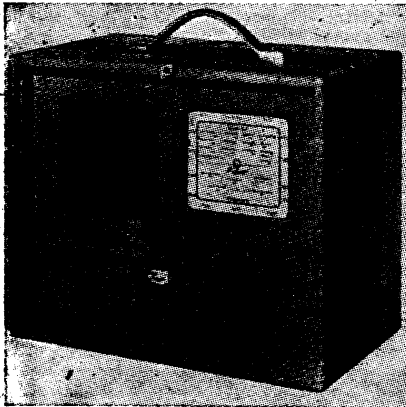


PILOT TWIN MIRACLE

AC, DC, BATTERY TRANSPORTABLE



THE Pilot Twin Miracle receiver is designed for AC, DC or battery operation, and is interesting in that it automatically changes over to battery operation should the mains fail or be switched off, and from battery to mains operation when the mains are switched on. The battery supply is an all-dry combined LT and HT unit.

The receiver is a 4-valve plus rectifier superhet, and is fitted with frame aeri-als in a leatherette-finished carrying case. It covers the MW and LW bands, and when operating on AC or DC mains it is suitable for voltages of 200-240 V.

Release date: August, 1939.

CIRCUIT DESCRIPTION

Tuned frame aerial input L3, C19 (MW), plus L4, C19 (LW) to first valve (V1, Brimar 1A7EG), a heptode operating as frequency changer with electron coupling. Provision for connection of external aerial via A socket, isolating condenser C1 and frame aerial coupling coils L1, L2 to L3 and L4. An external earth must not be connected, because the chassis is "live" to the mains.

V1 oscillator grid coils L5 (MW), plus L6 (LW) are tuned by C20; parallel trimming by C21 (MW) and C22 (LW); series tracking by C24 (MW) and C23 (LW). Reaction from anode via C5 by coil L7 and common impedance of tracking condensers which are included in both grid and anode circuits.

Second valve (V2, Brimar 1N5G) is a variable-mu RF pentode operating as intermediate frequency amplifier with tuned-primary tuned-secondary iron-cored transformer couplings C25, L8, L9, C26 and C27, L11, L12, C28.

Intermediate frequency 451KC/S.

Diode second detector is part of single diode triode valve (V3, Brimar 1H5G). Audio frequency component in rectified output is developed across load resistance R6 and passed via AF coupling condenser C8 and manual volume control R7 to CG of triode section, which operates as AF amplifier. IF filtering in diode circuit by C7, R3, and in triode anode circuit by C9.

DC potential appearing across R6 is

also developed across R4, R5, and that at their junction is tapped off and fed back through decoupling circuit as GB to FC and IF valves, giving automatic volume control.

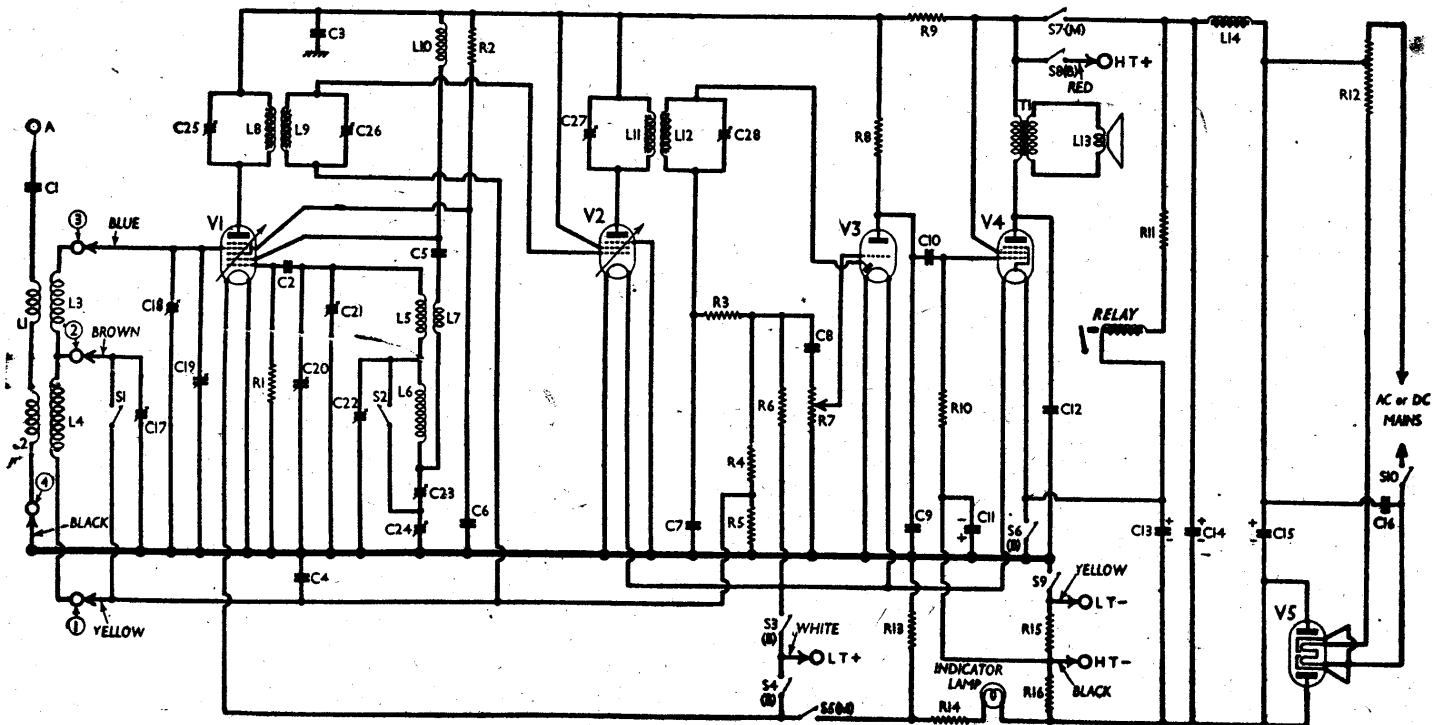
Resistance-capacity coupling by R8, C10 and R10 between V3 triode and pentode output valve (V4, Brimar 1C5EG). Fixed tone correction by C12 in anode circuit.

Power Supply

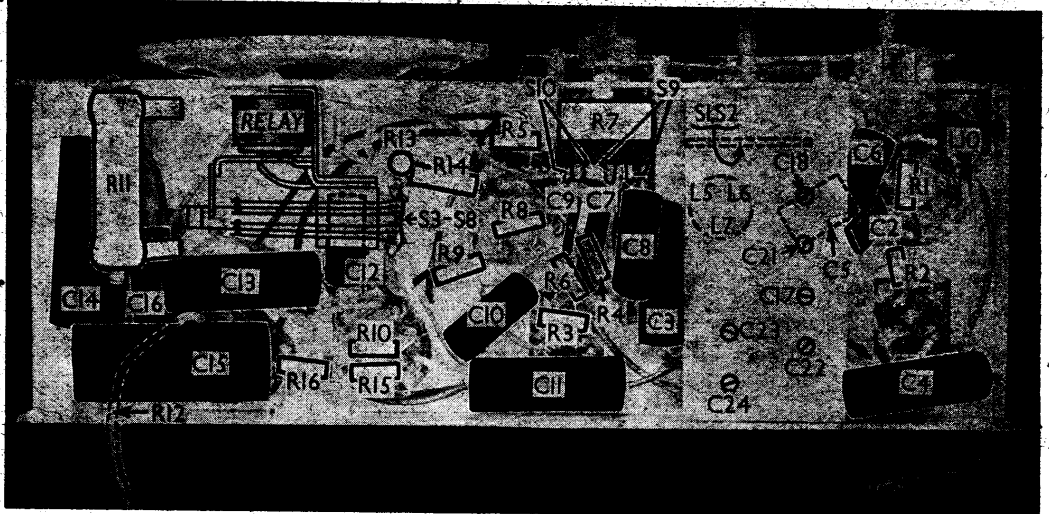
This receiver is designed to operate from dry batteries or AC or DC mains, and automatically to adjust itself to which of these forms of supply is presented.

Since the change-over switching action may not be immediately apparent from a study of the circuit diagram, the two circuits, one for battery operation and the other as it arranges itself for operation from AC or DC mains, are separately described in detail below, and the switches concerned in the change-over S3 to S8 are coded with the letters B and M to indicate when they open and close: when working from the battery unit all the B switches are closed, and the M switches are open; when working from AC or DC mains, the M switches are closed, and the B switches are open. The on/off switches S9, S10 are ganged.

Battery Operation.—The combined dry HT and LT battery unit is permanently housed in the casing of the receiver, and permanently connected by a plug and socket connector to the chassis. When the receiver on/off switches are open,



Under-chassis view. Diagrams of the S1, S2 and the S3-S8 switch units are given overleaf. The tags of S9 and S10 are indicated. R11 may be a tapped resistor in later models. R12 is incorporated in the mains lead.



S3(B), S4(B), S6(B) and S8(B) are all closed; so that when the receiver is switched "on," by turning the volume control knob, S9 closes and the receiver immediately begins to operate.

Under these circumstances, the HT circuit is from the junction of R15 and R16 (HT negative), via V4 automatic grid bias resistance R15, S9, chassis, valve circuits, HT positive line and S8 (B) to HT-positive.

The filament circuit is via S9 (LT negative) to chassis; then via V1 filament and S4(B) to LT positive; and via V2, V3 filaments and S3(B), to LT positive; and via S6(B), V4 filament and S3(B) to LT positive; so that all the filaments are connected in parallel across the 1.5V section of the battery unit.

AC or DC Mains Operation.—When the receiver is switched "on" for mains

operation, S9 and the mains switch S10, since they are ganged, close together, and the receiver again begins immediately to operate from the battery supply.

Now, however, the mains supply is connected across the line cord R12 and the heater of the rectifier valve (V5, Brimar 25Z6G or 1D5) via S10, and the rectifier begins to warm up. When emission begins in V5, an electron flow will occur from the mains through V5, R16, R15 and, via S9 and S6(B), which is still closed, through the relay winding, R11, L14, and part of R12 back to the mains.

Until the current thus produced reaches a certain critical value, the relay, which controls all the change-over switches, remains open, but at that point it closes and effects the change-over, closing the two M switches and opening the four B switches.

The HT circuit is now: V5 anode, R16, R15 (which continues to operate as V4 GB resistance) S9; chassis, valve circuits, HT positive line, S7(M), L14 and R12 to the mains.

The filament circuit is now in series with the HT supply; it runs from V5 anode via the mains indicator lamp, which glows when the receiver is operating from the mains, R14, V1 filament and R13 (connected in parallel via S5(M) and chassis), V2 and V3 filaments (connected in parallel), V4 filament, relay and R11 to HT positive line.

R13 and V1 filament, R14 and the indicator lamp are in parallel with R15 and R16.

From the foregoing, it will be seen that, if the receiver is operating from its battery, it will automatically change over to mains operation if the mains are subsequently connected; and conversely, if it is operating from the mains, and the supply fails or is switched "off," the receiver will change over to battery operation and continue to function. The indicator lamp then provides an indication of the source of power.

If the receiver is connected to DC mains and the lamp fails to glow after the normal warming-up period, the indication is that the mains plug requires reversing.

DISMANTLING THE SET

Removing Chassis.—Remove the three control knobs (pull off) and the back of the receiver, with frame aerials attached, (four set screws); withdraw the frame aerial plug and pull the mains cord through the hole in the back of its pressed-card container, when the back will be freed from the receiver. Unscrew the battery unit retaining clamp (two round-head woodscrews), withdraw its connecting plug, and remove the two wood retaining blocks (two countersunk head wood screws) screwed to the sides of the cabinet at the rear of the chassis. The chassis can now be withdrawn from the cabinet.

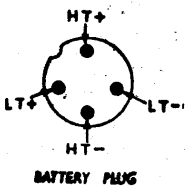
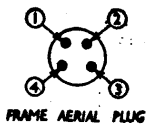
Removing Speaker.—The speaker may be removed from the chassis by unsoldering its leads at V4 holder, on the underside of the chassis, and withdrawing its fixing bolts. When replacing, connect the blue speaker lead to pin 3 on V4 and the red lead to pin 4 on the same valveholder.

COMPONENTS AND VALUES

CONDENSERS		Values (μF)
C1	Aerial isolating condenser...	0-0003
C2	V1 osc. CG condenser	0-00006
C3	HT circuit R.F. by-pass	0-25
C4	AVC line decoupling	0-1
C5	V1 osc. anode coupling condenser	0-0003
C6	V1 SG decoupling	0-01
C7	IF by-pass	0-0003
C8	AF coupling to V3 triode	0-01
C9	IF by-pass	0-0001
C10	V3 triode to V4 AF coupling	0-01
C11*	V4 CG decoupling	25-0
C12	Fixed tone corrector	0-005
C13*	Heater circuit smoothing (on mains)	25-0
C14*	HT smoothing condensers	40-0
C15*		40-0
C16	Mains RF by-pass	0-05
C17†	Aerial LW trimmer	—
C18†	Aerial MW trimmer	—
C19†	Frame aerial tuning	—
C20†	Oscillator circuit tuning	—
C21†	Osc. circuit MW trimmer	—
C22†	Osc. circuit LW trimmer	—
C23†	Osc. circuit LW tracker	—
C24†	Osc. circuit MW tracker	—
C25†	1st IF trans. pri. tuning	—
C26†	1st IF trans. sec. tuning	—
C27†	2nd IF trans. pri. tuning	—
C28†	2nd IF trans. sec. tuning	—

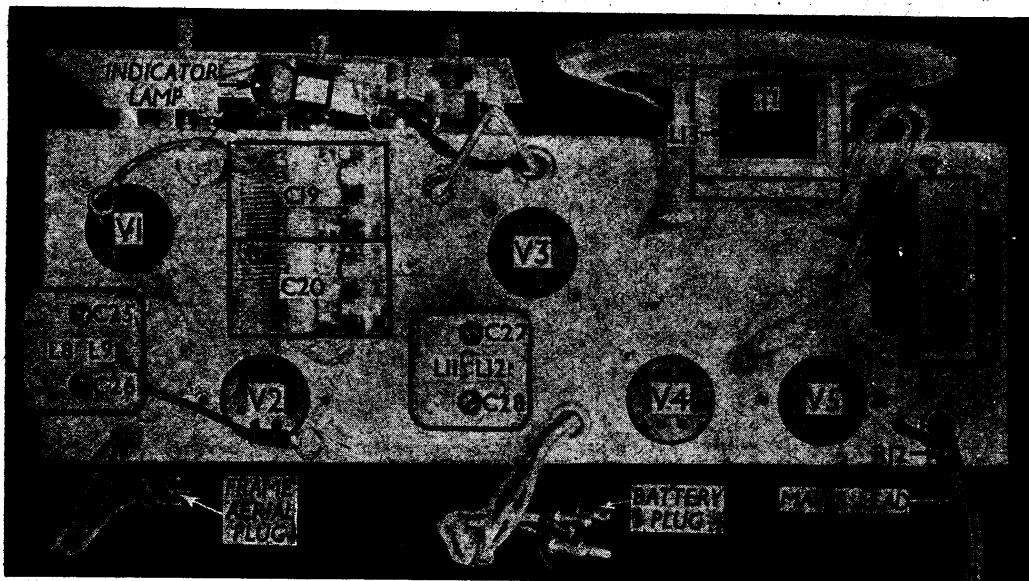
* Electrolytic. † Variable. ‡ Pre-set.

Circuit diagram of the Pilot Twin Miracle receiver. The switches S3-S8 are relay operated, and control the mains to battery changeover, and vice-versa. Switches with the suffix M close for mains operation, while those with the suffix B close for battery operation. The frame aerial and battery plug and socket connections are indicated and colour-coded.



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Supplement to The Wireless & Electrical Trader, Oct. 28, 1939



Plan view of the chassis. R12 is incorporated in the mains lead. Battery and frame aerial plug connections and diagrams are given in the circuit diagram.

RESISTANCES		Values (ohms)
R1	V1 osc. CG resistance	220,000
R2	V1 SG HT feed	56,000
R3	IF stopper	47,000
R4	AVC line feed resistances	3,300,000
R5		3,300,000
R6	V3 signal diode load resistance	2,200,000
R7	Manual volume control	2,000,000
R8	V3 triode anode load	1,000,000
R9	V1, V2, V3 HT feed	2,000
R10	V4 CG resistance	3,300,000
R11	V1-V4 heater circuit ballast	700
R12	V5 heater ballast (line cord)	320*
R13	V1 heater shunt (on mains)	25
R14	Indicator lamp series	50
R15	V4 automatic GB resistances	1,200
R16		2,000

* Tapped at 200 Ω from mains plug end.

OTHER COMPONENTS		Approx. Values (ohms)
L1	Frame aerial coupling coils	0-1
L2		0-2
L3	Frame aerial tuning coils	1-5
L4		31-9
L5	Osc. circuit MW tuning coil	3-5
L6	Osc. circuit LW tuning coil	6-5
L7	Oscillator reaction coil	85-0
L8	1st IF trans.	Pri. 6-5
L9		Sec. 6-5
L10	V1 osc. anode HT feed choke	130-0
L11	2nd IF trans.	Pri. 7-5
L12		Sec. 4-5
L13	Speaker speech coil	3-0
L14	HT smoothing choke	200-0
T1	Speaker input trans.	Pri. 430-0
		Sec. 0-3
Relay	Magnet winding	100-0
S1, S2	Waveband switches	—
S3-S8	Battery/mains change-over switches	—
S9	Battery switch	ganged R7
S10	Mains switch	—

VALVE ANALYSIS

Valve voltages and currents given in the tables (col. 2) are those measured in our receiver when it was operating on (a) a new HT battery reading 87V on load (battery table); (b) AC mains of 230V (mains table). 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.

Battery Operation

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 1A7EG	75	0.3	37	0.6
	Oscillator	1.3		
V2 1N5G	75	0.8	75	0.1
V3 1H5G	15	0.02	—	—
V4 1C5EG	78	4.7	80	2.0

Mains Operation

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 1A7EG	78	0.8	40	0.6
	Oscillator	1.1		
V2 1N5G	76	0.9	76	0.1
V3 1H5G	15	0.02	—	—
V4 1C5EG	85	8.2	90	2.8
V5 25Z6G	100†	—	—	—

† Measured between pin 5 on V5 and HT+ line at pin 4 on V4.

GENERAL NOTES

Switches.—S1, S2 are the waveband switches in a rotary unit beneath the chassis, under the metal plate carrying the group of trimmers. The diagram below shows the positions of the switches in the unit as seen from the rear of the underside of the chassis. Both switches are closed on MW and open on LW.

S3-S8 are in the relay-operated leaf switch unit beneath the chassis. This is also indicated in our under-chassis view, and a diagram of the end of the unit, showing the tags of the various

switches, viewed from the right hand end of the chassis, is given below.

The action of these switches is fully explained under "Power Supply," and it should be noted that switches with the suffix B are closed for battery operation and open for mains operation, while those with the suffix M are closed for mains operation and open for battery operation.

S9 and S10 are the battery and mains

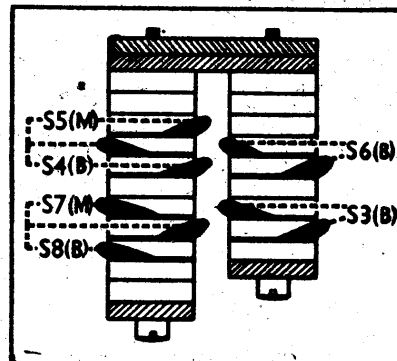


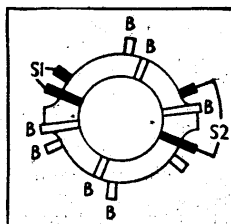
Diagram showing the tags of the S3-S8 switch unit, viewed from the right hand end of the chassis.

switches respectively, both ganged with R7, and closed when the set is switched on. The tags of these switches are indicated in our under-chassis view.

Coils.—L1-L4 are the frame aerial coupling and tuning coils, mounted on the back of the receiver. They are connected to the receiver by a small 4-pin plug and socket device. A diagram of the plug, viewed from the free ends of the pins, is given on the right of the circuit diagram. The pins are numbered to agree with the numbers in the circuit diagram itself, where the leads are also colour-coded.

L5-L7 are in an unscreened unit beneath the chassis, close to the S1, S2 switch unit. The IF transformers L8, L9 and L11, L12 are in two screened units on the chassis deck, with their associated trimmers. L10 is beneath the

Diagram of the S1, S2 switch unit, as seen from the rear of the underside of the chassis.



chassis. L14 is the smoothing choke, mounted on the chassis deck.

Indicator Lamp.—This is an Ever Ready type, rated at 6.3V, 0.15A, and fitted with a miniature bayonet cap. The bulb is sprayed red.

External Speaker.—No provision is made for this, but a low resistance (about 30) type could be connected across the speech coil of the internal speaker.

Battery.—The battery used in an Ever Ready All-Dry No. 3, giving 1.5V LT and 90V HT. It is fitted with a 4-pin socket, and is connected to the receiver by a 4-pin plug at the end of a lead. A diagram of the plug, looking from the free ends of the pins, is given at the right of the circuit diagram. It is coded to agree with the connections in the circuit diagram.

Rectifier Valve.—Receiver with serial numbers from 12,001 to 13,501 use a 25Z6G rectifier for V5 (as in our case); with serial numbers of 13,502 upwards V5 is a 1D5. This has a 5-pin base, instead of the octal used on the 25Z6G.

When the 1D5 is used, slight circuit modifications are made. In the first place, the line cord resistor R12 becomes 910 Ω , and is not tapped. L14 and the top of C15 then go direct to the mains.

In addition, there is an extra resistance of 800 Ω between L14 and the top

of C14. This is not achieved by a separate resistor, but the vitreous enamelled resistor R11 becomes 1,500 Ω , tapped at 700 Ω from the relay end, the remaining 800 Ω forming the additional resistance mentioned. S7(M) and the top of C14 then go to the tapping on the modified R11. Also, C15 becomes a 20 μ F 250V working type, instead of 40 μ F, 150V.

Resistor R12.—Where the line cord R12 is tapped (25Z6G valve), the tapping is the red lead emerging from the chassis end of the cord.

Chassis Divergencies.—Apart from those mentioned above, the following divergencies were found: C4 was 0.1 μ F, not 0.05 μ F as given by the makers; R9, R16 were 2,000 Ω , not 2,200 Ω ; and C16 is shown by the makers as being on the opposite side of S10.

Valve Connections.—The valves use American octal bases, and their connections are standard ones for their types. Pin 1 is blank in all cases, and pins 2 and 7 are the filament connections.

The only unusual valve is V3, a single diode triode. Its connections are: 1, blank; 2, filament; 3, anode; 4, blank; 5, diode; 6, blank; 7, filament; 8, blank; top cap, grid.

CIRCUIT ALIGNMENT

IF Stages.—Connect signal generator via a 0.1 μ F condenser to grid (top cap)

of V1, and via a similar condenser to chassis. Feed in a 451 KC/S signal, and adjust C25, C26, C27 and C28 in turn for maximum output. Repeat these adjustments.

RF and Oscillator Stages.—With gang at maximum, pointer should be horizontal. Connect signal generator via a suitable dummy aerial to the A socket, and via a 0.1 μ F condenser, to chassis. Alternatively, couple the output of the generator to the frame aerials by a turn or two of wire wound round the outside of the cabinet. The trimmers can be reached through a removable panel at the base of the cabinet, but only after the battery has been removed. The receiver is then aligned when operating from the mains.

MW.—Switch set to MW, tune to 200m on scale, feed in a 200m (1,500 KC/S) signal, and adjust C21, then C18, for maximum output. Feed in a 500m (600KC/S) signal, tune it in, and adjust C24 for maximum output, while rocking the gang for optimum results.

LW.—Switch set to LW, tune to 1,200m on scale, feed in a 1,200m (950 KC/S) signal, and adjust C22, then C17, for maximum output. Feed in a 1,900m (158 KC/S) signal, tune it in, and adjust C23 for maximum output, while rocking the gang for optimum results.