(vi) Cathode bias

See Sect. 5(vi) as for push-pull triodes, except that the screen dissipation must also be checked.

(vii) Parasitics

See Sect. 5(vii) as for push-pull triodes, also Sect. 3(iii)H.

(viii) Phase inversion in the power stage

In the interests of economy, push-pull is sometimes used in the output stage without a prior phase inverter. All such methods—except the Cathamplifier—have inherently high distortion, and some have serious unbalance between the two input voltages.

(A) **Phase inverter principle** (Fig. 13.44)

The grid of V_2 is excited from the voltage divider R_3R_4 across the output of V_1. $R_3 + R_4$ must be very much greater than the load resistance (say 50 000 ohms). R_5 and R_6 are grid stoppers. All other components are normal. R_k may be by-passed if desired.

FIG. 13.44

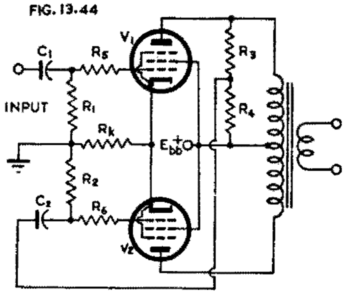

FIG. 13.45

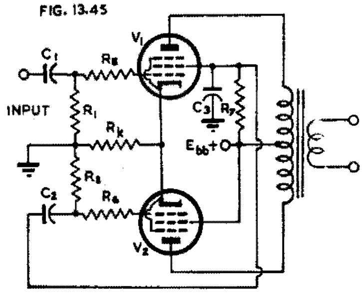

Fig. 13.44. *Push-pull circuit using phase inversion in the power stage.*
Fig. 13.45. *Push-pull circuit using screen resistance coupling from V_1 to the grid of V_2.*

The signal voltage on the grid of V_2 must first pass through V_1 where it is distorted, then through V_2 where it will be distorted again. Thus the second harmonic will be the same as for a single valve, and the third harmonic will be approximately twice the value with balanced push-pull. The balance, if adjusted for maximum signal, will not be correct for low volume, owing to the third harmonic " flattening."

(B) **Screen resistance coupling** (Fig. 13.45)

This is a modification of (A) being an attempt to obtain from the screen a more linear relationship than from the plate. No comparative measurements have been published. R_7 may be about 1500 ohms for type 6V6-GT or 2500 for type 6F6-G, with $E_b = E_{c2} = 250$ volts—the exact value should be found experimentally ; C_3 may be 0.002 μF. For better balance an equal screen resistor might be added for V_2. Ref. E10.

(C) **Common cathode impedance** (Fig. 13.46)

R_1 and R_2 in series provide a common cathode coupling impedance [see Chapter 12 Sect. 6(vi)]. R_2 may have a value of, say, 1000 ohms to give an approach towards balance, but necessarily must carry the plate currents of both valves—say, 70 or 80 mA—and will have a voltage of, say, 70 to 80 with a dissipation around 6 watts. Care should be taken to avoid exceeding the maximum heater-cathode voltage rating.

See Reference E23.

FIG. 13.46

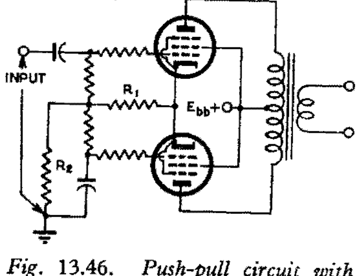

Fig. 13.46. *Push-pull circuit with common cathode impedance coupling.*

(D) **The Parry "Cathamplifier"**

The basic circuit is Fig. 13.46A, the two cathodes being coupled by a centre-tapped a-f transformer, whose secondary winding excites the grid of V_2. A theoretical analysis is given in Ref. E29, while some practical designs are in Ref. E30.

For balance, $\dfrac{N_3}{N_1 + N_2} = \dfrac{1 + g_m R/2}{g_m R}$ and $N_1 = N_2$

where g_m = mutual conductance of V_2.

Distortion is reduced by the factor $T(2T - 1)$
where $T = N_3/(N_1 + N_2)$.

Note that T should normally be slightly greater than 1.

Gain is reduced by the factor $T(T - 0.5)$.

The common cathode resistor R_0 helps to reduce unbalance.

In practice, R is made variable (say 100 ohms total) so as to permit the amplifier to be balanced experimentally. One method is to connect a valve voltmeter across R_0, and to adjust R for minimum reading.

Instability may occur if R is too small.

A modified circuit is Fig. 13.46B in which the centre-tapped primary of T_1 is not necessary.

Fig. 13.46C permits both a.c. and d.c. balancing.

Fig. 13.46D keeps the circulating screen current out of the cathode circuit and so maintains the ratio between plate and screen currents at the negative voltage peak swing. Resistors R_1 are to prevent coupling from cathode to cathode through the screen by-pass condensers; their values should be low—say 100 to 250 ohms each.

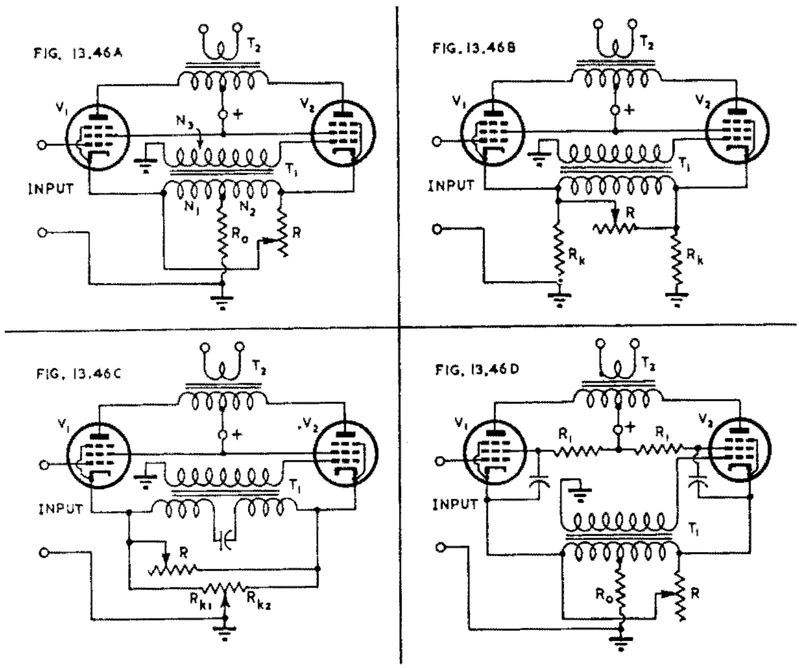

Fig. 13.46A. Basic circuit of Parry Cathamplifier, (B) Modified circuit, (C) With both a.c. and d.c. balancing, (D) Keeps circulating screen current out of cathode circuit (Ref. E30).