NEW and BETTER VALVES

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tune in the local station without overloading, but then we would not have sufficient amplification for the distant stations. Furthermore, the rate of current would be excessive. Engineers conceived the idea of uniting a power valve and a high gain screen-grid valve in the one, and they have evolved what we now call the variable-mu valve, or as the Americans call it "the multi-mu tube." This type of valve has at the present time several numbers, though it is expected that before long it will be standardised. One maker uses the number "235" and at this we will leave it.

Fundamental Character.

THE fundamental character of the multi-mu or variable-mu valve is the variation in the mutual or transconductance with grid-bias, that providing the valve amplification is controlled, not by varying the screen-grid voltage as before, but by varying the control grid-bias (the real "C" bias) between 3 and 50 volts. Maximum volume is obtained with "C" bias of —3 volts and a minimum at —50. Now to those who know anything about valves it will be apparent that when biased with —3 on the cathode, the valve is operating as an ordinary screen-grid amplifier, but when a bigger voltage approaching 50 is used, it is operating more in the manner of a power valve.

Mechanical Construction.

BEFORE considering the operation of this valve in more detail, we shall look for a few minutes at the mechanical construction. In ordinary valves the structure is uniform and a constant mutual conductance factor (mu) is obtained over the cathode area, but the new valve provides a mutual conductance factor which varies from point to point of the cathode area.

The control grid is divided into two sections which are mounted with a gap between them, but for low negative biases the entire cathode is in operation and the valve has about the same characteristics as it would if the gap were not present; in other words, like an ordinary screen-grid valve. If the grid bias is increased negatively, the electron current to the upper and lower parts of the control grid are cut off, leaving a low mutual conductance control through the gap. There are, however, very many methods in which the control grid may be adapted. The variable mutual conductance factor, however, is generally brought about by a gap in the control grid.

Cross Modulation.

IN the ordinary screen grid valve the signal, in passing through, becomes distorted, because of an increase in the modulation of the signal. This distortion is most evident when a powerful signal is tuned in. It is found that no more than .2 to .4 of a volt a.c. can be applied to the grid of the 224 valve, whereas in the 235 type, as large a voltage as from 4 to 10 may be applied without introducing distortion. This new valve, then, can handle a signal without distortion some 20 times as great as that which the 224 can handle under similar conditions. In the ordinary valve the distortion becomes worse as the input to the valve increases, and this is particularly evident in the 224 type owing to sharp plate cut-off.

Cross-Talk.

CROSS-TALK is commonly caused by the inter-modulation in the r.f. valves between the signals to which the receiver is tuned and a strong incoming signal of a different frequency, thus, when tuned, say, to 2BL on a modern set, operated in Wellington, we can hear 2YA in the background, yet between 2BL and 2YA there is a large dead space. In order to diminish this cross-talk it is necessary to use one or more pre-selective circuits ahead of the first valve, and these cut down the incoming signals to a very large extent.

To compensate for this we must turn our valves up so that they are magnifying at their maximum. The result is that a strong hiss is heard in the speaker. This hiss can be kept down only by operating the valve well below its maximum. As the 235 valve can handle this strong current from the local station without this pre-selection circuit, a normal aerial is used and less valve hiss results.

Application to Present Receivers.

AS the variable-mu valve is of almost similar characteristics to the ordinary 224, it can be used in a socket designed for that valve. However, best results cannot be obtained because of the provision of only a small amount of grid bias, whereas bias must be variable between 3 and 50, if the best results are to be had.

Experimenters can use the valve, for it is necessary only for them to put in a higher valued resistance in the cathode of their screen-grid valve. The volume control for a tuner can be a 20,000 ohms wire-wound potentiometer. When using 235 valves bear in mind that the plate current drain is slightly higher than that of the 224 type, and that when the volume is controlled by varying the control grid the plate current will vary considerably. For this reason it would be really unwise to fit a set designed for the 224 valve with 235 valves without making any alteration to the circuit.

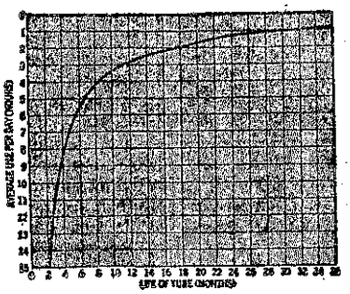
Advantages to be Obtained by Using the 235 Valves.

1. An increase of the maximum allowable input voltage for distortionless operation.
2. Extension of the range of automatic volume control.
3. Reduction of cross-talk by a factor of several hundred times.
4. Improvement in uniformity of control over the entire range of volume control.
5. Reduction of hum or carrier due to incomplete power pack filtering.
6. Reduction in receiver noise due to the possibility of working the valve below its maximum point. The slope can be varied from .08 mamps per volt and the low mu end to approximately 1 mamp per volt at the high mu end, or, expressing this in the American terms, 5 mmhos at the lower end and 1000 mmhoms at the high mu end. The 224 varies from 1000 at the high mu end to 100 at the lower mu end where the valve becomes inoperative.

THIS will Surprise YOU

A Valve's Life is Short and Merry

THis table will give some idea as to whether or not your valves want renewing. Glance along the vertical scale until you see the number of hours you use YOUR set daily, then travel along the line crossing the graph until the curve is met. Now go down to the bottom and see how long your valves should last. If they have been in longer than this they want renewing.



For example, imagine that on three days a week the set goes on at 10 a.m., is shut of at 10 p.m., with four hours of quiet during this time. That leaves eight operating hours. During the remaining hours it is turned on at 6 and off at 10—four hours. The average for a day is approximately six hours. Referring to the chart, we notice that our valves want renewing after six months—that is if only the best is wanted of them. Of course they will go far longer than that, but try another set and note the difference.

Few valves are good after fifteen hundred hours' service. Just jot down the hours YOUR set is in use this week and divide the number into 1500 and see how many weeks your valves are good for. You will be surprised. Just try it and see!