In order to visualize the operation of this circuit consider firstly the situation with V_2 removed. Resistors R_5 and R_9 in series form the load on valve V_1, and the voltage at the point X will be in proportion to the voltage at the grid of V_3. When V_2 is replaced, the voltage initially at point X will cause an amplified opposing voltage to be applied to resistors R_7 and R_9. If resistor R_7 is slightly greater than R_5, it will be found that the point X is nearly at earth potential. If the amplification of V_2 is high, then R_7 may be made equal to R_5 and point X will still be nearly at earth potential. The point X is therefore floating, and the circuit a true Paraphase ; the derivation of the name " Floating Paraphase " is obvious.

FIG. 12.31

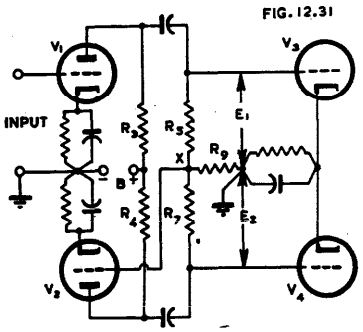

FIG. 12.32

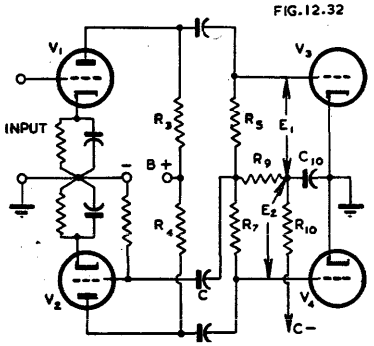

Fig. 12.31. *The Floating Paraphase self-balancing phase inverter with cathode bias.*
Fig. 12.32. *The Floating Paraphase circuit with fixed bias in the following stage.*

The degree of balance is given by

$$\frac{E_1}{E_2} \approx \frac{R_5}{R_7} + \frac{1}{A_2}\left(1 + \frac{R_5}{R_7} + \frac{R_5}{R_9}\right) \qquad (1)$$

where A_2 = voltage gain of V_2 into plate load resistor R_4 and following grid resistor R_7.

If $R_5 = R_7 = R_9$, then $E_1/E_2 = 1 + 3/A_2$ (2)

If V_2 is type 6J5 (or half type 6SN7-GT) $R_4 = 0.1$, $R_5 = R_7 = R_9 = 0.25$ megohm, then $A_2 = 14$ and $E_1/E_2 = 1.21$ which is too high to be acceptable. In such a case R_7 may be increased to, say, 0.3 megohm giving $E_1/E_2 = 1.03$.

If V_2 is type 6SQ7 with $R_4 = R_5 = R_7 = R_9 = 0.25$ megohm, then $A_2 = 48$ and $E_1/E_2 = 1.06$ which is generally acceptable.

If V_2 is a pentode (e.g. type 6J7) with $R_4 = R_5 = R_7 = R_9 = 0.25$ megohm, then $A_2 = 104$ and $E_1/E_2 = 1.03$, which is very close.

The gain from the grid of V_1 to the grid of V_3 is only slightly less than the gain with $R_9 = 0$.

FIG. 12.33

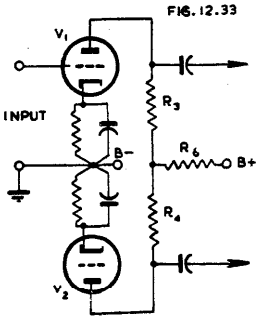

Fig. 12.33. *Common plate impedance self-balancing phase inverter.*

If fixed or partially-fixed bias is employed, it is necessary to couple the grid of V_2 to point X through a suitable condenser (C in Fig. 12.32). In addition, a hum filter (R_{10}, C_{10}) may be required, because most partially-fixed bias sources contain appreciable hum voltage ; any hum voltage appearing across the grid resistor of V_2 is amplified by V_2 and V_4. References C12, C14, C16.

(B) Common plate impedance (Fig. 12.33)

This follows the same principle as the Floating Paraphase, except that the common impedance is in the d.c. plate circuit instead of in the shunt a.c. (following grid) circuit. Here similarly