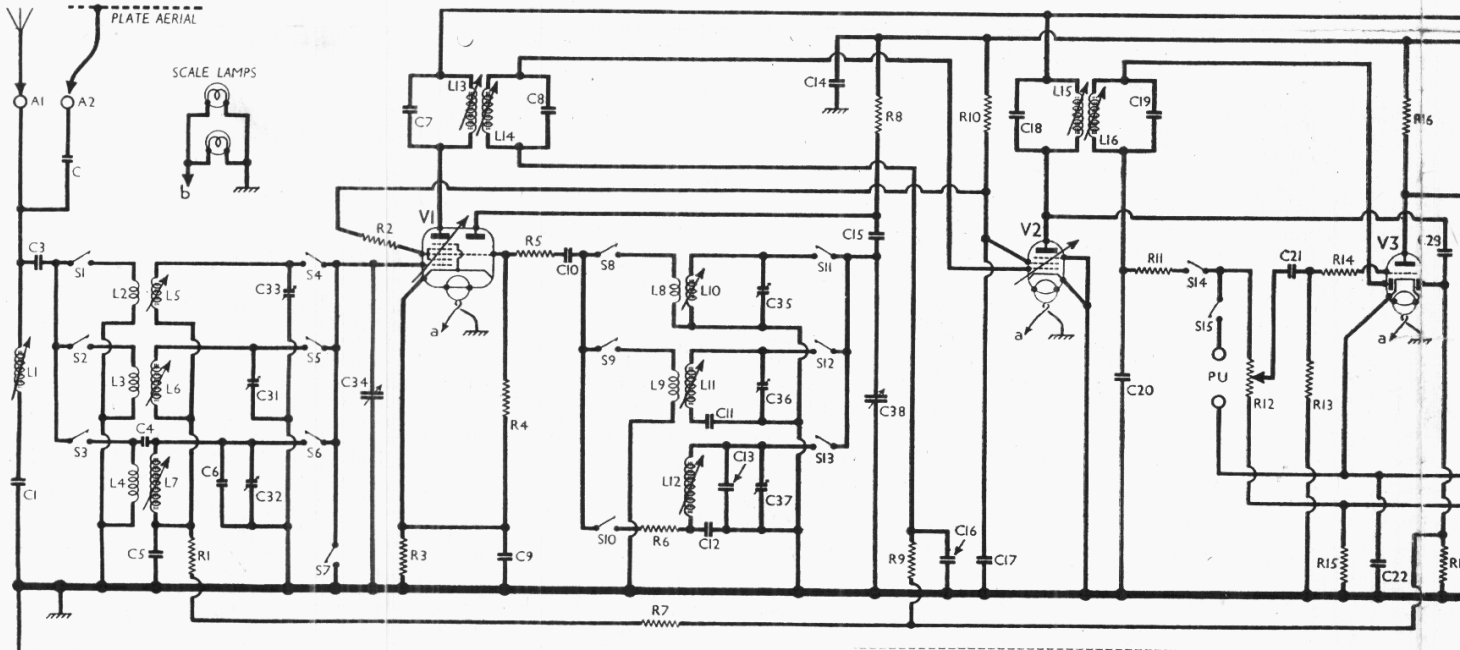
Second valve **(V2, Mazda metallized VP41)** is a variable-mu R.F. pentode operating as intermediate frequency amplifier with tuned-transformer couplings **C7, L13, L14, C8** and **C18, L15, L16, C19** in which the tuning capacitors are fixed and alignment is effected by varying the positions of the iron-dust cores.

Intermediate frequency 465 kc/s.

Diode second detector is part of double diode triode valve **(V3, Mazda metallized HL41DD).** Audio frequency component in rectified output is developed across manual volume control **R12,** which is the diode load resistor, and passed, via A.F. coupling capacitor **C21,** C.G. resistor **R13** and grid stopper **R14,** to C.G. of triode section, which operates as A.F. amplifier. I.F. filtering by **C20, R11** in diode circuit and **R14** in triode grid circuit. Provision for the connection of a gramophone pick-up across **R12,** via the radio/gram change-over switches **S14, S15.**

Second diode of **V3,** fed from **V2** anode via **C23,** provides D.C. potential which is developed across load resistor **R17** and fed back through decoupling circuits as G.B. to F.C. and I.F. valves, giving automatic gain control.

Resistance-capacitance coupling by **R16, C24, R18,** via C.G. stopper **R19,** between **V3** triode and beam tetrode output valve **(V4, Mazda metallized Pen 45).** Fixed tone correction in tetrode anode circuit by **C26,** and variable tone control by **R21, C25.** Provision is made for the connection of a low-impedance external speaker across **T1** secondary winding, and a third winding on this transformer de-



Circuit diagram of the Ultra T491 3-band A.C. superhet. T is attached to the rear of the cabinet. The scale lamps h secondary winding on the mains transformer. The sever on the output transformer in our front view of the chassi identified here by their numbers. These must be carefull if the direction of the feed-back secondary winding is rever the primary winding, instability will occur.

livers A.F. voltages which are applied to **V3** cathode circuit, giving negative feedback.

H.T. current is supplied by I.H.C. full-wave rectifying valve **(V5, Mazda metallized UU6)**, with smoothing by resistors **R22, R23** and electrolytic capacitors **C28, C29, C30.** A separate secondary winding is provided on the mains transformer **T2** to energize the two scale lamps.

DISMANTLING THE SET

Withdraw the plate aerial plug (if used) and pull off the four control knobs;

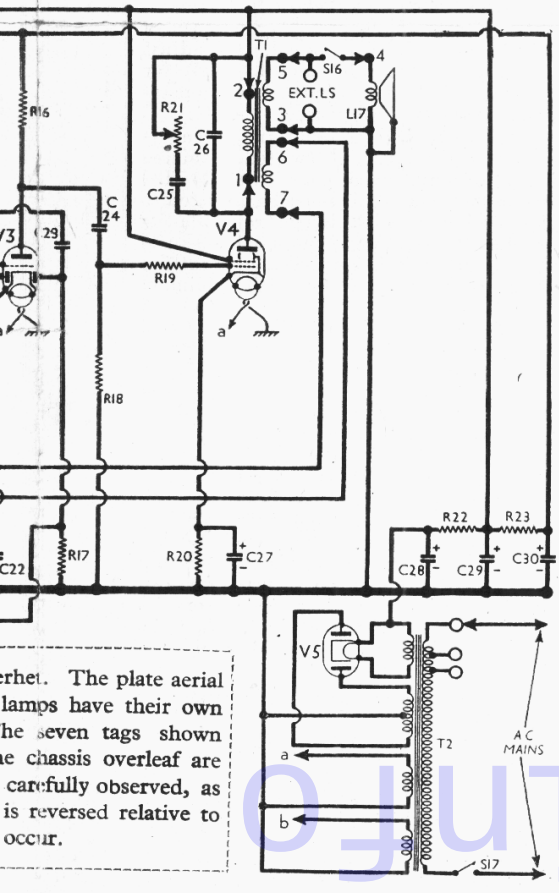
stand the cabinet, upside down, on a felt pad on the bench and remove the six machine screws (with metal washers) located in slots along the edges of the metal base-plate;

grasp the projecting flange at the rear of the base-plate and lift the complete chassis assembly from the cabinet;

remove the cheese-head screw (with two metal washers) securing the speaker magnet to its supporting bracket, and hinge the speaker forward until it lies flat on the bench;

slacken the cheese-head screws located on each side of the fly-wheel, and swing the main receiver chassis backward, taking care that the rear paxolin panel is not trapped between the chassis and the base-plate.

When replacing, a metal washer should be fitted on each side of the rubber grommet on the speaker supporting bracket. Care should be taken to ensure that the plate aerial lead is not left inside the cabinet, and that the paxolin rear panel is correctly positioned in its slots in the cabinet before screwing down the base-plate.



erhet. The plate aerial lamps have their own he seven tags shown ie chassis overleaf are carefully observed, as is reversed relative to occur.

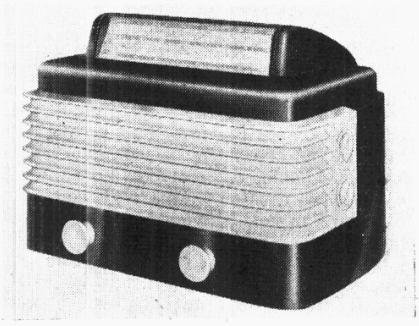
COMPONENTS AND VALUES

If the component numbers given in the following tables are used when ordering replacement parts, dealers are advised to mention the fact in the order, as these numbers may differ from those used in the manufacturers' diagram.

	CAPACITORS	Values (μF)	Locations
C1	I.F. filter tune ...	0·00027	K7
C2	Aerial series capacitors ...	0·000022	B3
C3	Aerial series capacitors ...	0·00047	L5
C4	L.W. image rejector	—	L4
C5	Hept. C.G. decoup.	0·05	K5
C6	Aerial L.W. trim ...	0·000047	K4
C7	1st I.F. transformer tuning ...	0·00012	B2
C8	1st I.F. transformer tuning ...	0·00012	B2
C9	V1 cath. by-pass ...	0·05	K7
C10	V1 osc. C.G. ...	0·00018	K6
C11	Osc. M.W. tracker	0·00054	J4
C12	Osc. L.W. tracker...	0·0002	K6
C13	Osc. L.W. trim. ...	0·0001	K4
C14	H.T. R.F. by-pass	0·05	F6
C15	Osc. anode coup....	0·0001	K6
C16	V2 C.G. decoup. ...	0·05	H6
C17	S.G.'s H.T. decoup.	0·05	K7
C18	2nd I.F. transformer tuning ...	0·00012	C2
C19	2nd I.F. transformer tuning ...	0·00012	C2
C20	I.F. by-pass ...	0·0001	G6
C21	A.F. coupling ...	0·001	G6
C22	F.-B. by-pass ...	0·05	G7
C23	A.G.C. coupling ...	0·0001	H7
C24	A.F. coupling ...	0·01	F6
C25	Tone control ...	0·1	F7
C26	Tone corrector ...	0·001	H8
C27*	V4 cath. by-pass ...	50·0	F7
C28*	H.T. smoothing capacitors ...	16·0	G7
C29*	H.T. smoothing capacitors ...	24·0	G7
C30*	H.T. smoothing capacitors ...	16·0	G7
C31‡	Aerial M.W. trim....	0·00007	K4
C32‡	Aerial L.W. trim....	0·00007	K4
C33‡	Aerial S.W. trim....	0·00007	K5
C34†	Aerial tuning ...	0·0005§	A1
C35‡	Osc. S.W. trim. ...	0·00007	K5
C36‡	Osc. M.W. trim. ...	0·00007	K4
C37‡	Osc. L.W. trim. ...	0·00007	K4
C38†	Oscillator tuning ...	0·0005§	B1

* Electrolytic. † Variable. ‡ Pre-set.
§ "Swing" value, min. to max.

	RESISTORS	Values (ohms)	Locations
R1	Hept. C.G. decoup.	1,000,000	K6
R2	V1 S.G. stabilizer...	68	K6
R3	V1 fixed G.B. ...	220	K7
R4	V1 osc. C.G. ...	47,000	K7
R5	Osc. stabilizing resistors ...	56	K6
R6	Osc. stabilizing resistors ...	12,000	J5
R7	A.G.C. decoup. ...	470,000	H6
R8	Osc. anode load ...	39,000	J6
R9	V2 C.G. decoup. ...	2,200,000	H6
R10	S.G.'s H.T. feed ...	18,000	H6
R11	I.F. stopper ...	100,000	G6
R12	Volume control ...	1,000,000	G9
R13	V3 C.G. resistor ...	2,200,000	G6
R14	V3 C.G. stopper ...	47,000	G6
R15	V3 G.B., A.G.C. delay	1,500	G6
R16	V3 triode load ...	47,000	G6
R17	A.G.C. diode load...	470,000	H6
R18	V4 C.G. resistor ...	470,000	F7
R19	V4 C.G. stopper ...	47,000	F6
R20	V4 G.B. resistor ...	180	F7
R21	Tone control ...	25,000	A1
R22	H.T. smoothing resistors ...	700	F8
R23	H.T. smoothing resistors ...	2,200	E8



The appearance of the Ultra T491. The waveband and tone controls are seen on the right.

	OTHER COMPONENTS	Approx. Values (ohms)	Locations
L1	I.F. filter coil ...	5·5	L7
L2	Aerial coupling coils	0·25	L5
L3	Aerial coupling coils	1·0	L6
L4	Aerial coupling coils	6·5	L4
L5	Aerial tuning coils	Very low	L5
L6	Aerial tuning coils	2·0	L6
L7	Aerial tuning coils	11·0	L4
L8	Oscillator reaction coils	6·0	J5
L9	Oscillator reaction coils	0·9	J4
L10	Oscillator tuning coils	Very low	J5
L11	Oscillator tuning coils	2·5	J4
L12	Oscillator tuning coils	6·0	J6
L13	1st I.F. trans. Pri.	8·0	B2
L14	1st I.F. trans. Sec.	8·0	B2
L15	2nd I.F. trans. Pri.	8·0	C2
L16	2nd I.F. trans. Sec.	8·0	C2
L17	Speech coil ...	2·1	B1
T1	Output trans. Pri. 1-2	250·0	
	Output trans. Sec. 3-5	0·9	H9
	Output trans. Sec. 6-7	0·1	
T2	Mains trans. Pri., total	28·0	
	Mains trans. H.T. Sec., total	370·0	
	Mains trans. Rect. heat sec.	Very low	F8
	Mains trans. Heater sec.	Very low	
	Mains trans. Scale lamp sec.	1·5	
S1-S15	W/band and gram. switches ...	—	K5
S16	Int. spkr. switch ...	—	C3
S17	Mains sw., g'd R12	—	G9

VALVE ANALYSIS

Valve voltages and currents given in the table below are those measured in our receiver when it was operating on mains of 230 V, using the 220-234 V tapping on the mains transformer. The receiver was tuned to the lowest wavelength on the M.W. band, and the volume control was at maximum, but there was no signal input.

Voltages were measured on the 400-V scale of a model 7 Avometer, except where otherwise indicated, chassis being the negative connection.

Valve	Anode (V)	Anode (mA)	Screen (V)	Screen (mA)	Cath. (V)
V1 TH41	267	2·6	98	6·6	2·7§
	Oscillator 73	3·2			
V2 VP41	267	5·5	98	1·2	—
V3 HL41DD	124	2·0	—	—	2·9§
V4 Pen 45	255	44·0	267	8·0	9·2§
V5 UU6	290†	—	—	—	320

† A.C. § 10V. meter range.

GENERAL NOTES

Switches.—**S1-S13** are the waveband switches, and **S14, S15** the radio/gram change-over switches, ganged in two rotary units beneath the hinged main chassis. These are indicated in our front view of the chassis by the numbers **1** and **2** in diamonds, with arrows to show the directions in which they are viewed in the diagrams in col. 2, where they are shown in detail.

The table (col. 3) gives the switch positions for the four control settings, starting from the fully anti-clockwise (gram) position of the control knob. A dash indicates open, and **C,** closed. It should be noted that the sequence is unusual : Gram, M.W., L.W., S.W.

S16 is the internal speaker switch, operated by the external speaker plug when it is pushed right home, when it opens to mute the internal speaker.

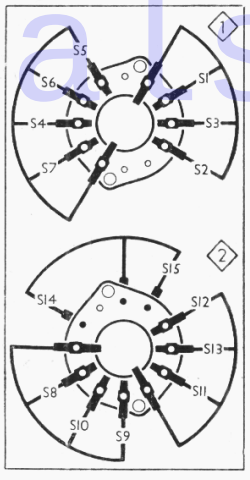
S17 is the Q.M.B. mains switch, ganged with the manual volume control **R12,** which is mounted on the front of the small power unit.

Coils.—All the R.F. and oscillator coils (with the exception of **L1**), trimmers, switches and capacitor gang are mounted in an assembly which is attached to the hinged main chassis, where it forms the shorter limb of overall "L" shape. When the chassis is raised on its hinges, all pre-set adjustments face the rear, as shown in our photograph of the front of the chassis. The aerial I.F. filter circuit **L1, C1** is mounted on the main chassis, just behind the tuning assembly.

Scale Lamps.—These are two Osram M.E.S. type lamps, with small clear spherical bulbs, rated at 6.5 V, 0.3 A.

External Speaker.—Two sockets are provided at the rear of the chassis for the connection of a low impedance (about 2-4 Ω) external speaker.

Capacitor C4.—This is made up from a pair of insulated wires about 3in long to form an image rejector coupling. In practice it is adjusted by snipping off end pieces until the right degree of rejection is obtained, as explained under "Circuit Alignment." The image is found near the middle of the L.W. band, but it is produced by a M.W. signal at 1,149 kc/s (261 m). **C4** is omitted in some models.



Diagrams of the two waveband switch units, which are viewed from opposite directions, as indicated by the arrows in our front view of the chassis. On the right, in the next column, is the associated table.

Switch	Gram.	M.W.	L.W.	S.W
S1	—	—	—	C
S2	—	C	—	—
S3	—	—	C	—
S4	—	—	—	C
S5	—	C	—	—
S6	—	—	C	—
S7	C	—	—	—
S8	—	—	—	C
S9	—	C	—	—
S10	—	—	C	—
S11	—	—	—	C
S12	—	C	—	—
S13	—	—	C	—
S14	—	C	C	C
S15	C	—	—	—

Chassis Divergencies.—In addition to the omission of **C4** in some models, there are also one or two possible component value variations. **R7** may be 1,000,000 Ω instead of 470,000 Ω, and **C21** may be 0.01 μF. In the latter event, a small "top boost" coupling capacitor will be connected between the top end of the volume control **R12** and its slider. The value will be 0.0001 μF (100 pF).

CIRCUIT ALIGNMENT

These operations must be carried out with the chassis removed from the cabinet, and a dummy scale (calibrated 0-180 deg) is embossed on the rear of the gang drive drum to enable this to be done. Readings on this scale are taken against a metal pointer fixed beneath the tone control **R21** (location reference A1), and with the gang at maximum capacitance the reading should be 180 deg.

I.F. Stages.—Switch set to L.W., tune to 16 deg, connect signal generator, via an 0.05 μF capacitor in the "live" lead to control grid (top cap) of **V1** and the **E** socket, feed in a 465 kc/s (645.16 m) signal, and adjust the cores of **L16, L15, L14, L13** (C2, H7, B2, J7) for maximum output.

R.F. and Oscillator Stages.—Transfer "live" signal generator lead to **A** socket, via a suitable dummy aerial.

I.F. Filter.—With the set still switched to L.W. and tuned to 16 deg, feed in a strong 465 kc/s signal, and adjust the core of **L1** (L7) for minimum output.

R.F. and Oscillator Stages.—Transfer signal generator leads to **A** and **E** sockets via a suitable dummy aerial. With the gang at maximum capacitance, the pointer should indicate 180 deg on the gang drive drum.

M.W.—Switch set to M.W., tune to 8 deg, feed in a 200 m (1,500 kc/s) signal, and adjust **C36** and **C31** (K4) for maximum output. Tune to 150 deg, feed in a 500 m (600 kc/s) signal, and adjust the cores of **L11** (J4) and **L6** (L6) for maximum output. Repeat these operations until no improvement results.

L.W.—Switch set to L.W., tune to 16 deg, feed in a 1,000 m (300 kc/s) signal, and adjust **C37** and **C32** (K4) for maximum output. Tune to 163.5 deg, feed in a 2,000 m (150 kc/s) signal, and adjust the cores of **L12** (J6) and **L7** (L4) for maximum output. Repeat these operations until no improvement results.

If the **L4, L7** assembly has been replaced a new pair of twisted insulated wires 3in long, which constitutes **C4** (L4) should be fitted. This must be adjusted to give optimum L.W. image rejection by feeding in a strong 261 m (1,149 kc/s) signal, tuning it in on L.W., and cutting off short sections of **C4** until minimum output is obtained.

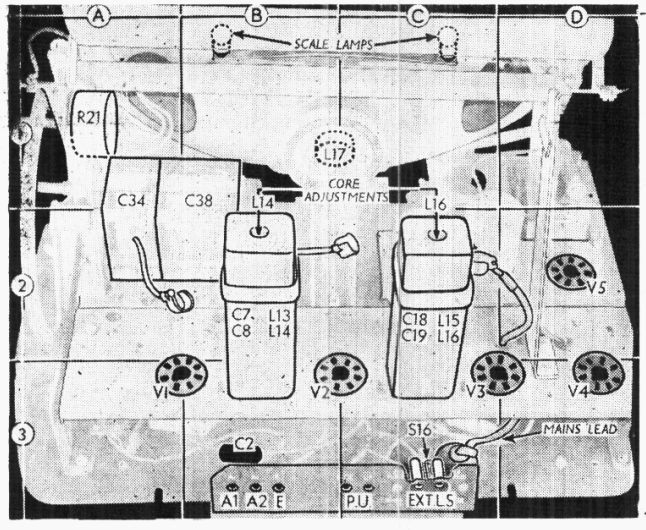
S.W.—Switch set to S.W., tune to 28 deg on scale, feed in a 20 m (15 Mc/s) signal, and adjust **C35** and **C33** (K5) for maximum output. Tune to 127.5 deg, feed in a 40 m (7.5 Mc/s) signal, and adjust the cores of **L10** (J5) and **L5** (L5) for maximum output. Repeat these operations until no improvement results.

Finally, replace the chassis in the cabinet and check that the cursor coincides with the high wavelength ends of the three scales when the gang is at maximum capacitance. It may be adjusted in position by lifting the glass scale from its slot in the top of the cabinet, when the cursor carriage may be slid along the drive cord to correct the error.

DRIVE CORD REPLACEMENT

About six feet of nylon braided glass yarn is required for the tuning drive cord, which should be partly made up before being fitted, as the tension spring is inserted at a break in the run of the cord.

The best position for the work is from the drive wheel end, with the chassis on its base and the main chassis section swung right back on its pivots so that the



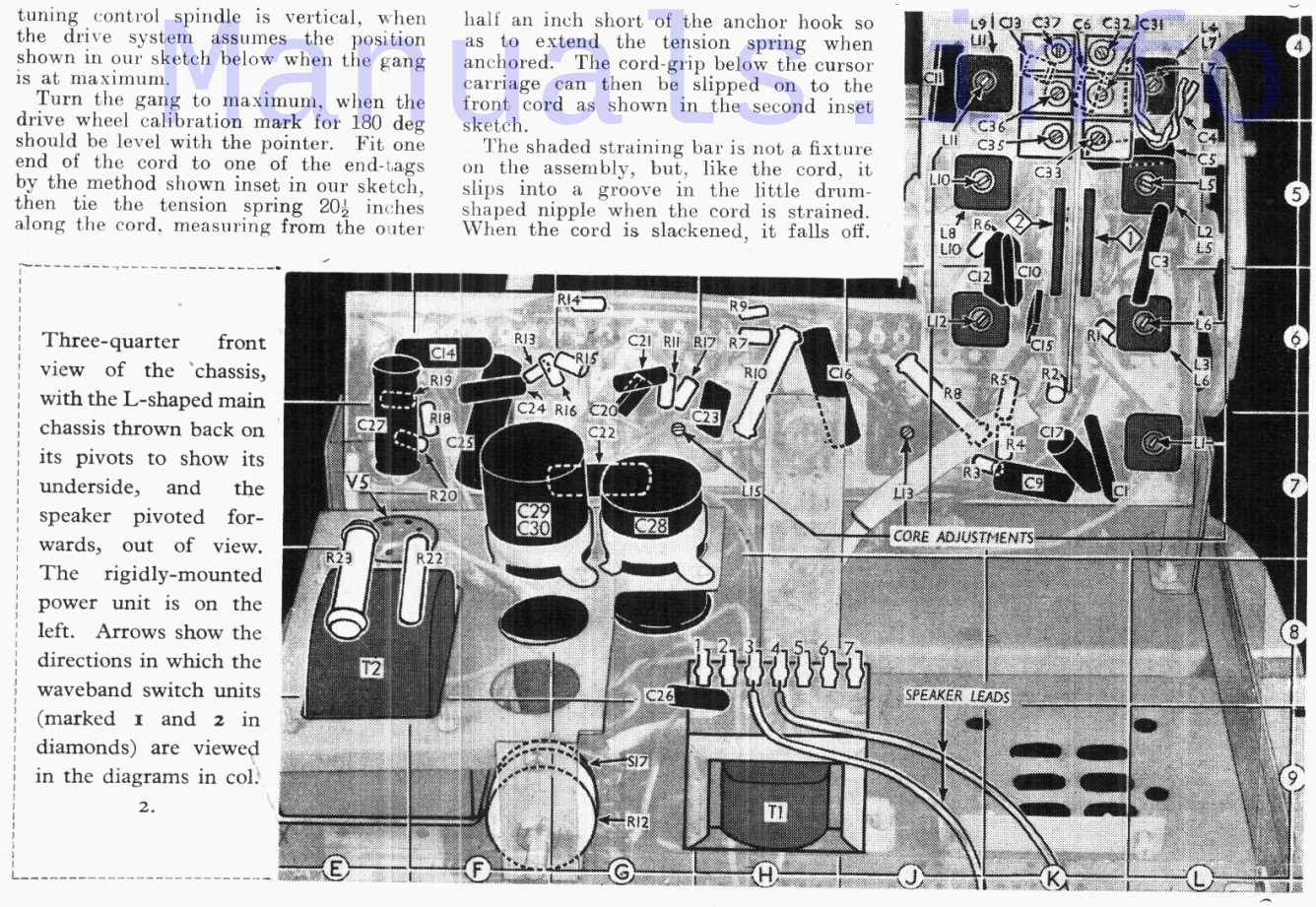
Three-quarter rear view of the chassis, as seen with the three units in their "working" position. The connecting panel in the foreground slides into grooves in the cabinet moulding. The panel is cut away to show the position of **S16.**

tuning control spindle is vertical, when the drive system assumes the position shown in our sketch below when the gang is at maximum.

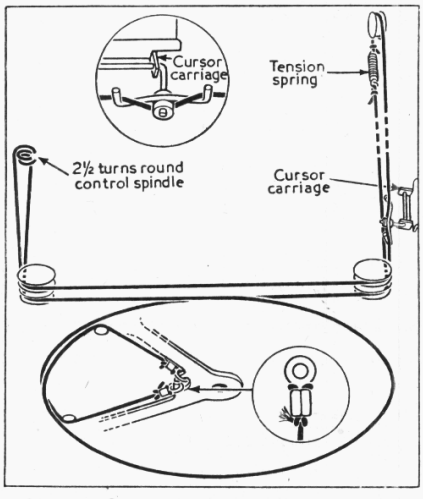
Turn the gang to maximum, when the drive wheel calibration mark for 180 deg should be level with the pointer. Fit one end of the cord to one of the end-tags by the method shown inset in our sketch, then tie the tension spring 20½ inches along the cord, measuring from the outer end of the tag. No special tag is provided for this, but a non-slip knot should be used. Cut off the spare cord, and tie one end of it to the other end of the spring.

Anchor the tag to the lower hook on the drive wheel as seen in our sketch, then run the cord as shown, finally tying off to another end-tag like the first, but about half an inch short of the anchor hook so as to extend the tension spring when anchored. The cord-grip below the cursor carriage can then be slipped on to the front cord as shown in the second inset sketch.

The shaded straining bar is not a fixture on the assembly, but, like the cord, it slips into a groove in the little drum-shaped nipple when the cord is strained. When the cord is slackened, it falls off.



Three-quarter front view of the chassis, with the L-shaped main chassis thrown back on its pivots to show its underside, and the speaker pivoted forwards, out of view. The rigidly-mounted power unit is on the left. Arrows show the directions in which the waveband switch units (marked 1 and 2 in diamonds) are viewed in the diagrams in col. 2.



Sketch of the drive cord system as seen when viewed over the drive wheel when the chassis is raised on its pivots. The cord grip and end-tag are shown in insets.

SERVICE SHORT-CUTS

G.E.C. BC3946

The writer has found instability in these receivers occurring only on the lower half of the S.W. band.

Although the circuit has been carefully checked for a fault the only cure found has been to open-circuit switch S7 (*Trader Service Sheet* 362) which normally short-circuits the 33,000 Ω H.T. feed resistor (one of three) to the oscillator anode.

In the writer's experience this still provides a sufficiently high H.T. voltage for the oscillator anode, even when the H.T. battery voltage is low.—**R. C. B.,** Ambleside.

PYE 75B

Instances have occurred in which a short piece of stiff springy wire has been found inside one of the I.F. transformer cans, where it may cause various intermittent short-circuits: primary-secondary; H.T.-earth; ends of winding; etc., which are very difficult to trace.

The wire is used as a strainer against the iron-core adjustment screw, to hold the screw firmly, and is used in most cases where iron-core screws are found. In an I.F. can, however, the confined space limits its length, and one end might easily slip past its retaining pin.

As this wire is fitted in many I.F. transformers to-day, it is a point to watch when re-assembling one to see that the wire is central, as it is a fault that could occur in most modern receivers.—**R. C. B.,** Ambleside.

McMICHAEL 451

An unusual fault was found in one of these receivers which was working on S.W., but not on M.W. or L.W. An I.F. signal injected at the TH41 control grid gave a normal output. A new F.C. valve was tried, all the H.T. voltages were checked and all the oscillator circuit components examined.

Testing with the signal generator on M.W., I found that upon disconnecting C6 (*Trader Service Sheet* 787) the set came to life on M.W., although calibration was well out, but on L.W. the set was still "dead." I found eventually upon close inspection that the trouble was due to a hollow rivet on the waveband switch unit wafer short-circuiting the junction tag of L6, C29, C6 to the junction tag of C15, C34, etc. on the opposite side of the wafer.

Another McMichael 451 was brought in later which would not operate on S.W. Connecting the aerial to the F.C. control grid gave weak results, and I began to check the tuning coils, but recalling the previous case I examined the switch unit. I found that with L2 disconnected a short-circuit existed between the aerial and earth sockets, due again to one of the hollow rivets shorting to a tag on each side of the wafer.—**D. G.,** Glasgow.

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