CF 50 Microphone pre amplifier pentode

The CF 50 was specially designed for the amplification of very low voltages. Hum, background noise and microphony have all been reduced to a minimum and the principal application of the valve is as a pre-amplifier in crystal or ribbon-microphone equipment.

This valve is capable of being operated to give a stage gain of about 300, producing an effective alternating output voltage of 3 V with less than 1 % distortion or, if required, a gain factor of between 395 and 45 with distortion less than 0.4 % and an output voltage of 0.1 V_{eff}. This versatility of the valve may be ascribed to the fact that the input signals in this case are extremely small.

Details of the operating possibilities of this valve are set out in Tables I and II.

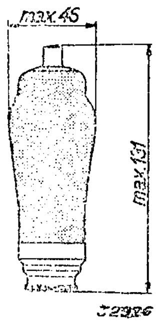

Fig. 1
Dimensions in mm.

In view of the fact that the valve is specially intended for the amplification of very small signals, extra care must be taken to prevent hum, since otherwise the level of the hum will quickly approach that of the input signal itself. For this latter reason the valve is equipped with a bifiliar filament, in consequence of which the external magnetic field is very weak; as this field is proportional to the strength of the current, the heater current has been kept as low as possible, namely 200 mA, so that, in effect, there is hardly any external field at all. To ensure sufficient emission from the cathode on this current it has been necessary to employ a heater voltage of 30 V. The ultimate result is that, using a grid impedance of 0.5 megohm, the voltage on the grid corresponding to the hum on both grid and anode is less than 1 μV. Taking into consideration the fact that the voltage delivered by the microphone is of the order of 1 mV, it may be claimed that the ripple level is very low indeed. In a cathode resistor without a decoupling capacitor the induced ripple voltage will be about 20 μV.

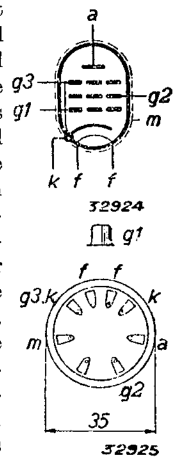

Fig. 2
Arrangement of electrodes and base connections.

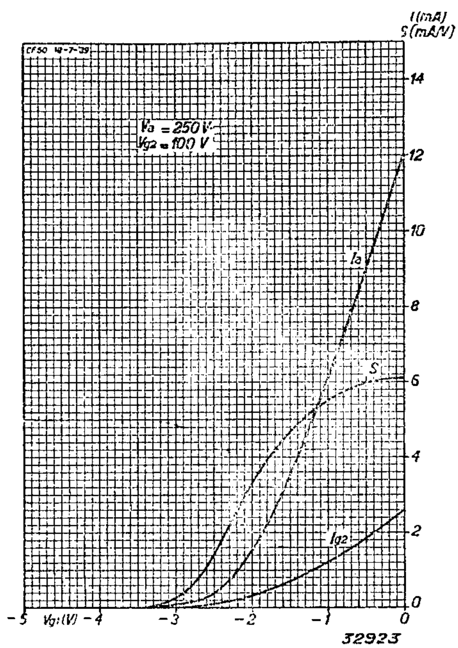

Fig. 3
Anode current Ia, screen-grid current Ig_2 and mutual conductance S as functions of the grid bias Vg_1 with Va = 250 V and Vg_2 = 100 V.

The equivalent noise resistance of the CF 50 is 2,500 ohms, which corresponds to an effective value of 0.7 μV for the noise voltage on the grid at a bandwidth of 10,000 c/s and this, compared with the voltages applied to the grid, is also extremely low. In fact, the equivalent noise resistance gives the impression of being unnecessarily low in comparison with the customary value of the grid leak, but it should be remembered that crystal microphones have a markedly capacitive character, due to which fact the noise resistance of the microphone, for the greater part of the frequency range, is considerably lower than the matching resistance based on the response over a relatively small range of low frequencies. The low value of the equivalent noise resistance of the CF 50 is a result of the high mutual conductance with a low anode current (S = 3.3 mA/V, I_a = 1.5 mA).

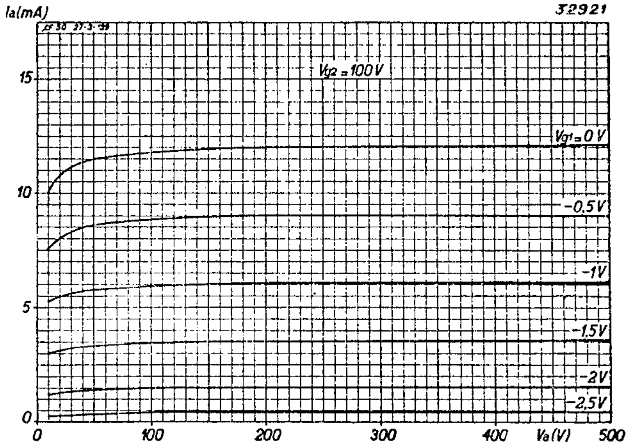

Fig. 4
Anode current as a function of the anode voltage for different values of grid bias, at a screen potential of 100 V.

Finally it may be noted that microphony is eliminated as far as possible by the use of special double mica supports for the system of electrodes; on the whole, then, the CF 50 is an excellent valve for the pre-amplification stage of the more sensitive type

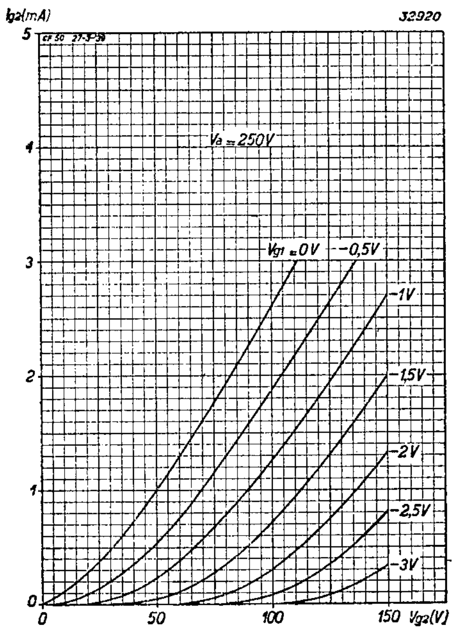

Fig. 5
Screen-grid current as a function of the screen voltage for different values of grid bias, with 250 V anode voltage.

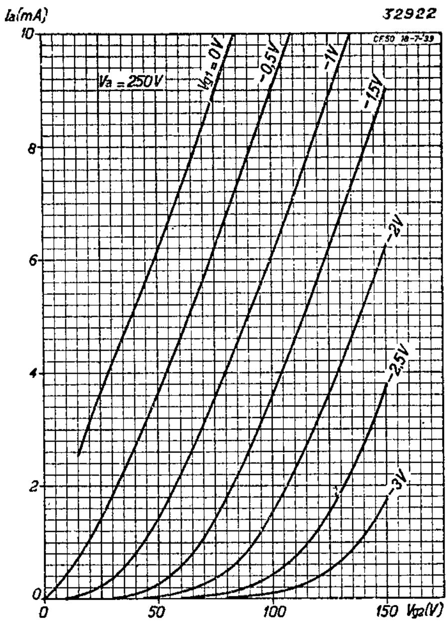

Fig. 6
Anode current as a function of the screen voltage for different values of grid bias, with 250 V anode voltage.

of amplifier, more especially on account of the low noise resistance in cases where the voltage to be amplified comes from a source of which the noise resistance is also comparatively low.

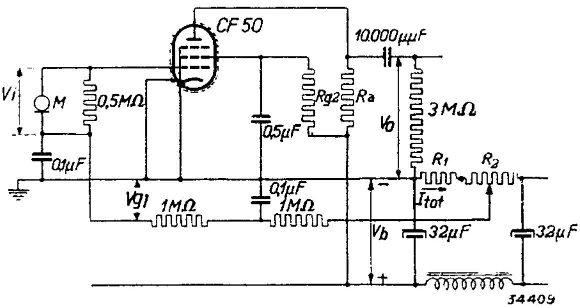

Fig. 7
Circuit diagram showing the CF 50 used as a microphone pre-amplifier.

HEATER RATINGS

Heating: indirect, A.C. or D.C., series or parallel supply.
Heater voltage V_f = 30 V.
Heater current I_f = 0.200 A.

CAPACITANCES

$C_{ag1} < 0.03$ μμF
$C_{g1} = 13$ μμF
$C_a = 14.5$ μμF

STATIC RATINGS

Anode voltage	V_a	= 100 V	250 V
Screen-grid voltage	V_{g2}	= 100 V	100 V
Grid bias	V_{g1}	= —2 V	—2 V
Anode current	I_a	= 1.5 mA	1.5 mA
Screen-grid current	I_{g2}	= 0.3 mA	0.3 mA
Mutual conductance	S	= 3.3 mA/V	3.3 mA/V
Internal resistance	R_i	= 2 M ohms	2.5 M ohms
Amplification factor; screen with respect to control grid	μ_{g2g1}	= 45	45
Equivalent noise resistance in the frequency range 50 to 10,000 c/s	R_{eq}	= —	2,500 ohms

TABLE I

OPERATING DATA: CF 50 used as resistance-coupled A.F. amplifier without gain control (see Fig. 7)

Supply voltage V_b (V)	Anode resistor R_a (M ohm)	Screen-grid series resistor R_{g2} (M ohm)	Cathode resistor R_k (ohms)	Anode current I_a (mA)	Screen current I_{g2} (mA)	Voltage gain V_o/V_i	Output voltage V_o (V_{eff})	Total distortion d_{tot} (%)
250	0.3	0.9	2,000	0.7	0.18	315	3	< 1
200	0.3	0.8	3,000	0.5	0.15	260	3	< 1
100	0.3	0.4	7,000	0.2	0.07	150	3	< 1
250	0.2	0.7	1,800	0.9	0.22	295	3	< 1
200	0.2	0.64	2,000	0.7	0.18	245	3	< 1
100	0.2	0.32	5,000	0.3	0.09	145	3	< 1
250	0.1	0.64	1,800	0.9	0.22	280	3	< 1
200	0.1	0.56	2,200	0.7	0.19	230	3	< 1
100	0.1	0.28	5,000	0.3	0.09	140	3	< 1

TABLE II

OPERATING DATA: CF 50 used as a resistance-coupled A.F. amplifier with control of the amplification (see Fig. 7)

Supply voltage V_b (V)	Anode resistor R_a (M ohm)	Screen-grid series resistor R_{g_2} (M ohm)	Grid bias V_{g_1} (V)	Anode current I_a (mA)	Screen-grid current I_{g_2} (mA)	Voltage gain V_o/V_i	Output voltage V_o (V_{eff})	Total distortion d_{tot} (%)
450	0.3	1.0	—2	1.4	0.38	395	0.1	0.2
450	0.3	1.0	—6	0.72	0.18	260	0.1	0.2
450	0.3	1.0	—10	0.22	0.06	90	0.1	0.2
450	0.3	1.0	—11	0.11	0.04	45	0.1	0.4
450	0.3	1.0	—12	0.04	0.02	7	0.1	3
450	0.2	0.8	—2	1.78	0.44	350	0.1	< 0.2
450	0.2	0.8	—6	0.94	0.23	230	0.1	< 0.2
450	0.2	0.8	—10	0.18	0.05	45	0.1	< 0.2
450	0.2	0.8	—11	0.08	0.02	20	0.1	0.4
450	0.2	0.8	—12	0.03	0.01	3	0.1	3
450	0.1	0.5	—2	2.8	0.64	245	0.1	< 0.2
450	0.1	0.5	—6	1.5	0.33	180	0.1	< 0.2
450	0.1	0.5	—10	0.25	0.05	38	0.1	0.3
450	0.1	0.5	—11	0.09	0.02	15	0.1	1.1
450	0.1	0.5	—12	0.03	0.01	3	0.1	5

MAXIMUM RATINGS

Anode voltage in cold condition . . . . V_{ao} = max. 550 V
Anode voltage . . . . V_a = max. 250 V
Anode dissipation . . . . W_a = max. 1 W
Screen voltage in cold condition . . . . V_{g2o} = max. 550 V
Screen voltage at I_a = 1.5 mA . . . . V_{g2} = max. 125 V
Screen voltage at I_a < 0.25 mA . . . . V_{g2} = max. 450 V
Screen dissipation . . . . W_{g2} = max. 0.5 W
Cathode current . . . . I_k = max. 10 mA
Grid voltage at grid current start (I_{g1} = + 0.3 μA) V_{g1} = max. —1.3 V
External resistance between control grid and cathode R_{g1k} = max. 3 M ohms
External resistance between heater and cathode . . . R_{fk} = 20,000 ohms
Voltage between heater and cathode . . . . V_{fk} = max. 100 V