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Build an antique shortwave radio

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DETAILS INSIDE

Build an antique

Tune the airwaves with this vintage shortwave receiver. Beautifully presented and featuring 1930's triode valves and plug-in spiderweb coils, it is guaranteed to bring back the excitement of the "good old days".

by DAVID WHITBY

Judging by the response to the article *How To Build A 1920s Wireless Set*, in the November 1983 issue, there is a real interest in experimenting with early circuit designs and techniques.

Many readers who built the Unidyne one valve set also expressed interest in the possibility of an all band set with plug-in coils, built to the same vintage standards as the Unidyne. So by popular demand (and with much pleasure) we have produced the *Reinartz 2*.

We have designed the set around two medium-impedance triode valves, type HL2K (RAF type VT50). These valves have 2V filaments, a 4-pin British base and perform well in this circuit at frequencies up to more than 20MHz.

Obviously, valves of this era (they are a 1930s design, and were made at the beginning of WWII) are now as scarce as hens' teeth, but sufficient stocks are held to enable several hundred of these kitsets to be produced.

Main features

The circuit is of the regenerative

detector type followed by one stage of audio amplification. The regeneration arrangement is the famous Reinartz circuit, about which more will be said later.

Plug-in "spiderweb" coils are employed to cover the various wavebands (broadcast to approx. 20MHz). The plug-in formers for these have been specially produced for the kitset and allow for easy winding of coils that are very efficient, even though they were first designed around 70 years ago.

The kitset is supplied with three of these plug-in formers, with spares available separately for those who would like to experiment with other wavebands.

Tuning is carried out by an air-spaced variable capacitor which is driven by a precision 6:1 vernier dial. Both the capacitor and the dial are of relatively modern design but make for precise and stable tuning on the shortwave bands. As can be seen from the photographs, they do not detract noticeably from the vintage flavour of the radio.

The tuning capacitor has two sections of around 200pF and 90pF. The 200pF

Front and rear views of the vintage set, showing the 1920's style construction.



shortwave radio

section is used for tuning the set while the other section is connected via a 30pF trimmer capacitor (C8) to the reaction capacitor (see circuit). Although not a feature of the original Reinartz circuit, this last step reduces the amount of travel required by the reaction capacitor over each tuning range.

The reaction capacitor has been built especially for the kit and consists of a 25pF airspaced beehive capacitor fitted with a shaft and mounted in a brass frame. This little capacitor has the advantage of requiring four turns of the shaft from minimum to maximum capacity which, in effect, gives a vernier action to the reaction control.

In terms of appearance, the set is built on a high quality (Meranti) wooden baseboard, which has a "cove" routed edge to create a really attractive vintage appearance. The tuning and reaction controls, on/off switch and phone jack socket are mounted on a front panel of gold lettered black bakelite, which is attached to the baseboard by means of

PRICE PANEL

A full kit of parts for the Reinartz 2 are available from Technicraft, 338 Katoomba St, Katoomba, NSW 2780. Phone (047) 82 3418.

Prices are:

Basic kit (does not include headphones or power supply)	\$77
Vintage Style "A" and "B" Battery Holder	\$21
AC Power Supply/Audio Amplifier Kit (incl AC plugpack)	\$37
High Impedance Headphones (STC, 3400)	\$14
Spare Valves (HL2K)	\$ 7
Spare Plug-in Coil Formers	\$ 3

Note: Prices include packing and postage. Please allow four weeks for delivery.

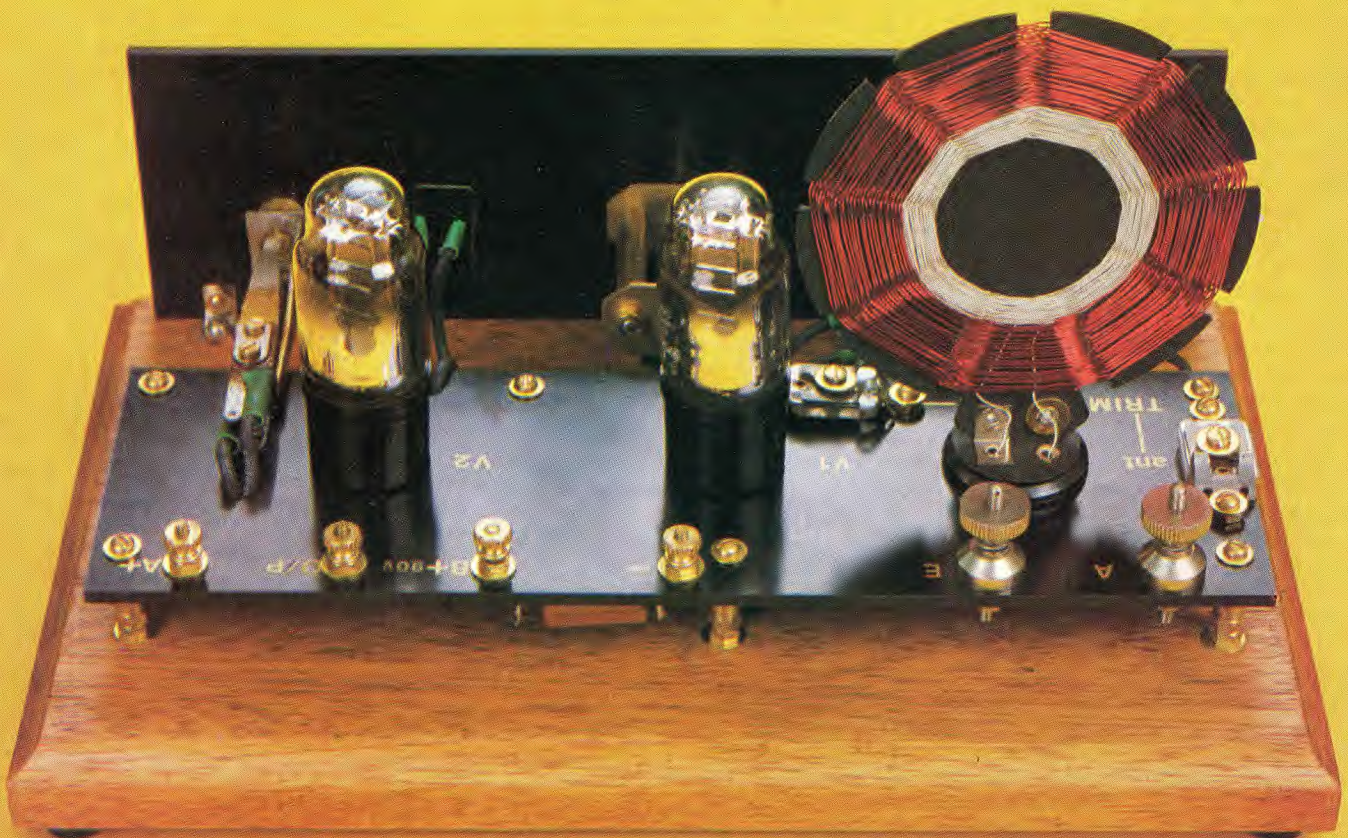
three small right-angle brackets.

A rear sub panel, also of black bakelite, holds most of the other components, including the coil and valve sockets, and the terminals for the aerial, earth and power supply connections.

The set is designed to operate medium or high impedance headphones. If you have built the Unidyne kit and would like to use the low impedance phones supplied with that kit, then a small

valve output transformer (ratio not particularly critical) should be used for best results. There is room to fit this on the baseboard behind the front panel. For those who require headphones, a suitable set of high quality 3400Ω STC phones is available (1940 vintage).

The set requires an "A" battery voltage of from 3-4.5V at around 100mA, and a "B" battery with a voltage of 90 volts or thereabouts at approx



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1.5mA. Two heavy duty alkaline "D" cells will provide a suitable supply for the filaments while a series string of 10 216 9V batteries will provide a very long-lasting "B" battery.

A battery box to hold these could be easily made up and the battery snaps for the 216 batteries and holders for the D cells are cheap and easy to obtain. If you don't want to go to the trouble of making your own battery box, then a complete battery holder system mounted on a wooden base to match the radio is available (see photograph).

An AC-powered supply which also contains an audio amplifier and a small loudspeaker is also available as a kit. This supply can also be used to power up the Unidyne and provide loudspeaker volume, making it possible to share the listening experience with friends and family. Further details of this are given towards the end of the article.

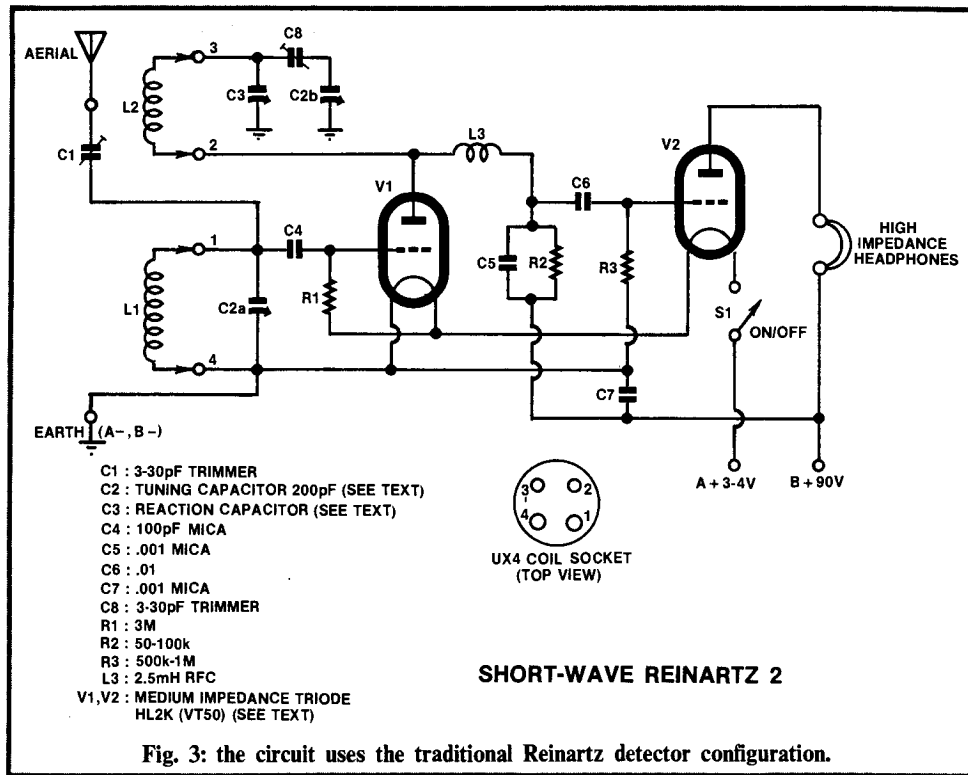
The Reinartz Circuit

Of all the sets built by hobbyists over the years from the 1920s onwards, the all-band one or two valve sets with plug-in coils were probably the most popular. Of these the Reinartz circuit was undoubtedly the best known.

The name Reinartz alone will no doubt conjure up feelings of nostalgia in many of our readers and bring to memory those exciting and sometimes weird and wonderful little sets they cut their teeth on.

The basic circuit arrangement was devised in the USA by J. L. Reinartz and was published in the June 1921 and the March 1922 issues of *QST* magazine. This single valve set was of the "leaky grid" regenerative detector type. It employed a spiderweb coil with switched taps to cover various wavebands and featured variable capacitor control of the regeneration (or reaction).

It was this capacitive reaction control



which was the main distinguishing feature of the Reinartz circuit compared to previous regenerative detector arrangements.

Previous methods of regeneration control included the "swinging reaction coil" (as in the Unidyne set), the tuned anode Variometer circuit (due to Armstrong), and other methods which used a fixed reaction coil coupled to the tuning coil and controlled the amount of reaction by varying the filament or anode voltages of the valve.

All of these methods were workable (some more so than others) on the long and medium wavelengths, but when it came to operation on the shorter wavebands, reaction control became

very tricky. An unstable receiver was often the result.

The Reinartz circuit quickly became popular mainly due to the smooth reaction control made possible by the arrangement — especially on the shorter wavelengths.

Simply explained, the reaction capacitor is in series with the reaction coil and is thus able to control the RF current through this coil. Adjustment of the capacitor provides precise control over the amount of positive feedback (regeneration) in the circuit.

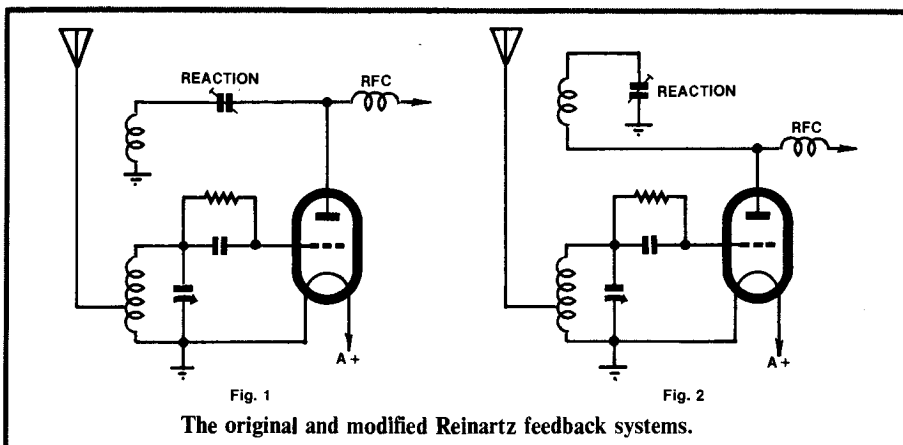
The basic circuit shown in Fig. 1 was soon modified to that shown in Fig. 2, the main improvement being a reduction in body capacity effects by earthing the moving plates of the reaction capacitor.

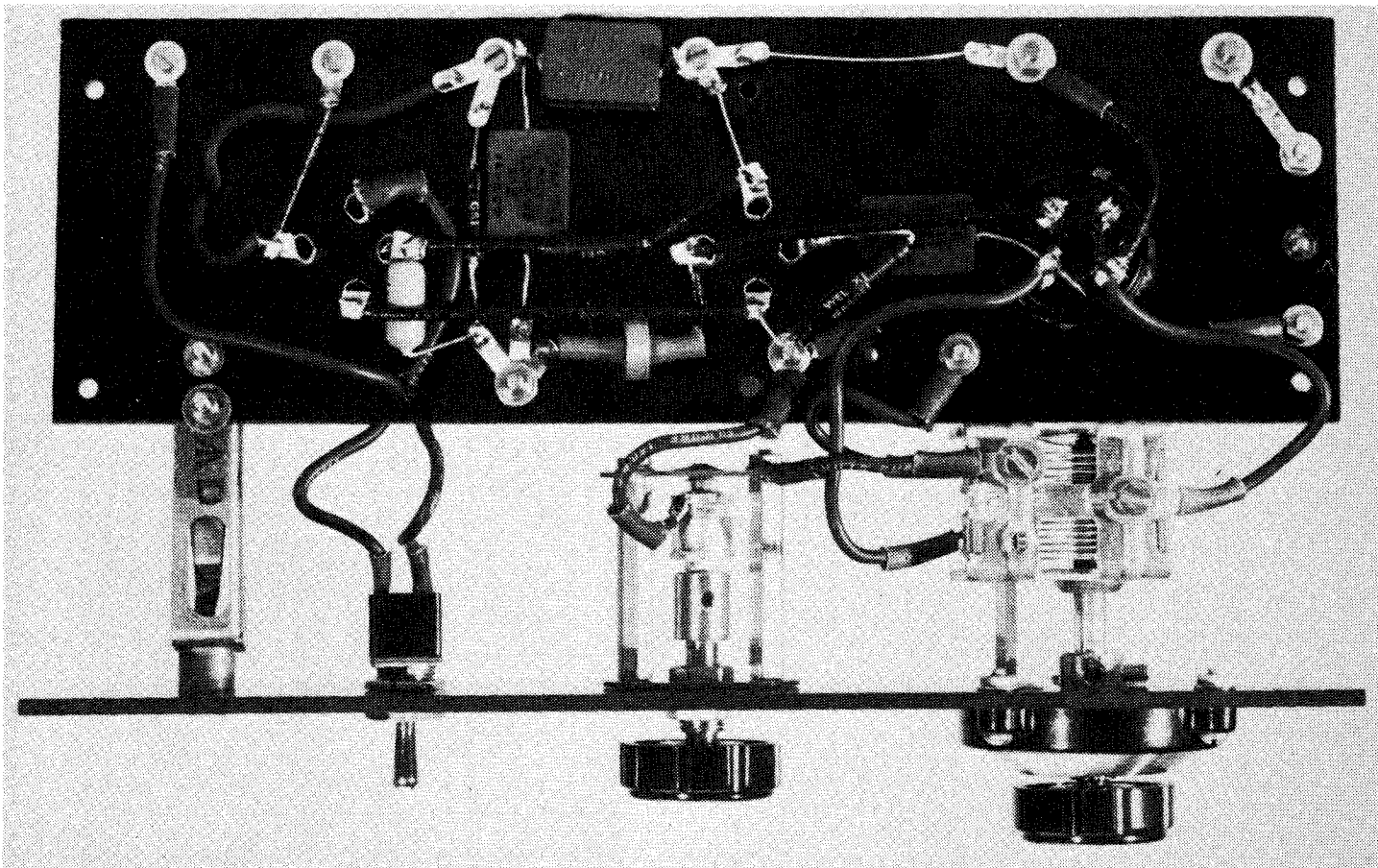
It was in this form that the circuit became widely known and used. Many one and two valve Reinartz sets were described in the pages of *Radio and Hobbies* over the years. These went under such names as *Little Jim* sets, many versions of which were published from the 1930s until the 1950s.

The Reinartz 2 embodies many of the features of the earlier sets, so let's take a closer look at the circuit.

Circuit Details

The full circuit diagram is shown in Fig. 3. Signals from the aerial are coupled via C1 (3-30pF trimmer) into the





View showing the sub panel wiring and connections to the front panel components.

tuned circuit L1 and C2a. Those frequencies selected by the tuned circuit are detected by the grid of V1 which together with C4 and R1 forms a "leaky grid" detector arrangement (for a full explanation of this, refer to the Nov 1983 article). To improve the sensitivity of the detector to weak signals, "grid leak" resistor R1 is connected to the positive side of V1 filament.

Regeneration is accomplished by L2/C3 which feeds back some of the RF energy amplified by V1 into L1 in such a way as to aid the original signal and bring about a great increase in gain and selectivity. The setting of C3 controls the

amount of regeneration, the optimum setting being just short of the point of oscillation (as evidenced by a high-pitch howl).

L3 is an RF choke which prevents loading of the regeneration system by the following stage. It also operates in conjunction with bypass capacitor C5 to prevent RF currents from passing to the output stage. An RF choke in this position was always a feature of the Reinartz sets.

Audio signals developed across V1 load resistor R2 are coupled via C6 into the grid of V2 which drives the headphones.

It will be noted that the valve filaments are connected in series. This is done to provide an effective negative grid bias voltage for V2 — obtained by virtue of the fact that both sides of V2's filament are positive with respect to the grid which is at earth potential through R3.

C7 is an RF bypass capacitor across the "B" supply and S1 switches power to the set by making or breaking the filament supply.

Construction

The first thing to do is to finish the wooden base. This comes routed and drilled and requires only fine sanding and then two coats of satin polyurethane with a light sanding between coats. While this is drying the tuning and reaction capacitors and the on/off switch can be fitted to the front panel.

Put this aside and then fit all the major mechanical parts to the sub panel as shown in Fig. 4. The various electronic components can then be soldered in position and the wiring run using the black rubber-covered wire supplied with the kit.

When the baseboard is thoroughly dry, screw the four rubber feet into the four corner holes. This done, fit the three right angle brackets which hold the front panel in place (use the woodscrews supplied) and mount the six 3/4-inch

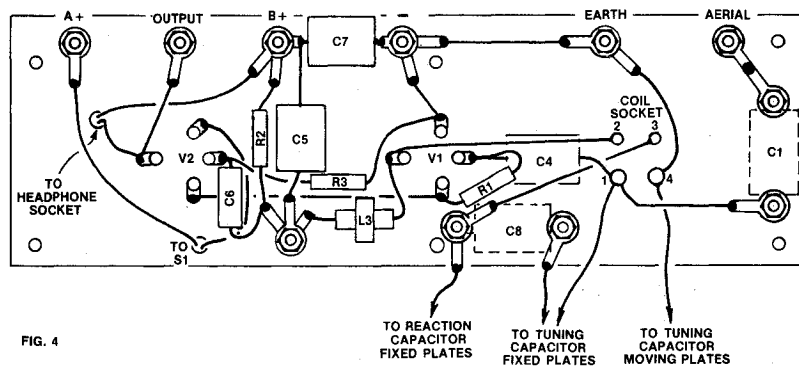


FIG. 4

Wiring diagram of the sub panel. Compare it with the photograph above.

Even though some modern components have had to be used, the 1920's style has been effectively recreated.



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tapped brass spacers by means of the 1-inch x 1/8-inch screws from underneath the baseboard.

Both panels may now be fitted to the baseboard with the screws supplied and the wiring from the back panel to the components on the front panel completed according to the circuit and wiring diagrams. Make sure that you don't transpose the connections to the fixed plates of the tuning capacitor (C2). Pin 1 of L1 goes to the 200pF section while the lead from C8 goes to the 90pF section.

Full winding instructions for the coils are supplied with the kitset. Table 1 indicates the number of turns and wire gauges for each band.

Three plug in coil formers (one large and two small) are supplied with the kit, along with a selection of wire of various gauges suitable for winding all the coils listed.

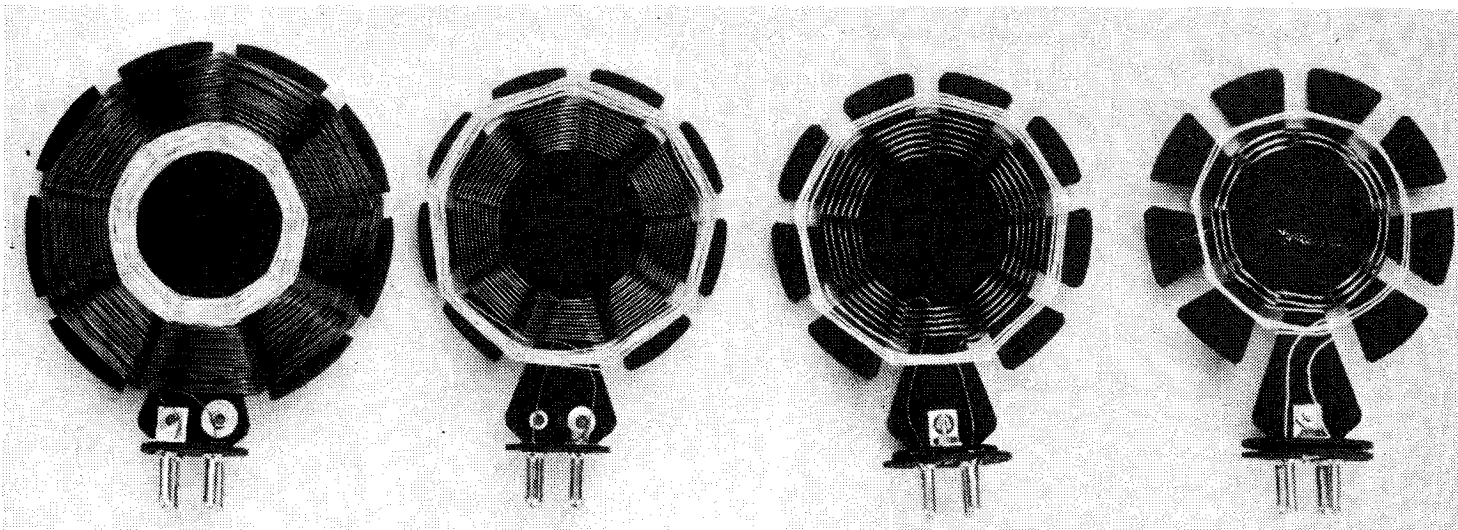
The band covered by coil No. 2 on the chart is probably the least important as there are very few worthwhile stations in this band. Winding details for this band

are included mainly to make the chart complete.

Spare coil formers and wire are available for those who would like to experiment with this band or other bands, such as those below 550kHz or above 20MHz.

Aerials

For best results an outdoor aerial (antenna?) of from 10-30 metres long and mounted as high as possible is desirable. However, quite respectable results can be achieved with a good indoor aerial in



These four plug-in coils provide coverage from 560kHz to 19MHz. Table 1 shows the winding details.

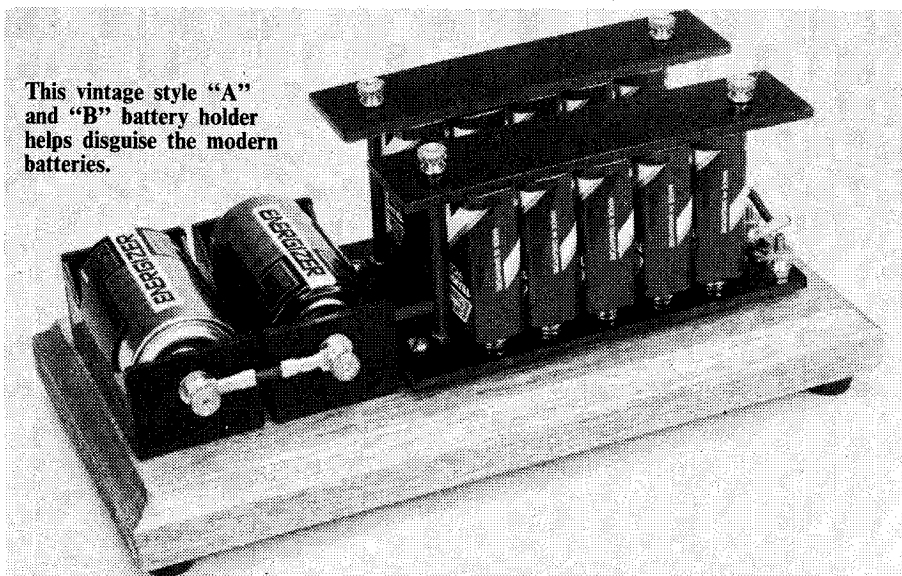
many locations (10-15 metres of wire around the room, etc). In most cases an earth will be found advantageous. A guide sheet to suitable aerials and earths is supplied with each kit.

When you are trying the set on any band for the first time start with the reaction capacitor plates fully out of mesh and vary the setting of the tuning capacitor. You will probably hear some stations even if only weakly.

Tune so that the station you want comes in as loudly as possible. Then gradually turn the reaction capacitor so that the plates come into mesh. The volume of the station will increase as you do this, and if you now check the setting of the tuning capacitor you will find that it has shifted slightly. After a little practice you will be able to tune the set very accurately in a few seconds.

At higher frequencies, the setting of both controls becomes more critical and more skill is required to obtain the best results. You may find it easier to make tuning a two-handed job. In any case, it is interesting to note that with correctly adjusted regeneration the set performs as well as much larger sets do without regeneration.

With a good aerial and earth and careful tuning an amazing number of



This vintage style "A" and "B" battery holder helps disguise the modern batteries.

stations can be received, especially at night, on all bands.

AC Power Supply/Audio Unit

Before closing, a few words about the AC power supply, which has been designed for this set and also for the Unidyne.

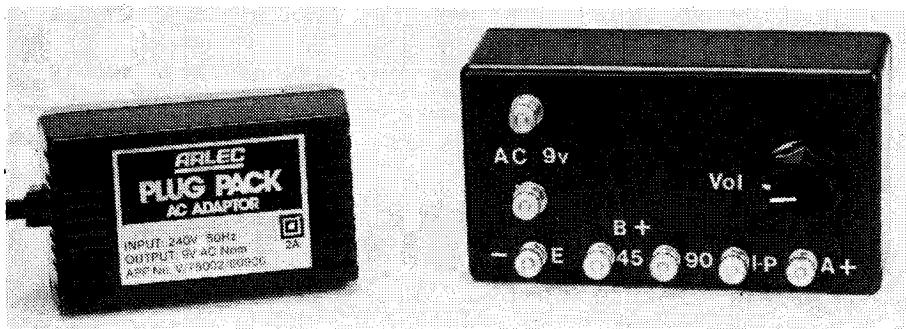
This supply utilises a 9-volt AC plugpack and by means of a voltage

multiplier provides approx 45 volts (for the Unidyne) and approx 90 volts (for the Reinartz 2). A rectifier/filter and IC regulator is employed to provide a filament supply of 3.6 volts which is suitable for both sets. An IC audio amplifier together with a volume control and speaker is also included, enabling loudspeaker output from both these vintage sets.

Most of the components for this are mounted on a printed circuit board and the whole circuit is housed in a black moulded box with brass terminals for all inputs and outputs.

This unit is a worthwhile addition to both of these vintage sets and as well as eliminating battery costs enables the listening experience to be shared with others.

We hope you will get as much pleasure from building and operating the "Reinartz 2" as we have from hunting down the parts and re-creating this little item of radio history.



Above: optional AC supply/audio amplifier unit (see text).

COIL	FREQUENCY RANGE	L1 (TUNING)	L2 (REACTION)	COMMENTS
1	560kHz-1.5MHz BROADCAST	60T 26 B&S ENAMELLED	40T 33DCC OR 30 B&S ENAMELLED	REACTION COIL WOUND ON FIRST. 3-3/4" DIA. FORMER
*2	1.5-3.6MHz	24T 24 B&S	14T 33DCC	TUNING COIL WOUND ON FIRST. REACTION COIL SPACED 1/8" FROM TUNING COIL. 3-1/8" DIA. FORMER
3	3.45-8MHz	12T 20 B&S	7T 26DCC	WINDING AND FORMER AS FOR NO. 2.
4	7.7-19MHz	5T 18 B&S	4T 26DCC	MOST INTERNATIONAL SHORT-WAVE TRANSMISSIONS ARE IN THESE BANDS

* OPTIONAL

Table 1: coil winding details (see text regarding coil 2).



A rarity these days: genuine high impedance headphones.