Economy Measures *for* All-Dry Receivers

By R. J. CABORN

NOW that the warm days have been with us for some time, the portable radio has come into prominence in many domestic circles. This is particularly true, of course, of the all-dry and the "personal" portable, as both these sets enjo the advantages of being completely self-contained and of using batteries which may be easily replaced without any risk of mess or damage.

Unfortunately, these all-dry receivers have one disadvantage: a high cost of upkeep. Although manufacturers do their best to utilise circuits which entail minimum current drain, the batteries still wear out; and it is an irritating, but true, fact that the smaller the battery, the greater its price and the shorter its life.

In this article the writer points out methods of obtaining a longer life from these batteries; and touches also upon arrangements which may be made to take advantage of external supplies, should the receiver be operated at home and not as a portable.

The "Life" of the Battery

To obtain a clear picture of how we may extend the apparent "life" of the batteries let us first of all analyse the losses in receiver performance which occur as the batteries wear out with normal use.

The first thing to note is that the internal resistance of the batteries (particularly that of the HT battery) increases with use. Amongst other things, this increase can cause reduced output owing to the fact that the output valve is not feeding into an impedance represented by the speaker transformer primary alone, but into a load given by the primary *and* a series resistor equal to the internal resistance of the battery itself. See Fig. 1. The effect of the increased internal resistance is most noticeable in the output anode circuit, since this deals more with changes in current than do the other anode circuits in the set.

Secondly, the increase in internal resistance of the HT supply has the effect of introducing instability, insofar as the anode circuits become badly decoupled to chassis; the result being either reduced performance or actual oscillations.

In the third place, low HT voltage may cause the oscillator to cease functioning on one or more wavebands. This occurs fairly readily in some cases, giving us a receiver which is still capable of excellent results at the reduced battery voltages existing, were it not for the fact that the oscillator had stopped working.

Fourthly, the LT circuits should be considered. Although there is not really much that one may do to reduce LT consumption, one or two hints are, nevertheless, given below.

Fifthly and finally, there is the apparent reduction in battery life given by the fact that the particular receiver is faulty, due to incorrect alignment, unserviceable valves and

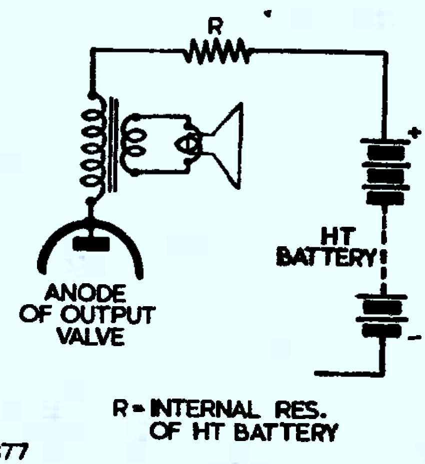

Fig. 1: Illustrating how the internal resistance of the HT battery may reduce the efficiency of the output anode circuit.

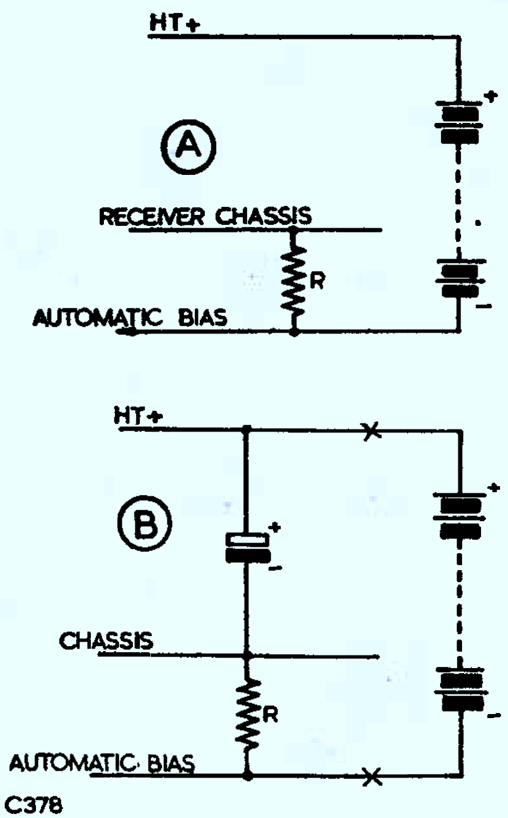

Fig. 2 (a) : The method used in many receivers to supply HT and automatic bias.

Fig. 2 (b) : How the HT supply may be decoupled (The crosses mark alternative points at which the battery may be switched).

so on. Obviously enough, in this case, the set should be overhauled, whereupon it would be able to work properly over a wider range of battery voltages than occurred previously.

HT Decoupling

We picked as our first example the reduction in performance given by the increased internal resistance of the HT battery. The cure for this is simple : a large value capacitor connected across the HT supply. It is really surprising to find how many commercial receivers do not use such a capacitor, when its inclusion nearly always gives a very noticeable increase in performance, particularly when the batteries are beginning to wear.

Before the additional capacitor is fitted, however, it is necessary to examine the circuit layout of the receiver. Owing to the small size and compact design of most portables it is usually best to use an electrolytic component, and this type of capacitor cannot of course be left permanently connected, as the slight current drain it causes would shorten the life of the HT battery. Also, it would be advisable to give a little thought as to *how* it may be connected, since the HT negative line is seldom taken directly to chassis.

Fig. 2 (a) shows a popular circuit in which the negative terminal of the HT battery is connected to chassis *via* a resistor R, in order to give a source of automatic bias. The HT supply is decoupled in a case of this sort simply by connecting the additional capacitor as shown in Fig. 2 (b); that is, between HT positive and chassis.

At first sight, the circuit of Fig. 2 (b) may not appear to give an effective solution to the problem owing to the fact that the resistor R is still in circuit and may act as a common load for the HT returns of all the stages in the receiver, thereby causing instability or negative feedback to the output stage. In practice, these faults do not occur, since the returns of the various anode loads are taken, *via* the additional capacitor, to chassis, and not to HT negative. As the cathodes of the valves are also taken to chassis all amplification in the receiver is carried out between the HT positive line and chassis, the additional capacitor ensuring that there is an easy path between these points and that no signal voltages appear elsewhere. The resistor R therefore acts only as a DC dropping resistor, and no signal voltages are built up across it.

The same holds true for almost every type of all-dry receiver in which HT decoupling is required, it being effected simply by connecting the capacitor between HT positive and chassis.[1]

As was mentioned before, the additional capacitor used for the decoupling is electrolytic, and it should have a value of 5 to 10μF at around 150 working volts. A capacitor of this size will be quite small in size and it should be able to fit into all but the most compact of receivers. There is no need to worry about its positioning on the chassis as it may be mounted at any convenient point. The connecting leads need not be kept very short; although it is advisable to run them over the most direct route.

The inclusion of the extra decoupling capacitor will, of course, necessitate switching off the HT battery when the receiver is not in use. The HT circuit may be broken in either lead from the battery (as shown at the points marked with a cross in Fig. 2 (b)) and this may incur a little rewiring at the on-off switch of the receiver.

Apart from increasing the efficiency of the

1. This is not necessarily true for AC/DC/Battery sets which may utilise a different method of decoupling. Usually, however, these sets have electrolytic capacitors connected permanently across the HT supply, whether they are switched to "mains" or "battery".

output stage, the additional capacitor will also, of course, remove any tendency towards instability which may be caused by increases in the internal resistance of the HT battery.

It must also be remembered that the use of the capacitor does not, of course, increase the life of the HT battery ; instead, it enables the receiver to work when this has dropped to a lower voltage (very often, a *much* lower voltage) than would otherwise be the case.

The Oscillator

The effect of reduced HT and LT voltage sometimes causes the frequency changer oscillator to stop working, whilst the rest of the set is still capable of giving good results. The symptoms of oscillator failure are given by the fact that the set suddenly goes "dead", although the rest of the receiver seems quite "lively". Increasing the supply voltages will usually cause the receiver to start working again.

This failure usually points to a faulty oscillator valve and this should be replaced before anything else is suspected. 1.4 volt frequency changers are notoriously "fussy" as regards oscillator voltages and they wear out fairly quickly.

Cessation of oscillations often occurs on one band only. This does not necessarily point to a failure in that particular band ; (although, of course, the wave change switch and the appropriate coils and components should be examined for faults). Instead, it often means that the oscillator is *just* managing to work on the other wave bands and that the whole circuit, or the valve itself, is at fault.

If replacement of the oscillator valve does not remove the trouble, and the coils, wave-change switch and so on are above reproach, the next thing to look for are faults of a general nature. The connections to the oscillator should be examined as, also, should the insulation of the appropriate components. To take an example, it only needs a small amount of dirt on the oscillator valveholder to cause losses sufficiently large to stop oscillation. Cleaning the valveholder, the wave change switch and any other oscillator components with carbon tetrachloride often removes dirt and grease which is invisible to the eye. It must be remembered that the value of the oscillator grid leak in these sets is often as high as 0.25 to 0.5 Meg Ω, so small leaks caused by dirt, etc., can therefore have very noticeable effects.

Occasionally, although the writer does not necessarily recommend this course, the performance of the oscillator may be improved by altering the values of the grid leak and

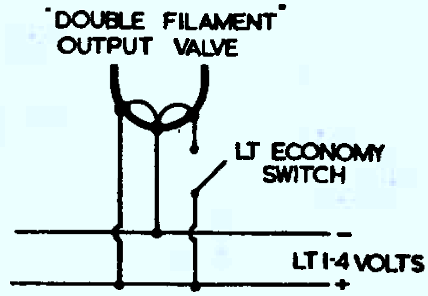

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Fig. 3 : A suggested method for effecting an economy in LT current.

grid coupling capacitor. If either of these are increased, it should be found possible to maintain oscillations at lower battery voltages. If, however, the values are increased too much, the oscillator is liable to "squeg" on the resumption of full voltages. Squegging will be evident as a strong hiss either all over or on part of one of the bands.

The LT Supply

As was stated above, there is really very little that can be done to increase the life of the LT battery. When the receiver is being used constantly the LT battery may polarise fairly rapidly and give an apparently shortened life. In this case, it is often worth while leaving the battery in a fairly warm place (room temperature is quite sufficient) for a fortnight or so whilst another battery is used in its place. It may then be found that the first battery will have become depolarised and should be capable of a further lease of life. (The old "dodge" of popping a worn-out battery in the oven (!) or near the fire can hardly be recommended).

A small saving may be effected if a double filament valve (such as the 3Q5) is used in the output stage. An "economy" switch could then be fitted as shown in Fig. 3, it being used to cut out one of the filaments at times when the set is only required to play quietly. However, the use of this switch may cause the life of the filament always in use to be slightly shortened, since it carries all the cathode current when the switch is in the "economy" position. Nevertheless, with the average four valve superhet, a saving of 20% of the total LT consumption can be given by this means.

Using External Batteries

A considerable saving in the cost of running the smaller type of all-dry portable can be obtained if the receiver is connected to external, full-size batteries when it is not actually in use as a portable. That is to say, unless the set is being utilised for such things as picnics, outings, etc., its internal batteries may be disconnected and the set worked from an external and cheaper source of supply.

This, admittedly, leads to a certain amount of inconvenience, which will have to be reduced by the constructor as he may best think fit. For instance, it can hardly be considered worth while fiddling with the plugs and sockets of the internal batteries every time such a change is required ; and so a little ingenuity may be required.

A very neat way of effecting the change-over is given by fitting a small socket to the back of the set, in company with a switch which connects the receiver either to the internal batteries or to the socket. When the set is used in the home a plug connected to the appropriate external supply is fitted to the socket and the switch is set to "external". Should the set be wanted in its portable form the switch is returned to "internal".

A full-size 120 or 90 volt HT battery, or a mains eliminator may be used for the external HT supply. The LT voltage could be given by a really heavy 1.5 volt battery (such as three or four "bell" batteries in parallel) or, much cheaper, by a two-volt accumulator in series with the appropriate value of resistance.[1]

If these external supplies were fitted in a box or cupboard with a neat connecting wire leading to the plug for the back of the receiver, they would not detract from the appearance of the room in which they were installed; and they would enhance the usefulness of the portable receiver. They would also give rise to a considerable economy in its running.

1. The value of resistance used should be capable of dropping the 2 volts supplied by the accumulator to 1.4 and *not* 1.5 volts. Thus a receiver whose LT consumption is 250 mA would require a series resistor equal to $\frac{2-1.4}{0.25}$ ohms, that is, 2.4 ohms.

ANSWERS TO QUIZ

(1) Mr. Brain forgot to check the resistance of the headphones which, like many of these ex-Service types, were low impedance and quite unsuitable for a crystal set without a matching transformer.

(2) Switch both mains leads. Use three-pin plugs to ensure correct connection to the mains, i.e., neutral lead to chassis. Enclose the set completely in a cabinet of insulating material, with no trace of metal outside. Avoid metallic escutcheons and loudspeaker grilles. Use bushed knobs so that no bare shaft is exposed. Grub screws should be driven deeply beneath the surface of the knobs and the holes filled with hard wax to cover the screwheads. Chassis fixing bolts through the bottom of the cabinet should have the heads insulated in some manner. There should be no direct connection from chassis to earth. The aerial coil must be isolated from chassis and from the grid coil, or the aerial connected via a small capacitor (mica) of adequate voltage rating. Neither conductor of a co-axial or twin-feeder dipole feeder should be connected to chassis. The output transformer secondary, and any extension speaker leads, to be isolated from chassis. (Voice-coil negative feedback connections can cause extension leads to be "live".)

Remember that the chassis and everything connected to it may be "live"—even when the switch is in the "off" position.

(3) Wrong. Only second-harmonic is eliminated in the output stages, which is unfortunate because third-harmonic is the most offensive to the ear.

(4) To prevent loss of gain through negative current feedback, by bypassing feedback voltages set up across the cathode resistor. At audio frequencies, it also bypasses any hum which may be developed across the same resistor.

(5) Right. The signals at the anodes are in opposite phase and no instability is likely. This is only true so long as the amplifier is used alone; a pre-amplifier would need to be well decoupled before being used with the amplifier.

(6) Generally the line scan amplifier, line output transformer, and flyback EHT sections are responsible for radiation, which can influence broadcast receivers within a short distance. Such interference does not seem to occur frequently, and it is easily cured by attention to screening.