"TRADER" SERVICE SHEET

973

PHILIPS 400A

Covering also Model 500A

THE Philips 400A is a 4-valve (plus rectifier) 3-band superhet designed to operate from A.C. mains of 100-250 V, 50 c/s. The consumption at 220 V is quoted at 220 mA. The waveband ranges are 16.5-54.5 m, 185-580 m and 715-2,000 m.

500A is a similar model with tuning indicator added, the differences being explained overleaf.

Release dates and original prices: 400A, August 1950, £17 17s.; 500A, September 1950, £22. Purchase tax extra.

CIRCUIT DESCRIPTION

Aerial input via coupling coils **L2** (S.W.), **L3** (M.W.) and **L4** (L.W.) to single-tuned circuits **L5, C32** (S.W.), **L6, C32** (M.W.) and **L7, C32** (L.W.). Corrective coupling on L.W. via **C1** and a section of **L7** which maintains the aerial efficiency constant over the band. I.F. rejection by **L1, C28** across aerial input.

First valve **(V1, Mullard ECH42)** is a triode-hexode operating as a frequency changer with internal coupling. Oscillator anode coils **L12** (S.W.), **L13** (M.W.) and **L14** (L.W.) are tuned by **C39.** Parallel trimming by **C36** (S.W.), **C37** (M.W.) and **C6, C38** (L.W.); series tracking by **C33** (S.W.), **C34** (M.W.) and **C35** (L.W.). Reaction coupling from grid by **L10** (M.W.) and **L11** (L.W.). On S.W., the reaction coupling comprises a double resonant circuit **L8, C33, L9** which resonates at both ends of the band to maintain a constant oscillator output over this range.

Second valve **(V2, Mullard EF41)** is a variable-mu R.F. pentode operating as intermediate frequency amplifier with tuned transformer couplings **C3, L15, L16, C4** and **C9, L17, L18, C10.**

Intermediate frequency 470 kc/s.

Diode signal detector is part of double diode triode valve **(V3, Mullard EBC41).** Audio frequency component in rectified output is developed across load resistors **R8, R9** and is passed via manual volume control **R11,** coupling capacitor **C15** and grid stopper **R13** to grid of triode section. Top boost at the low level settings of the volume control is provided by passing a proportion of the audio frequency output, via **C13,** to a tap on the control. Bass boost by **R10, C14.** I.F. filtering by **C11** in the diode circuit, and **C21** in **V4** control grid circuit.

Provision is made for the connection of a pick-up across **R11** via **S23** which closes when the tone switch is turned to Gram. **S22** opens and **S21** closes to prevent radio break-through. D.C. potential developed across **R8, R9** is fed back as grid bias to the F.C. and the I.F. valves, giving automatic gain control.

Resistance-capacitance coupling by **R16, C20, R17,** via grid stopper **R18,** between **V3** triode and pentode output valve **(V4, Mullard EL41).** Fixed tone correction in anode circuit by **C24.** Provision is made for the connection of a low impedance speaker across the output transformer **T1** secondary.

A proportion of the speech coil voltage is fed back to the volume control circuit from a tap on **T1** secondary, and to the grid circuits of **V3** and **V4** via a potential divider **R21, R22, R23** across the secondary winding. Five-position tone control is provided by changing the frequency characteristic of the feed-back via switches **S24-S26.** Three of these positions operate on radio signals and two on gram only, the changeover from radio to gram being performed by **S21-S23,** which are ganged with the tone control switches.

H.T. current is supplied by I.H.C. full wave rectifying valve **(V5, Mullard EZ40)** whose heater is fed from the same winding on **T2** as the rest of the valves. Smoothing by **R24** and electrolytic capacitors **C26** and **C27.**

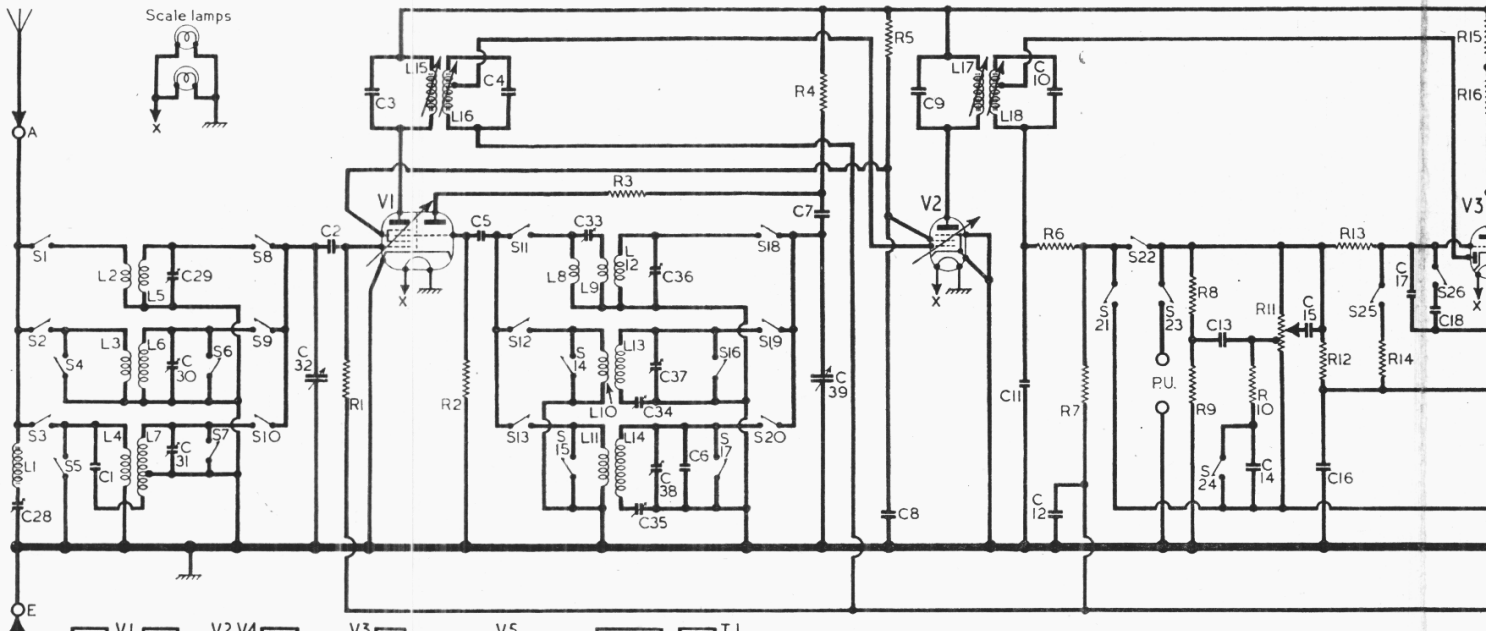
Bias for all valves is obtained from the voltage drop along **R20,** in the negative H.T. lead to chassis. That for **V3** triode and **V4** is tapped off from the feed-back potential divider **R21, R22, R23,** which is shunted via **T1** secondary across **R20** and performs the dual functions of dividing up the G.B. voltage and the feed-back voltages.

VALVE ANALYSIS

Valve voltages and currents given in the table below are those measured in our receiver when

Valve	Anode		Screen	
	V	mA	V	mA
V1 ECH42	225	2·8	88	3·0
	Oscillator			
	90	3·7		
V2 EF41	225	5·7	88	2·0
V3 EBC41	95	0·6	—	—
V4 EL41	235	32·0	225	4·4
V5 EZ40	236†	—	—	—

† Each anode, A.C.



Circuit diagram of the Philips 400A and, with the addition of a cat tuning indicator, the 500A. The circuit diagram of the C.R. indicator at the foot of col. 6. Four degrees of feedback, derived from the sp circuit, are applied at various points in the audio frequency circuit, a with which is the 5-position tone control device. Special meaures h adopted in the L.W. aerial coupling circuit to maintain a constant efficiency throughout the band.

RADIO SPARES PM7 CONNECTIONS

GREY

BLACK — YELLOWS

it was operating on A.C. mains of 235 V. The receiver was tuned to the highest wavelength end of the M.W. band, with the volume control at maximum and the tone switch fully anti-clockwise, but there was no signal input.

Voltage measurements were made with an Avo Electronic Testmeter, which introduces no appreciable voltage drop in the circuit to which it is connected, and allowance must be made for the load imposed by other meters. The voltage measured across **R20** was 8.5 V and that on the cathode of **V5** was 260 V. All readings were taken with the negative meter lead connected to chassis.

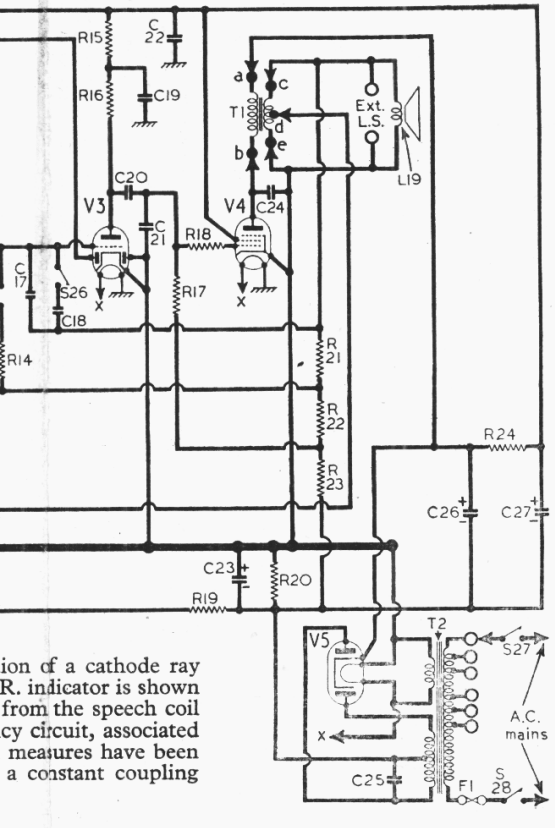
COMPONENTS AND VALUES

	RESISTORS	Values	Locations
R1	V1 C.G.	1·5MΩ	H3
R2	V1 osc. C.G. ...	33kΩ	G3
R3	V1 osc. stopper ...	47Ω	G4
R4	Osc. H.T. feed ...	33kΩ	G4
R5	S.G. feed	27kΩ	G4
R6	I.F. stopper ...	47kΩ	G4
R7	A.G.C. decoupling	1·5MΩ	G4
R8	Signal diode load ...	330kΩ	F3
R9		68kΩ	E3
R10	Tone corrector ...	68kΩ	E3
R11	Volume control ...	2·65MΩ	F3
R12	V3 C.G.	2·2MΩ	E4
R13	Grid stopper ...	47kΩ	E3
R14	Part tone control ...	560kΩ	E3
R15	V3 triode load ...	100kΩ	F4
R16		100kΩ	F4
R17	V4 C.G.	560kΩ	F4
R18	V4 grid stopper ...	1kΩ	F4
R19	G.B. decoupling ...	6·8MΩ	G4
R20	Common G.B. ...	180Ω	E4
R21	Neg. feed-back potential divider	220kΩ	E4
R22		1MΩ	E4
R23		560kΩ	E4
R24	H.T. smoothing ...	1·2kΩ	C1

	CAPACITORS	Values	Locations
C1	Aerial coupling ...	18pF	J3
C2	V1 C.G.	220pF	H3
C3	1st I.F. trans. tuning	115pF	B2
C4		115pF	B2
C5	V1 osc. C.G. ...	56pF	H4
C6	L.W. osc. trimmer	33pF	J4
C7	Osc. anode coupling	470pF	H4
C8	S.G. decoup. ...	0·22μF	H3
C9	2nd I.F. trans. tuning	115pF	C2
C10		115pF	C2
C11	I.F. by-pass ...	82pF	G4
C12	A.G.C. decoupling	0·047μF	G4
C13	Tone compensators	390pF	E3
C14		0·01μF	E3
C15	A.F. coupling ...	0·0033μF	E3
C16	F.-B. coupling ...	0·022μF	E4
C17	Parts tone control	10pF	E3
C18		56pF	E3
C19	Tone corrector ...	0·1μF	F4
C20	A.F. coupling ...	0·01μF	F4
C21	I.F. by-pass ...	150pF	F4
C22	R.F. by-pass ...	0·0022μF	G4
C23*	G.B. by-pass ...	100μF	J3
C24	Tone correction ...	0·0047μF	F3
C25	R.F. by-pass ...	0·022μF	C1
C26*	H.T. smoothing ...	47μF	A1
C27*		47μF	A1
C28‡	I.F. filter tune ...	30pF	A2
C29‡	S.W. aerial trim. ...	50pF	J3
C30‡	M.W. aerial trim....	25pF	J3
C31‡	L.W. aerial trim....	25pF	J4
C32†	Aerial tuning ...	492pF	B1
C33‡	S.W. osc. tracker...	125pF	J4
C34‡	M.W. osc. tracker	575pF	J4
C35‡	L.W. osc. tracker...	175pF	J4
C36‡	S.W. osc. trimmer	30pF	J4
C37‡	M.W. osc. trimmer	30pF	H4
C38‡	L.W. osc. trimmer	30pF	J4
C39†	Oscillator tuning ...	492pF	B2

* Electrolytic. † Variable. ‡ Pre-set.

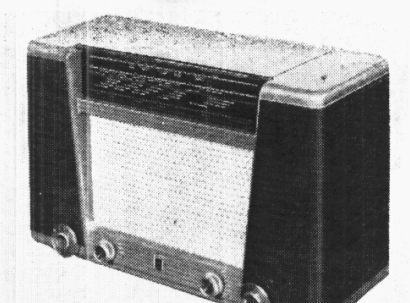
	OTHER COMPONENTS	Approx. values (ohms)	Locations
L1	I.F. filter coil ...	37·0	A2
L2	Aerial coupling coils	1·8	A1
L3		100·0	A1
L4		183·0	A2
L5	Aerial tuning coils	Very low	A1
L6		6·0	A1
L7		200·0	A2
L8	Oscillator reaction coils	2·5	A2
L9		0·5	A2
L10		2·6	A2
L11		5·0	A2
L12	Oscillator tuning coils	Very low	A2
L13		6·8	A2
L14		190·0	A2
L15	1st I.F. trans.	Pri. 6·8	B2
L16		Sec. 6·8	B2
L17	2nd I.F. trans.	Pri. 6·8	C2
L18		Sec. 6·8	C2
L19	Speech coil ...	2·8	—
T1	Primary	770·0	G3
	Secondary, total ...	0·7	G3
T2	Primary, total ...	74·0	
	H.T. sec., total ...	400·0	D1
	Heater sec. ...	Very low	
F1	Heat coil fuse ...	—	D2



ion of a cathode ray
R. indicator is shown
from the speech coil
cy circuit, associated
measures have been
a constant coupling

DISMANTLING THE SET

Removing Chassis.—Remove the four control knobs (recessed grub screws) from the front of the cabinet, withdrawing their fixing screws completely;
unsolder the leads from the speech coil tags on the speaker;
unsolder the lead from the earthing tag at the left hand rear edge of chassis;
remove two wood screws with washers, securing scale lamp holders to top corners of sub-baffle, and release drive wire from cursor carriage;
remove four chassis bolts (with washers and lock washers) and withdraw chassis.
When replacing, check that with the gang at minimum, the cursor coincides with zero on the 0-200 scale. The black speaker lead should be connected to the right hand speech coil tag. When fitting the control knobs, first slip them on to their spindle, then insert the grub screw. The knob boss is not threaded: the thread is in the spindle, and the screw applies pressure to the far side of the boss.
Removing Speaker.—Remove nut at top edge of



The appearance of the Philips 400A, which has a plastic cabinet. The 500A has a wooden cabinet. The tuning indicator is located on the right of the tuning scale.

speaker, securing speech coil tag panel and insulating strip, and two remaining nuts holding edge of speaker to sub-baffle.

GENERAL NOTES

Switches.—**S1-S20** are the waveband switches, ganged in two rotary units beneath the chassis. These are indicated in our under-chassis view, and shown in detail in the diagrams in col. 1 overleaf where they are drawn as seen from the rear of an inverted chassis.

The table below them gives the switch positions for the three control settings, starting from the fully anti-clockwise position of the control knob. A dash indicates open and **C** closed.

S21—S26 are the tone control and radio/gram change-over switches, ganged in a single rotary unit beneath the chassis. Its position is indicated in our chassis photograph, and it is shown in detail in the diagram in col. 3 overleaf.

Their action is shown in the table below it, starting from the fully anti-clockwise position of the control knob and using the position numbers marked on the control knob. A dash indicates open, and **C** closed. Positions 1, 2 and 3 provide three control settings for radio, and positions 4 and 5 two further positions for gram. The change-over occurs automatically.

S27, S28 are the Q.M.B. mains switches, ganged with the volume control **R11.**

Scale Lamps.—These are two Philips lamps, with M.E.S. bases and clear tubular bulbs, rated at 6.5 V, 0.3 A. Their type number is 8028D-00.

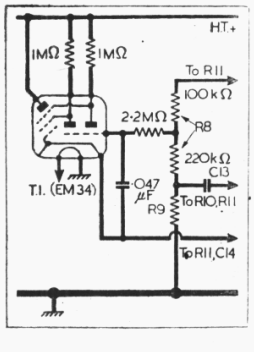
External Speaker.—Two sockets are provided at the rear of the chassis for a low impedance (5·7 Ω) external speaker.

Fuse F1.—This consists of a soft-metal link which is normally hooked over two hooks on the mains transformer, holding them together. When the link melts, one of the hooks springs away from the other. Replacements are made with a type 08.100.99 fuse.

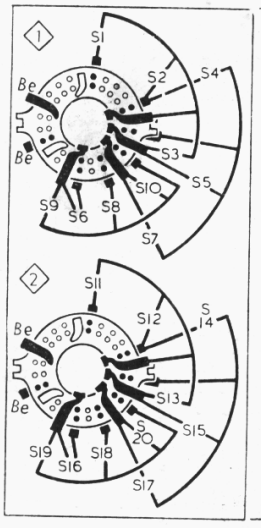
Wire Trackers.—There are six trimmers and trackers of the special Philips wire-wound type, from which wire may be removed but to which it must not be added. When adjusting these, a short piece of wire should be slowly unwound, with an eye on the output meter. If output rises, continue until peak output is detected, and cut off spare wire. If output falls, replace trimmer with a new one.

Model 500A.— This model is fitted in a wooden

Circuit diagram of the tuning indicator in the 500A. **R8** is divided into two parts to provide a tapping point for the control grid.



Waveband Switch Units



Diagrams of the waveband switch units, drawn as seen from the rear of an inverted chassis. Below the diagrams is the associated table.

Switch	S.W.	M.W.	L.W.
S1	C	—	—
S2	—	C	—
S3	—	—	C
S4	C	—	—
S5	C	C	—
S6	C	—	—
S7	C	C	—
S8	C	—	—
S9	—	C	—
S10	—	—	C
S11	C	—	—
S12	—	C	—
S13	—	—	C
S14	C	—	—
S15	C	C	—
S16	C	—	—
S17	C	C	—
S18	C	—	—
S19	—	C	—
S20	—	—	C

General Notes—*continued*

cabinet, with a detachable bottom cover, and is fitted with an EM34 tuning indicator, but otherwise it is like the 400A. The circuit of the tuning indicator and the points at which it is connected to our circuit diagram of the 400A are shown in the diagram in col. 6 overleaf. **R8** is split into two parts to provide a feed point for the control grid.

Arising out of these differences, the dimensions of the tuning cursor drive wires are changed, and the alignment is modified. The drive wire dimensions are given for both models under "Drive Cord Replacement." As the cabinet has a bottom cover, alignment can be performed with the chassis in its cabinet, so that it is unnecessary to fix a piece of tape to the drive wire.

CIRCUIT ALIGNMENT

Adjustments to the I.F. stages may be carried out with the chassis in the cabinet, but for R.F. and oscillator adjustments it must be withdrawn. This does not apply to model 500A.

I.F. Stages.—Switch set to M.W., turn gang to minimum, volume control to maximum and tone control to position 2. Connect signal generator leads, via a 0.032 μF capacitor in the "live" lead, to control grid (pin 6) of **V1** and chassis. Feed in a 470 kc/s (638.3 m) signal and adjust the cores of **L18, L17** (location reference C2) and **L16, L15** (B2) in that order for maximum output, reducing the input as the circuits come into line to avoid A.G.C. action.

I.F. Rejector.—Transfer signal generator leads, via a dummy aerial, to **A** and **E** sockets and adjust **C28** (A2) for minimum output, feeding in a strong 470 kc/s (638.3 m) I.F. signal.

R.F. and Oscillator Stages.—Remove chassis from cabinet (model 400A only). Fix a small piece of adhesive tape or paper to the drive wire, about half an inch from the spring, and with the gang at minimum make a pencil mark on the tape to coincide with the extreme left-hand line engraved at the upper edge of the horizontal pulley mounting bracket. Using the mark on the paper as a cursor, the set can be tuned to the trimming point, represented by a second engraved line about half an inch to the right of the first one, and to the tracking point, represented by a third line nearer the right-hand end of the bracket. In the 500A, for "trimming point" read 18 on the log scale (bottom of scale panel); and for "tracking point" read 185 on log scale.

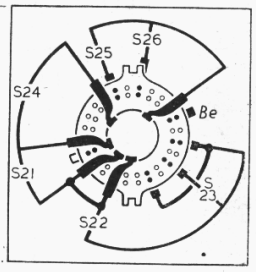
Note that **C29, C30, C31, C33, C34** and **C35** are trimmed by adjusting the amount of wire with which they are wound. Wire may only be removed: none must be added. These are in location references J3, J4.

S.W.—Switch set to S.W., tune to trimming point, feed in a 17.24 m (17.4 Mc/s) signal and adjust **C36** for maximum output. Tune to tracking point, feed in a 49.18 m (6.1 Mc/s) signal and adjust **C33** for maximum output. Return to trimming point, feed in a 17.24 m signal and adjust **C29** for maximum output.

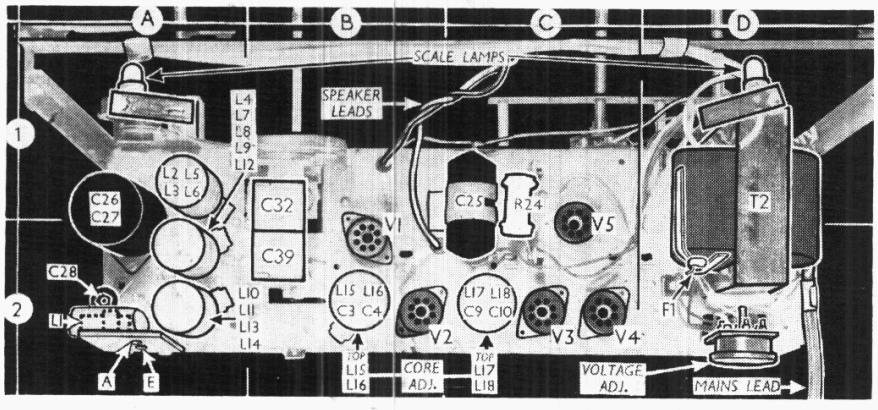
M.W.—Switch set to M.W., tune to trimming point, feed in a 193.6 m (1,550 kc/s) signal and adjust **C37** and **C30** for maximum output. Then adjust **C34** at 545.4 m (550 kc/s) at tracking point. Return to trimming point, feed in a 193.6 m signal again and re-adjust **C37** for maximum output.

L.W.—Fit a new **C35** and unscrew **C38** to its minimum capacitance. Switch set to L.W., tune to tracking point, feed in a 1,893 m (158 kc/s) signal and, by removing turns, reduce the capacitance of **C35** to a point just beyond maximum output. Tune to trimming point, feed in a 750 m (400 kc/s) signal and adjust **C38** and **C31** for maximum output. Tune to tracking point, feed in a 1,893 m signal and re-adjust **C35** for maximum output, removing further turns as necessary. Return to trimming point, feed in a 750 m signal and re-adjust **C38** for maximum output.

Diagram of the tone control and radiogram change-over switch unit. The associated is table below.



Switch	Radio			Gram	
	1	2	3	4	5
S21	—	—	—	C	C
S22	C	C	C	—	—
S23	—	—	—	C	C
S24	—	—	C	—	—
S25	—	—	C	—	—
S26	—	C	—	C	—



Plan view of the chassis. The scale lamps are normally fixed to the sub-baffle. **F1** is a soft-metal link holding two spring-loaded hooks together.

DRIVE CORD REPLACEMENT

There are two separate drive systems for the main drive and the cursor drive, the one using cord and the other, wire. These cables must be made up before they are fitted. Sketches at the foot of cols. 4 and 5 show the two systems separately, although in fact the large cursor drive drum and the small one are concentrically attached to each other. In both sketches, the system is viewed from the front of the chassis.

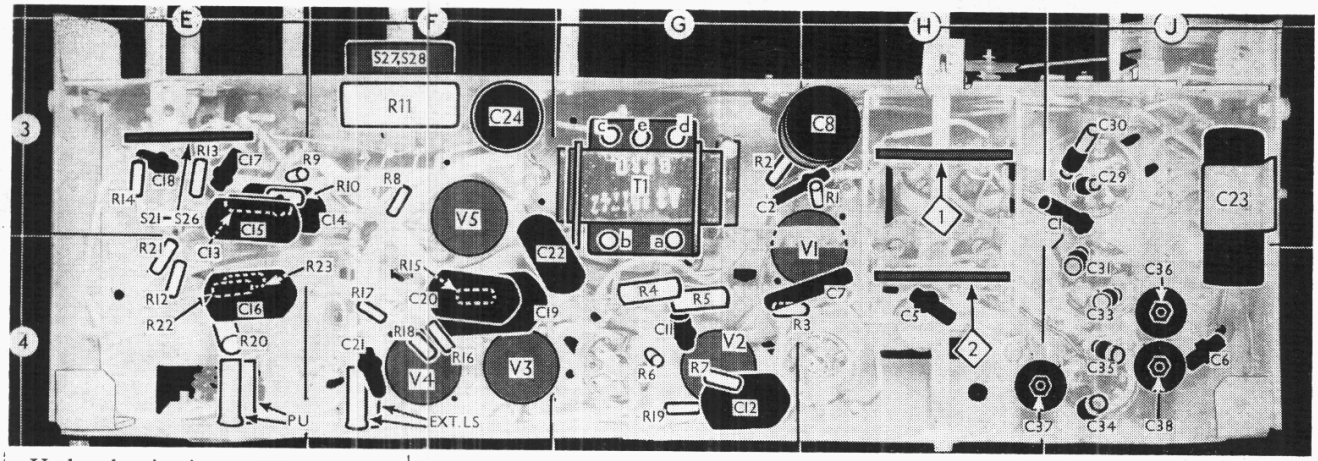
The materials required are 4 feet of cord, part No. 06. 606. 29; 75mm and 85mm (about 6.3 inches altogether) of flexible tubular outer casing, part No. 08. 010. 54; 1,600mm of stranded wire drive cable, part No. 33. 403. 04.; and a few metal end collars.

Main Drive.— Using the cord, make up a length 973mm (about 38⅜ inches) overall, with a loop at each end, threading on the two lengths of outer casing before tying off the loops. The makers tie off after clamping on a collar.

Clamp a third metal collar about half-way along the cord, 439mm (about 17½ inches) from one end and 534mm (about 21 inches) from the other, keeping the shorter length of outer casing on the shorter section of cord, and so on.

Turn the gang to minimum, and the cursor drive to the high wavelength end of its travel. Then turn the cursor drive drum 1½ turns clockwise, when the slot in the smaller cursor drive drum will be at 12 o'clock.

Insert the central metal collar into the slot from the rear, the end with the longer cord attached to it going in first. Take the shorter length ½ turn clockwise round the drum, then 2¾ turns anti-clockwise round the control spindle, winding towards the rear.



Under-chassis view. Diagrams of the switch units appear elsewhere.

ALL-DRY PORTABLE TROUBLES

Take the cord through the right-hand cable guide, and slide the flexible outer cable into position. Continue the cord anti-clockwise round the outer gang drum and hook it on to the anchored spring.

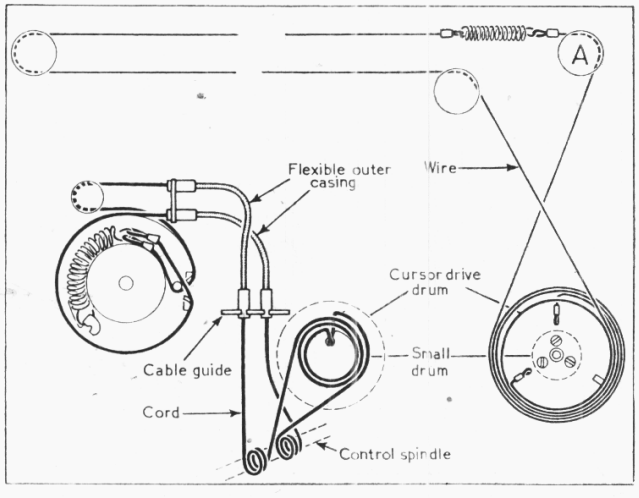
Take the longer end of cord, and wind on 2 turns anti-clockwise towards the rear, then down and 2½ turns clockwise round the control spindle, in front of the existing turns, winding towards the front.

Lead the cord up through the left-hand cable guide, sliding the flexible outer cable into position. Hook the loop on to the anchored spring, then strain the cord over the pulley above the drum as shown.

Cursor Drive.—Two separate wire cables are required for the cursor drive, and they should be made up before fitting. They each require a loop at one end and a collar to act as a stop at the other. One measures 590mm (about 23.25 inches) overall, and the other 1,000mm (about 39½ inches) in the 400A receiver. In the 500A, the lengths are 610mm (about 24 inches) and 975mm (about 38½ inches) respectively.

Turn the gang to maximum, when the three slots in the larger cursor drive drum will be at about 5 o'clock, 8 o'clock and 12 o'clock. Insert the non-looped end of the shorter cable into the slot at 12 o'clock, and wind 2¾ turns clockwise round the drum, winding towards the rear. Continue up to pulley **A**, hook the loop to the tension spring and anchor that somewhere convenient.

Insert the non-looped end of the longer cable into the slot at 8 o'clock, and wind 1½ turns anti-clockwise round the drum, winding towards the rear. Then pass it round the pulleys as shown, and hook its loop to the other end of the spring.



Sketches of the two drive systems, one of cord and one of wire. Both are viewed from the front of the chassis.

PYE 75B

One of these sets was brought in with the complaint of weak results even with new batteries. The I.F. were retrimmed and showed nearly normal results, although one side of the first I.F. required an extra 10 pF for resonance. After being on for about half an hour, the owner reported that the set faded to half volume, coming up well again after a short rest.

The times, however, varied considerably on further testing. We suspected the battery (L.T.) at first, as this showed a slight voltage drop, but this was not sufficient to cause less than half volume. The first valve was slightly weak on test, but here again it was not the main fault. On cutting out the A.V.C. by shorting the earthy end of the frame aerial to chassis, volume came up to normal, although usually this gives a slight drop in volume on these sets.

After checking the A.V.C. circuit, a voltmeter test between the frame and earth showed a very slight and hardly measurable positive voltage to earth whenever the set faded, which died down very slowly when the set was switched off. Finally, we found that the H.T. tag on the wavechange switch had a slight leakage to the frame aerial tag, and was giving a positive bias and consequent grid current to the F.C. valves. It seemed to us that there was no reason why the H.T. negative instead of positive should not be broken, especially as the contacts on these switches are very close together in places. On making this alteration the set again worked perfectly and the I.F. transformer would trim much more sharply.—**L. T.**, *Scarborough.*

EVER READY "C"

Recently we had two of these portables to service which had gradually become insensitive on medium waves. Suspecting I.F. coil drift complete realignment was carried out, when the discovery was made that a screened lead connecting the anode of V_2 (*Trader* Service Sheet 816) to the second I.F. transformer primary L_9 was damping the circuit to such an extent that the trimmer C_{21} had little or no effect.

Removal of this lead and the substitution of a piece of unscreened plastic flex cured the trouble. To avoid possible instability the unscreened wire was led through an existing hole in the chassis, along the chassis deck, behind the speaker transformer and down again to the underside through a gap near it to the I.F. transformer tags.

No instability was noticed after realignment, and the receivers were returned after test to their owners, who expressed complete satisfaction. We hope other readers of your very useful journal will benefit from this tip.—**A. S.**, *Chilwell.*

ALBA "ROVER" 2715

A few cases have occurred in which the metal rectifier (MR1 in *Trader* Service Sheet 934) has broken down, and then S.T.C. RM1 replacement units have followed suit. The receiver is an all-dry mains/battery portable, and all along the performance in each model on batteries has been unaffected by the breakdowns, while searching tests have failed to reveal any fault in the receiver.

Contact was established with the makers, who said they had not experienced any abnormal trouble in this direction, but they suggested that it may have occurred in this case because the mains voltage was high. Our mains here are 230 V A.C.

They suggested further that where this trouble is experienced it is advisable to use two RM1 units connected in series, thus doubling the peak inverse voltage rating which apparently in my case was being exceeded on the single unit. I thought that if other dealers were aware of this possibility it might save them a lot of time and perhaps several RM1s.—**D. I.**, *Islington.*

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