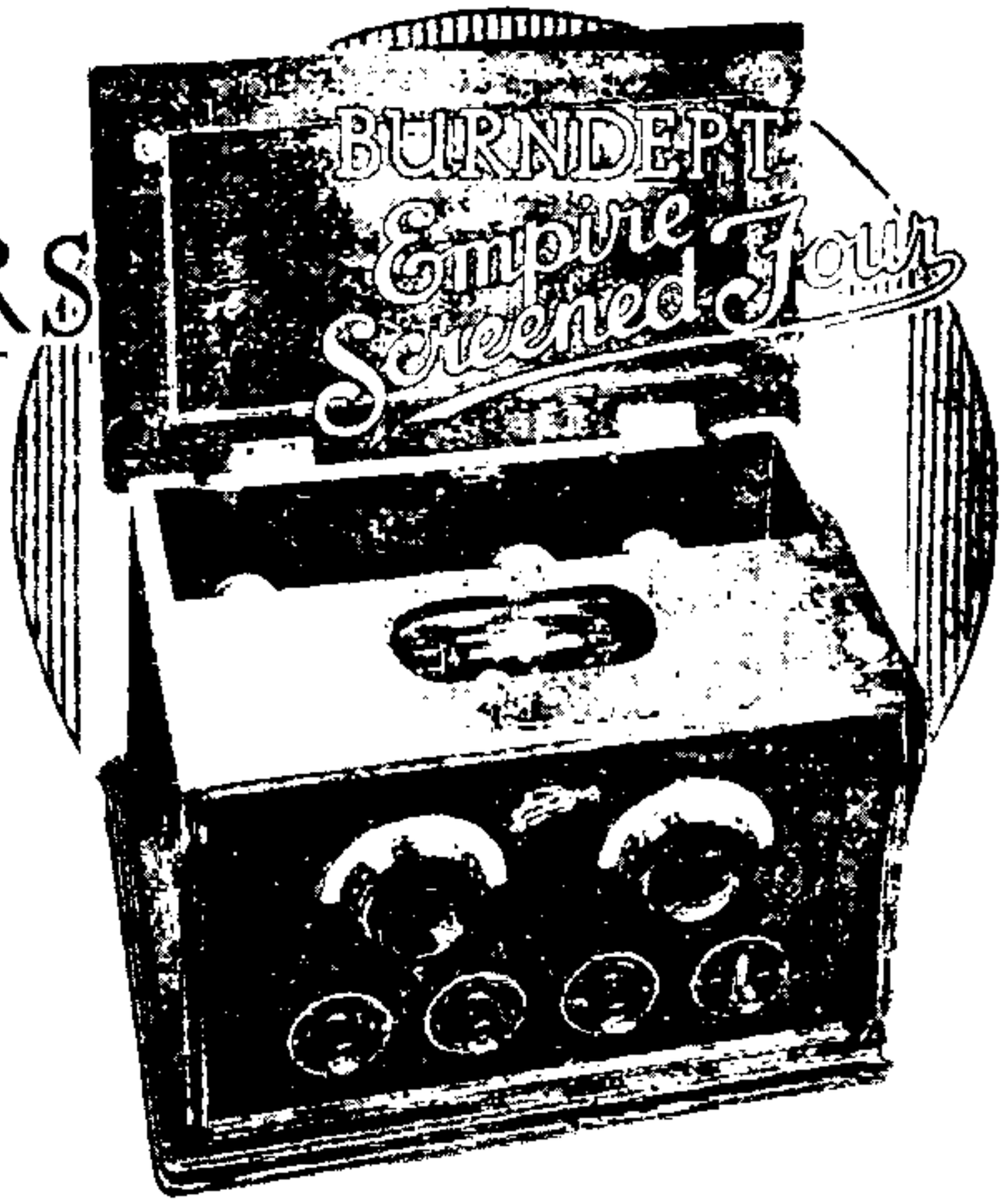
BROADCAST RECEIVERS

A Short=wave Receiver with Screened=grid H.F. Amplification.



THE Empire Screened Four has been developed in response to numerous enquiries from overseas, and is really a special edition of the Burndept Screened Four, which was designed for European reception and includes coils for long-wave as well as medium-wave broadcasting. Outside Europe, however, the long waves are of little interest as the majority of broadcast stations overseas are confined to the 200-500-metre band. In the "Empire" receiver, the long-wave coils are omitted, and their place is taken by ultra-short-wave coils covering a wave-band of 20-48 metres. The Colonial listener will therefore be able to keep in touch with the home country through 5SW, and will also be able to receive his local station on the 200-500-metre band should the latter exist. Conversely, the listener in this country will be able to pick up Australian, South African, and American broadcasting, in addition to the B.B.C. programmes. True, he will have to forgo 5XX, but the sensitivity of the set on the 200-500 band is sufficient to give several alternative programmes.

Interesting Circuit Arrangement

On examining the set for the first time, one cannot fail to be impressed by the robust simplicity of the design. The controls are well placed, and while being simple to operate give a wide range of adjustments so that the performance of the set can be modified to extract the most from any given set of receiving conditions. Accessibility has been carefully considered; the valves, grid bias battery, and filament resistors can all be exchanged without the necessity of opening up the interior of the set. The screened grid valve is situated in a well at the top of the set, where it is readily accessible, and at the same time is in an ideal position in relation to the screening compartments inside the set.

The circuit consists essentially of a screened grid H.F. stage followed by a leaky grid detector with reaction and two L.F. stages, the first being resistance-capacity coupled and the second transformer-coupled. The circuit includes many interesting refinements, and it is worth while to examine it in some detail, working through from the aerial to the loud speaker.

The aerial circuit is built as a self-contained unit, and has for its base a rotary selector switch giving three degrees of selectivity on each wavelength range. When the switch is moved over from the group of contacts on the right controlling the medium waves to those on the left, a cam on the switch spindle closes an additional pair of contacts which short-circuit the medium-wave coil, leaving only the short-wave coil in circuit. On short waves perfect electrical contact is essential to selectivity, and for this reason a special system of contacts has been developed. The switch arm consists of a clip which securely grips both sides of the contact pegs, the pegs being mounted radially on the flanged base. On the 220-560-metre band the switch varies the aerial tapping point on the tuned grid coil, the minimum selectivity and maximum signal strength being obtained when the whole of the coil is included in the aerial circuit. On short waves not more than a quarter of the grid circuit turns are included in the aerial circuit, even in the position for maximum signal strength, and in order to improve selectivity the remaining contacts are used to introduce small capacities in series with the aerial. The contact giving maximum selectivity is entirely isolated, and the minute capacity to the adjacent contact is the only medium through which signals are transferred from the aerial to the tuning circuit. This capacity does not amount to more than one or two micro-microfarads, yet it is sufficient to pass the ultra-high frequencies covered by the 20-48-metre band. The knob operating the selector switch is on the extreme left of the sloping front panel.

The aerial coils are mounted on the switch base with their axes at right angles, and their position is clearly shown in one of the photographs. The short-wave coil

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is interesting on account of its small diameter, which gives a good ratio of winding length to diameter and also tends to keep the field associated with the coil within small dimensions. Tinned copper wire is used, and the turns are located in a thread cut in the ebonite former.

The dimensions of the tuned anode coils are essentially the same, but in this case the windings are centre-tapped, the +H.T. feed being connected to the centre of each coil. The top of each coil is connected through the reaction condenser with the anode of the detector valve, the bottom of the coil going, of course, to the anode of the screened grid H.F. valve. A change-over switch, the knob of which is on the extreme right of the panel, connects in circuit the appropriate coil for long or short waves and at the same time disconnects the coil not in use. The same switch carries contacts for L.T., and both H.T. leads, which are disconnected when the switch is in the intermediate position.

The Method of Controlling Volume.

It is interesting to note that the screened grid is supplied with the requisite potential through a series resistance from the H.T. battery. This method is quite satisfactory where it is required to drop a comparatively small voltage, and in the Burndept set a separate H.T. tapping of lower voltage is provided for the first three valves. The potential of the screen will, however, depend on the screen current, which may vary with different valves. It will also depend on the anode current, which is closely linked up with the screen current. A filament resistance for the screened grid valve is used as a volume control, and this will affect the anode current so that the volume control is really a combination of the effect of the reduced emission from the filament and the change in screened grid volts.

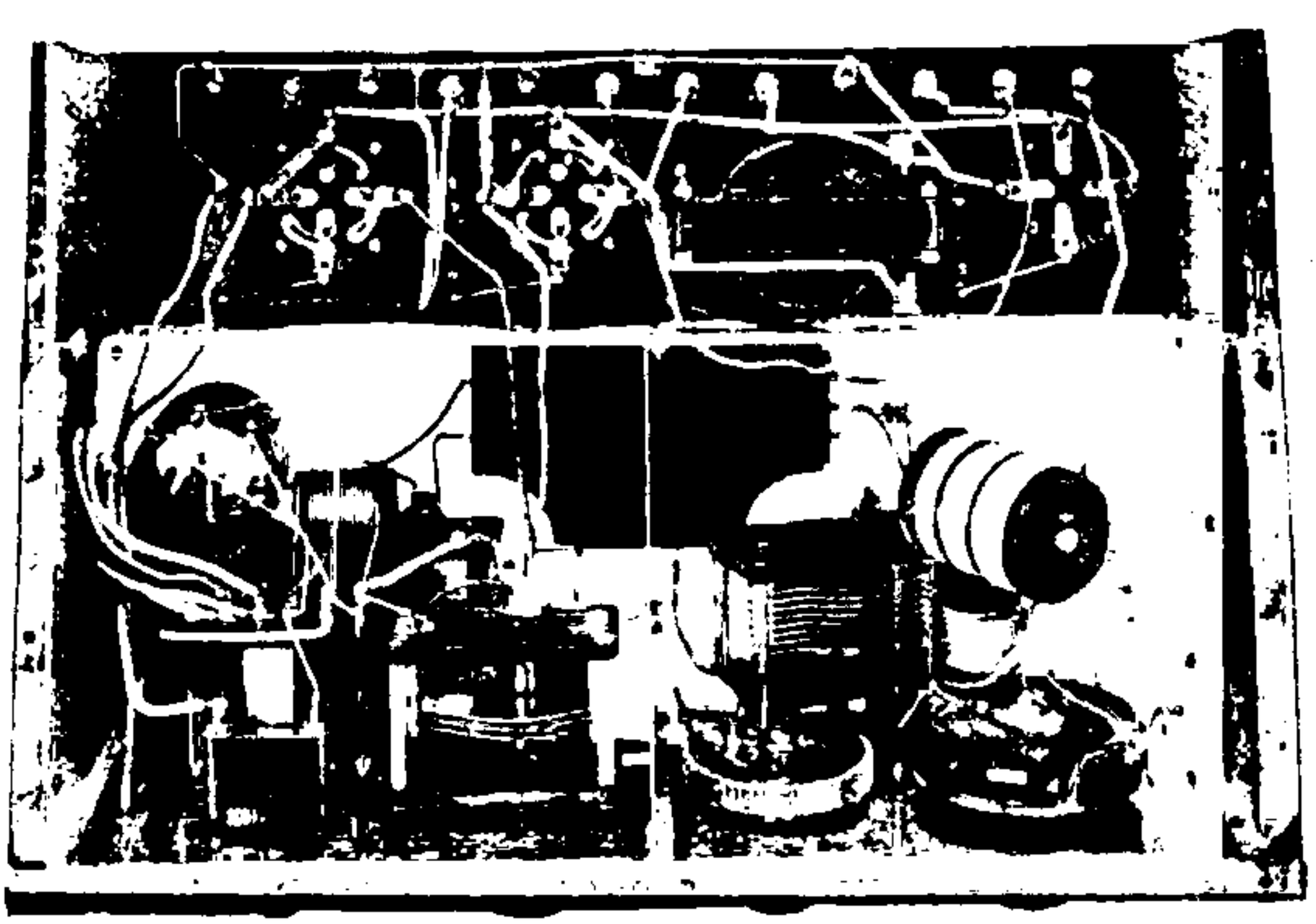
The aerial and tuned anode circuits are segregated into separate screening boxes as shown in the view of the underside of the set. The screened grid valve, which is of the double-ended variety, is bridged across the two compartments, the dividing partition coinciding with the screened grid.

The low-frequency portion of the circuit follows conventional practice. The detector, which operates on the leaky grid principle and therefore draws an appreciable anode current, is coupled to the first L.F. valve through the medium of a heavy duty, wire-wound anode resistance, and a Ferranti A.F.3 transformer is used to couple the L.F. valve to the output valve. The loud speaker terminals are connected directly in the anode circuit of the last valve, so that if one of the new super-power valves is used it may be desirable to connect a transformer or filter circuit externally to divert the steady anode current from the loud speaker windings.

The arrangements for providing grid bias are interesting. A separate grid battery, housed in a special compartment at the back of the set, is provided for the power output valve, the remaining valves derive their bias from the filament circuit through the fall in potential across fixed resistors in series with the filament of each valve. These resistors are of the well-known Burndept screw-in type, and are interchangeable.

In spite of the fact that there are three tuning controls (including reaction) the set is no more difficult to tune on short waves than a conventional reacting detector circuit. The right-hand tuning dial is calibrated directly in metres, and this was found to be an invaluable aid in searching for any given station. A compensating condenser is fitted in the well at the top of the set near the screened valve for the purpose of adjusting the tuning condenser to the scale, but it is unnecessary to touch this unless the set has been dismantled for any reason, as each set is properly adjusted at the works before dispatch.

One of the secrets of effective tuning on short waves is to work with the absolute minimum of reaction when searching for a station so that the set oscillates only over a very narrow band of wavelengths when the two circuits are brought into resonance. If too much reaction is used it is difficult, if not impossible, to tell when the two circuits are in tune. Having found the carrier wave of the station with the set oscillating



Interior view with base removed, showing screening compartments and tuner units.

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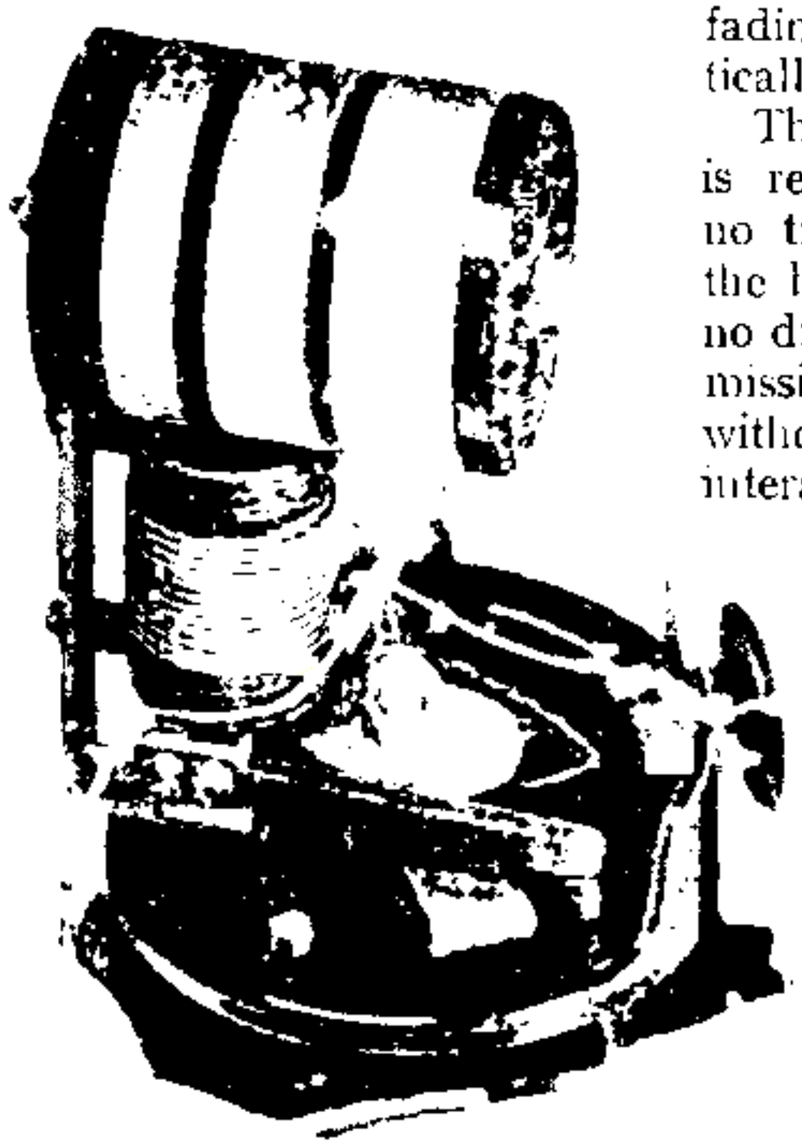
(radiation is negligible as the H.F. valve acts as an effective buffer between the detector and the aerial) the reaction should be backed off until oscillation just ceases. As the reaction knob is small this is a somewhat delicate operation, and in our opinion a graduated dial would be a useful adjunct to the reaction control.

A very fruitful source of annoyance in short-wave sets is the prevalence of "blind spots" in the tuning range - places where more than the normal degree of reaction has to be used to bring the set up to the oscillation point. In the Burndept set there is absolutely no trace of this trouble, and the set behaves just as logically on short waves as on the medium band.

The performance on the normal broadcast wavelengths is good. Position 2 on the selector switch is best for general reception, and gives adequate selectivity for all normal purposes. When the set is installed near to a powerful transmitter it may be necessary to use the No. 3 position, but this considerably reduces signal strength, and the maximum permissible reaction must be used to maintain range. However, at 1¾ miles from 2LO the No. 2 position was found to be satisfactory, and good signals were received from several Continental stations in addition to 5GB.



Close-up view of aerial tuner and selector switch.

On short waves, also, the No. 2 position was found to be best both from the point of view of signal strength and ease of control. On March 3rd, Melbourne (Australia) was received at good loud speaker strength. Short-period fading was present for part of the time, but some pianoforte solos came through clearly, and the announcer's "Melbourne Station now closing down. Good morning everybody," and the chimes of 6 a.m. (Australian time) were easily distinguished. On March 5th Schenectady (2XAF) was received during the reading of market prices. The signals were not quite as loud as those from Melbourne, but there was no fading, and the sound level remained practically constant.

The stability of the set on short waves is remarkably good. There is absolutely no trace of hand capacity, and provided the batteries are in good condition there is no drift in the tuning; the Melbourne transmission was held for over half an hour without touching the controls. There is no interaction between the aerial and the loud speaker leads; it so happens that the "Aerial" and "L.S." terminals are adjacent on the terminal panel, an arrangement which would immediately show up the presence of H.F. in the loud speaker leads.

The set as a whole reflects great credit on the development department of the Burndept works. The disposition of the parts has been well thought out, the workmanship is clean, and the wiring extremely neat.

In conclusion a word of praise is due to the instruction booklet, which not only gives full details of the circuit and many useful hints on tuning, but also contains a special section at the end for the information of service engineers abroad.

The price of the Empire Screened Four is £25, exclusive of royalty, valves and batteries. The valves and additional equipment for "super-power" operation cost about £17 10s., but a cheaper equipment is available for those who do not require superlative loud speaker reproduction.