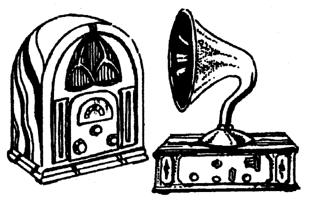
Vintage Radio

by PETER LANKSHEAR



Building a 70-year-old classic

Last month we introduced one of the most widely known classic receivers of the 1920's, the Browning-Drake. Unusual in that sets were both factory made and home built, its design combined simplicity with good performance and economy, and it was the genesis of many successful designs made well into the 1930's.

If the number of inquiries I receive is any indication, a significant number of receivers based on the Browning-Drake have survived and been rescued, although some are in a somewhat dilapidated state and in need of restoration or even rebuilding. Many enthusiasts would like to have a Browning-Drake receiver in their collections, but, although there were thousands made originally, there will never be a sufficient number of original models to satisfy the demand. I do know of several Browning-Drake receivers that have been built successfully in recent years, not as a restoration of an existing set, but from individual components.

Although some pretty comprehensive rebuilds and 'cannibalisations' are undertaken by dedicated and skilled workers, it is rare for a replica of a factory production model receiver to be successful. To duplicate even the metalwork would be very difficult. There is just too much specialised processing and equipment required.

With the Browning-Drake, the situation is somewhat different. Although there were factory assembled receivers and 'official' kitsets, many others were made by hobbyists with limited resources and modest facilities, and no two of these sets were completely identical. It can be argued that, provided that genuine components from the appropriate period are used, the exact assembly date of a receiver of this nature is not vitally important.

An example was a recent project around the 'Little General' that we featured in our July 1992 column. This was taken up by North East Vintage Radio Club in Benalla, for the 1993 subject of their annual 'Hellier Award' construction project. The excellent entries all differed in individual detail, and although assembled 50 years after the original design appeared, authentic components were used, and the receivers are arguably genuine 'Little Generals'.

There are good precedents for this. The Antique Wireless Association of America, the world's pioneer and probably the largest vintage radio organisation, regards recreating amateur built equipment as a legitimate activity and regularly reports in their Bulletins on members' building of early equipment.

For several years I had been accumulating the necessary bits and pieces, gleaned as swaps, junk purchases, gifts and downright scrounging, and recently I found sufficient motivation to set about building a 'new/old' Browning-Drake receiver, based on instructions featured in the 1929/30 *New Zealand Radio Guide and Call Book*.

Wide range of valves

Some of the earlier Browning-Drakes were quite large, but this version is of more manageable proportions with a panel of 460 x 175mm. The days of radio stores stocking shiny black panels are long gone, and finding a suitable material today may take some effort. I used 5mm-thick black switchboard Formica. This is readily drilled and engraved, the only disadvantage being that the surface hasn't the extreme shine of the original

Fig.1: Mid-1920's radios were frequently housed in functional tabletop chest cabinets with lift-up lids; the chief variations being the degree of ornamentation. Cabinets like this could be made with basic tools or purchased ready made.

PARTS LIST

1	Black Formica panel 460 mm x 175 mm
1	Wooden baseboard
2	Tuning capacitors single gang, 350 pf - 500 pf
2	Coil formers, 750 mm dia
4	Valve sockets 4 pin baseboard mounting
2	Audio transformers
2	Rheostats, 6 ohm and 30 ohm
2	Tuning knobs
2	Small knobs
4	Terminals
1	Neutralising capacitor 5 - 50 pf
1	Mica capacitor 1000 pf
1	Mica capacitor 250 pf
1	Mica capacitor 100 pf
1	Grid leak resistor 1 - 5 meg.

Insulated wire, busbar, sleeving
Battery cable
Hardware
Approximately 35 metres (100 grammes) of 22 SWG (0.63 mm) enamelled wire

panels. As an alternative, wood grained Formica was sometimes suggested.

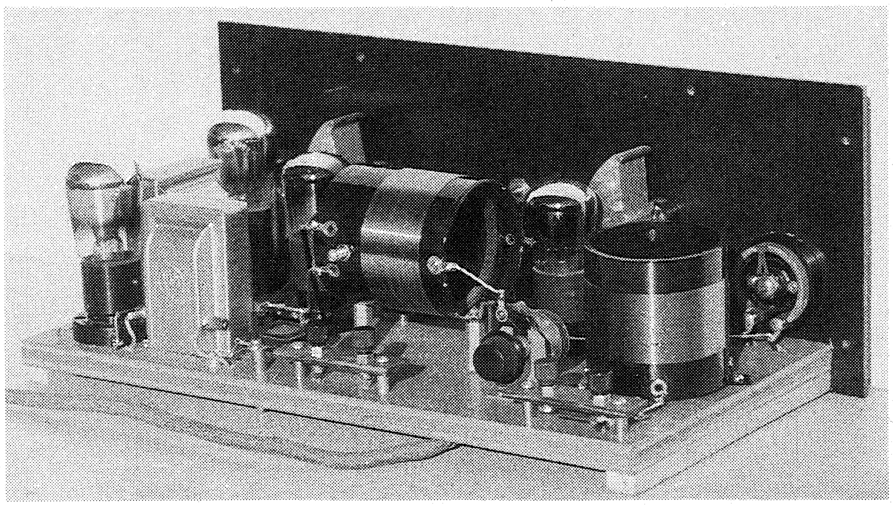
Glen Browning, in his original models, used UV199 valves with their own special miniature sockets, but as these valves are now very scarce — and the sockets even rarer — it seemed a better idea to use the standard four pin American UX socket, which suits a wide range of valves, including the electrically identical UX199. Many other types of valve are suitable.

Those fitted to the Browning-Drake in the photographs are a pair of Philips A609, one A615 and a Mullard PM6, and it works just as well as with the traditional 01A's and UX199's. Type 30 valves, with 2.0 volt filaments, likewise proved to be satisfactory.

The table of suggested types is far from exhaustive, and most general purpose battery powered triodes will be suitable. The chief requirement is for all the filaments used at one time to have the same voltage...

Tuning capacitors do not have to be identical; in fact, Browning's prototype used a 500pF unit for the RF stage and a 350pF type for the detector. The reason for this difference is the close coupling of the aerial, whose capacitance can be significant. This has the effect of restricting the tuning coverage by compressing the range of capacitance variation.

Some Browning-Drake designs even provide coil data for 250pF detector tuning capacitors, but the modern AM broadcast band covers a wider range of frequencies than in 1930, and now 350pF is the minimum recommended size.



By modern standards, Browning-Drake components were huge — especially the coils, which were commonly about 75mm in diameter. There was no shielding, which was considered inefficient; instead mutual coupling was avoided by mounting the coils at right angles. The baseboard is raised by about 10mm to clear the filament and battery wiring — a technique often used in early sets.

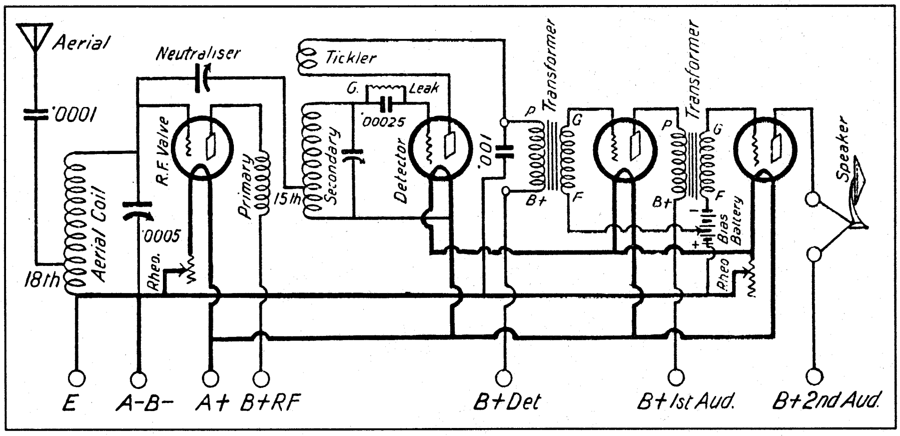


Fig.2: Few receivers ever packed as much performance into a very simple circuit as the Browning-Drake. Original versions had a rheostat for each valve filament, but otherwise this 1929 circuit is very close to the original.

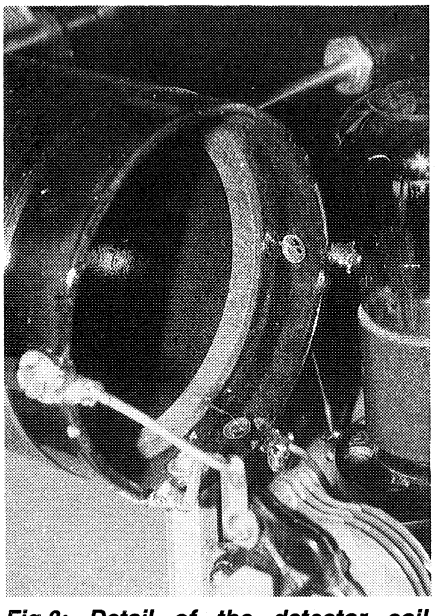


Fig.3: Detail of the detector coil, showing the position of the primary winding inside the main coil former. The tickler winding control shaft and its front panel bushing are visible at upper right, above the RF valve.

Neutralising capacitors were usually of the semi-fixed type, and came in a wide variety of shapes and sizes. However, although not essential, a fully variable capacitor is helpful for experimentation, and I used an Australian 'Radiokes' 50pF miniature which, incidentally, was patterned on an American 'Pilot' model. A 35pF maximum capacitance would have been adequate, but using the bigger model was no real disadvantage.

Radio construction 60 - 70 years ago was not a matter of inserting components on to pre-drilled printed circuit boards! It was accepted that there could be a fair amount of 'user building' of components, especially tuning coils.

Large, efficient coils are essential to the good performance of these old receivers and are likely to require the most time and effort in this project. Formers were made from ebonite, Bakelite or some form of impregnated cardboard. I was fortunate to be given a pair of ebonite (hard rubber) formers, but today this material is unobtainable.

Even Bakelite coil former is scarce and it might be necessary to resort to cardboard tubing saturated with shellac or varnish. Some of the modern materials such as PVC or Alkathene pipe are ideal electrically and mechanically, but some purists would be offended by their use.

There were commercially made Browning-Drake coils, honeycomb wound without formers, and another popular method was to wind coils on sheets of celluloid wound round a suitable glass bottle as a mandrel. Coil diameter of all types should be about 3" (75mm), wound with 22 SWG (0.63mm) wire; use 68 turns for 350pF and 56 turns for 500pF tuning capacitors. The tappings are not critical and can remain at 15 turns for the detector coil, and 18 turns for the aerial connection for either type of capacitor.

The Regenaformer

The most complex item of the project is undoubtedly the detector tuning coil or 'Regenaformer' and this does require a little lathe work for the primary and tickler (feedback) winding formers.

As explained last month, the significant feature of the Browning-Drake receiver is the special primary winding of the Regenaformer. This consists of only 15 turns of fine wire, wound as compactly as possible in a groove in a section of former located inside the main former and in line with the bottom of the tuned winding. Fig.3 should make this clear. Ideally, it should be turned out of Bakelite or hard rubber, but hardwood would be a practical substitute.

At the other (top) end of the Regenaformer is the feedback or regeneration winding, picturesquely called a 'tickler' (Fig.4). Through a 90° rotation, the tickler adjusts the amount of positive feedback, from minimal when at right angles to the main winding, to maximum with the windings in line. It is a good idea to fit stops to limit rotation, or some enthusiast is bound to twist the leads off!

The tickler has a total of 20 turns of fine wire, connected to the outside world with flexible leads. I used the braided voice coil pigtails from an old speaker cone. Some discarded volume control pots provided excellent bearings for the shafts of the tickler assembly. Fig.4 shows the general idea.

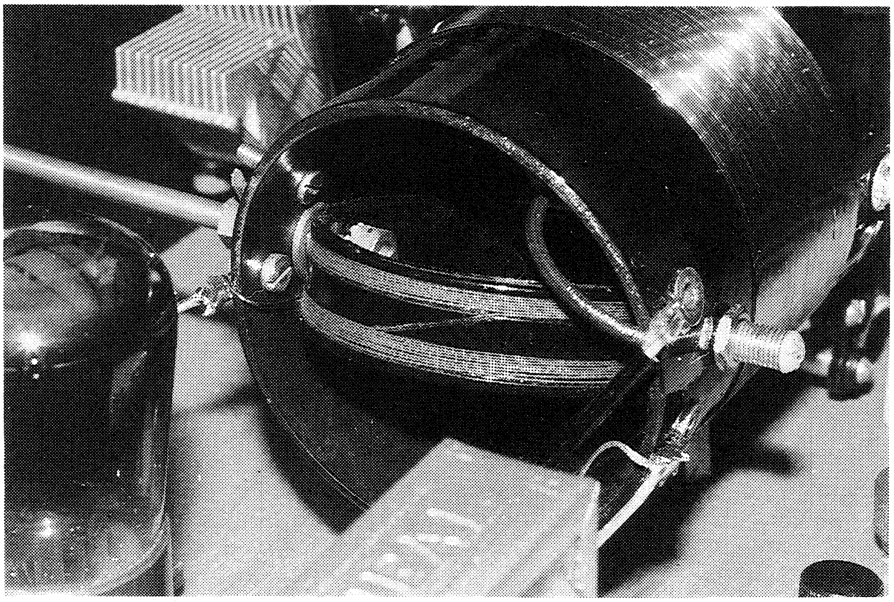


Fig.4: The tickler winding is the most complicated part of the receiver. Although not essential, the turned recesses in the tickler former are helpful in holding the winding in place. The shaft bushings came from old potentiometers.

Phasing most important

The correct phasing of the connections to the primary winding and the Regenaformer are absolutely essential, for neutralisation and regeneration.

Assuming that the three windings on the detector coil are in the same direction, and that the primary is at the *earthy* end of the tuned winding, with the regeneration winding at the other or grid end of the coil: then the ***start*** of the primary winding connects to the anode of V1 and the ***finish*** to HT.

In the case of the tickler, again with the winding sense and plane of the coils the same, the ***start*** of the coil goes to the anode of the detector valve and the ***finish*** connects to 'P' of the first audio transformer. It is worth taking extra care to check that the winding relationships are absolutely right — it may save undoing things later.

The audio transformers can have the usual ratios of 3:1 to 5:1, and although not essential, a matched pair looks well. I used AWA 'Ideal' units. Chances are, unfortunately, that the transformers will have open circuited windings. This need not be a disaster. We illustrated a method of rewinding audio transformers in this column for September 1991, and specialist rewinders are now advertising their services.

Faulty components

This brings us to the subject of component condition. Much of the work in a project of this nature involves renovating individual components before they are installed. Where possible, items should be dismantled, cleaned and if necessary, repainted or replated. Not only will they

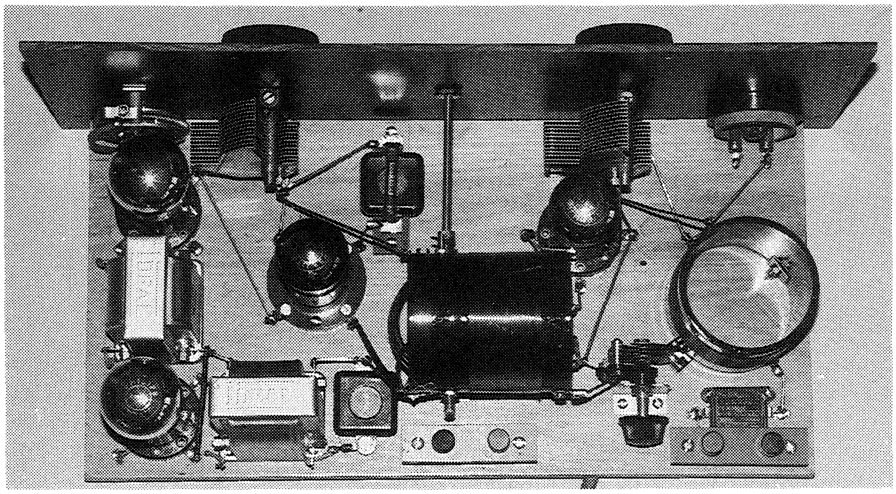


Fig.5: Cabinet and panel dimensions are sufficient to permit a compact but uncrowded layout. The relatively few components are screwed to the baseboard. They can be readily identified, with the aerial coil to the right, the detector coil and valve in the centre and the first audio valve at lower left.

SOME SUITABLE VALVE TYPES FOR BROWNING-DRAKE RECEIVERS

FILAMENT VOLTAGE	AMPLIFIERS RF & AF	DETECTOR	OUTPUT	OUTPUT BIAS
2.0	30 A209 PM1 HL210	30 PM1A HL210	31 P215	-22.5 -10.5
3.3	**'99***	**'99***	'20	-22.5
4.0	A409 A415	A409 A415	B405 P410	-18.0 -9.0
5.0	**'01A*** 112A UX221 PM5 C509	**'O1A*** 112A UX221 PM5 200A C509	**'01A*** 112A '71A C503	-9.0 -9.0 -27.0 -27.0
6.0	A609 A615 PM5	A609 A615 PM6D	B605 PM6	-18.0 -7.5

* TYPES USED IN ORIGINAL B-D RECEIVERS

look better for this treatment, but unsuspected faults may be found.

In my case, the tuning capacitors provided a problem which had to be corrected after construction was completed. Initially they appeared to be in such good condition that no attention seemed necessary; but, out of sight, the bearings had become very dirty, creating havoc with intermittent operation when in use.

The remaining components are the resistors and three mica capacitors, which are likely to be quite large by modern standards. Check their capacitance carefully, for even moulded capacitors can have developed faults, including disintegration of tinfoil electrodes.

The only fixed resistor

It was common practice for detector grid capacitors to have a pair of clips to hold the only fixed resistor in many of the receivers of the period: the grid leak. Often, this was a glass tube with metal caps, containing a strip of carbon coated paper as the element, which is quite likely today to be open circuited. Some ingenuity will be necessary to fix this problem.

It may be possible to remove the end caps and renew the element with a strip of paper, with a few soft pencil line drawn over the surface; but a more pragmatic and far easier way is to insert a modern miniature 1 - 2 megohm resistor, which if painted black will be fairly unobtrusive.

Several patterns of filament rheostat were in common use. R2 has a low value, typically only 5 - 10 ohms, and is used to regulate the detector and audio valves' filament supply. These controls often had a blank section or 'cam', as an on/off switch to disconnect the supply.

The RF valve filament rheostat, R1, is the main gain control, and should be capable of reducing the filament current virtually to zero. A practical problem is the range of filament currents encountered, varying from 60mA for a type 30 or UX199 to 250mA for an '01A. Values between 30 and 50 ohms for the gain control are a reasonable compromise.

'Chest' type case

An important item is a suitable cabinet. The drawings are of a tabletop 'chest' style with lift-up lid, which was popular during the 1920's. With varying degrees of ornamentation, similar cabinets were used for many radios, and home constructors could buy them ready made or build their own.

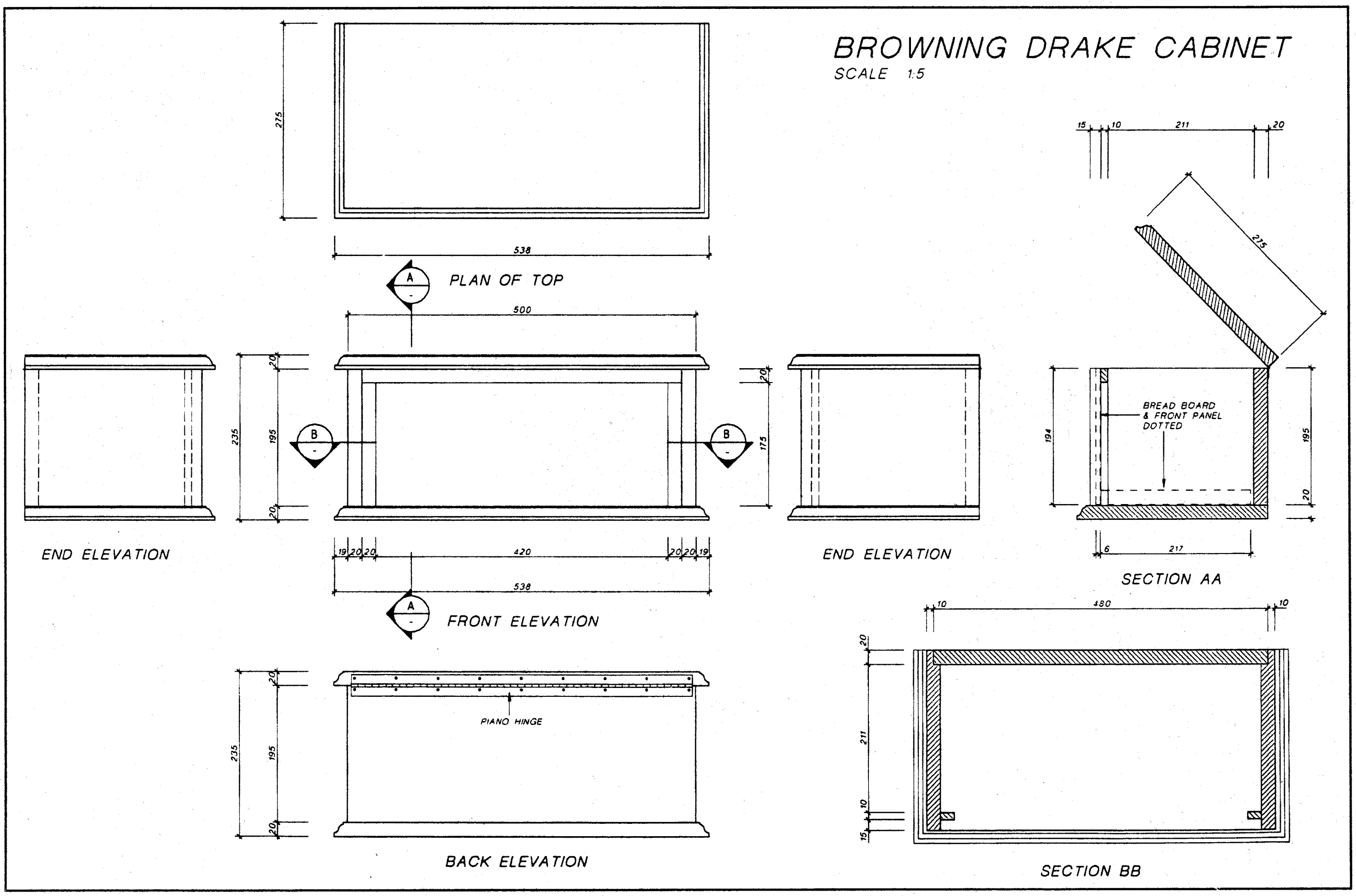
The one illustrated was made with basic home workshop tools, the only specialist machining being that of the edges of the lid and base. This work could be undertaken by a joinery workshop at minimal cost.

Any suitable timber

The timber used can be of practically any variety that appeals. Mine was made from an ancient oak bedhead, but many local timbers have very attractive grains. Any finish desired can be applied, and French polish would be very appropriate.

Attached to the panel is the all important 'breadboard'. The wood used should be stable and not prone to warp; 15mm plywood is ideal. As can be seen in the photographs, 10mm laths should be attached to the underside at the ends to provide wiring clearance. A couple of coats of shellac should be applied.

Now the components can be mounted. It is a good idea to start with installing the bushing for the Regenaformer shaft, which, for the sake of symmetry should be at the centre line of the panel. The position of the other components can be identified in the photographs. Layout is



Very little specialist machining is required for the cabinet. Mahogany, walnut and oak were used for early receiver cabinets, but many local timbers are suitable. It's a good idea to have the cabinet finished before cutting the front panel to final size.

not unduly critical, but to avoid unwanted coupling, the tuning coils should be mounted at right angles to each other. A similar precaution should be taken with the audio transformers.

Exposed wiring

There are two types of wiring. With the exception of the anode lead for V4, grid and anode wiring is in bare solid tinned conductor above the 'deck' and in the manner popular in the efficiency conscious 1920's, is strictly 'point to point' with black sleeving where insulation is essential. Supply leads, battery leads and the V4 anode lead are in traditional stranded hookup wire on the underside of the baseboard. As all terminations are above the baseboard, access holes are drilled under each terminal.

Lacing in bootmaker's waxed linen thread can be used to tidy up loose leads. Although it disappeared with the advent of mains powered receivers, above-chassis exposed point to point wiring remained popular in transmitter construction until quite recent times.

With the wiring completed, the receiver is ready for its first firing up. An aerial, preferably an outside type and 10 - 30 metres long, a loudspeaker and a power supply will be needed. If a classic horn speaker is not available, an ordinary moving coil type with a 5k to 15k output transformer will do, but bear in mind that, by today's standards, the sound level will be modest.

Suitable power supply

For a power supply, the Universal Battery Eliminator described in the March 1990 column is ideal. By the way, RCS Radio now stocks suitable printed circuit boards, making construction of these units easier and more professional looking than with Veroboard.

Before switching on, make doubly sure that the filament voltage is correct for the valve series used. Bias for the audio amplifier with 90 volts HT is 1.5 volts. Correct bias for output valves operating at 135 volts HT is given in Table 1. No bias is required for the remaining two valves, but some experimenting with their HT voltages for smoothest operation may be required. A good starting point is 68 volts for the RF stage and 22 volts for the detector.

With projects of this nature, in spite of all the right precautions taken with checking out components, there always seems to be some unexpected fault or malfunction. As mentioned previously, in my case it was dirty bearings on the tuning capacitors; so be prepared to do some troubleshooting.

With any faults cleared, back off the RF gain control and switch the filament supply on. The detector should go into oscillation with a 'plop' as the reaction control is rotated. If it does not do so with a healthy valve in the detector socket, and assuming that the phasing of the windings is correct, more detector voltage may be necessary — or, as a last resort, more turns should be put on the tickler.

With the detector working correctly and the regeneration control backed off to just *below* the oscillation point and with the RF gain control advanced, the two tuning capacitors can be brought into line. Stations should be heard, together with whistles and squawks, indicating that the RF stage is oscillating and requiring neutralisation.

Setting neutralisation

A signal generator may be necessary for this if you are not in a good reception area, but assuming that you are, tune in a strong signal near the middle of the band. Now cut the RF rheostat right off — if necessary, putting a piece of paper between the rotor and the resistor element. The signal will still be heard, although with reduced output. Adjust the neutralisation control for MINIMUM output, checking that the two tuning controls remain in resonance. There should be a distinct null as the neutralising capacitor is rotated. At this point, the set is neutralised and operational.

One idiosyncracy with transformer coupled regenerative grid-leak detectors is a tendency to break out into a loud audio howl, just as the regeneration control is getting to the best point. This can easily be cured by connecting a high value resistor in parallel with the first audio transformer primary. Start with about one megohm, and try smaller values until a cure is evident.

And that's it! With a good aerial and earth connected, old timers will have no difficulty in getting the Browning-Drake to give an excellent account of itself. Newcomers should soon master the use of the regeneration control and learn how to keep the tuned circuits in line when tuning in a new signal. Increasing regeneration improves selectivity, and if the RF filament rheostat has insufficient control for very strong signals, some judicious detuning of the RF amplifier can be used. ❖