mutual conductance—of the complete output circuit against drive voltage. The ideal would, of course, be a straight line parallel to the input voltage axis (indicating there is no change of gain with input swing), but regrettably this is not the case with designs popular at the moment. To provide a comparison of the different types of output circuits, I have prepared gain plots showing the effects of different bias levels, these being illustrated in Figs. 3 and 4. From these it is now easy to see the characteristic change in gain which can occur during the transfer from one sub-amplifier to the other. Referring to Fig. 3 about a 10% gain change occurs during transfer, whatever the bias level is set at.

The output circuit in Fig. 4 is a quasi-complementary type giving most interesting results. The main conclusion is that it is impossible to bias this circuit for symmetrical gain change and in practice it proves very difficult to establish which biasing point would give the best results concerning the *rate* of gain change.

This method of describing a class B amplifier can give an insight into the problems involved with a conventional design. First, each sub-amplifier has to have two regions in its transfer characteristic:

—the constant gain region (above bias point A in Fig. 2)

—the non-linear region (below this point).

Second, the non-linear region of each sub-amplifier has to be complementary to its partner, otherwise the situation shown in the $g_m$ diagrams (Figs. 3 & 4) will occur. An interesting point is that the only reason why the non-linear region of the transfer curve is important is because the input signal normally traverses this region as well as the linear portion. If this was not the case most of the design problems in class B amplifiers would be solved.

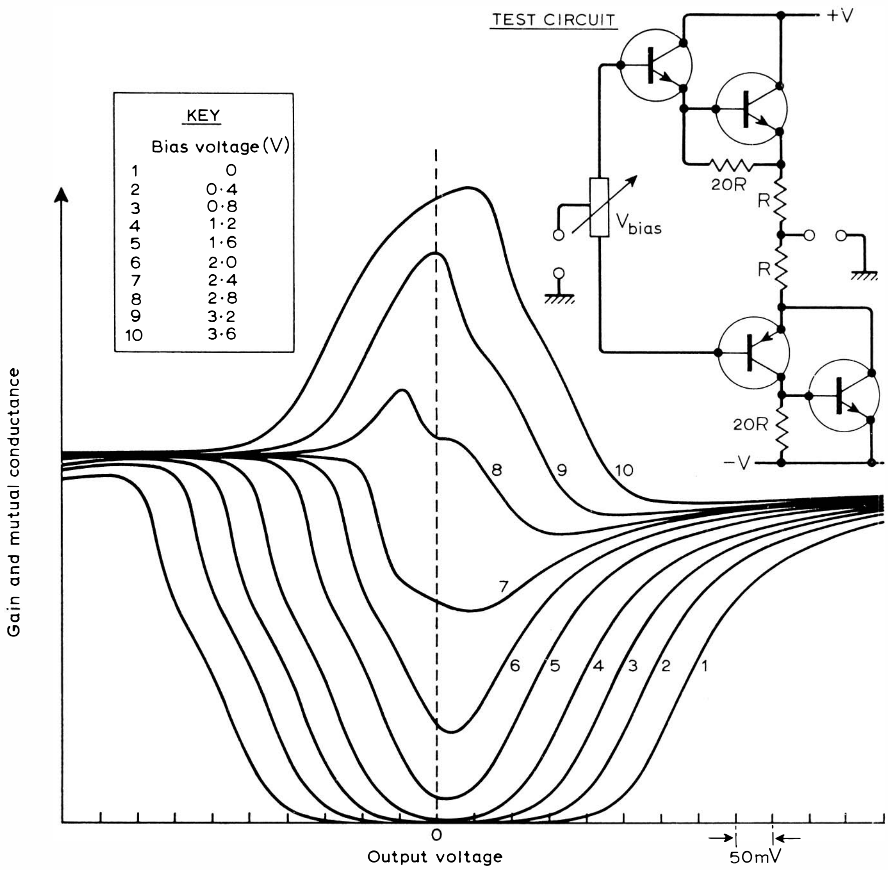


*Fig.4. Curves for quasi-complementary output circuit show impossibility of biasing circuit for symmetrical gain change.*

It is difficult to realize at first that a class B amplifier has to have this non-linear region in the sub-amplifier characteristic so that the two halves of the waveform can be separated. With conventional designs this is a built-in feature, but it need not be so. Assuming we define class A operation to include any amplifier where the input signal never traverses the non-linear region, the sub-amplifiers of a class B amplifier can operate in class A as long as the input signals are uni-directional. To accomplish this the required non-linear element is placed before the sub-amplifier inputs.

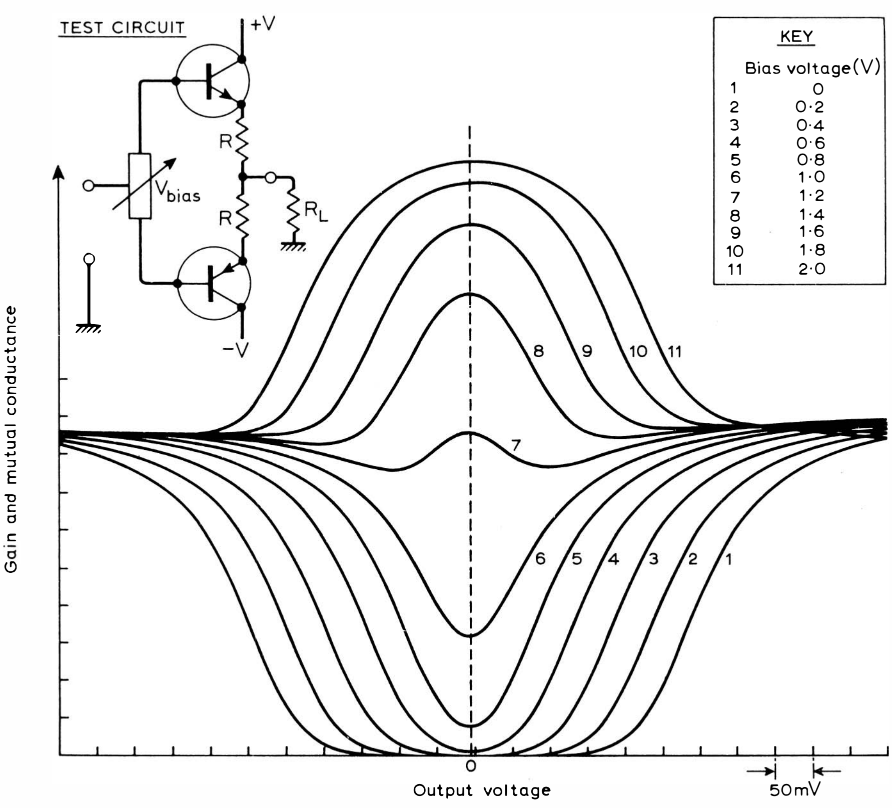


*Fig.3. Gain—or mutual conductance—of simple symmetrical output circuit showing change in gain which can occur during transfer from one sub-amplifier to the other. Effect of different bias levels is shown.*

## New approach

Now the key to the problem is in the proposition that each sub-amplifier should be considered as a separate class A design, hence distortion generated by each of these units can be held to an extremely low level as long as the input signal can be prevented from driving the amplifier into the cut-off region. In the new approach, the output sub-amplifiers are biased *above* the non-linear region and *uni-directional* signals are fed into the input. This arrangement is illustrated in Fig. 5, where the necessary circuit changes are shown by comparison with Fig. 1. The obvious difference is the addition of the two diodes at the input which produce the uni-directional signal to drive the output sub-amplifiers. The linear transfer of signal between the two amplifiers is now dominated by this signal splitter.

**Signal splitter.** As the name implies the task of the signal splitter in a class B amplifier is to segregate the top and bottom halves of the signal waveform. Normally this is achieved by using the non-linear characteristics of each half of the output stage, but as this particular approach leads to