CONVERTING BATTERY PORTABLES TO MAINS OPERATION

By MICHAEL J. DUNN

If you have an old battery portable superhet with octal valves and conventional wiring, it may be given a new lease of life by being converted to mains operation. Our contributor describes the necessary steps for typical receivers of this class

THERE ARE A GREAT NUMBER OF OUTDATED superhet battery portables about, using the now obsolete range of valves with octal bases (DK32, DF33, DAC32 and DL35 or their equivalents). Many readers, their relatives or their friends, may have such a set stored away or discarded; alternatively, they frequently sell at very low prices in the salerooms and elsewhere. These sets are eminently suitable for conversion to mains operation because the valve base connections are materially the same as those in the mains superhet series 6K8, 6K7, 6Q7 and 6G6—all of which, if not already possessed by most constructors, are otherwise freely and cheaply obtainable from advertisers. The basic circuitry of the set itself requires little or no alterations or additions and, furthermore, the final process of alignment is simplified by the fact that, at most, only a small amount of trimming is required in the aerial and oscillator circuits to offset the small change of inter-electrode capacitances given by the new valves. For these reasons not only can one make a good and very compact mains superhet transportable very economically, but the process also offers an excellent opportunity for the comparative beginner to identify the salient features of a simple superhet circuit and to get it going without complicated alignment procedure.

Although it is not absolutely essential for the battery set to be in working order this is most desirable, and it is a very good plan to try and get it going as such before embarking on the conversion, so as to eliminate any faults outside the actual parts undergoing modification.

The class of receiver to be converted will almost certainly have a frame aerial; some constructors may prefer to substitute a ferrite rod and this can easily be done but will put up the costs. Alternatively a dual-range aerial coil may be fitted, and this will require some sort of external aerial. On the whole the best plan is to use the existing frame aerial as this not only means that no extra expenditure is involved but it also satisfies the existing conditions of the set's input circuit. The oscillator coils and i.f. transformers will be left *in situ* and require no alterations.

The Conversion—General Considerations

(1) The fundamental addition to the set is the provision of a cathode circuit for each valve in place of the directly heated filament circuit which served for the battery valves.

(2) In the battery circuit, negative bias for the grid of the output valve is almost certainly derived

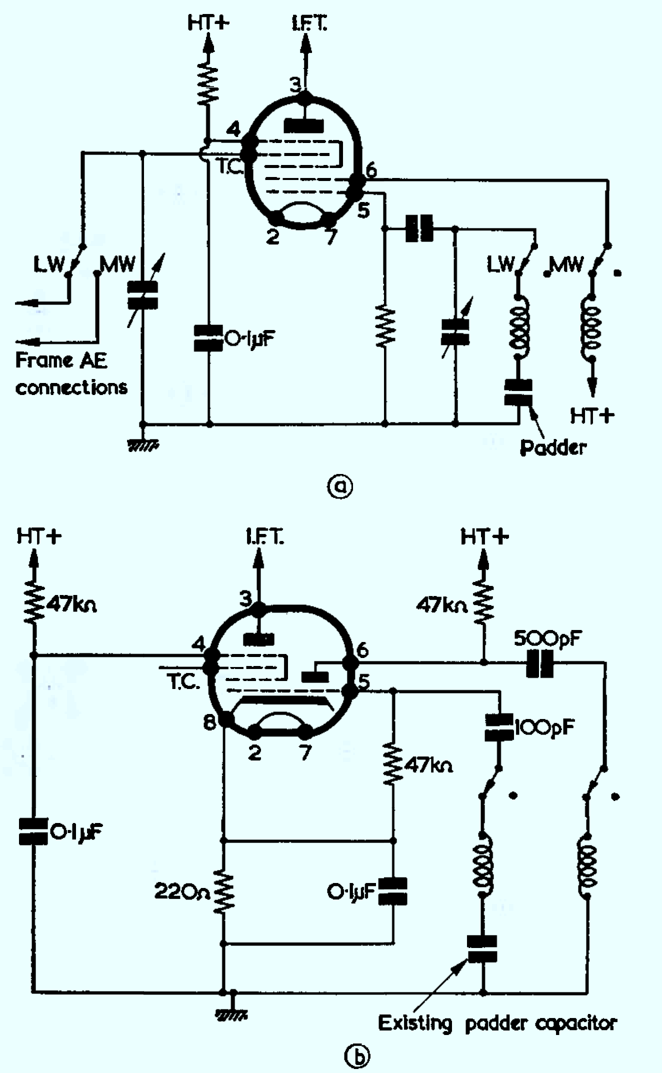


Fig. 1 (a). Stage 1. Original battery circuit using a DK32 valve and (b) circuit after conversion for use with 6K8

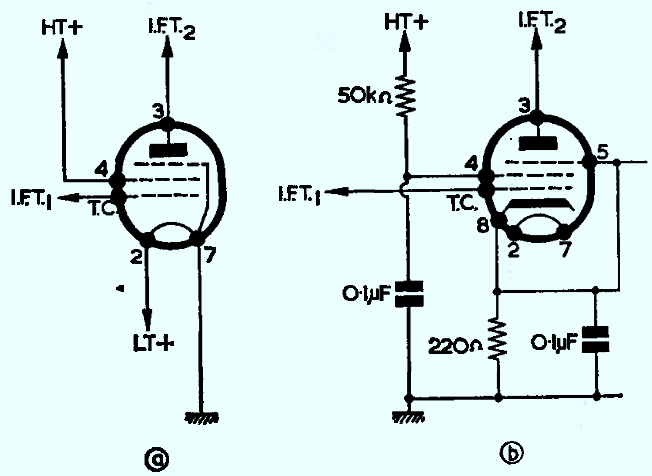


Fig. 2 (a). Stage 2. Original battery circuit using a DF33 and (b) circuit after conversion for 6K7

from a dropper resistor in the h.t. negative lead, this being shunted by a capacitor. These two components can be removed and the h.t. negative lead connected direct to chassis; the new indirectly heated valves will then get their bias from their cathode resistors.

(3) Some alterations will be required in the h.t. positive circuit to allow for the increase in potential required by the mains valves. Most of these modifications will be discussed in the stage-by-stage description which follows, but one important factor applies to the set as a whole and is best dealt with at the outset. All capacitors connecting to the h.t. positive circuit should be checked to ascertain their working d.c. voltage, as in some sets this will be too low at, say, 150V working. This mainly applies to such capacitors as screen grid decouplers. These should be replaced, if necessary, with components rated at 350V working. The question of working voltage particularly applies to the coupling capacitor between V_3 (diode triode) anode and V_4 (output pentode) grid. As this must be a really reliable component it is probably best to renew it in any case. Any 0.1μF capacitors which are removed for low working voltage can be tested, and if found satisfactory, can be re-used as cathode bypass capacitors for V_1 (frequency-changer) and V_2 (i.f. amplifier).

(4) The valve base connections correspond closely between the two series of valves, but the following points should be noted.

(*a*) Pin No. 1 of all mains valves connects with any external metal shell fitted, and should be connected to chassis.

(*b*) Pins 2 and 7 originally connect with the filament of the battery valves and require no alteration for the 6.3V heater supply. If one side is connected to chassis, this may remain so.

(*c*) Except for V_1, the mains frequency changer, pin 6 has no internal connection and with the mains valves, may be used as an anchor tag.

(*d*) The new cathode connection, pin 8 on all-mains valves, has no function in the battery valves and in some sets may be found to have been used as a tag for other connections. If so, the wires should be disconnected and anchored to a single insulated tag which may be conveniently secured by one of the bolts holding the valve base, or by any other adjacent bolt.

We are now in a position to discuss the modifications stage by stage.

The Frequency Changer (V_1 6K8 Fig. 1(b)).

Pin 8, Cathode. Requires 220Ω ¼W resistor to chassis bypassed by 0.1μF capacitor.

Pin 6, Oscillator anode. Originally connected through coil direct to h.t. positive. The modification requires the insertion of a 47kΩ ½W resistor in the anode circuit to drop the h.t. potential and this is best achieved by (*a*) connecting the resistor from h.t. positive to pin 6, (*b*) inserting a 500pF capacitor between pin 6 and the upper end of the coil, and (*c*) connecting the lower end of the coil to chassis (i.e. the end originally connected to h.t. positive). This alteration is suggested because

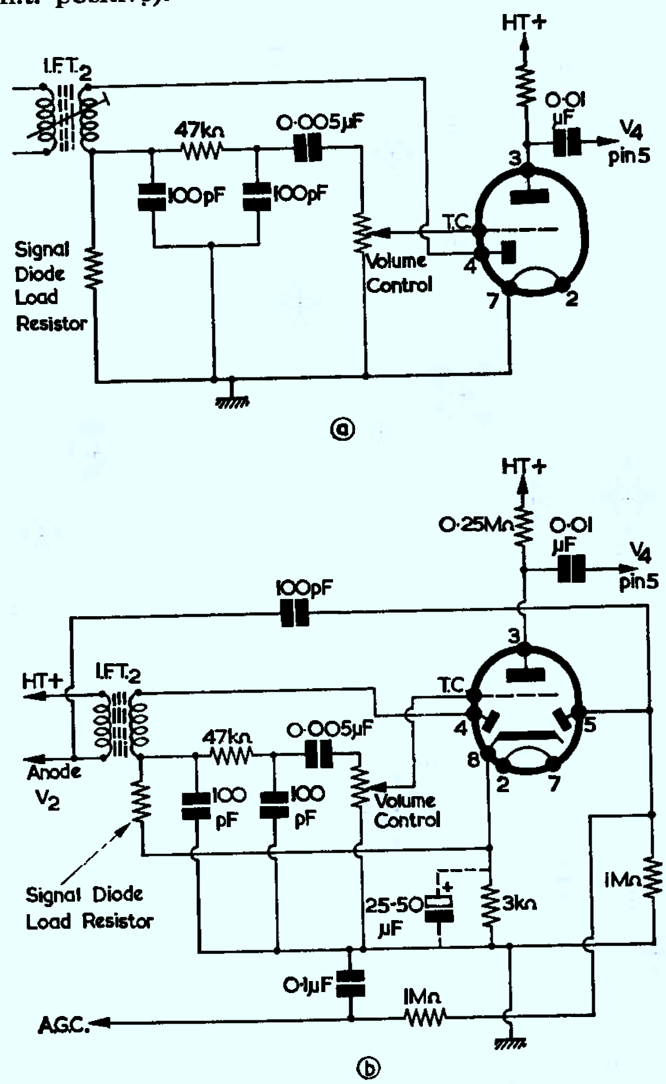


Fig. 3 (a). Stage 3. Original battery circuit with DAC32 (a.g.c. components not shown) and (b) modifications required for 6Q7 in at least one set the writer failed to get consistent oscillation by leaving the coil in the h.t. circuit, but found that it worked perfectly after the above modification had been carried out.

Pin 4, Screen-grid. If the existing resistor is not in the region of 47kΩ ½W, it should be changed to this value and a 0.1μF capacitor, 350V working connected between this pin and chassis.

No other changes to this valve base are required.

The I.F. Amplifier (V_2 6K7 Fig. 2).

Pin 8, Cathode. Requires 220Ω ¼W resistor, bypassed by 0.1μF capacitor.

Pin 4, Screen-grid. 47kΩ ½W resistor to h.t. positive and 0.1μF capacitor to chassis. One word of caution is needed here. In some sets the DF33 will be found to have its screen-grid connected direct to h.t. positive and in these cases pin 4 may be used as a general h.t. distribution point. The leads so connected will then have to be removed, whereupon they can conveniently be transferred to pin 6, which is vacant, and the 47kΩ resistor connected between pins 4 and 6.

Pin 5. Suppressor grid. Connect to pin 8.

No other modifications are required for this valve base.

Detector and First A.F. Stage. (V_3 6Q7 Fig. 3).

This probably calls for more detailed attention than any other stage because of the complication of the a.g.c. circuit, but the beginner need suffer no undue anxiety and the modification will be found to be quite instructive. The problem to be solved is the fact that, with the battery DAC32, a single diode does duty for both signal detection and provision of an a.g.c. potential. The indirectly headed valve type 6Q7 requires cathode bias and, as the original diode load is returned to chassis, this modification could impose a delay

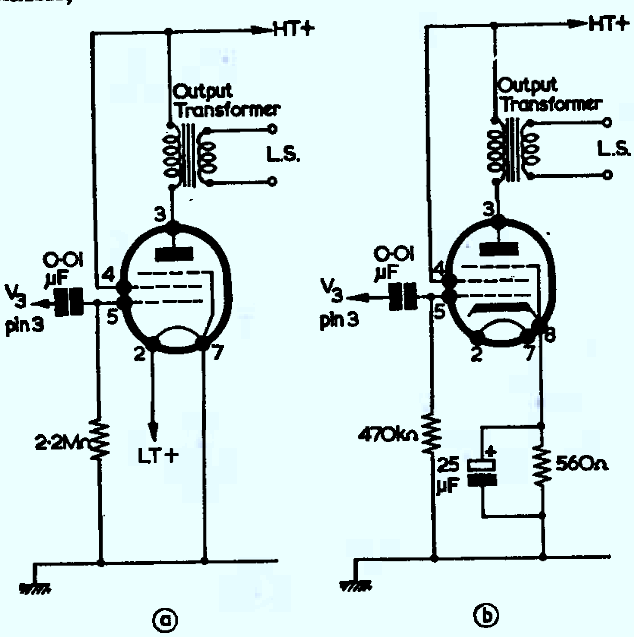


Fig. 4 (a). Stage 4. Original battery circuit with DL35 and (b) circuit after conversion from 6G6

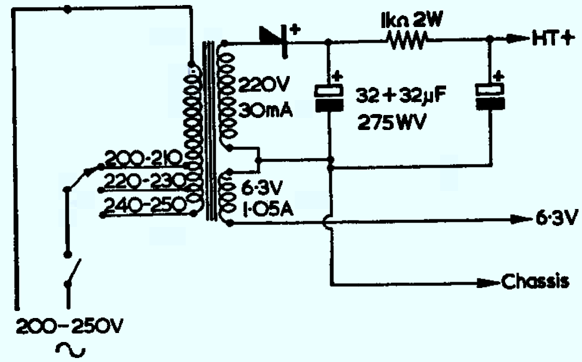


Fig. 5. Circuit of a suitable power supply

bias on the diode so that it would rectify weak signals either improperly or not at all, giving rise to poor sensitivity and distortion. Such a delaying potential is, however, useful in the a.g.c. circuit and, as the 6Q7 has two diodes, the two functions may be conveniently separated. The original a.g.c. line should be identified, traced to its source and temporarily disconnected. The subsequent modification of this stage may then be carried out in the following manner:

(1) Locate the chassis end of the signal diode load resistor and transfer this connection from chassis to pin 8 of the valveholder—the cathode. (Detector diode is pin 4.)

(2) Insert a 1MΩ ¼W resistor between d_2 (pin 5) and chassis and reconnect the a.g.c. line to this pin via a 1MΩ resistor, if the latter is not already present.

(3) Either join the two diodes (pins 4 and 5) via a 100pF capacitor or place this capacitor between V_2 anode and d_2 (pin 5). The latter is probably the better course and is that shown in Fig. 2 (*a*).

(4) Insert R_k, 3kΩ, between pin 8 and chassis together with a bypass capacitor of 25-50μF, 12V working. (This capacitor is optional.)

(5) Make sure that the anode load resistor is of the correct value. This should be around 0.25MΩ ¼W and the original may be found to be too high. The coupling capacitor between the anode of V_3 (pin 3) and the grid of V_4 (pin 5) should be rated at at least 350V working and be leak-free.

Output Stage (V_4 6G6 or other suitable valve. Fig. 4)

The writer chose a 6G6 valve because it has very modest power requirements and is obtainable very cheaply. For a small set of this kind it is found to be completely adequate and it is important to avoid the dissipation of too much heat inside the small cabinet. Furthermore, the relatively low I_k of this valve makes the design of the power pack very simple and minimises the current passing through the primary winding of the output transformer. The alterations to this stage are quite straightforward and present no difficulties. See Fig. 4. A bias resistor of 560Ω is suitable for the 6G6, but if another valve is chosen the correct value of R_k should be obtained from the relevant valve data. The inclusion of a 25 or 50μF cathode bypass capacitor will make the set noticeably more lively. The grid leak, between pins and chassis, should be reduced, if necessary, to 470kΩ ¼W.*

Power Supplies

The power supply requirements for the mains circuit using the 6G6 output valve are 200 volts h.t. at approximately 30mA, and 6.3 volts heater at 1.05A. Under these conditions, h.t. smoothing can be carried out quite satisfactorily with a suitable resistor, a choke being unnecessary. It is preferable to use a mains transformer having a separate h.t. secondary winding in order to give isolation from the mains supply. A suitable circuit is shown in Fig. 5, in which the rectifier may be a "metal" or contact-cooled component.

Many battery portable superhets have no provision for isolating the chassis (and speaker frame) from contact by the user and, in consequence, it is normally undesirable to employ power supply circuits which would cause the chassis to have the same potential as one side of the mains supply.

In a number of portable receivers, the on-off switch is ganged with the volume control, and a switch of this type may be employed for switching the mains input after conversion. Other receivers have the on-off switching incorporated with the wavechange circuit. In such instances a separate toggle switch will need to be fitted to the receiver cabinet to provide on-off switching. Alternatively, and provided there is sufficient space on the receiver chassis, the existing volume control may be replaced by a component incorporating an on-off switch.

* It may be necessary to add a capacitor having a value around 0.002μF in parallel with the output transformer primary to reduce shrillness. Also, if the existing output transformer is to be retained, it would be preferable not to employ output valves having anode currents greatly in excess of that of the 6G6 as such valves would increase the risk of primary winding burn-out.—EDITOR.

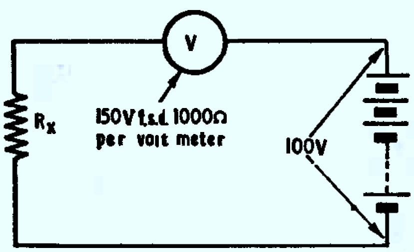
Voltmeter Measures Resistance

By R. F. Thorpe

IT IS NOT GENERALLY KNOWN THAT A VOLTMETER may be used to measure resistance in quite a simple manner. This is done by employing the formula:

$$R_X = \frac{R\ (E-E')}{E'}$$

where R_X is the unknown resistance, R is the meter resistance, E is the applied voltage and E′ is the meter reading.



If, for example, we connect a 1,000Ω per volt, 150 volt f.s.d., meter as shown in the accompanying diagram, we have R=150,000Ω and E=100 volts. Should we obtain a meter reading of 10 volts then,

$$R_X = \frac{150{,}000\ (100-10)}{10}$$

$$=1{,}350{,}000\Omega$$

The process of reasoning used to arrive at the formula is as follows:

$$\frac{E}{E'} = \frac{R+R_X}{R}$$

$$\therefore ER = E'R + E'R_X$$

$$\therefore -E'R_X = -ER + E'R$$

$$\therefore E'R_X = ER - E'R$$

$$\therefore R_X = \frac{R\ (E-E')}{E'}$$

"FOLIAC" CONDUCTIVE CEMENT—NO.L.719

This new product from the Dispersions Division of Graphite Products Ltd., Point Pleasant, Wandsworth, London, S.W.18 (Telephone Vandyke 6422), is a ceramic cement containing a dispersed metal filler.

As a cement it will make strong joints between most metals and other materials such as silicon carbide, graphite and ceramics. Joints are substantially unaffected by temperatures up to 600°C and can in fact withstand 1,000°C for short periods. What is unusual about it is that, by virtue of the metal in its composition, it is a good thermal and electrical conductor. The electrical resistivity of a bar of the cement is 6.56×10^{-4} ohms cms.

Many applications can be foreseen for this new cement in the electric, electronic and engineering industries.