C/EM 2 Electronic indicator

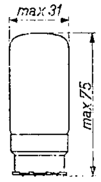
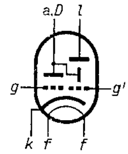


Fig. 1
Dimensions in mm.

The Philips C/EM 2 is an indicator for accurately tuning the receiver to the required station. It works on the same principle as the EM 1, being a high-vacuum valve, with conical screen which is viewed from above. Two fan-shaped fluorescent patterns are formed on the screen and the width of these sectors varies with the tuning.
The difference between this tube and the EM 1 is that instead of four deflector plates only two are provided, whilst there is an extra grid between the anode and the fluorescent screen. As in the EM 1. moreover, the indicator comprises two sections, combined in a single envelope. The lower part of the tube is a triode with a high amplification factor and serves to amplify the direct voltages obtained from the automatic gain control circuit. In the upper portion of the valve a grid is mounted between the conical fluorescent screen and the cathode, by means of two rods. The supporting rods of the triode-anode protrude into the virtual indicator section and lie in the same plane as the grid supports; there are therefore two ways in which electrons from the cathode to the anode (fluorescent screen) can be controlled, viz.

1) by utilizing the deflecting effect of the two triode-anode supports, which serve the same purpose as the four deflector plates in the EM 1 and react upon the width of the light sectors; simultaneously an intensity variation occurs when the voltage on the triode anode falls;

2) the light strength of the fluorescence is controlled by the application of different potentials to the grid of the indicator; in other words, this controls the brilliance, which can ultimately be made to disappear altogether. At the same time, due to the deflecting action of the grid supports, the angles of the sectors can be varied; this means that the indication can be obtained in various ways:



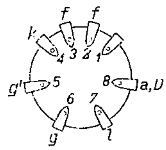


Fig. 2
Arrangement of electrodes and base connections.

a) The tuning can be rendered visible by coupling the grid of the triode section to the A.G.C. circuit; the anode supports, projecting into the indicator, then receive a higher or lower voltage due to the variable voltage drop across a series resistor as in the case of the EM 1; the electrons on their way to the anode are thus deflected to a greater or lesser degree.

b) Alternatively, the voltage on the grid of the indicator itself may be varied, for instance by connecting it to the screen-grid circuit of a controlled R.F. or I.F. valve, leaving the triode section available for other purposes, such as the suppression of interference due to crackle, or the amplification of the A.G.C. voltage.

c) Tuning can be made visible by means of a combination of the two above-mentioned arrangements. It is possible to obtain an effect whereby the light sectors on the fluorescent screen are very small and of low intensity when the receiver is not tuned to a station. As the tuning approaches the carrier-wave frequency the intensity increases until the area of the light sectors, and their intensity, are at a maximum (the screen is then saturated), after which, on a strong carrier wave, a maximum width of about 150° may be reached.

Tuning is thus facilitated by the variations in the intensity as well as by the changes in the width of the light sectors, especially on weak signals.
As in the EM 1, the cathode is provided with a screen cap to avoid unpleasant effects caused by the light emitted by the cathode.

The C/EM 2 can be used in A.C. sets as well as car radio receivers, and A.C./D.C. sets with series heater supply. Since the direct voltage on the fluorescent screen must never be less than 200 V, the use of this tube in the latter type of receiver is restricted to those working on 220 V D.C. without voltage doubling, A.C. 220 V mains, and 110 V A.C. with voltage doubling.

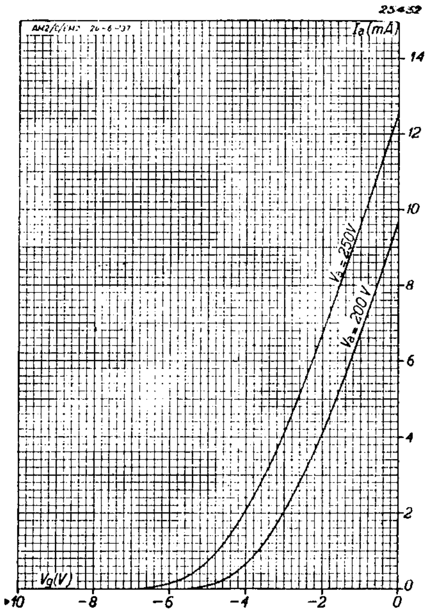


Fig. 3
Triode section of the C/EM 2. Anode current as a function of the grid bias at Va = 200 V and 250 V.

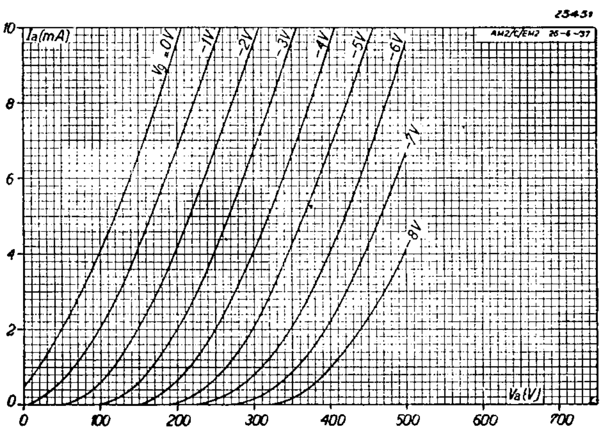


Fig. 4
Triode section of the C/EM 2. Anode current as a function of the anode voltage for various values of grid bias, reproduced on a large anode-current scale.

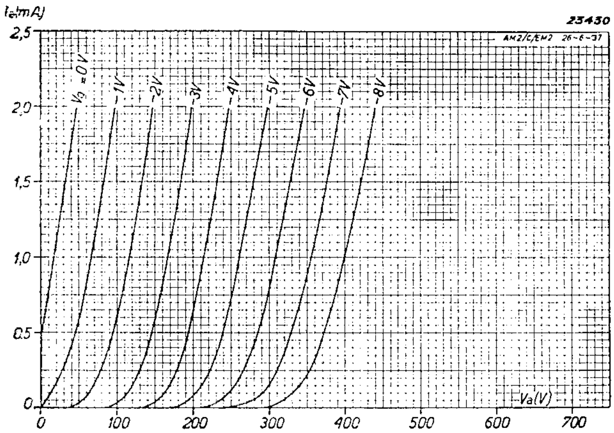


Fig. 5
Triode section of the C/EM 2. Anode current as a function of the anode voltage for various values of grid bias, reproduced on a small anode-current scale.

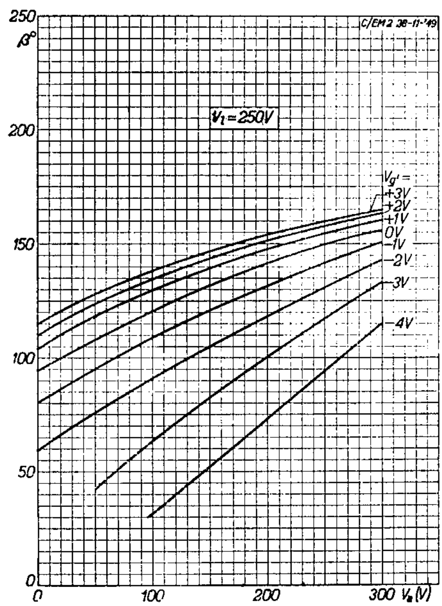


Fig. 6
Light sector angle β of the fluorescent screen as a function of the anode voltage *Va* of the triode section, with the grid bias *Vg* of the indicator section as parameter. The broken lines on the curve indicate the range in which the light sectors decrease in size. Voltage *Vl* on the screen constant at 250 V.

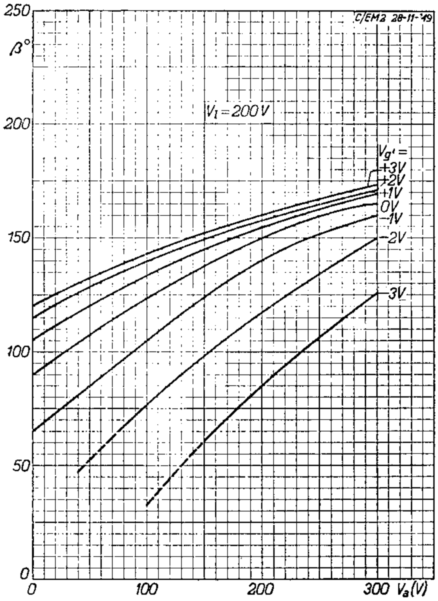


Fig. 7
Light angle β of the fluorescent screen as a function of the voltage *Va* on the triode anode and deflector rods, with the voltage *Vg′* on the grid of the indicator section as parameter. The broken lines in the curves indicate the range in which the intensity of the light decreases. Voltage *Vl* on the screen constant at 200 V.

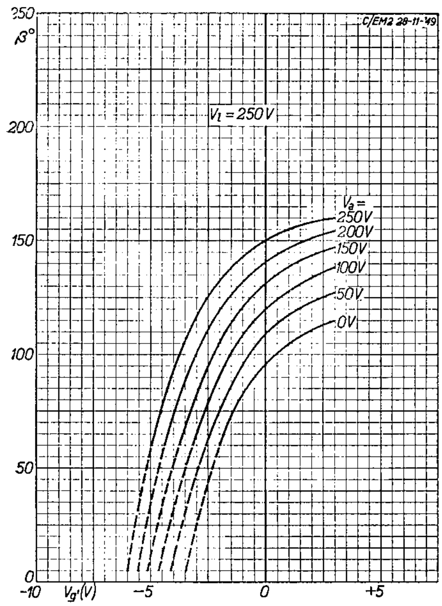


Fig. 8
Light angle β of the fluorescent screen as a function of the voltage *Vg′* on the grid of the indicator section, with the voltage *Va* on the anode of the triode as parameter. Voltage *Vl* on the fluorescent screen constant at 250 V.

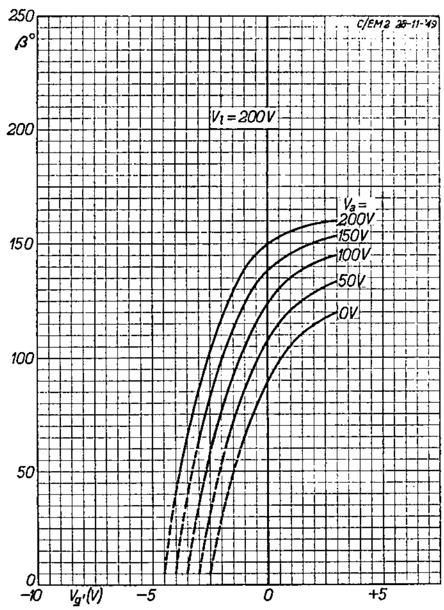


Fig. 9
Light angle β of the fluorescent screen as a function of the voltage *Vg′* on the grid of the indicator section, with the voltage *Va* on the anode of the triode as parameter. Voltage *Vl* on the fluorescent screen constant at 200 V.

HEATER RATINGS

Heating: indirect by A.C. or D.C., series or parallel supply.

Heater voltage	V_f	= 6.3 V
Heater current	I_f	= 0.200 A

OPERATING DATA: Triode section

Anode voltage	V_a	= 200 V	250 V
Grid voltage	V_g	= —2.5	—3.5 V
Anode current	I_a	= 3 mA	3 mA
Mutual conductance	S	= 2 mA/V	2 mA/V
Amplification factor	μ	= 50	50
Internal resistance	R_i	= 25,000 ohms	25,000 ohms

OPERATING DATA: Indicator section

Voltage on fluorescent screen . . V_l = 250 V

1. Indicator grid voltage V_g' variable.

Angle of fluorescent sector	β =	5°	150°	160°
Voltage on anode of triode	V_a =	250	250	250 V
Voltage on grid of indicator	V_g' =	—6	0	+ 3 V

2. Voltage on anode of triode V_a variable.

Angle of fluorescent sector	β =	95°	150°
Voltage on indicator grid	V_g' =	0	0 V
Voltage on triode anode	V_a =	0	250 V

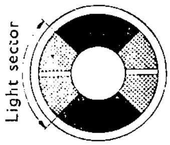
Voltage on fluorescent screen . . V_l = 200 V

1. Indicator grid voltage V_g' variable.

Angle of fluorescent sector	β =	5°	150°	160°
Voltage on anode of triode	V_a =	200	200	200 V
Voltage on grid of indicator	V_g' =	—4.5	0	+ 3 V

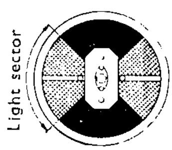
2. Voltage on anode of triode V_a variable

Angle of fluorescent sector	β =	90°	150°
Voltage on indicator grid	V_g' =	0	0 V
Voltage on triode anode	V_a =	0	200 V



a

With screening



b

Without screening

Fig. 10
Definition of the light angle β. Top view of electronic indicator,
a. with cathode light screened.
b. with cathode light not screened.

MAXIMUM RATINGS

V_{ao}	= max. 550 V
V_a	= max. 300 V
W_a	= max. 1.5 W
V_{lo}	= max. 550 V
V_l	= max. 250 V
V_l	= min. 150 V
I_l	= max. 1 mA
I_k	= max. 12 mA
V_g (I_g = + 0.3 μA)	= max. —1.3 V
V_g' (I_g' = + 0.3 μA)	= max. —1 V
R_{gk}	= max. 2.5 M ohms
$R_{g'k}$	= max. 2.5 M ohms
R_{fk}	= max. 20,000 ohms
V_{fk}	= max. 125 V [1]

[1]) Direct voltage or effective value of alternating voltage.