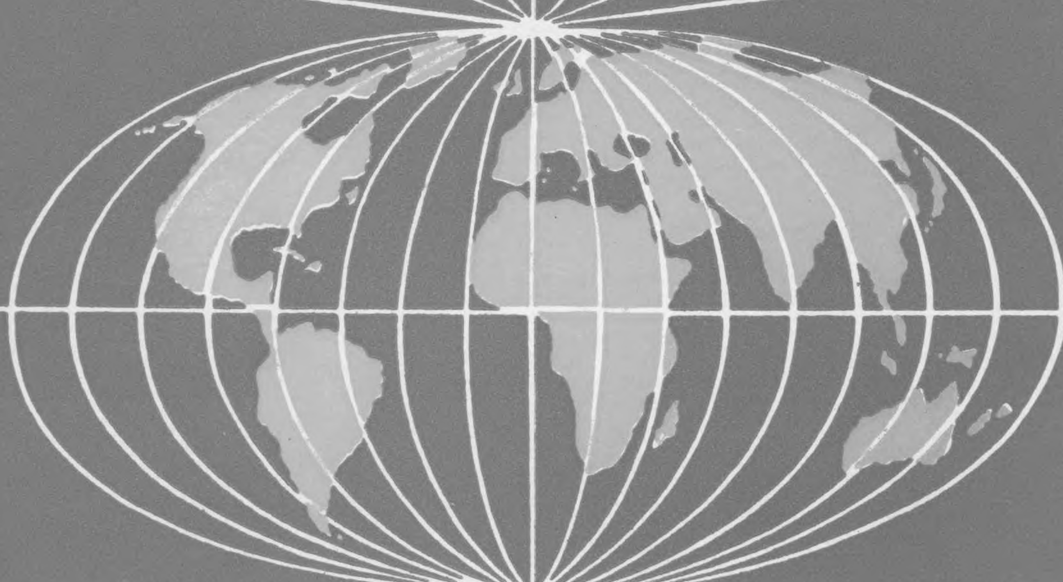
ALL DRY BATTERY PORTABLE CONSTRUCTION



- SIMPLE & CHEAP TO BUILD
- POINT TO POINT WIRING
- DUAL FERRITE AERIAL FOR HIGH SENSITIVITY

12½

135

2/6

ALL DRY BATTERY
PORTABLE
CONSTRUCTION

"Marchwood",
Bounder Treath,
Coverack, Helston,
Cornwall TR12 6TQ

BERNARDS (Publishers) LTD.
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General Editor

WALTER J. MAY

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ALL - DRY BATTERY PORTABLE CONSTRUCTION

Midget components are now readily available to the Home Constructor, and for this reason there exists a growing desire to build all-dry battery receivers.

Until very recently, the term " Portable " dictated the use of a frame aerial; a contrivance which is both awkward to construct, and appallingly inefficient even when carefully made. This situation has now altered, since a new material termed " Ferrite " has been developed on the continent, with properties which promise to revolutionise the size of future portable receivers.

FERRITE ROD.

Unfortunately, very little is known about Ferrite in this country, and to the author's knowledge only two firms are distributing it at the present time.

Perhaps a few words about it would not be out of place. As the name implies, Ferrite possesses magnetic properties and is made from iron, but there the similarity ends. Ferrite is intensely hard and very brittle, dark grey in colour and exhibits a metallic sheen when broken.

Iron exists in three forms, alpha, gamma, and delta. Alpha iron has polymorphic properties, and is used as the main ingredient in the manufacture of Ferrite rod for the radio industry. The powdered materials are subjected to a sintering process, the mixture being extruded whilst in a plastic state to form the rods, in a similar manner to toothpaste being squeezed from a tube.

For many years it has been known that the received signal current in a frame aerial is proportional to the loop area in square wavelengths, and to the number of turns. Thus for maximum efficiency, a frame aerial has to be very large, which is in direct opposition to the modern trend of miniaturisation. It was later discovered that a dust core placed in the loop, increased the field concentration, giving a result equivalent to a greater loop area, and this phenomenon has been utilized in aircraft to reduce the size of the loop required for a given sensitivity.

Ferrite rod takes this process one stage further. The " frame aerial " shrinks to the proportions of an elongated coil wound around the rod, the device depending entirely upon the Ferrite to produce the field concentration; which it does with remarkable efficiency.

Is it possible to increase the received signal currents still further ? In the case of a frame aerial this can be accomplished by increasing the number of turns, or the size of the frame; the equivalent procedure with Ferrite is to increase the number of turns or the amount of core material used.

In the design given, two Ferrite rods are used, and the windings are " parallelled "; an arrangement which permits twice the number of turns, whilst still retaining an inductance value in the neighbourhood of 200 Microhenrys.

CIRCUIT DESCRIPTION

At this stage it is customary to remark that the circuit is a " Conventional Superhet," and that the circuit is " quite straightforward." Can we pass over such well-worn phrases and consider the ways in which this design differs from others which are apparently similar.

Good performance has governed the choice of components throughout the entire circuit.

Two Ferrite rods pick up a signal which is almost comparable to a good outdoor aerial, thus the circuit has an initial advantage over the conventional portable with its frame aerial of inadequate dimensions. Frequency Changing is accomplished by using a DK96 valve, which possesses high conversion efficiency; and the oscillator circuit is designed around the well-known Weymouth HO3 coil.

Both I.F. Transformers are of the latest design, and have the astounding " Q-factor " of 140. Most midget I.F. transformers have a " Q " of about 100, thus the I.F. performance is well above average.

A bass-lift network is incorporated in the anode load of the DAF96, and the reproduction is refreshingly rich without losing any of the crisp qualities which are necessary for the reproduction of speech and stringed instruments.

No specific make of output transformer has been quoted, and in this matter the constructor can use his own discretion. Ample space has been left on the chassis for mounting this component, which should have a primary impedance of 10,000Ω, the secondary being selected to match the loudspeaker.

The case shown is one which happens to be readily available, at a very modest price. It will be noticed, however, that the complete receiver with batteries occupies only about half of the available space. Thus if the constructor intends to make his own cabinet, the finished receiver can be made very much smaller without altering the chassis layout at all.

CONSTRUCTION

Fig. 1 shows how the chassis should be marked out and drilled. Aluminium is probably the easiest material to work with (20-gauge being sufficiently rigid). The valve holes can be made with a chassis punch or cutter without difficulty, whilst the slots for the I.F. transformers should be cut with a tension file fitted in a hack-saw frame.

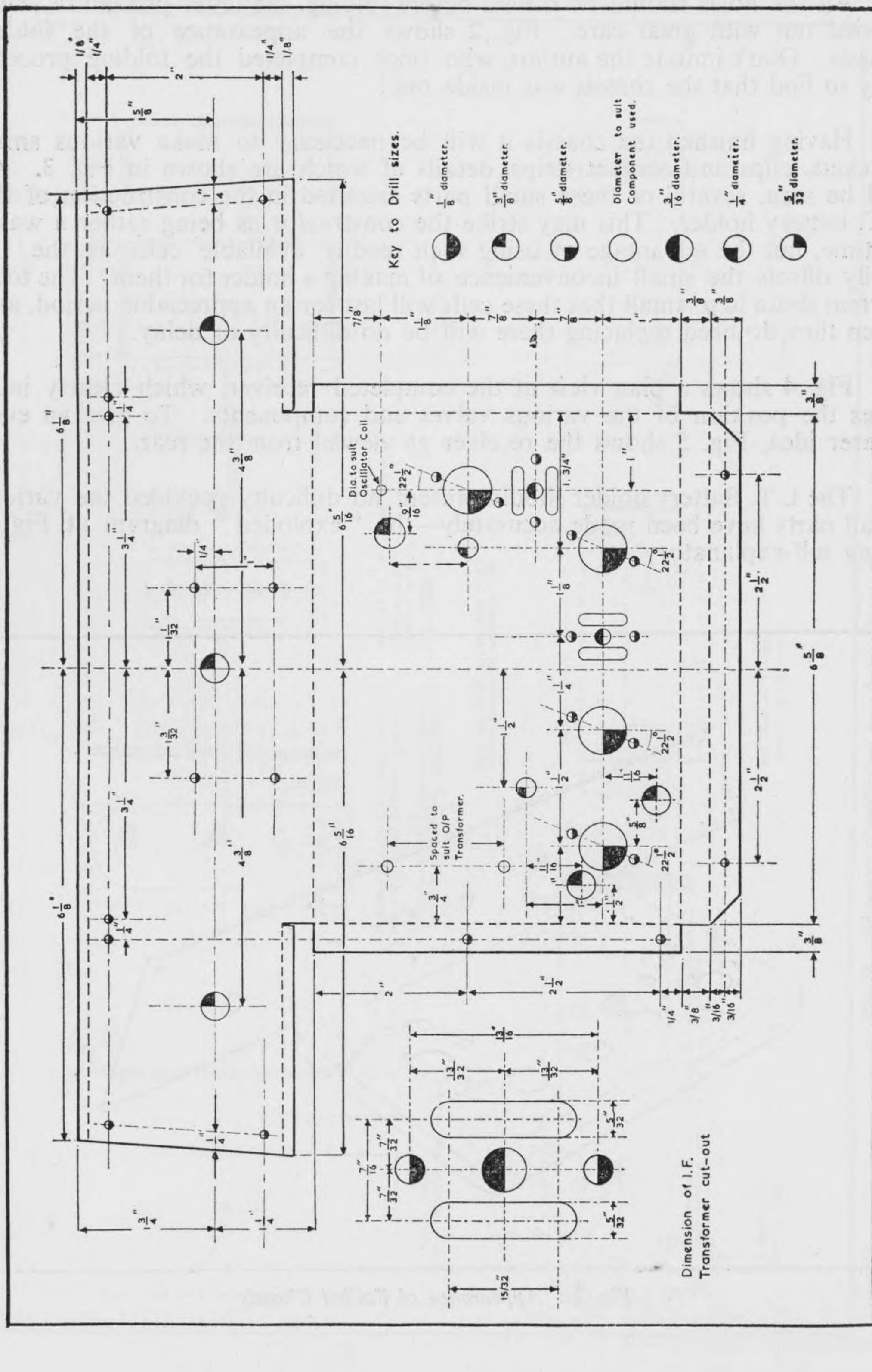

Fig. 1. Diagram for marking and drilling chassis

All the holes should be drilled before folding, the latter procedure being carried out with great care. Fig. 2 shows the appearance of the folded chassis. Don't imitate the author, who once completed the folding process, only to find that the chassis was inside out!

Having finished the chassis it will be necessary to make various small brackets, clips and contact strips, details of which are shown in Fig. 3. As will be seen, several of these small parts are used in the construction of the L.T. battery holder. This may strike the constructor as being rather a waste of time, but the advantage of using such readily available cells as the U2 easily offsets the small inconvenience of making a holder for them. The total current drain is so small that these cells will last for an appreciable period, and when they do need replacing there will be no difficulty or delay.

Fig. 4 shows a plan view of the completed receiver, which clearly indicates the position of the various valves and components. To give an even clearer idea, Fig. 5 shows the receiver as viewed from the rear.

The L.T. Battery holder should present no difficulty provided the various small parts have been made accurately—the "exploded" diagram at Fig. 6 being self-explanatory.

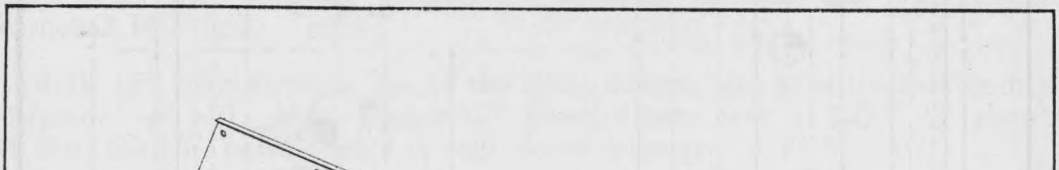

Fig. 2. Appearance of Folded Chassis

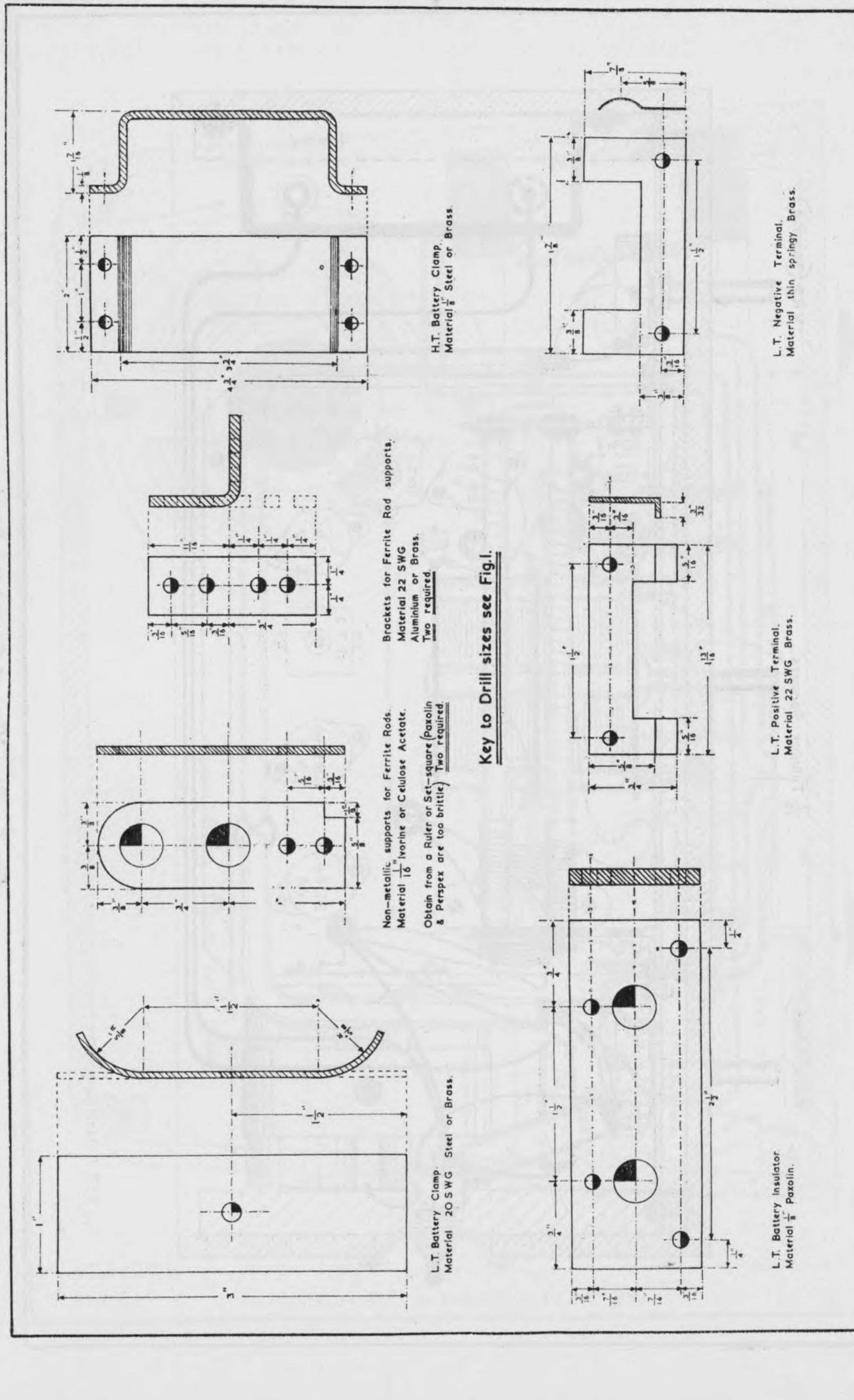

Fig. 3. Marking details for brackets, clips and contact strips.

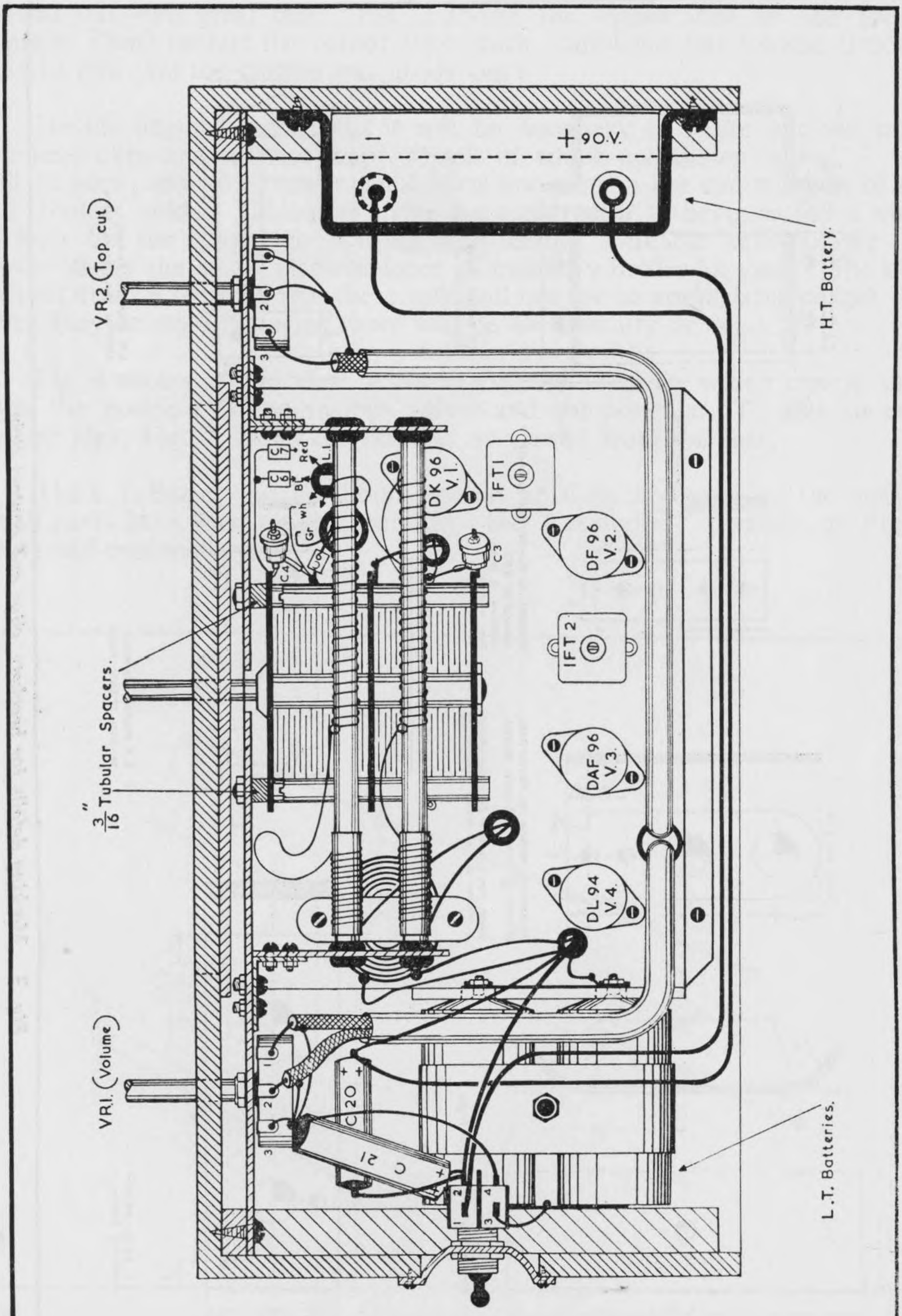

Fig. 4. Plan View of Completed Receiver

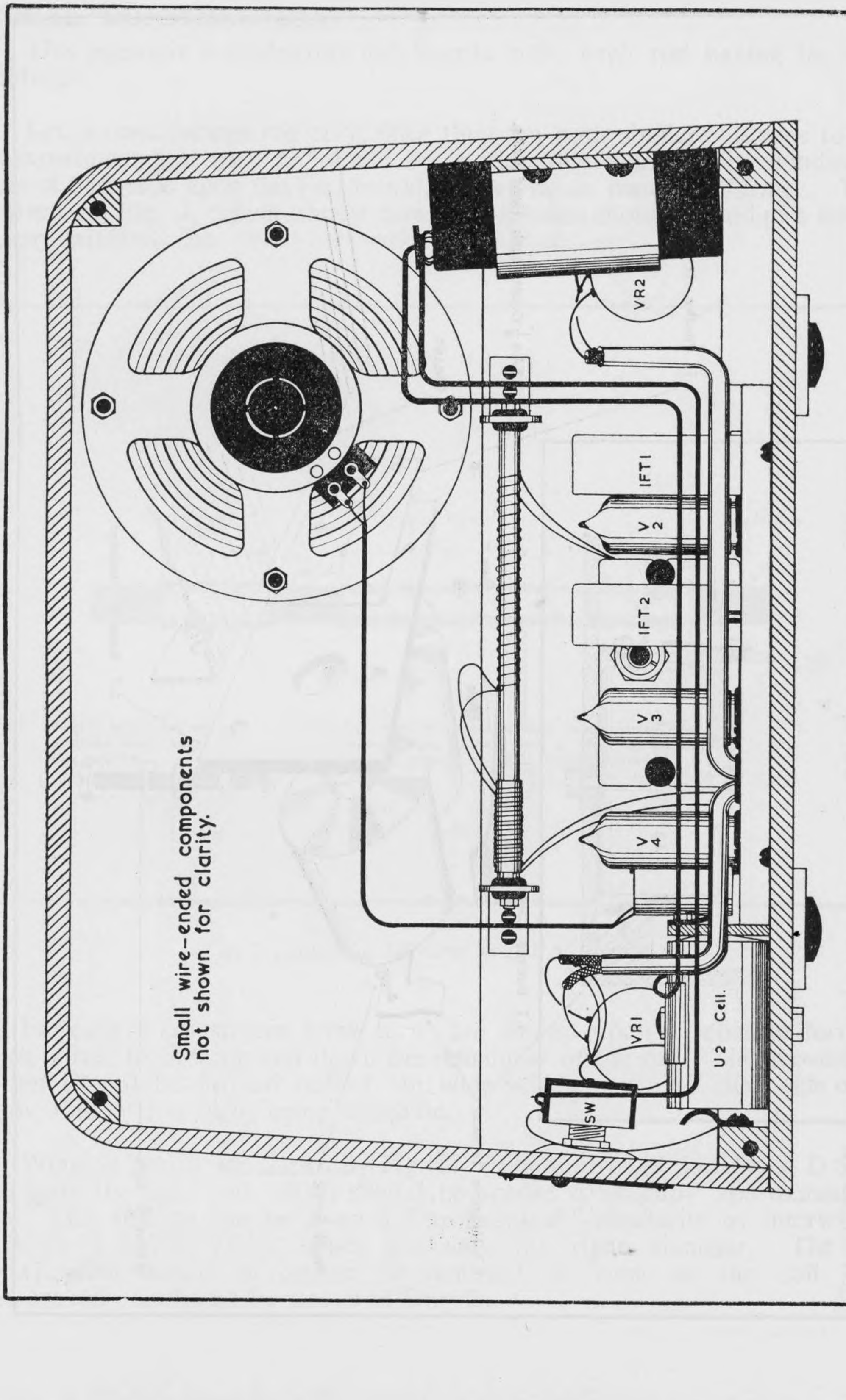

Fig. 5. Rear View of Completed Receiver

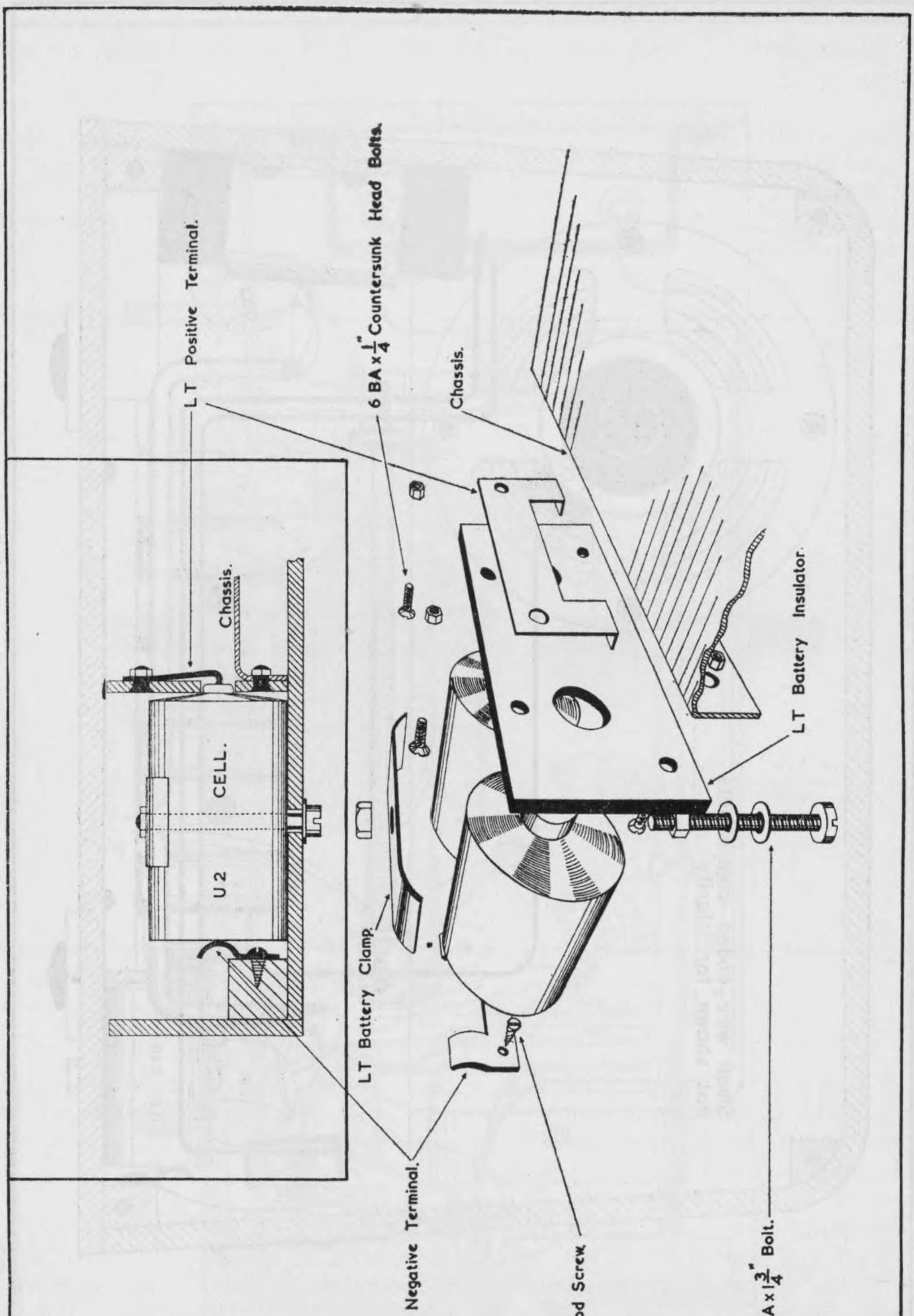

Fig. 6. "Exploded" Diagram of L.T. Battery Holder

AERIAL CONSTRUCTION

This assembly is made from two Ferrite rods, each rod having its own windings.

Let us consider one rod only, since they are both similar. It was found by experiment that the " Q " could be considerably increased by winding a layer of Sellotape upon the Ferrite rod, to act as an insulated former. This is given in Fig. 7, which shows how the Sellotape should extend to a length of approximately 3in.

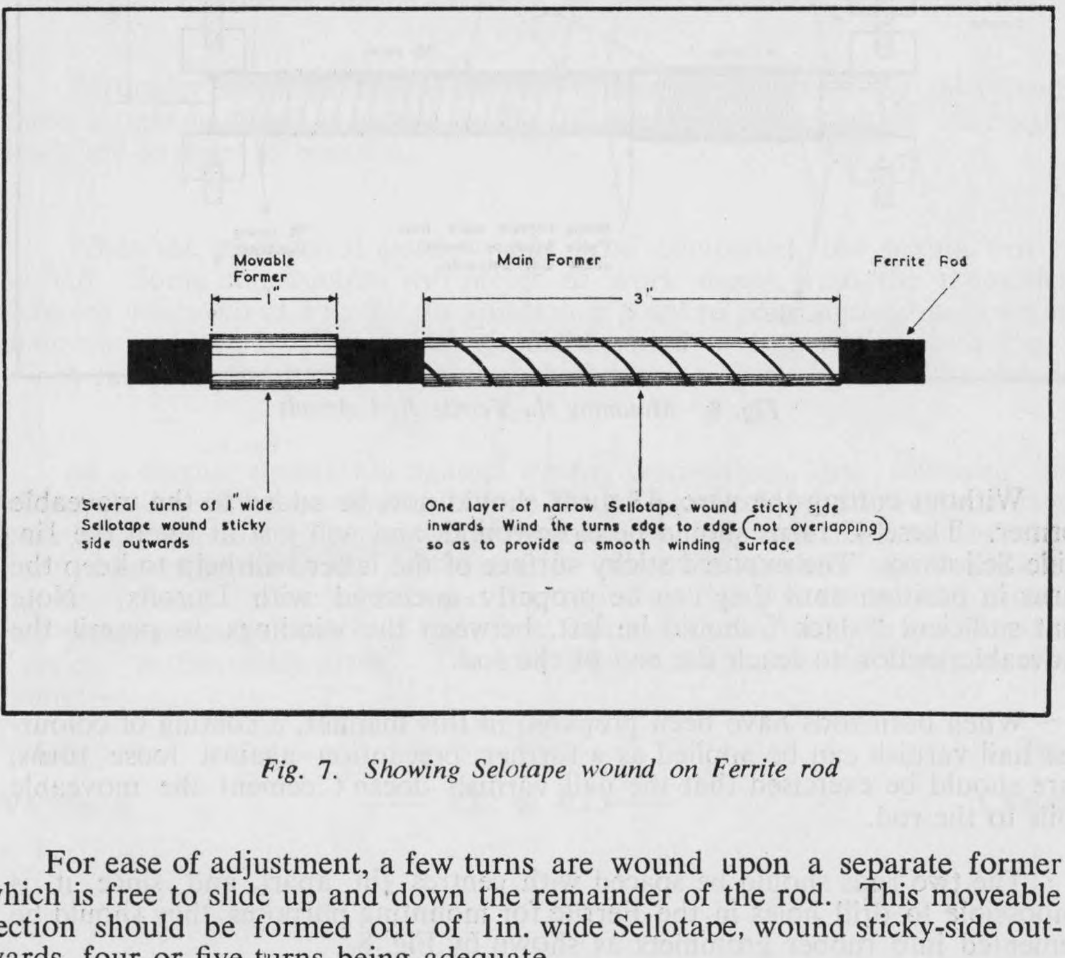

Fig. 7. Showing Selotape wound on Ferrite rod

For ease of adjustment, a few turns are wound upon a separate former which is free to slide up and down the remainder of the rod. This moveable section should be formed out of 1in. wide Sellotape, wound sticky-side outwards, four or five turns being adequate.

Winding details are shown by Fig. 8. Ninety turns of 26 S.W.G. D.S.C. wire form the fixed coil, which should be spaced to occupy approximately 2¾in. This spacing can be given a " professional " regularity by interwinding with 36 S.W.G. D.S.C. which is exactly the right diameter. The 36 S.W.G. wire should, of course, be removed as soon as the coil has been securely anchored by means of Durofix.

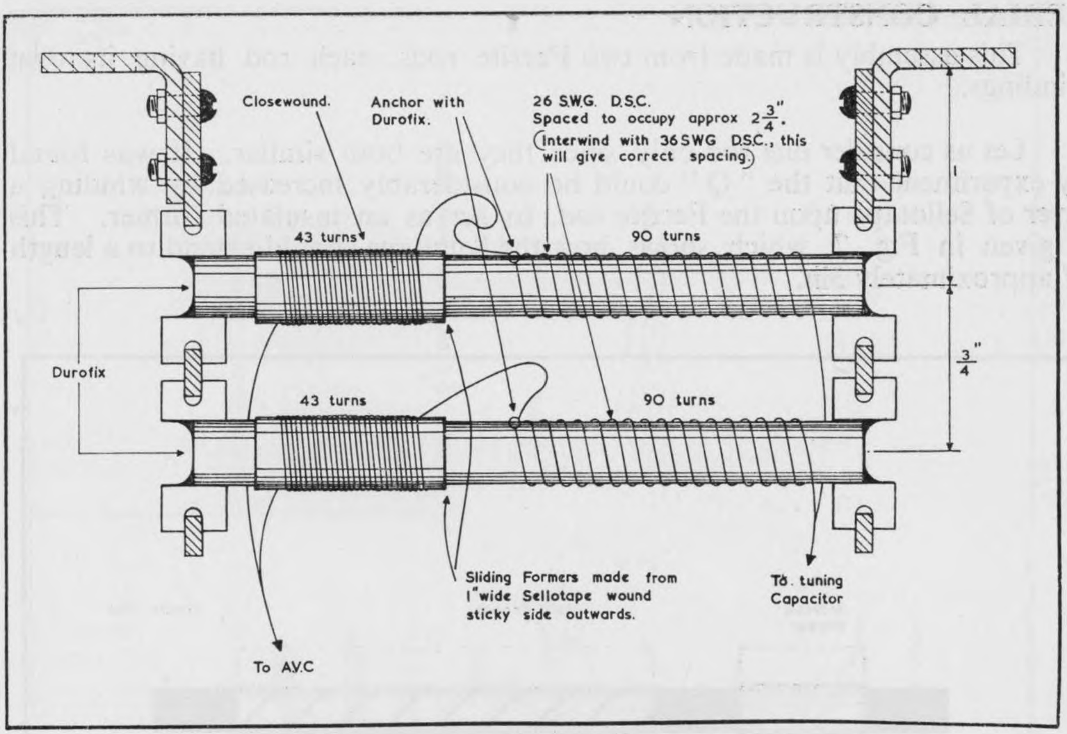

Fig. 8. *Mounting the Ferrite Rod Aerials*

Without cutting the wire, 43 turns should now be added to the moveable former. These 43 turns should be closewound, and will just fit upon the 1in. wide Sellotape. The exposed sticky surface of the latter will help to keep the turns in position until they can be properly anchored with Durofix. Note that sufficient " slack " should be left, between the windings, to permit the moveable section to reach the end of the rod.

When both rods have been prepared in this manner, a coating of colourless nail varnish can be applied as a further precaution against loose turns; care should be exercised that the nail varnish doesn't cement the moveable coils to the rod.

The two rods should be spaced with centres $\frac{3}{4}$in. apart, and since it is impossible to drill holes in the Ferrite for mounting purposes, they should be cemented into rubber grommets as shown by Fig. 8.

These grommets cannot be mounted direct in a metal bracket, because even when non-ferrous materials are used, the bracket behaves like a shorted turn which appreciably lowers the efficiency. The brackets are therefore made from a non-metallic substance, the dimensions being shown in Fig. 3. Thin Paxolin or Perspex could be used, but both substances were found to be too brittle for easy working, and Cellulose Acetate sheet or Ivorine were found to be better.

A source from which either of the latter materials can be obtained, is an old geometrical " set square " or a plastic ruler. Small metal angle brackets should be fashioned for mounting the Ivorine as shown by Fig. 3.

When mounting the tuning capacitor, it should be noted that it is supported by four bolts passing through the front apron of the chassis. Four Tubular spacers will be required as shown in Fig. 4, which should have a thickness of 3/16in. Two of the bolts have to pass through holes which are already occupied by rivets, which secure the manufacturers' mounting feet. These rivets should be drilled out, and the front mounting feet discarded.

Particular attention should be paid to the orientation of the valve bases; these should be fitted as shown in Fig. 10, which ensures that all connecting leads are as short as possible.

When the mechanical assembly has been completed, the wiring can be started. Some constructors will prefer to work direct from the theoretical diagram as shown at Fig. 9. In addition, a point to point underchassis wiring diagram is shown by Fig. 10, this should be used in conjunction with Fig. 4 which indicates the few connections which have to be made above the chassis.

As a further precaution against wrong connections, the following list shows all the wiring in tabular form. The left hand column shows the starting point, which should be connected to the pin, or tag, indicated on the right hand side. Figures in the centre are the reference numbers of components, the latter being connected between the tags mentioned on either side. Should two components be shown in the centre column, they should be connected in " series " in the order given. The folllowing example clearly illustrates this point:—

Join	**Via.**	**To**
V4 Pin 6	**—— R12 & R13——**	**Chassis**

☆

WIRING INSTRUCTIONS

Join	Via.	To
LT Battery Positive		V4 Pins 1 and 7
V4 Pin 5 and centre screen		Chassis
V3 Pin 7		V4 Pin 7
V3 Pin 1 and centre screen		Chassis
V3 Pin 7		V2 Pin 7
V2 Pins 5, 1 and centre screen		Chassis
V2 Pin 7		V1 Pin 7
V1 Pin 1 and centre screen		Chassis
C1/C2 Earth connection		Chassis
Live end of Ferrite windings (Two wires)		C1 (Rear section of Tuning capacitor)
C1		V1 Pin 6
C1—C3 (Mount on the tuning capacitor above chassis)		Chassis
" Earthy " end of Ferrite windings (Two wires)	—— C5 ——	Chassis
(Two wires)		IFT 1 Tag D
V1 Pin 2		IFT 1 Tag A
V1 Pin 5	—— C8 ——	Chassis
V1 Pin 5	—— R3 ——	IFT 1 Tag B
IFT/1 Tag B	—— R2 ——	L1 Blue
V1 Pin 3		L1 Green
V1 Pin 4	—— R1 ——	V1 Pin 7
V1 Pin 4	—— C9 ——	C2
L1 Red	—— C7 ——	Tuning Capacitor Earth
L1 Blue	—— C6 ——	Tuning Capacitor Earth
L1 White		C2
C2	—— C4 (Mount on tuning capacitor above chassis)	Tuning Capacitor Earth
IFT/2 Tag B	—— R5 & R9 ——	V3 Pin 4
V3 Pin 4	—— C15 ——	Chassis
IFT/1 Tag B		Junction of R5 and R9
Junction of R5 and R9	—— C10 ——	Chassis
Junction of R5 and R9		V4 Pin 3
V4 Pin 3		C20 Positive
SW Tag 2		C20 Negative
V4 Pin 6	—— R12 & R13 ——	Chassis
Junction of R12 and R13		SW Tag 2
SW Tag 2		C21 Positive
C21 Negative		Chassis
SW Tag 4		Chassis
SW Tag 3		LT Negative
C20 Positive	—— Flexible Lead ——	HT Positive
SW Tag 1	—— Flexible Lead ——	HT Negative
IFT/1 Tag C		V2 Pin 6
V2 Pin 3	—— C 12 ——	Chassis

V2 Pin 2		IFT/2 Tag A
V2 Pin 3	—— R4 ——	IFT/2 Tag B
V2 Pin 3	—— C11 ——	IFT/2 Tag B
IFT/2 Tag C		V3 Pin 3
IFT/2 Tag D	—— C13 ——	Chassis
IFT/2 Tag D	—— R6 ——	V3 Pin 2 (blank pin)
IFT/2 Tag D	—— R7 ——	"Live" side of C5
V3 Pin 2	—— Screened Lead ——	VR1 Tag 1
VR1 Tag 3		VR1 case (Earth)
VR1 Tag 2	—— Screened Lead, C14 ——	V3 Pin 6
V3 Pin 6	—— R8 ——	Chassis

Earth both screened leads to the case of VR1; and at V3, having first slipped some large diameter Sistoflex over them to prevent accidental short-circuits to C20 or the LT batteries.

V3 Pin 5	—— C18 ——	V4 Pin 6
Junction of R5 and R9	—— R10 & R11 ——	V3 Pin 5
Junction of R10 and R11	—— C16 ——	V3 Pin 5
V3 Pin 5	—— C17 and screened lead ——	VR2 Tag 3

Earth the braiding to the case of VR2 and at V3 Sistoflex sleeving is again desirable but this time not essential.

VR2 Tags 1 and 2		Earth to case and braiding
V4 Pin 2	—— R14 and C19 ——	V4 Pin 3

Connect the output transformer primary leads to V4 Pins 2 and 3; the secondary winding should be taken to the loudspeaker speech-coil via flexible leads.

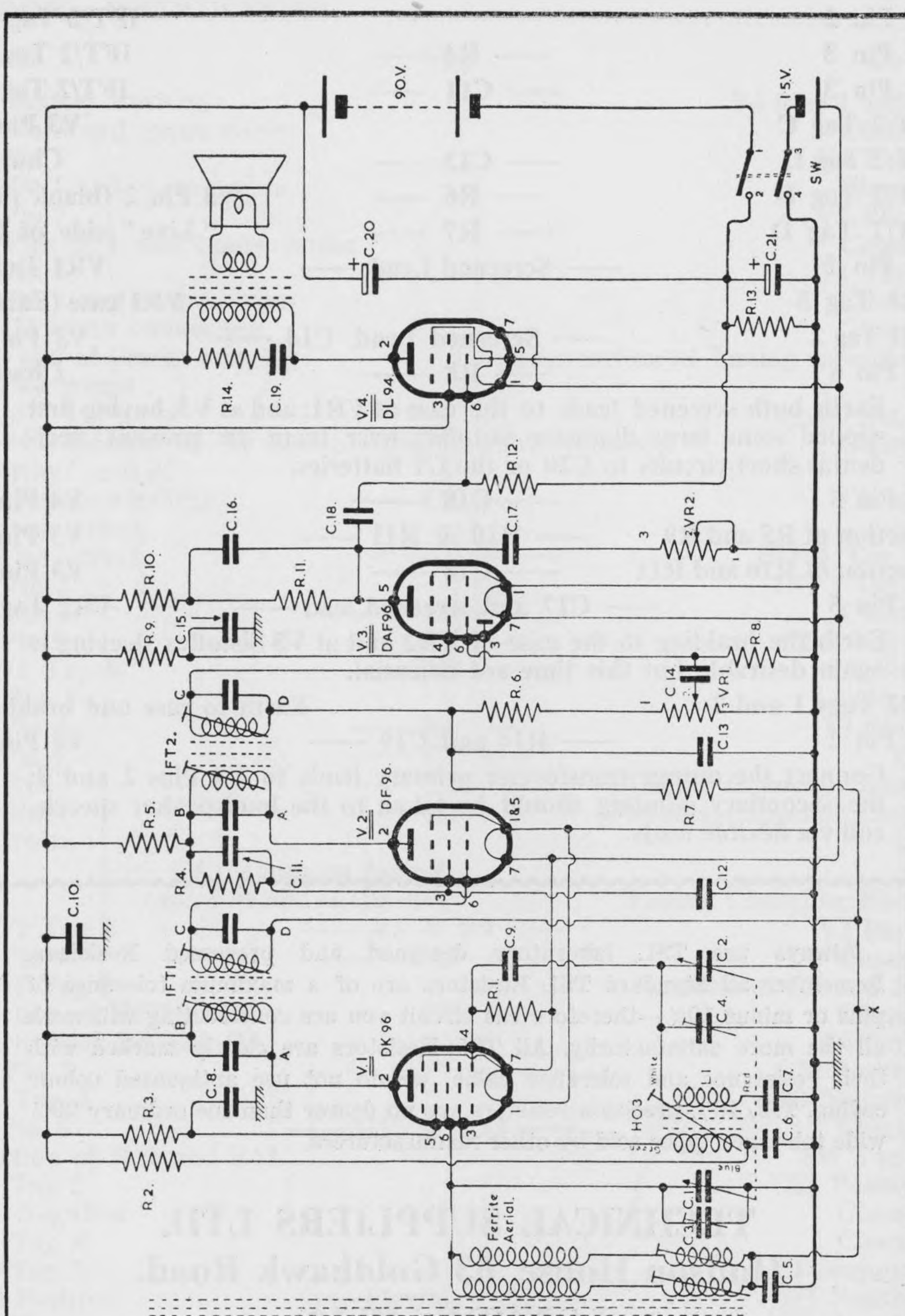

Fig. 9. Theoretical Circuit Diagram of " All Dry Portable " Receiver

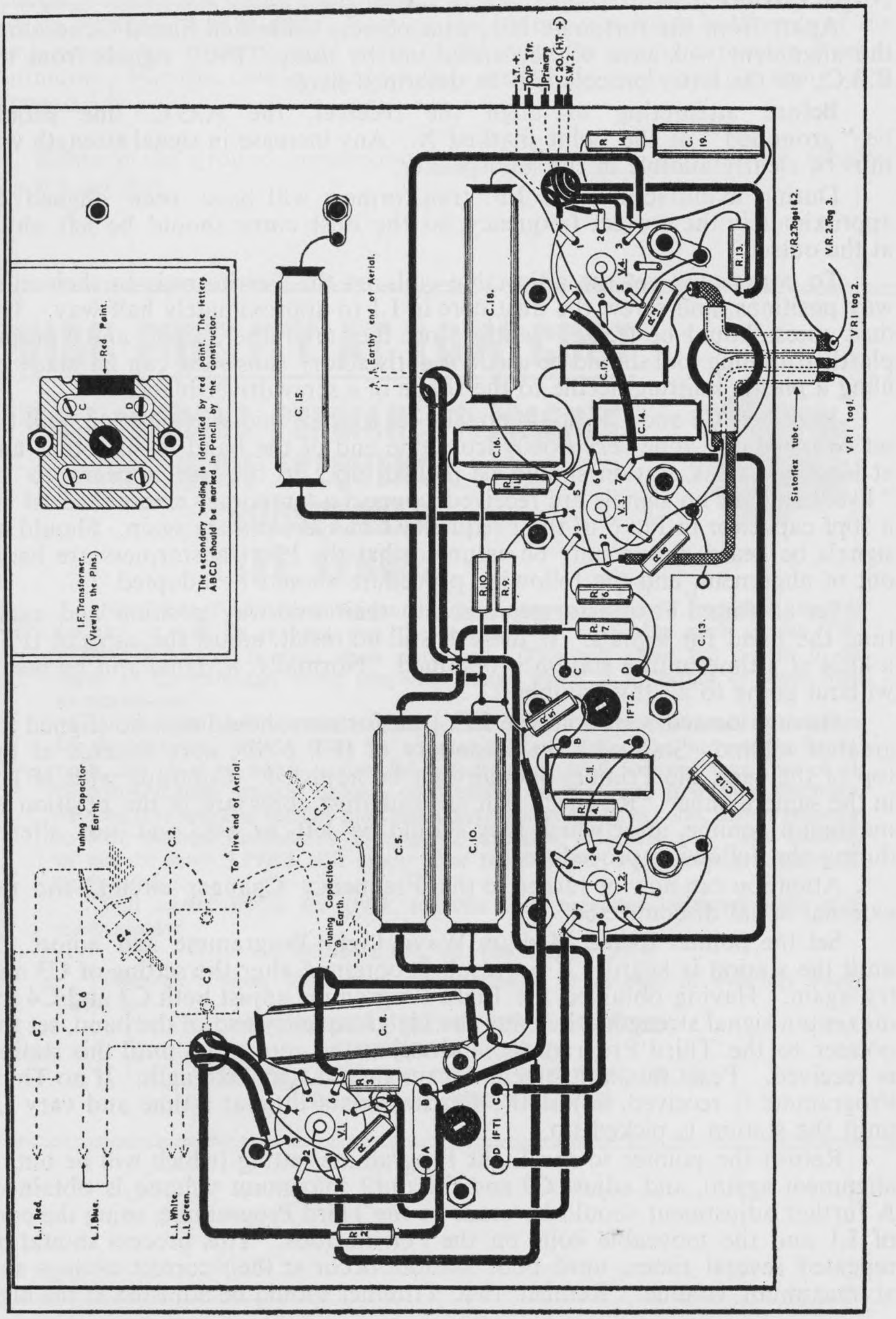

Fig. 10. Point to Point Under Chassis Wiring Diagram of " All Dry Portable " Receiver (Used in conjunction with Fig. 4).

ALIGNMENT

Apart from the fortunate few, who possess calibrated Signal Generators, the alignment will have to be carried out by using " live " signals from the B.B.C., so the latter process will be described here.

Before attempting to align the receiver, the A.G.C. line should be " grounded " at the point marked X. Any increase in signal strength will thus be clearly audible in the loudspeaker.

During manufacture, the I.F. transformers will have been aligned to approximately the correct frequency, so the dust cores should be left alone at the outset.

To commence, set the adjustable coils on the Ferrite rods to their mid-way positions, and screw the dust core in L1 to approximately half-way. The dust cores should be treated gently, since they are rather fragile, and a proper plastic trimming tool should be used. A satisfactory substitute can be made by filing a plastic knitting-needle to the shape of a screwdriver blade.

Trimmers C3 and C4 should now be set to their mid-way position, and the set switched on—tune very slowly from one end of the band to the other and at least one weak station should be picked up If the set appears to be " live " and yet no signals are received, connect a temporary external aerial via a 50pf capacitor to Pin 6 of the Frequency Changer, and try again. Should no signals be heard, it can only be assumed that the I.F. transformers are badly out of alignment, and the following procedure should be adopted.

Set all four I.F. transformer cores to their mid-way position and again tune the band for signals. If there is still no result, adjust the cores of IFT2 a little at a time until a station is obtained. Normally, a signal will be heard without going to all this trouble.

Having located a station, the I.F. transformers should now be aligned for greatest volume. Start with the Secondary of IFT 2 (the core situated at the top of the can); the Primary should then be adjusted. Continue with IFT 1 in the same manner. Re-check that all four dust cores are in the position of maximum volume, after which they should be left as set, and not altered during the following procedure.

Attention can now be turned to the Frequency Changer circuit, and the external aerial disconnected.

Set the pointer to the Medium Wave Light Programme and adjust C4 until the station is heard. If no result is obtained alter the setting of C3 and try again. Having obtained the Light Programme adjust both C3 and C4 for maximum signal strength. Leaving the high frequency end of the band, set the pointer to the Third Programme, and adjust the core of L1 until this station is received. Peak this adjustment for maximum signal strength. If no Third Programme is received, adjust the Ferrite rods a little at a time and vary L1 until the station is picked up.

Return the pointer to the Light Programme setting (which will be out of alignment again), and adjust C3 and C4 until maximum volume is obtained. A further adjustment should be made to the Third Programme, using the core of L1 and the moveable coils on the Ferriite rods. This process should be repeated several times, until both stations occur at their correct settings and at maximum volume. Rember that Trimmer should be adjusted at the high frequency end of the band, Inductances at the low frequency end. An easy way of looking at it is this: Varying the Inductance alters both ends of the band, whilst the trimmer only takes effect when the tuning capacitor is set at minimum. For this reason, the trimmers should always be the last thing to be adjusted.

Remove the ground connection from point " X " and fit the receiver into it's cabinet.

COMPONENTS LIST

RESISTORS TSL.

R1	33 k Ω	R8	10 M Ω
R2	33 k Ω	R9	3.3 M Ω
R3	120 k Ω	R10	820 k Ω
R4	39 k Ω	R11	220 k Ω
R5	2.2 k Ω	R12	2.2 M Ω
R6	100 k Ω	R13	470 Ω
R7	2.2 M Ω	R14	10 k Ω

POTENTIOMETERS. DUBILIER.

Ref.	Value	Remarks	Type
VR1	2.0 M Ω	Log. Non-switch	C
VR2	1.0 M Ω	Log. Non-switch	C

FIXED CAPACITORS. T.C.C.

Ref.	Value	Type	Ref.	Value	Type
C5	0.05μF	CP 34 H	C14	0.01μF	CP 112 H
C6	0.01μF	CP 112 H	C15	0.05μF	CP 34 H
C7	500pF	SMP 501	C16	300pF	CP 110 S
C8	0.05μF	CP 34 H	C17	1000pF	CP 110 N
C9	100pF	SMP 101	C18	0.05μF	CP 34 H
C10	0.05μF	CP 34 H	C19	1000pF	CP 110 N
C11	0.01μF	CP 112 H	C20	8μF 150vw	Electrolytic CE 85 FE
C12	2200pF	CTH 310			
C13	100pF	SMP 101	C21	100μF 6vw	Electrolytic CE 88 A

VARIABLE CAPACITORS

C1 C2	2 x 500pF	Type MG Jackson Bros. (London) Ltd.
C3	50pF	Philips Concentric Trimmer.
C4	50pF	Philips Concentric Trimmer.

VALVES

Ref.	Type.	Ref.	Type.
V1	DK96 Mullard.	V3	DAF96 Mullard.
V2	DF96 Mullard.	V4	DL94 Mullard.

SUNDRIES

Qty.	Description.	Type.	Supplied by:
1	Portable Radio Case		Vesco.
2	6in. x 5/16in. Ferrite Rods.		TSL
1	M.W. Oscillator Coil.	HO3	Weymouth Radio Manufacturing Co. Ltd.
2	Midget I.F. Transformers.	AMF 375T	TSL
1	Midget Output Transformer. (Primary Impedance 10,000Ω)		
1	4in. P.M. Loudspeaker (Elac)		Electro Acoustic Indus. Ltd.
1	D.P.S.T. Toggle Switch.	S267	A. F. Bulgin and Co. Ltd.
1	Toggle Switch Escutcheon. (Florentine Bronze)	E2/1	A. F. Bulgin and Co. Ltd.
4	B7G Miniature Valve Bases.	XM7/U	McMurdo Instruments Ltd.
1	90 volt H.T. Battery.	B 131	Ever Ready Co. (G.B.) Ltd.
2	1.5v. L.T. Cells.	U 2	Ever Ready Co. (G.B.) Ltd.
1	H.T. Positive Battery connector.	75/945	The Carr Fastener Co. Ltd.
1	H.T. Negative Battery connector.	75/946	The Carr Fastener Co. Ltd

Assorted pieces of brass and aluminium sheet; nuts, bolts. washers, soldering tags, wire, grommets, etc.

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96.	Crystal Set Construction	1/-
97.	Practical Radio for Beginners, Book 1	3/-
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