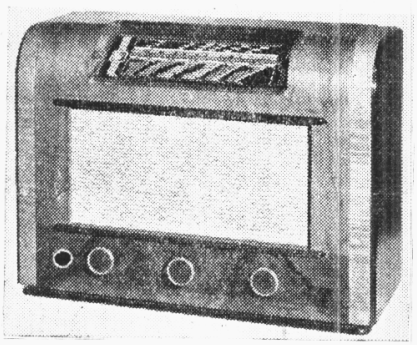
Supplement to The Wireless & Electrical Trader, July 13, 1940

"TRADER" SERVICE SHEET 475

MULLARD MAS 139

3-BAND AC SUPERHET



The Mullard MAS 139 3-band AC table superhet receiver.

THE Mullard MAS 139 is a 4-valve (plus valve rectifier) AC 3-band superhet. It employs a tuned RF stage preceding the triode-heptode frequency changer, and the SW range is 16·7-51m. An interesting feature of the set is the use of a special duplex tuning indicator of the cathode ray type, with sections of high and low sensitivity. Pick-up switching is provided.

The receiver is suitable for use on 100-260V, 50-100 C/S AC mains.

Release date: April, 1940.

CIRCUIT DESCRIPTION

Aerial input via coupling coils **L1** (SW), **L2** (MW) and **L3** (LW) to single tuned circuits **L4, C37** (SW), **L5, C37** (MW) and **L6, C37** (LW), which precede first valve **(V1, Mullard EF9)**, a variable-mu pentode operating as RF amplifier. **C1** shunts the aerial circuit via **S4** on MW and LW bands.

Tuned-secondary RF transformer coupling by **L7, L10, C41** (SW), **L8, L11, C41** (MW) and **L9, L12, C41** (LW) between **V1** and triode heptode valve **(V2, Mullard ECH3)**, which operates as frequency changer with internal coupling. Oscillator grid coils **L13** (SW) **L14** (MW) and **L15** (LW) are tuned by **C42**; parallel trimming by **C45** (SW), **C46** (MW), and **C13, C47** (LW); series tracking by **C14** (SW), **C15, C43** (MW) and **C16, C44** (LW). Reaction by coils **L16** (SW), **L17** (MW) and **L18** (LW).

Third valve **(V3, Mullard EF9)** is an RF pentode operating on radio with fixed GB as intermediate frequency amplifier with tuned-primary tuned-secondary iron-cored transformer couplings **C10, L19, L20, C11** and **C19, L21, L22, C20**; tuning is effected by adjustment of iron cores.

Intermediate frequency 470 KC/S.

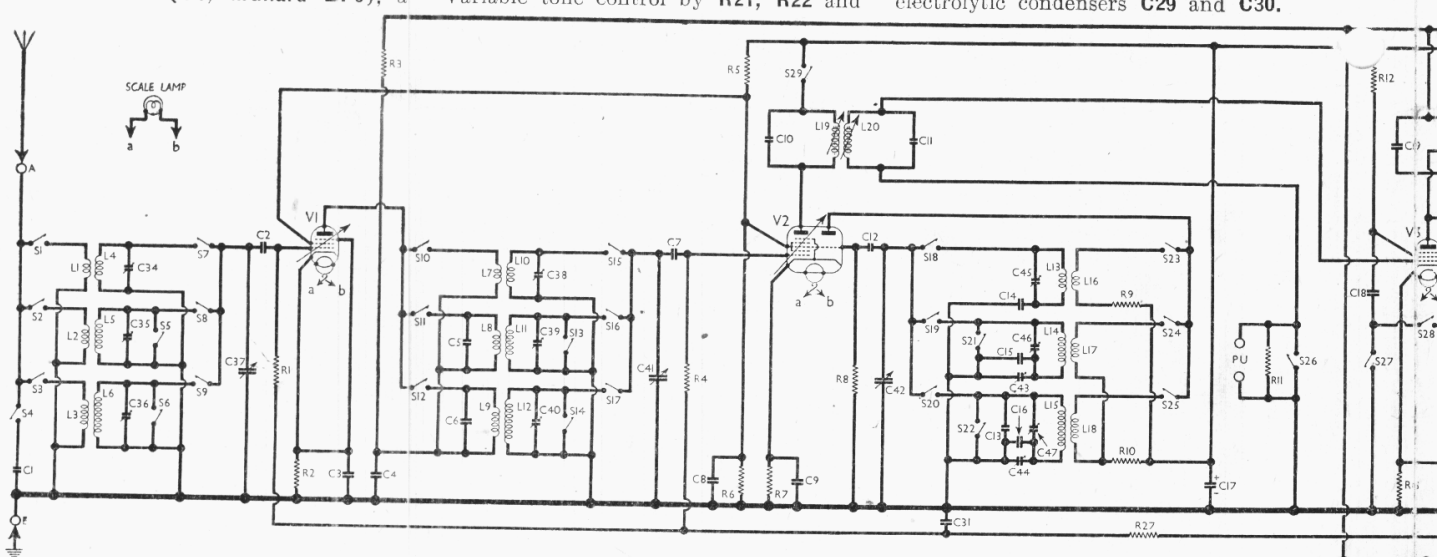
Diode second detector is part of double diode output pentode valve **(V4, Mullard EBL1)**. Audio frequency component in rectified output is developed across manual volume control **R19**, which also operates as load resistance, and passed via AF coupling condenser **C26** and grid stopper **R23** to CG of pentode section, which provides the only AF amplification on radio. Tone compensation by **R18, C25** across part of **R19**. Fixed tone correction by **C28** in anode circuit. Variable tone control by **R21, R22** and **C27**, also in anode circuit. Provision for connection of low impedance external speaker across secondary of output transformer **T1**.

Control voltage for the cathode ray tuning indicator **(T.I., Mullard EM4)** is applied to its control grid from the junction of the resistances **R15** and **R16**, which form a potential divider across **R19**.

Special arrangements are made for using a gramophone pick-up. Sockets are provided across **S26**, which is closed on radio, between **L20** and chassis, so that when its plugs are inserted the pick-up is included in the grid circuit of **V3**, which operates on gram as a triode AF amplifier with its second grid as the anode. **R12**, which on radio is the screen feed resistance, becomes the anode load, and **C18**, which on radio is the screen by-pass, becomes the AF coupling condenser. **S27** opens, and **S28** closes to connect **C18** to **R19**; **S29**, in **V2** heptode anode circuit, opens to mute radio.

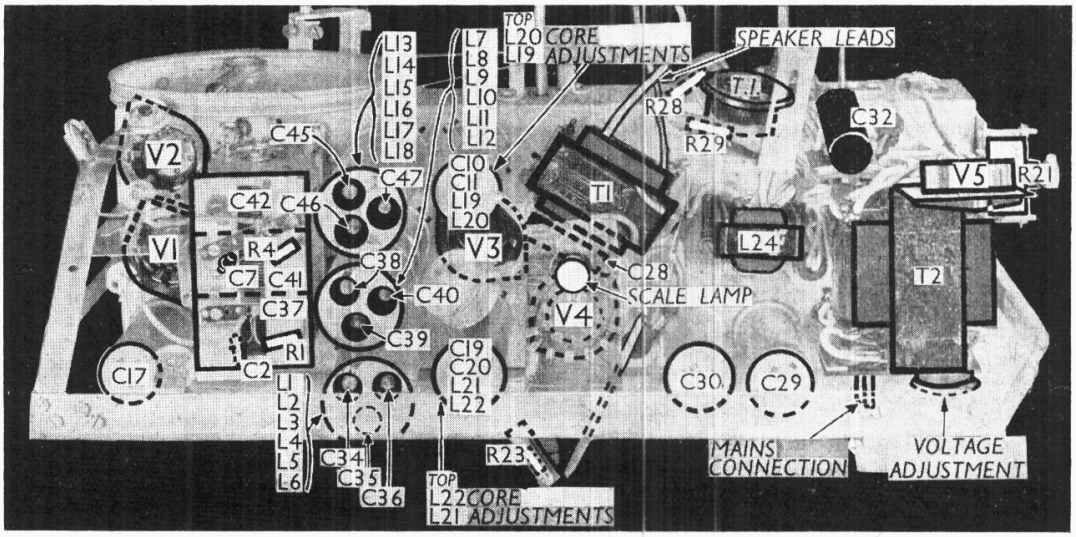
Second diode of **V4**, fed from **V3** anode via **C24**, provides DC potential which is developed across load resistance **R26** and fed back through decoupling circuit as GB to RF and FC valves, giving automatic volume control. Delay voltage is obtained from drop along resistances **R24, R25** in **V4** cathode lead to chassis.

HT current is supplied by full-wave rectifying valve **(V5, Mullard AZ1)**. Smoothing by iron-cored choke **L24** and electrolytic condensers **C29** and **C30**.



Circuit diagram of the Mullard MAS 139 receiver. For pick-up reproduction **V3** acts as an AF amplifier, the second grid being used as an anode. **R12** becomes the anode load and **C18** the AF coupling condenser. Note the EM4 tuning indicator, which has two sections with different degrees of sensitivity.

Plan view of the chassis. **R23** is on a small assembly attached to the top cap connector of **V4**. The cores of **L19-L22** are adjustable through holes in the sides of the coil cans, indicated roughly by arrows. **R28, R29** are associated with the tuning indicator holder. **R21** is the variable tone control.



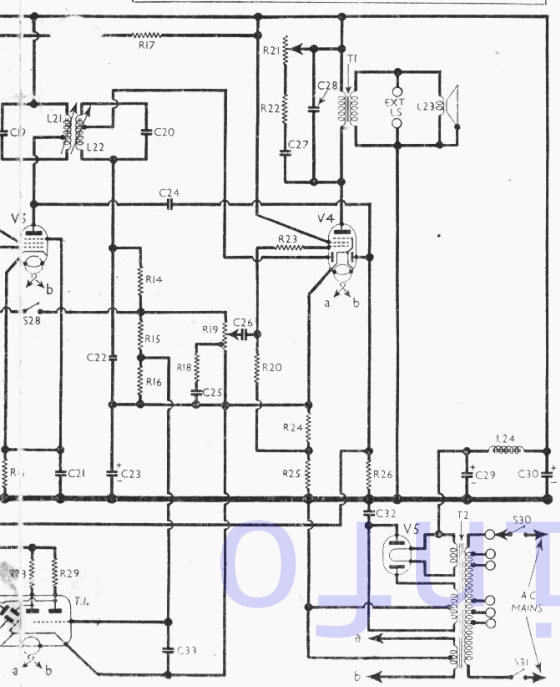
COMPONENTS AND VALUES

NOTE.—To avoid confusion when ordering a replacement component from the manufacturers, dealers quoting our component numbers should mention that they are taken from the "Trader" Service Sheet.

	RESISTANCES	Values (ohms)
R1	V1 CG resistance	820,000
R2	V1 fixed GB resistance ...	390
R3	V1 anode HT feed	1,800
R4	V2 heptode CG resistance ...	820,000
R5	V1, V2 SG's HT feed potential divider	10,000
R6		33,000
R7	V2 fixed GB resistance ...	220
R8	V2 osc. CG resistance ...	47,000
R9	SW reaction damping ...	68
R10	MW and LW reaction damping	1,800
R11	PU shunt	470,000
R12	V3 SG HT feed; anode load on gram.	47,000

	RESISTANCES (*Continued*)	Values (ohms)
R13	V3 fixed GB resistance ...	330
R14	IF stopper	47,000
R15	T.I. CG feed potential divider	3,300,000
R16		2,200,000
R17	HT feed resistance	8,200
R18	Part of tone compensator ...	47,000
R19	Manual volume control; V4 signal diode load	350,000*
R20	V4 pent. CG resistance ...	1,000,000
R21	Variable tone control ...	50,000
R22	Part of variable tone control	100
R23	V4 grid stopper	1,000
R24	V4 pentode GB and AVC delay resistances	150
R25		220
R26	V4 AVC diode load	680,000
R27	AVC line decoupling	1,200,000
R28	T.I. anodes HT feed resistances	1,500,000
R29		1,500,000

*Tapped at 75,000 Ω from low potential end.



	OTHER COMPONENTS	*Approx. Values (ohms)
L1	Aerial SW coupling coil ...	3·5
L2	Aerial MW coupling coil ...	28·0
L3	Aerial LW coupling coil ...	100·0
L4	Aerial SW tuning coil ...	0·05
L5	Aerial MW tuning coil ...	5·0
L6	Aerial LW tuning coil ...	45·0
L7	RF trans. SW pri. coil ...	2·5
L8	RF trans. MW pri. coil ...	280·0
L9	RF trans. LW pri. coil ...	470·0
L10	RF trans. SW sec. coil ...	0·05
L11	RF trans. MW sec. coil ...	5·0
L12	RF trans. LW sec. coil ...	45·0
L13	Osc. circuit SW tuning coil	Very low
L14	Osc. circuit MW tuning coil	8·5
L15	Osc. circuit LW tuning coil	19·0
L16	Oscillator SW reaction ...	1·0
L17	Oscillator MW reaction ...	3·5
L18	Oscillator LW reaction ...	3·5
L19	1st IF trans. Pri.... ...	7·5
L20	1st IF trans. Sec. ...	7·5
L21	2nd IF trans. Pri., total...	7·5
L22	2nd IF trans. Sec., total	7·5
L23	Speaker speech coil... ...	4·0
L24	HT smoothing choke ...	280·0
T1	Output trans. Pri.... ...	640·0
	Sec. ...	0·6
T2	Mains trans. Pri., total ...	48·0
	Heater sec. ...	0·1
	Rect. heat. sec.	0·15
	HT sec., total...	400·0
S1-S25	Waveband switches ...	—
S26-S29	Radio-gram change switches	—
S30-S31	Mains switches, ganged R19	—

	CONDENSERS	Values (μF)
C1	MW and LW aerial shunt...	0·000082
C2	V1 CG condenser	0·0001
C3	V1 cathode by-pass... ...	0·1
C4	V1 anode decoupling ...	0·047
C5	RF transformer MW pri. shunt	0·000047
C6	RF transformer LW pri. shunt	0·00027
C7	V2 heptode CG condenser...	0·0001
C8	V1, V2 SG's decoupling ...	0·1
C9	V2 cathode by-pass... ...	0·1
C10	1st IF trans. pri. tuning ...	0·000091
C11	1st IF trans sec. tuning ...	0·000097
C12	V2 osc. CG condenser ...	0·000047
C13	Osc. circuit LW fixed trimmer	0·000039
C14	Osc. circuit SW tracker ...	0·0045
C15	Osc. circuit MW fixed tracker	0·0004
C16	Osc. circuit LW fixed tracker	0·000136
C17*	HT smoothing condenser...	32·0
C18	V3 SG decoupling (radio); V3 AF anode to V4 pentode coupling (gram.)	0·047
C19	2nd IF trans. pri. tuning ...	0·000103
C20	2nd IF trans. sec. tuning ...	0·000103
C21	V3 cathode by-pass... ...	0·047
C22	IF by-pass	0·000047
C23*	V4 cathode by-pass... ...	25·0
C24	Coupling to V4 AVC diode	0·0000082
C25	Part of tone compensator...	0·047
C26	AF coupling to V4 pentode	0·022
C27	Part of variable tone control	0·047
C28	Fixed tone corrector ...	0·0022
C29*	HT smoothing condensers	28·0
C30*		32·0
C31	AVC line decoupling ...	0·1
C32	V5 anode RF by-pass ...	0·022
C33	T.I. CG decoupling	0·047
C34‡	Aerial circuit SW trimmer	0·00003
C35‡	Aerial circuit MW trimmer	0·00003
C36‡	Aerial circuit LW trimmer	0·00003
C37†	Aerial circuit tuning ...	0·00049
C38‡	RF trans. sec. SW trimmer	0·00003
C39‡	RF trans. sec. MW trimmer	0·00003
C40‡	RF trans. sec. LW trimmer	0·00003
C41†	RF trans. secondary tuning	0·00049
C42†	Oscillator circuit tuning ...	0·00049
C43‡	Osc. circuit MW tracker ...	0·0002
C44‡	Osc. circuit LW tracker ...	0·000032
C45‡	Osc. circuit SW trimmer ...	0·00003
C46‡	Osc. circuit MW trimmer...	0·00003
C47‡	Osc. circuit LW trimmer ...	0·00003

* Electrolytic. † Variable. ‡Pre-set.

DISMANTLING THE SET

The cabinet is fitted with a detachable bottom, upon removal of which (six screws with washers) access may be gained to most of the components beneath the chassis.

Removing Chassis.—Switch to SW band

Supplement to The Wireless & Electrical Trader, July 13, 1940

and remove the three control knobs (recessed grub screws) from the front of the receiver;
remove a fourth knob, with its extension spindle (screw inside cabinet);
slacken the knurled scale pointer adjusting screw (on pointer carriage beneath tuning scale) and slip the drive wire free;
remove the knurled fixing screw on the tuning indicator mounting bracket, and free the unit;
slip the waveband indicator control wire loop from its anchorage on the indicator lever by pushing the indicator round towards the LW position;
unsolder the two leads from the three tags on the speaker;
disconnect earthing lead (set screw at rear of chassis, near radio/gram switch);
tighten up the four transit screws by inserting a suitable screwdriver into the holes in the hollow bolts holding the chassis to the bottom of the cabinet and turning clockwise. (This prevents the rubber - mounted suspension brackets from falling away and considerably facilitates handling of the chassis);
remove the hollow bolts (with large metal washers).

When replacing, before fixing the chassis fixing bolts, fit the waveband indicator control wire, which passes under a pulley wheel at one end of the chassis and over another at the top of the cabinet.

Connect the red speaker lead to the two left-hand tags on the speaker, and the yellow lead to the third tag.

Do not forget to replace the earthing lead between the chassis and the screen in the bottom of the cabinet.

Finally, slacken the transit screws two or three turns each.

Removing Speaker.—Slacken the three nuts (with lock-nuts and lock-washers) holding the clamps to the speaker rim, and swivel the clamps.

When replacing, the connecting strip should be at the top.

VALVE ANALYSIS

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

Voltages were measured on the 400V scale of a model 7 Universal Avometer, chassis being negative.

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 EF9	250	5·0	95	1·5
V2 ECH3	155	2·2	95	3·2
	Oscillator			
	145	3·2		
V3 EF9	260	5·5	85	1·5
V4 EBL1	235	35·0	260	6·0
V5 AZ1	310†	—	—	—
T.I. EM4	30*	0·15	—	—
	Target			
	260	0·8		

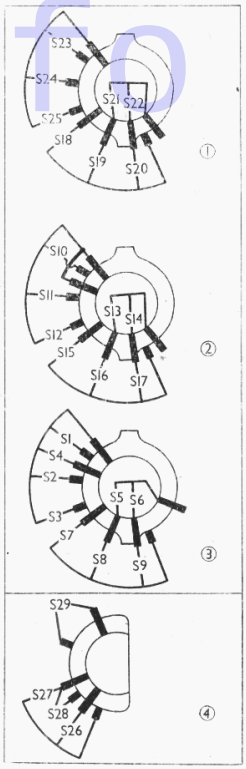
† Each anode, AC.
* Approx. value each anode (pins 5 and 8), DC.

GENERAL NOTES

Switches.—S1-S25 are the waveband switches, in three rotary units beneath the chassis. These are indicated in our under-chassis view, and shown in detail in the top three units of the diagram in col. 3, where they are drawn as seen looking from the rear of the underside of the chassis.

The table (col. 4) gives the switch positions for the three control settings, starting from fully anti-clockwise. A dash indicates *open* and **C** *closed*.

S26-S29 are the radio-gram change switches, ganged in a single lever-operated unit at the rear of the chassis. This is indicated in our under-chassis view, and shown in detail in the bottom unit (4) of the switch diagram in col. 3, where it is drawn as seen looking from the tone control end of the underside of the chassis.

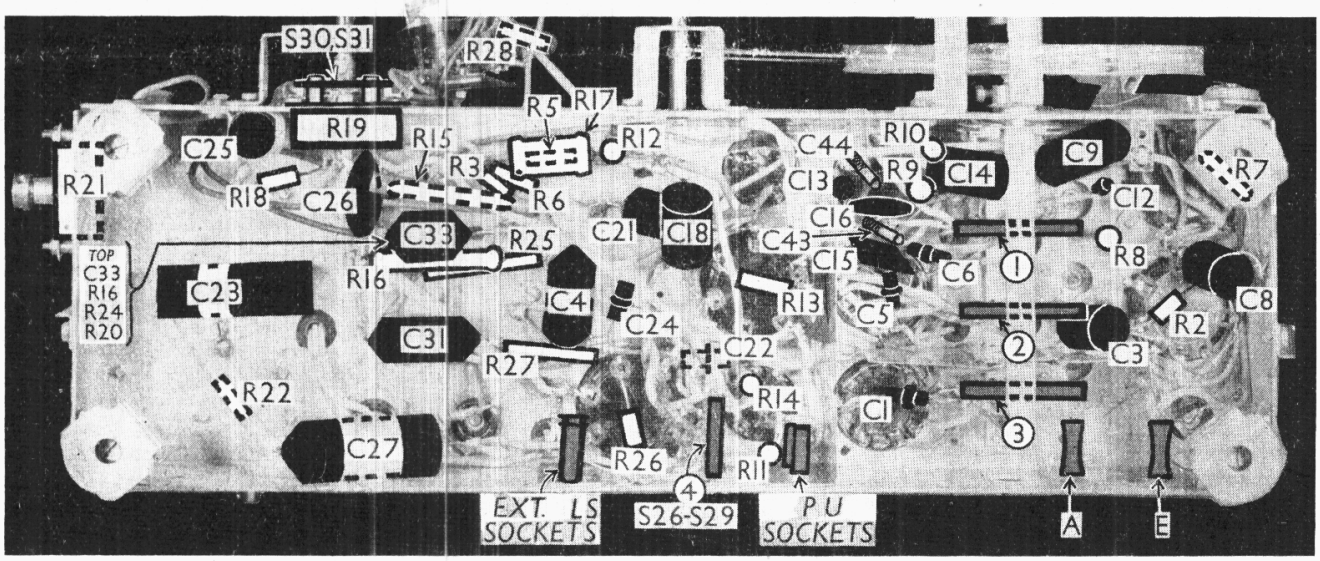


Diagrams of the wave-change switch units (1 to 3) and the radio-gram switch unit (4). The first three are drawn as seen from the rear of the underside of the chassis, and the fourth as seen from the tone control end of the underside of the chassis.

S26, S27 and **S29** are closed on radio (lever down towards bottom of chassis) and open on gram (lever up towards chassis deck.) **S28** is closed on gram, and open on radio.

S30 and **S31** are the QMB mains switches, ganged with the volume control **R19.**

Coils.—L1-L6, L7-L12 and **L13-L18** are in three large screened units on the chassis deck, each having three trimmers reached through holes in the tops of the cans.



Under-chassis view. The three wavechange switch units (1 to 3) and the radio-gram switch unit (4) are shown in detail in column 3 above. The arrows show the directions in which they are viewed. **C43 and C44** are wire-wound pre-set condensers. **R28** is mounted, with **R29** (not shown in this view), on the T.I. holder.

SWITCH TABLE

Switch	SW	MW	LW
S1	C	—	—
S2	—	C	—
S3	—	—	C
S4	—	C	C
S5	C	—	—
S6	C	C	—
S7	C	—	—
S8	—	C	—
S9	—	—	C
S10	C	—	—
S11	—	C	—
S12	—	—	C
S13	C	—	—
S14	C	C	—
S15	C	—	—
S16	—	C	—
S17	—	—	C
S18	C	—	—
S19	—	C	—
S20	—	—	C
S21	C	—	—
S22	C	C	—
S23	C	—	—
S24	—	C	—
S25	—	—	C

The IF transformers **L19, L20** and **L21, L22** are in two smaller screened units on the chassis deck. They contain the fixed trimmers **C10, C11** and **C19, C20** respectively, and the core adjustments are at the sides of the cans, as indicated roughly by arrows in the plan chassis view.

L24, the smoothing choke, is mounted on the chassis deck.

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

Scale Lamp.—This is a Philips MES type, part no. 8091D.

Resistance R23.—This is mounted on a small assembly attached to the top cap connector of **V4.**

Resistances R28, R29.—These are mounted inside insulating sleeving across the appropriate tags on the T.I. holder.

Volume Control R19.—This is tapped at about 75,000 O from the bottom end (as drawn in our circuit diagram). The two tags close together near the periphery of the control are the two ends of **R19**; the single tag near the periphery is the tapping, and the tag near the centre of the control is the slider connection.

Condensers C43, C44.—These trackers are of the wire-wound type, and are adjustable by altering the length of the spiral wire winding. Each is in parallel with a fixed condenser **(C15, C16).**

Tuning Indicator.—The EM4 tuning indicator is a special duplex type, one section of which has a low sensitivity, to indicate powerful stations, while the other section has a high sensitivity, and so responds to very weak signals. The internal connections are shown in the circuit diagram, while the external connections, using the standard numbering for an E type base, are: 1, blank; 2, heater; 3, heater; 4, cathode; 5, A2 (least sensitive section); 6, control grid (common to both sections); 7, target; 8, A1 (most sensitive section).

CIRCUIT ALIGNMENT

IF Stages.—Switch set to MW, turn gang condenser to minimum and volume control to maximum. Connect signal generator, via a 0.1 μF condenser to control grid (top cap) of **V2,** and to chassis. Prepare a shunt circuit consisting of a 20,000 O resistor and a 0.1 μF condenser in series. Connect shunt circuit across **L21,** feed in a 470 KC/S signal and adjust core of **L22** for maximum output. Transfer shunt circuit across **L22,** and adjust core of **L21** for maximum output. Connect shunt circuit across **L19,** and adjust core of **L20** for maximum output. Transfer shunt circuit across **L20,** and adjust core of **L19** for maximum output. Remove shunt circuit and seal all trimmers.

RF and Oscillator Stages.—Connect signal generator, via a suitable dummy aerial, to the **A** and **E** sockets. For setting the gang at the lower wavelength ends of the scale the special 15 degree jig (Part No. 09.992.440) is necessary.

SW.—Switch set to SW. Fit the 15 deg. jig, and set the gang to it. Feed in a 17 MC/S (17.65m) signal (via a SW dummy aerial), and adjust **C45, C38** and **C34** for maximum output. **C45** should be set to the first peak reached from *minimum* capacity. Remove 15 deg. jig, and seal SW trimmers.

MW.—Switch set to MW. Fit the 15 degree jig as before to the front of the gang condenser, and set the gang to it. Feed in a 1,442 KC/S (208m) signal, and adjust **C46, C39** and **C35** for maximum output.

Remove 15 deg. jig, feed in a 545 KC/S (550m) signal, and tune it in. Adjust **C43** (by altering length of wire winding) for maximum output, while rocking the gang for optimum results. Replace 15 deg. jig and adjust gang to it, feed in a 1,442 KC/S (208m) signal, and retrim **C46.** Remove jig and seal MW trimmers.

LW.—Switch set to LW. Fit the 15 deg. jig and set the gang condenser to it. Feed in 405 KC/S (740m) signal, and adjust **C47, C40** and **C36** for maximum output.

Remove jig, feed in a 160 KC/S (1,875m) signal, and tune it in. Adjust **C44** (by altering the length of the wire winding) for maximum output, while rocking the gang for optimum results. Replace the 15 deg. jig, and adjust gang to it, feed in a 405 KC/S (740m) signal, and retrim **C47.** Remove jig, and seal LW trimmers.

Pointer Adjustment.—Switch set to MW, feed in an 811 KC/S (370m) signal, tune it in accurately, and adjust the pointer carefully to 370m on the scale by altering the position of the pointer carriage on the drive wire.

Television: A Standard Textbook

A BOOK entitled Television, which is likely to become a standard work on the subject for students, research engineers and designers, has just been published in New York, and is distributed in Great Britain by Chapman and Hall, Ltd., at 36s. net.

The book is by the well-known American television engineer, Dr. V. K. Zworykin, and his collaborator, Dr. G. A. Morton, both of the Electronics Research Laboratory of the Radio Corporation of America. Dr. Zworykin is famous for his development of the iconoscope, which is the kernel of the Marconi-EMI system of transmission in this country.

The sub-title of the book is "The Electronics of Image Transmission," and as might be expected, electron optics figure largely in the text, the authors being two of the greatest authorities on this subject.

The opening chapters are devoted to the electron theory in relation to thermionic, photo-electric and secondary emission, and to the theory of luminescence. This is followed by two chapters on electron optics, and one on vacuum practice, which describes the mechanical side of technique for the production of high vacua. This completes the first section of the book.

The second section deals generally with the principles of television, including the fundamentals of picture transmission and reproduction, video pick-up devices and picture-reproducing systems. Under the heading of video pick-up devices and reproducing systems, mechanical systems, the intermediate film system, the Farnsworth dissector tube and the Scophony light valve are described. Fernseh and Telefunken systems are dealt with, but there appears to be no mention of the work of the Baird Company.

The third section of the book deals with the component elements of an electronic television system, starting with two detailed chapters on the iconoscope in its various forms, including the image multiplier type. Apart from the theory of the device, the manufacture and testing is fully covered.

Next comes a chapter on the kinescope, or, as we know it, the cathode ray reception tube. The methods used in manufacture are included in this chapter, together with some information on projection and demountable types. The electron gun, or electrode system of a cathode ray tube, has a chapter to itself, with a detailed analysis of the various types.

Video amplifiers are dealt with at length in the next chapter, from both theoretical and practical angles, and then follows an important chapter on scanning and synchronisation, with special reference, of course, to the American standard synchronising signal, which is similar to, but not the same as, that used by the BBC.

The next two chapters are devoted to the television transmitter and the television receiver. The transmitter chapter contains some detailed information on transmission lines and wide-band aerials. The receiver chapter includes a diagram and component values for a complete experimental receiver.

The fourth, and shortest, section of the book describes in detail the American RCA-NBC television system, and terminates in a brief chapter on current and future television problems.

Altogether the book contains 646 pages and a large number of line and half-tone illustrations. Many parts of it assume a good mathematical knowledge, but nevertheless the authors have at all points interspersed a considerable amount of practical information.

Although not to be recommended to the beginner in television, the book will certainly be of considerable use to all serious students of the subject, and others who need the vast amount of authentic information it contains.

W. E. M.

Printed in Great Britain by ST. CLEMENTS PRESS, LTD., Portugal Street, Kingsway, London, W.C.2.