How to build a 1920's style

"Valves are dead but not forgotten" has been said of late (Sept. issue). This little gem may represent a last opportunity to bring an ancient circuit to life and at the same time gain a valuable memento of the "golden era" of the valve before it is also "forgotten".

by DAVID WHITBY

Availability

The full kit of parts for the Unidyne wireless set (not including the batteries) is available from Technicraft, 388 Katoomba Street, Katoomba, NSW 2780. Phone (047) 82 3418. Price is $79.50 plus $5 postage and packing. Spare valves and other parts are also available. Stictly limited numbers of this kit will be available.

Amid the ever increasing pace and advancement of electronics technology, there exists a growing interest in the history of radio, or "wireless" as it was then known.

The collecting and restoration of vintage receivers, components, and all manner of paraphernalia from the pioneering days has become an established hobby, with a growing number of clubs, societies, and publications being formed around the world to cater to the many enthusiasts of this relatively new area of antiquity.

The author was first bitten by the vintage radio bug whilst involved in designing up-to-the-minute and anything-but-vintage data-communications equipment in the mid 1970s.

Was it brought on by an overdose of plastic microchips, a touch of nostalgia for "the good old days", or simply a desire to find out where all "this" started? Probably all three, but it wasn't long before all sorts of strange and dusty haunts were being explored in search of crystal sets, valves, books, and innumerable other relics of the technological past.

The 1920s

The one-valve set described here came about as the result of a desire to build a set from scratch, using the circuits and techniques of the 1920s, and also as the

Wireless Set

outcome of the rescue of a fair quantity of early valves and other components from an old Melbourne warehouse before it was demolished to make way for a car park.

The wireless literature of the era shows the 1920s to have been a most active and interesting period with great technical improvements having been effected during and after the First World War and then the "coming of age" with the advent of broadcasting during the early 1920s.

There was phenomenal growth in the component and set manufacturing industry with large numbers of new firms springing up almost overnight, but with only a handful being destined to last out the decade.

The surge of public interest and intrigue at "wireless", the new wonder, has possibly not been equalled since – even by video or computers. This was truly the era of the "home brew" set, a large proportion of receivers being made at home from plans published in the numerous wireless magazines of the time. A study of the "Listener In" from 1926-27 shows that there were at least 50 separate firms (mainly in Sydney and Melbourne) supplying components, kits, and sets to a hungry radio public.

This set, whilst not intended to duplicate a particular design of the era, contains many early circuit and construction techniques and has the appearance and feel of the genuine article. It has been the UNIDYNE in keeping with the many other "DYNES" of the era (NEUTRODYNE, SOLIDYNE, INFRADYNE etc) – the name UNIDYNE was actually used on a British home constructor's set of around 1924.

As much use as possible has been made of original type materials such as a mahogany base, Bakelite panel, cotton-covered wire, spiderweb coils and early type valves.

For those who have an interest in the pioneering days, building this set will provide hands-on experience in such skills as the ancient art of spiderweb coil winding, variometer tuning, leaky grid detection, "A" and "B" batteries and swinging coil reaction control – all essential knowledge for the vintage radio buff.

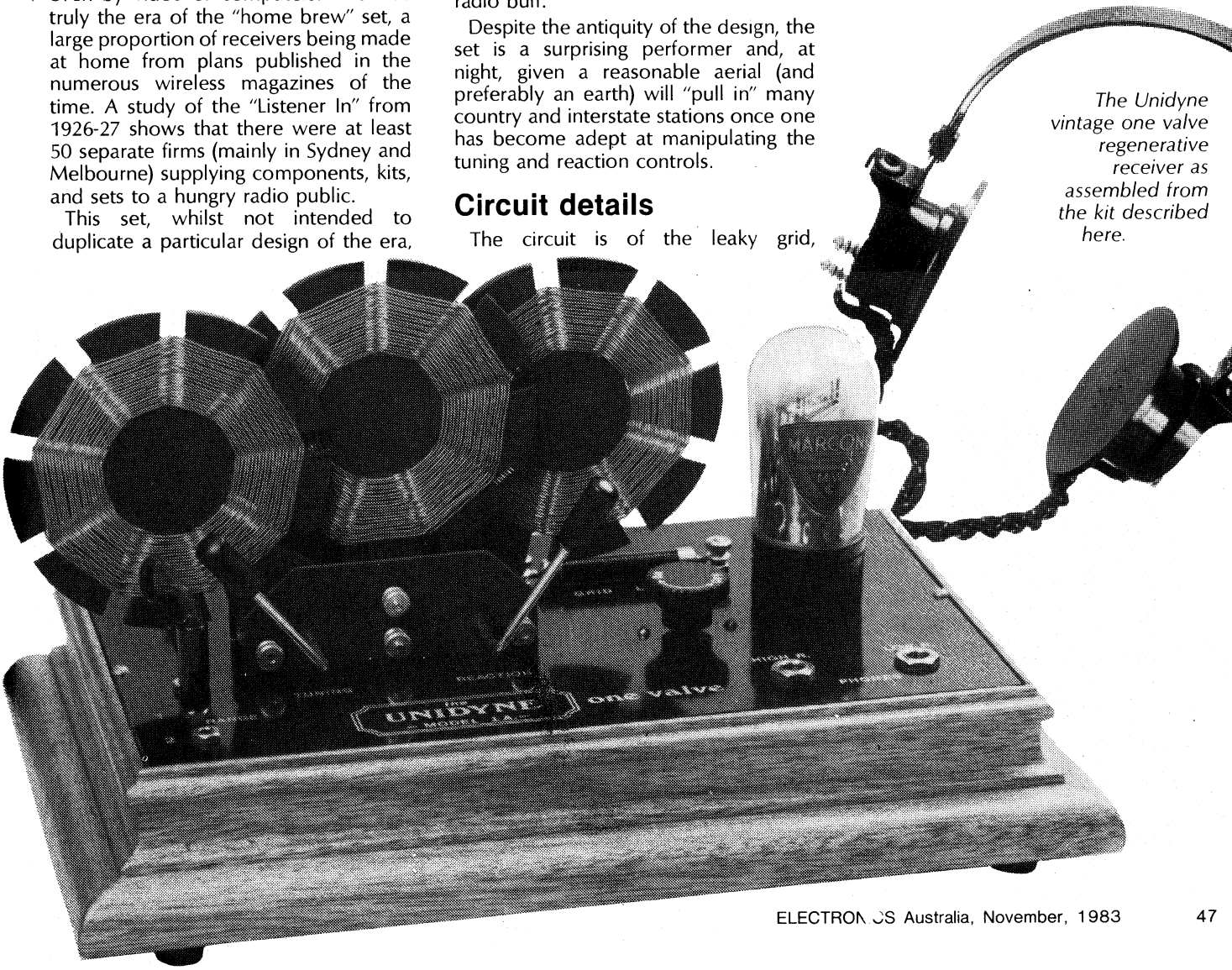
Despite the antiquity of the design, the set is a surprising performer and, at night, given a reasonable aerial (and preferably an earth) will "pull in" many country and interstate stations once one has become adept at manipulating the tuning and reaction controls.

Circuit details

The circuit is of the leaky grid, regenerative detector type, built around a single battery operated triode valve. Two valves are supplied with each kit. The one pictured is a Marconi type 210LF, which has a British 4-pin base and a 2V filament. The spare valve is a type VT50 (RAF number) which has the same base and filament but a smaller less bulbous envelope.

Filament current is supplied by two D-cells mounted in holders under the panel and the valve plate supply (B battery) is 45 volts made up of five No 216 (or P1) 9V batteries mounted in a specially made holder also under the panel. Output is into headphones, and an old type (pictured) is supplied with the kit. An output transformer is also provided so that either high impedance type (1-4kΩ) or low impedance type, such as modern stereo phones, may be used.

The regenerative one valve set was usually the next step up from the ultra simple and ever-popular crystal set and, although more expensive to build and operate, provided far greater reception range, selectivity, and volume, and all



The Unidyne vintage one valve regenerative receiver as assembled from the kit described here.

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without the gigantic aerial system necessary for the crystal set.

The circuit diagram is shown in Fig. 1. Signals picked up by the aerial are fed via C1 to the tuning circuit consisting of L1, L2 and C2, C3. Tuning is carried out by varying the inductance of the L1, L2 combination. Inductors L1 and L2 are identical flat radially wound "spiderweb coils" connected in opposition so that as their relative mechanical coupling is varied there is more (when close coupled) or less (when loosely coupled) cancellation of the equal and antiphase inductances.

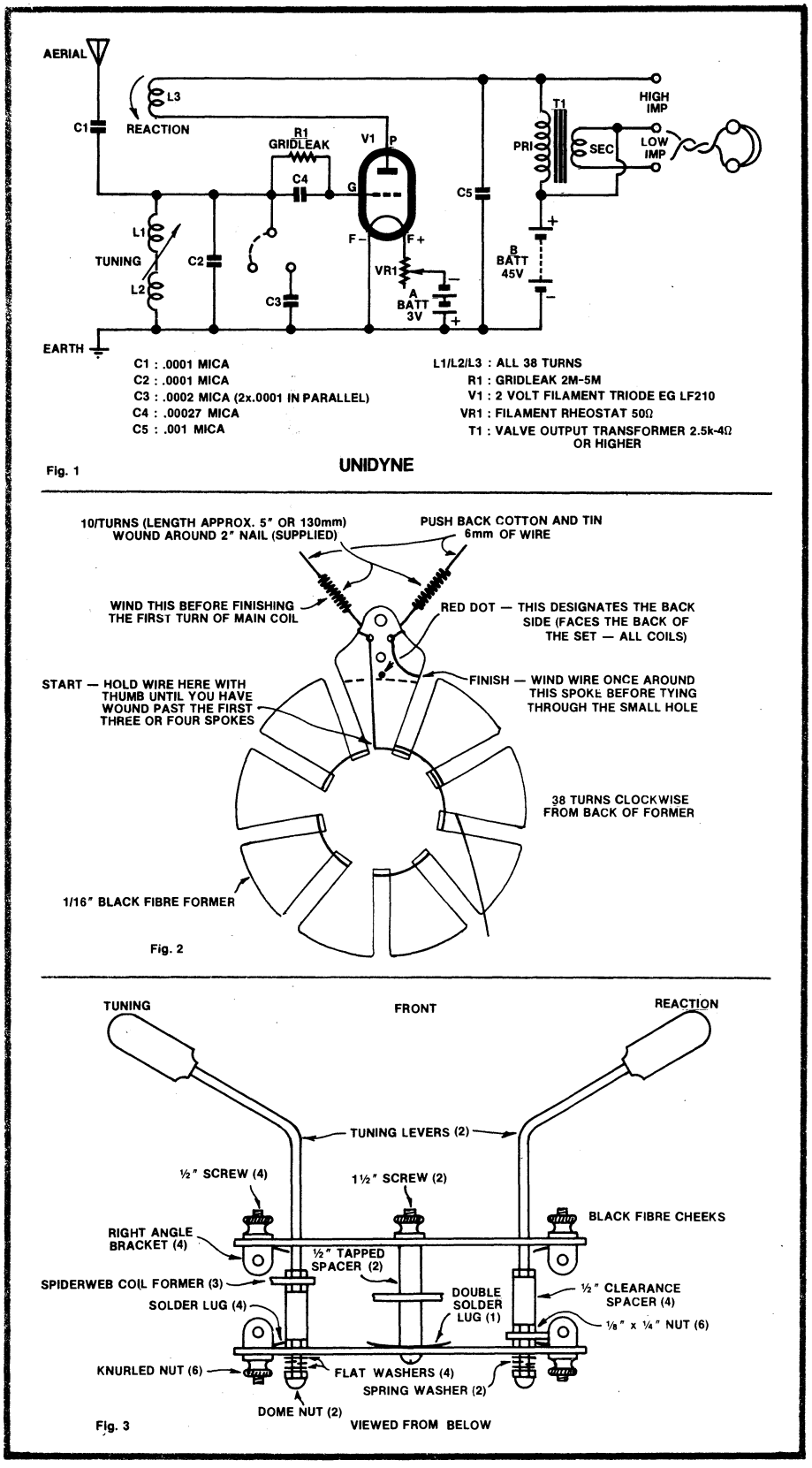

Fig. 1 Fig. 2 Fig. 3

Known as "variometer" tuning, this system was popular in various forms in the early days but soon gave way to the fixed inductance/variable capacitor system which is still used today. In order to cover the entire broadcast band two plug-selectable fixed capacitors (C2, C3) are provided.

The signal selected by the tuning circuit is detected by the grid of the valve, the detection system being known as "leaky grid" or "cumulative grid" detection.

In simple terms the grid/filament combination of the valve may be looked upon as a diode, with the triode concept of the valve ignored for the moment. On positive half cycles of the incoming signal the diode conducts, current flows through R1, a voltage is developed across R1, and C4 is charged to this voltage. The polarity of this charge is negative towards the grid and positive towards the filament.

On the following negative half cycle the diode does not conduct, but the grid is held negative by the charge on C4 which, however, commences to "leak" away through R1. If the next positive half cycle is weaker than the previous one, the voltage across C4 will continue to fall. If it is stronger the C4 voltage will rise. The time constant for R1/C4 is so chosen that it is just short enough to allow the charge on C4 to follow the highest modulation frequencies.

Thus the grid is made more or less negative, with respect to the filament, in accordance with the changes in RF signal which represent the audio modulation, ie, the grid is being varied at audio frequency. These grid variations are amplified by the valve's triode action, and appear as much stronger signals in the plate circuit.

Regeneration

At the same time, the RF signal applied to the grid is also amplified and appears as a stronger signal in the plate circuit. The secret of the high amplification of these simple sets lies in the use of regeneration or "reaction" as it was often called. This involves the coupling back of some of the amplified RF signal into the tuning circuit in such a way as to add to or assist the original signal (positive feedback). This increases the sensitivity and selectivity and makes long distance reception possible with simple circuitry.

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Regeneration is accomplished in this case by a third spiderweb coil connected in the plate circuit and arranged with variable mechanical coupling to the other coils to enable the amount of regeneration to be precisely controlled. In use the reaction coupling is increased until the set is just short of the point of oscillation, or howling, and it is at this point that the receiver is in its most sensitive and selective condition.

Capacitor C5 serves to bypass the RF component which would otherwise tend to be blocked by the impedance of the headphone circuit. In severe cases this could prevent proper functioning of the regeneration circuit.

Transformer T1 is a 2500Ω–3.5Ω standard valve audio output transformer. On/Off control is provided by the filament rheostat RV1 which disconnects the filament supply in its anticlockwise position thus also cutting off the B battery current which flows due to filament emission.

Construction

Assembly and wiring is best carried out with the panel mounted into the wooden base. Therefore the first job to be done is to prepare and finish the base. This is made from a special Philippine mahogany moulding (similar to a picture frame moulding) which in the kit is supplied mitred and glued – ready for finishing.

Start by thoroughly sanding down the base with the No 100 sandpaper provided, taking care to always sand along the grain. Finish off by sanding super smooth with the No 280 paper, observing the same precautions.

Dust down and apply one coat of satin (not gloss) clear polyurethane (Estapol or equivalent) with a good quality small brush (12-20mm), taking care to avoid runs. Allow to dry completely then sand lightly all over with the fine paper. Apply a final even coat and leave to dry in a warm, clean place.

While the base is drying, the coils can be wound. The three coils are identical, consisting of 38 turns of No 26B&S DCC (double cotton covered) wire wound on a nine spoke black fibre former as illustrated in Fig. 2. The odd number of spokes produces a coil with interleaved turns and resultant low distributed capacity and high Q (even though a 70-year-old design).

Carefully observe the starting procedure, ie, red dot towards the operator, and the interleaving as shown in Fig. 2. If a spoke is missed it will be necessary to unwind and correct the error. In order to produce a neat finish keep a firm but not too tight tension on the wire. Terminate the coil as shown – the little 10-turn coils at the start and finish are to provide flexible leads for the two coils which are mechanically movable.

The natural cotton colour of the wire is original and really looks the part but, as an alternative, if it is desired to simulate the more exotic green silk-covered wire of the era, then the coils can be dyed as follows:

Dip the finished coil into a solution of three parts methylated spirit to one part green drawing ink and then dry thoroughly – repeat if the colour is not vivid enough. The ink dyes only the cotton and is not easily visible on the black fibre former.

The assembly of the complete tuning/reaction unit is next and is shown in Fig. 3. The coils and tuning levers are supported by front and back cheeks made of the same black fibre material as the coil formers. Attach the tuning and reaction levers to two of the coils taking careful note of the difference in the arrangement of nuts and spacers between these two as shown in Fig. 3.

Tighten all nuts firmly with a spanner, ensuring that the levers are fixed close to the vertical centre line of the coils and through the outermost hole on the long spoke of the former. The red dot on the coil former should face the back of the tuning unit on all three coils.

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Attach the fixed coil to the back cheek, noting the arrangement in Fig. 3, and tighten the 1½in screws into the ½in tapped spacers at the front of this coil as shown.

Fit the threaded shafts of the tuning and reaction coils into the back cheek, tuning coil to the left and reaction coil to the right and fasten loosely (do not tighten yet) with the flat washers, spring washer and dome nut as shown.

To fit the front cheek move the levers to the vertical position, insert the ends of the lever into the appropriate holes in the cheek, and push the cheek down the levers, around the bends, and over the two central screws. Thread two knurled nuts onto these screws and the assembly will now be mechanically stable.

Attach the right-angle brackets and solder lugs, using ½in x 1/8in screws and knurled nuts as shown, and solder the coil wires to the lugs as follows.

From the front of the upright tuning unit:

1. Tuning coil – Left wire to left rear lug. Right wire to central lug.
2. Fixed coil – Left wire to left front lug. Right wire to central lug.
3. Reaction coil – Left wire to right rear lug. Right wire to right front lug.

The dome nuts on the end of the lever shafts can now be tightened just enough to allow easy, smooth movement of the coil levers. In some cases it may be necessary to add one or two flat washers under the dome nuts to produce enough friction with the nuts fully tightened. The small knobs on the end of the tuning and reaction levers are pushed on with a twisting action and the tuning unit is now ready to be fitted to the panel.

Assuming the base is completely dry the three battery holders and T1 can be screwed to the inside of it before the panel is attached. These are fitted with the brass roundhead screws provided, into the pilot holes ready drilled in the wood, taking care to note the relative polarities of the battery holders and the orientation of T1 from Fig. 4.

The two D-cell holders are standard modern components and the B battery holder (supplied complete) is fabricated from a bakelite strip with five sets of battery clips rivetted to it and a clamp to hold the batteries in position.

Next fit the bakelite panel into the base with reference to Fig. 4 and fasten it with the two screws provided. The panel is pre-loaded with the valve socket pins, with RV1, and the aerial and earth terminals.

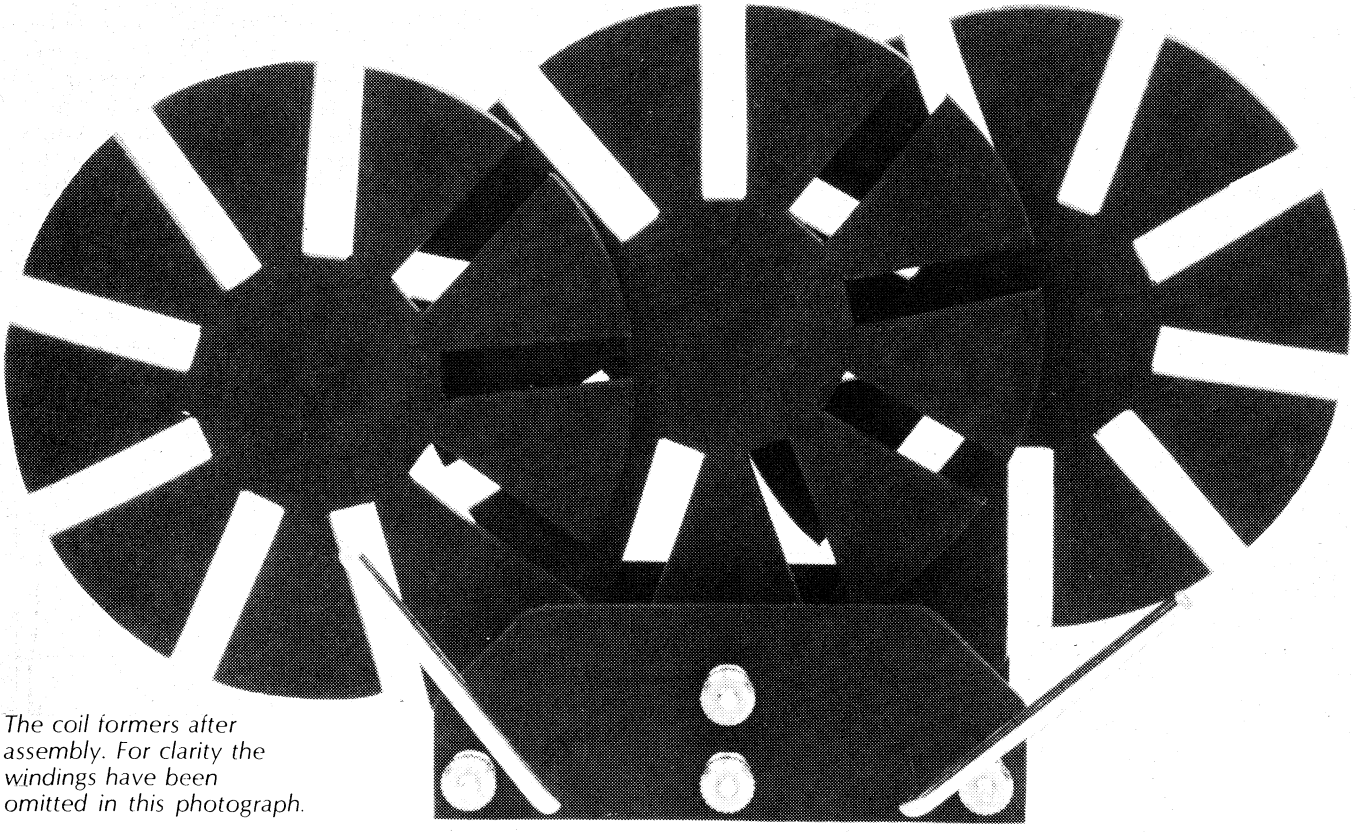
Fit the tuning reaction unit to the panel using the ⅝in long round head screws and tighten the nuts under the panel firmly using a spanner or nut driver. Fit all the solder lugs as shown in Fig. 4 using a flat washer under the nut in each case and then fit the phone jacks. The grid leak and C4 combination is mounted using ⅝in long screws with the nuts on top of the panel. The grid leak is held between these nuts and two knurled nuts, as seen in the photograph.

Wiring

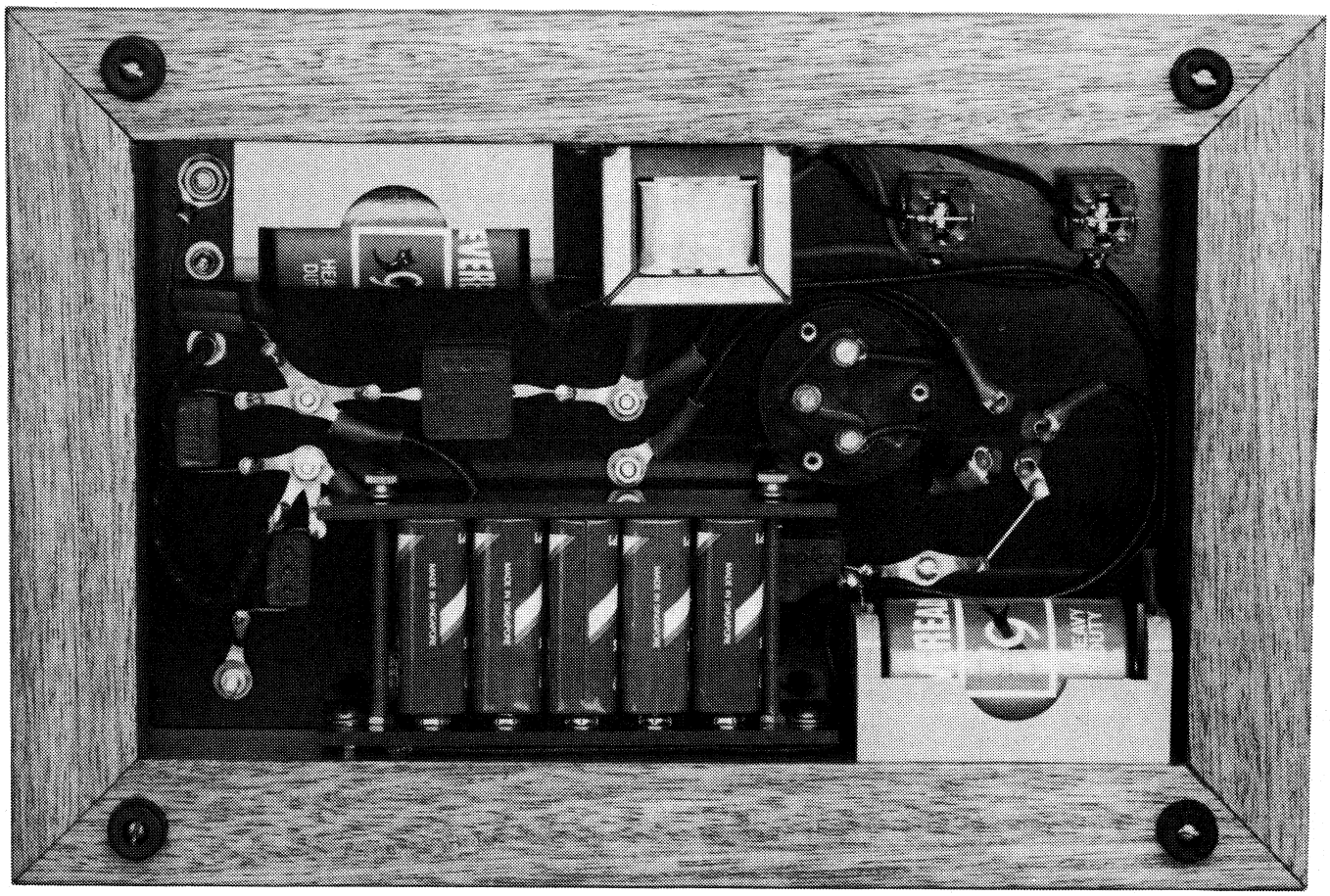
Arrange to support the set upside down (the kitset packing carton is ideal for this) and begin wiring by trimming and fitting the mica capacitors to the lugs as shown in Fig. 4. The main wiring is carried out with the black cloth or rubber covered wire supplied and a spaghetti sleeve is fitted over each lug after soldering. The wiring is fairly straightforward and should present no problems if Fig. 4 is followed carefully.

When finished double check the wiring to avoid the possibility of 45 volts appearing on the valve filament (a lot of vintage valves went that way in days of old) or of the B-battery being shorted (they give a very short life this way).

If all is well you can fit the batteries and the valve, connect an aerial, plug in the phones, and hear what 1983 programs sound like on a 1925 radio set. If the set does not operate, check with a multimeter that the filament voltage is reaching the filament and that the B battery voltage is reaching the plate. With the filament lit up (just visible) and RV1 full on there should be just under 2



The coil formers after assembly. For clarity the windings have been omitted in this photograph.



volts across the filament due to the residual resistance of RV1.

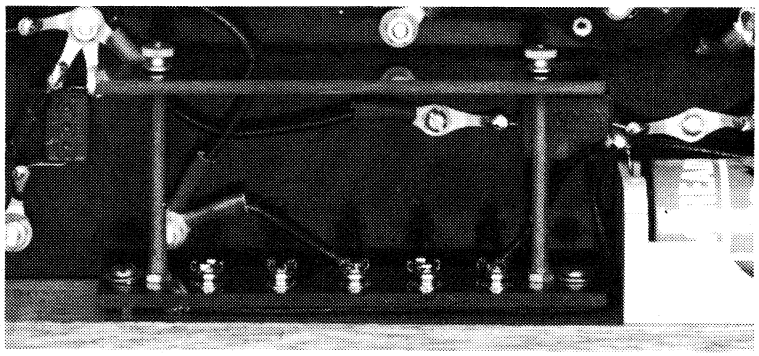
The filament current is 90-110mA with fresh batteries and the B battery current varies from 0.4mA to 1.5mA depending on the signal strength and the valve type. The B batteries will have a very long life (almost shelf life) and it should only be necessary to replace the two D cells from time to time if the set is used fairly frequently (these are not very expensive). Any problems in getting the set going should be covered by the information leaflet supplied with the kit.

The set works quite well in most locations with an indoor aerial of three to six metres but an outdoor aerial and an earth will boost reception remarkably, especially in country areas. An earth will also almost completely remove the effects of hand or body capacity on the tuning of the set.

The set attracts attention wherever it is seen and whilst the great enjoyment is in building and operating it there is also much pleasure in explaining and demonstrating it.

Overall the project will have served its purpose if it stimulates an interest in the origins of our particular branch of technology, with the knowledge that knowing where we have come from can often help us see more clearly where we are going.

Happy vintage listening!



Illustrations on this page show the arrangement of parts beneath the base of the receiver. Note that the wiring is in authentic 1920s style.

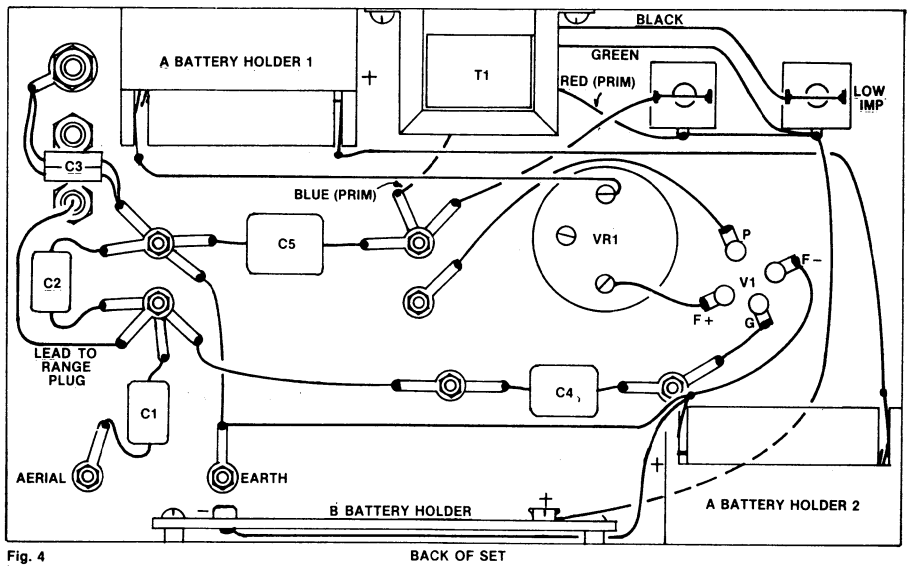


Fig. 4