A Very Useful Instrument

A Home-made Testing Apparatus

ASK the average radio experimenter what he would like to possess if funds would allow, and he would say something like this: "A nice set of measuring instruments, including a volt-voltage and a milliameter." There is no doubt that a range of high-class instruments gives a set builder more assurance and helps to keep a check on his work. This article deals with the construction of an instrument that has many uses. It tests A, B and C batteries, and has a further use, in as much as it will test each valve in the set under actual operating conditions. It can be used to determine the D.C. resistance of 'phones or loudspeaker, and also to check up resistances and transformer windings. Of necessity a few simple calculations will have to be described, but because of these the writer does not advise the absolute novice to give up the idea of making one.

Anyone who owns a multi-valve receiver will find this instrument a great help in his search for quality. Almost every listener is more or less interested in his receiver, and is constantly on the look-out for hints and information relating to its improvement. Why not do as the expert does and go over everything yourself?

Radio is not so very technical as people imagine. To understand how to check any valve from its published characteristics is not really difficult. To test a battery is less difficult still, and these are the only two parts of a wireless receiver that should decrease in efficiency with use. Therefore, to keep these up to scratch is to be sure of a continuance of the results obtained when the set was first installed. Keeping a check on the valves is of importance when it is realised that one faulty one in the set makes the whole receiver no better than that valve. It can be likened to a claim that is no stronger than its weakest link. Because the valve lights is no indication that it is working efficiently. In the case of the old bright emitter, the thin metallic filament gradually decomposed, and the electron stream was made by the filament itself.

The filaments of the more recent dull emitters are coated with an element called "thorium," and it is this, when at a dull red heat, that throws off electrons similar to those of the bright filament. If this dull red heat is exceeded at any time the thorium is liable to boil away, leaving the thin metallic filament on which the thorium was suspended. When in this condition the valve will light, but is absolutely useless in a receiver.

To weed out these parasites and substitute new valves will increase the general efficiency of the set three or four hundred per cent.

Use of Power Valves.

MUCH has been said recently on choosing a large enough power valve for the last stage. Overloading is the chief cause of unfaithful reproduction. The listener is inclined to blame his speaker. With the aid of the instrument to be described, it will be evident at a glance that the last valve is behaving itself. Adjustments to the B and C batteries can be made until the valve can carry all the load that is asked of it, and then when this is done, the speaker can be criticised.

It will surprise many when they look at the needle of the milliameter shaking about, denoting just when distortion occurs. It is far easier to see the effects of distortion than to rely upon the ear. A person is liable to get accustomed to his particular speaker, and to automatically correct its faults. The human ear can adapt itself to suit its owner, and imagination plays a great part when listening to the reproduction of, say, a singer.

Components for Tester

1 Milliameter (0-100) panel mounting.
1 Valve socket.
1 Double pole double throw switch.
1 100ohm. resistance (wire wound).
1 1000ohm resistance (wire wound).
2 Valve pins and sockets.
4 Terminals.
Ebonite, 9in. x 6in. x 3-16in.
Box as specified.
Connecting wire, flex, etc.

Assembling the Tester.

AN open-topped box has first to be made to house the milliameter and resistances. This also affords protection for the various leads to the milliameter. It can be made from any kind of timber of 3-8in. thickness and measures inside, 9in. x 6in. x 3in. deep. Two small strips can be fastened inside so that the ebonite panel can be slipped in flush with the tops of the sides and ends of the box. In the centre at the top of the ebonite mount the valve socket. This can be done from the top or underneath by drilling a hole large enough to take the valve pins and by fastening the socket with two nuts and bolts. Below this is mounted the double pole, double throw switch.

Refer to the diagram for the position of the milliameter, which should preferably be of the panel mounting type reading 0-100 m.a.

In the centre at the bottom of the panel are fastened the two valve pin sockets with two 1-8in. holes drilled just above. The use of these will be described later. On either side of the panel at the bottom ends are mounted two terminals. To lessen the chances of accident to the milliameter by accidental short circuit, the terminals are preferably of the insulated top type. Some method will now have to be found of mounting the resistances, and it will have to be largely left to the discretion of the builder, depending on the type and make of resistance used. This must be of the wire wound variety capable of passing 100 milliamperes without warming up and altering the resistance. Specify this when buying these components.

Making a Resistance.

IF fixed resistances are unprocurable, variable ones can be used, or they can be made by using suitable lengths of eureka or similar resistance wire wound on a non-inflammable former. If this method is adopted, get the particulars of the wire at the same time as buying. Resistance in ohms per yard is required as well as current-carrying capacities.

For instance Eureka resistance wire No. 32 SWE, has a resistance of 7.35 ohms per yard, and will safely carry 100 m.a. for a short time. A total resistance of 100 ohms can be obtained by using 100 x 7.35 yards of this wire, or 13 yards 22 inches. Wind on a rod of, hard fibre or similar material taking great care that the wire does not stretch. The actual resistance can be checked over afterwards against a known voltage.

The 100 ohm resistance can be made in the same way by winding on a spool ten times this quantity of the same wire. Nichrome wire has a higher resistance per yard than Eureka, so it would be best to use this, and avoid such a large resistance unit. Unless the wire is cotton or silk-covered, do not let adjacent turns touch when winding either resistance, or the reading of the volt meter will be quite inaccurate.

Yet another way of obtaining this resistance is by the use of 200 or 400 ohm potentiometers. A 200 ohm can be used for the low resistance, and three 400 ohm ones connected in series and neglecting one of the side terminals in each case, for the high resistance. These can be mounted underneath the panel and adjusted to the correct value by comparing the voltmeter with a good commercial one borrowed for the occasion. If this is not possible, they can be set if two new 45-volt batteries and a tested 6-volt accumulator are on hand. However, more of this later.

Now take the base of a broken valve. This can be obtained from any dealer if one is not to hand. Clean away all glass and file away the solder on the tip of the pins, cleaning the hole down the centre of each pin. Two lengths of twin flex, about two feet each, are cut, and the four ends soldered in the holes in the valve base pins. One twin lead for the filament, and the other two for the grid and plate lead. Mark