An old way around a new dilemma —

Simulating High-Z Headphones

From the early days of "wireless" a pair of high impedance headphones has been vital for the would-be experimenter with crystal sets and other elementary circuits. There's just one problem these days: you virtually can't buy them!

by WALTER NEVILLE

High impedance headphones have varied a good deal in appearance but they have almost invariably used the same basic principle.

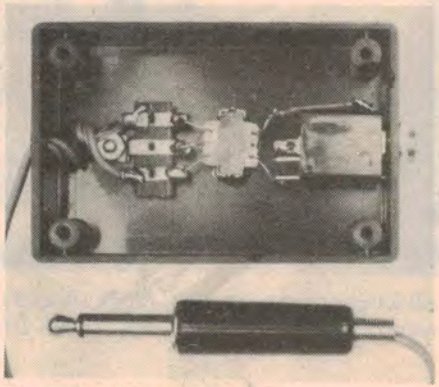
Each phone involves a cup (usually moulded) in which is mounted a small permanent magnet, with an iron polepiece at each end. Across the open face of the cup is clamped a thin steel diaphragm, all dimensions being arranged so that the inner surface of the diaphragm is just clear of the polepieces. Because the polepieces are attached to a permanent magnet, they attract the diaphragm and hold it under slight inward tension.

Around each pole piece is wound a coil of wire, through which the audio signal current is passed. Passage of an audio current modifies the magnetic attraction of the polepieces for the diaphragm, so that it tends to vibrate. In so doing it disturbs the adjacent air, producing sound waves in sympathy with the signal current through the coils.

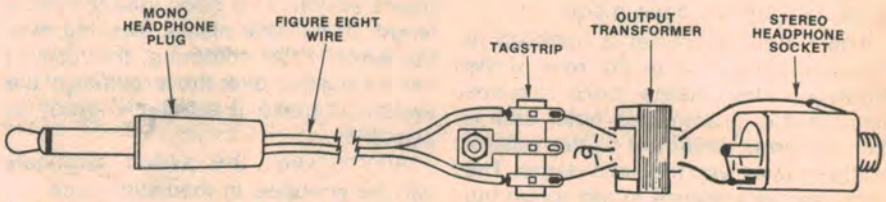
Because the coils are stationary, they can be wound with a large number of turns of fine wire, and can present a quite high impedance, nominally of a thousand ohms or more. When the coils in the respective earpieces are interconnected to one pair of flexible output leads, they commonly present a nett nominal impedance of around 2000 ohms. In practice, any headset with an overall impedance of anywhere from 1000 to 4000 ohms would qualify for description as a"high impedance" type.

Impedance is important in a headset to be used with a crystal receiver or with elementary 1 to 2-valve or 1 to 2-transistor receivers. The reason is simply that the audio signal currents produced by these receivers are very small and only by passing them through a fairly high impedance transducer can they produce enough acoustic energy to be heard.

In terms of fidelity and distortion, these traditional "magnetic" headphones have never been very marvellous but they are sensitive to small signal currents, they are traditional, and their use is assumed in a lot of older and ex-disposal type receivers and transceivers.



There is plenty of room to spare, even inside the smallest Jiffy box!



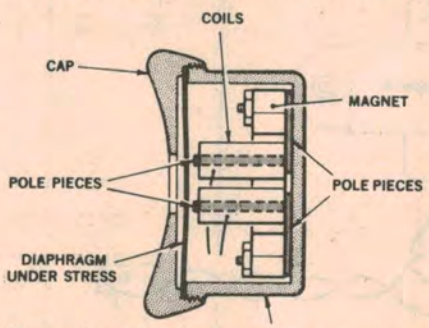
The wiring is simple but check the connections to the stereo socket, in case they differ from the one we used. See text re. wiring the phones in series or parallel.

The only trouble is that they seem to have disappeared off stockist's shelves!

Any number of headsets are available, of course, at a variety of prices. However, they are mostly "dynamic" types with miniature dynamic speakers mounted inside the earpieces. They are all intended for stereo listening and are all rated at 8 ohms or thereabouts. They work fine with stereo signals from a hifi system, but they are a poor proposition, as is, for the would-be experimenter with elementary receivers.

When we queried a few suppliers about importing conventional high impedance phones they suggested that, even if they did manage to locate some, they would have become a "specialist" line at a specialist price!

The best we could turn up was a limited supply of ex-military headsets from disposals sources. A.C.E. Radio in Marrickville, NSW have some at $3 per headset, plus $1 P&P in NSW and $1.75 P&P interstate. They are second-hand, the cords may need repair and they are of only medium impedance, but they are a reasonable proposition for the beginner/experimenter.



Illustrating the basic principles of the old-style magnetic headphone. The coils could easily be wound to present a high impedance — typically about 2000 ohms.

What about the tiny crystal earpieces, that are intended to plug into one ear? They can be used provided the circuit is arranged to suit them, but they are not very sensitive and they fall out of the ear at the slightest provocation! In most situations, they are a poor substitute for a real headset.

Fortunately, all is not lost and one can assemble the little adapter pictured here which can make any 8-ohm stereo headset behave in the manner of a mono headset of much higher impedance.

Heart of the unit is a miniature output transformer which connects between the crystal set (or whatever) and the 8-ohm phones. Physically, the primary winding connects to the receiver, via a short piece of twin lead,

normally by way of a conventional 6mm mono jack plug or one of the modern miniature equivalents.

The secondary (or 8-ohm) winding connects to the stereo phones, normally with both channels wired in parallel — achieved by bridging the two active lugs on the stereo headphone socket. (See diagram).

The transformer which we used came from Dick Smith Electronics and is shown as "1-k ohm CT to 8 ohm", catalog number M-0216, $1.00. Tandy list a transformer with the same ratio (catalog 273-1380) while similar products would almost certainly be available from other suppliers. Again, a suitable transformer could possibly be rescued from a discarded transistor portable of the older type; it doesn't even have to be a miniature component, provided it has a step-down ratio of the same general order.

Taking the figures "1k ohms to 8 ohms", the impedance ratio is 125:1. If the two tip segments of the stereo jack are bridged to put the phones in parallel, and if the phones are really 8 ohms each, their parallel impedance will be 4 ohms. Multiplying this by 125 gives an apparent impedance across the primary winding of 500 ohms, which should be adequate for most circuits requiring "high impedance" phones.

If you want to achieve a still higher impedance, it can be done very simply by ignoring the barrel of the stereo jack and connecting the transformer secondary to the two end segments. This puts the phones in series, produces a combined impedance of 16 ohms and a nominal impedance across the transformer primary of 2000 ohms. Acoustically, it means that the phones will be out of phase but, if it makes the signal louder with a crystal set, you'll probably prefer it that way!

CONSTRUCTION SIMPLE

There is not much to building up the adapter. We used a Jiffy box from Dick Smith Electronics measuring 80mm x 50mm x 28mm, but the shape and size is quite unimportant. The components including the tagstrip were arranged to support the transformer but, to make sure, it was spotted in place with a blob of Araldite.

The distribution of the lugs on the stereo socket may very with the brand supplied but it should be easy enough to identify them by inspection or by checking with a multimeter. For the normal parallel connection, connect one side of the transformer secondary (8 ohms) to the barrel of the plug, and the other side to the two end segments bridged together. The alternative series arrangement has already been mentioned.

As far as the primary winding is concerned, use the two ends and ignore the centre-tap. The polarity of the windings — which ends goes to what — is of no consequence.