The double diode EB 91

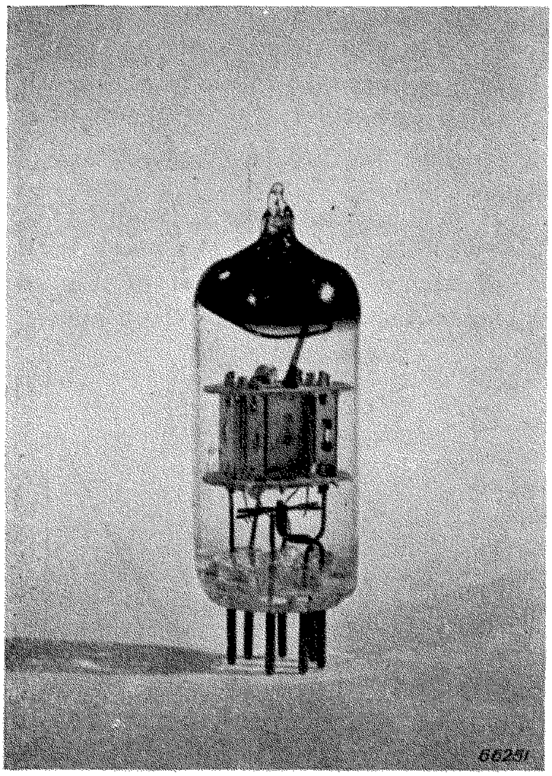

Fig. 1
The double diode EB 91 (about actual size).

Description

The EB 91 is a 7-pin miniature double diode with low internal resistances, so that it is suitable for use in circuits with low load resistances. Each section has an independent cathode, and an electrostatic screen is provided between sections.
One diode section may be used as vision demodulator, and the other section for such functions as D.C. restoration. In the sound channel of a receiver the EB 91 may also be used as an F.M. demodulator, for example in a ratio-detector circuit.

Application

The most important application of the EB 91 in a television receiver is in the vision demodulator stage. Only one diode section is required for this purpose and the other section can therefore be used as a D.C. restorer. The polarity of the diode used for demodulation depends upon a number of factors, such as the type of transmission (either positive or negative modulation may be used in the transmitter), the method of modulating the spot brightness of the picture tube (the video signal may be applied either to the cathode or to the grid of the picture tube) and the number of stages used for video amplification. Cathode modulation of the picture tube is now almost exclusively employed and, in the case of a direct-viewing tube, one stage of video amplification will usually be employed for systems operating with 405, 441, 525 and 625 lines.
In the 625-line system the modulation is negative, which means that the carrier amplitude is maximum during the synchronizing pulses. A signal of the polarity shown in Fig. 2 is therefore required at the cathode of the picture tube, whilst the signal at the grid of the video amplifying tube should have a polarity as shown in Fig. 3. It can therefore be seen that the polarity of the diode should be as illustrated in Fig. 4, in which the voltage across the load is also represented.
This signal would be directly suitable for the excitation of the video amplifying valve, provided the voltage at the dotted line (black level) in Fig. 4

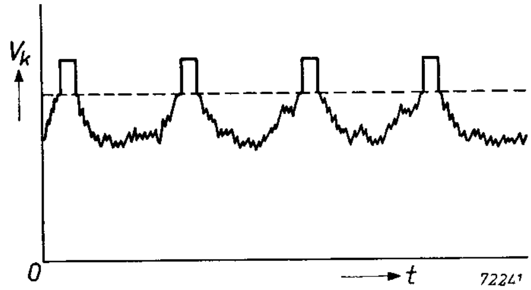

Fig. 2
Polarity of the signal required at the cathode of the picture tube.

is equal to the required standing bias. This is not normally the case and since, moreover, in the absence of a signal, the video amplifying tube would operate without any bias, a separate bias voltage is applied either by the inclusion of a cathode resistor or by a fixed grid voltage.

It is then necessary to apply D.C. restoration, so that the black level of the complete signal of Fig. 4 coincides with the standing bias of the video valve. For this purpose the remaining section of the EB 91 can be used. Fig. 5 gives the complete circuit of the EB 91 used as vision demodulator (diode section II) and as D.C. restorer (diode section I). The potential of the whole circuit with respect to the chassis is $-V_g$, which is the fixed bias for the video amplifying valve. The bias line is normally decoupled by an electrolytic capacitor of about 100 μF, whilst the internal resistance of the bias source is low, so that the potential of point *A* may be regarded as a fixed reference. It is therefore necessary to add to the signal appearing at $R_3 + L_1$ a voltage corresponding to the black level. This voltage is obtained by rectifying the I.F. signal with the diode section I. The operation of this diode needs some further explanation.

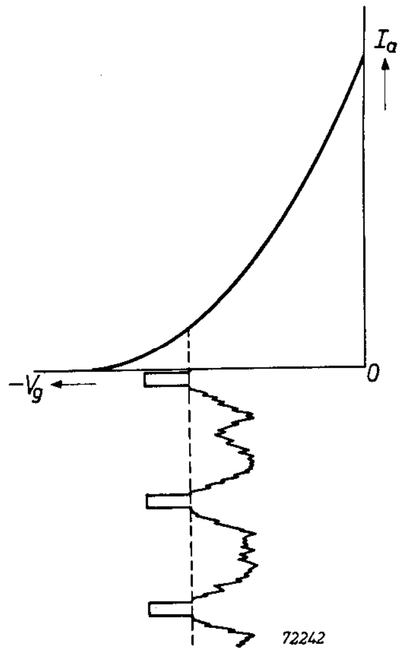

Fig. 3
Signal at the control grid of the single video stage.

It will be clear that the voltage supplied by the restorer must be free from modulation, whilst the load on the preceding I.F. circuit should be low so as to avoid undue damping. A load circuit with a long time constant and a high resistance should therefore be used. This implies that the detection efficiency of the restorer diode will be considerably greater than that of the detector diode, which has a load of only 3.9 kΩ. For average picture contrast and with one stage of video amplification, the I.F. signal required at the cathodes of the EB 91 is about

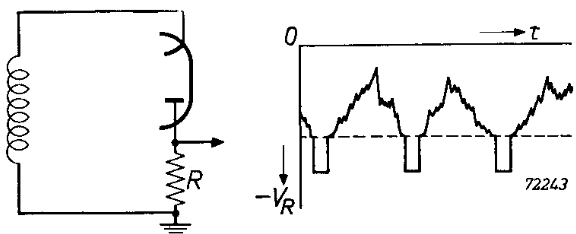

Fig. 4
Connection of the detector diode and the voltage across the load resistor.

2 V_{rms} during the synchronizing pulses. This I.F. signal will give rise to a voltage across the detector load R_3 of about —1.4 V also during the synchronizing pulses, which corresponds to a black level of 0.75 × (—1.4) = —1.05 V. An equal voltage of opposite polarity must therefore be delivered by the restorer diode. If R_1 is short-circuited a constant direct voltage of 2.8 V, corresponding to the peaks of the synchronizing pulses, arises across R_2. The efficiency of the restorer circuit is now reduced by means of R_1 to such an extent that the voltage across R_2 becomes 1.05 V, as required. It will be noticed that the time constants of R_2C_3 and R_1C_1 have been so chosen as to differ considerably. This has been done intentionally, so as to

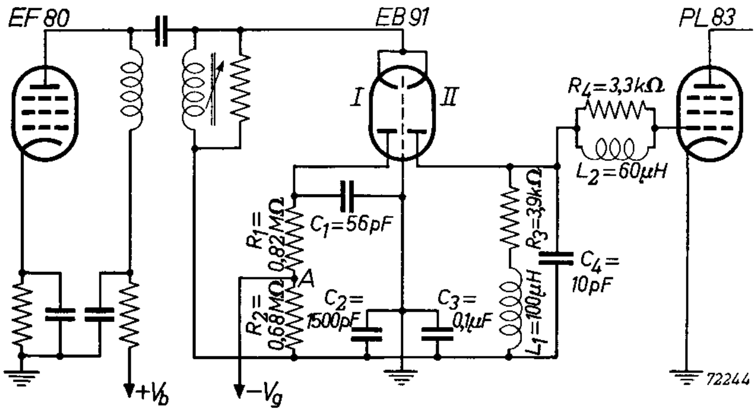

Fig. 5
Detector and D.C. restorer circuit employing the double diode EB 91.

prevent variations in the restorer voltage across R_2 during short interference pulses, such as arise from car ignition and telephone dialling. With this circuit, the voltage across R_2 does not change appreciably during a short interference pulse; the increase in rectified voltage occurring across R_1, which together with C_1 has a low time constant. Therefore, at the end of the interference pulse the restorer circuit quickly resumes normal operation, whereas with a high time constant of the total load the increase in rectified voltage and the resultant increase in picture brightness would persist for some considerable time.

In the load of the diode section II (fig. 5) a shunt peaking coil L_1 of 100 µH is included to compensate the effect of the shunt capacitor C_4 and the wiring capacitance upon the frequency response. For the same reason a series peaking coil L_2 of 60 µH is connected in series with the input of the video amplifying valve. This coil resonates with the input and wiring capacitance of the PL 83 at a frequency of about 5 Mc/s, thus improving the response at the high end of the video frequency band whilst I.F. signals are attenuated. Damped oscillations modulating the picture brightness would, however, occur after each rapid change in signal level if this resonant circuit were not adequately damped. A damping resistor R_4 of 3.3 kΩ is therefore connected across L_2.

DATA OF THE EB 91

Heater data

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

Heater voltage	V_f	=	6.3 V
Heater current	I_f	=	0.3 A

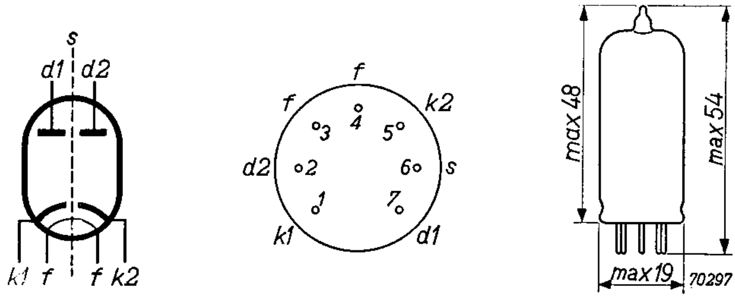

Fig. 6
Base connections and dimensions of the EB 91.

Capacitances (measured on the cold valve; with external screen)

Between anode of diode I and all others	C_{d1}	=	3.0 pF
Between anode of diode II and all others	C_{d2}	=	3.0 pF
Between the two anodes . .	C_{d1d2}	<	0.026 pF
Between cathode of diode I and all others	C_{k1}	=	3.5 pF
Between cathode of diode II and all others	C_{k2}	=	3.5 pF

Limiting values (each section)

Inverse anode voltage . . .	$V_{d\text{invp}}$	=	max. 420 V
Average anode current . . .	I_d	=	max. 9 mA
Peak anode current	I_{dp}	=	max. 54 mA
Voltage between heater and cathode	V_{fk}	=	max. 150 V
Peak voltage between heater and cathode	V_{kfp}	=	max. 330 V[1])

[1]) Cathode positive with respect to heater.

External resistance between heater and cathode . . .	R_{fk}	=	max. 20 kΩ[1])
Heater voltage during the warming-up period.	V_f	=	max. 9,5 V

Limiting values of each section for use as rectifier

Supply voltage	V_{tr}	=	max. 150 V_{rms}
Average anode current . . .	I_d	=	max. 9 mA
Reservoir capacitor	C_{filt}	=	max. 8 μF
Internal resistance of supply .	R_t	=	min. 300 Ω
Peak voltage between heater and cathode	V_{kfp}	=	max. 330 V[2])

[1]) If a high undecoupled resistance between heater and cathode must be used it may be advisable, in order to avoid hum, to reduce the heater voltage to about 5 V.

[2]) Cathode positive with respect to the heater.

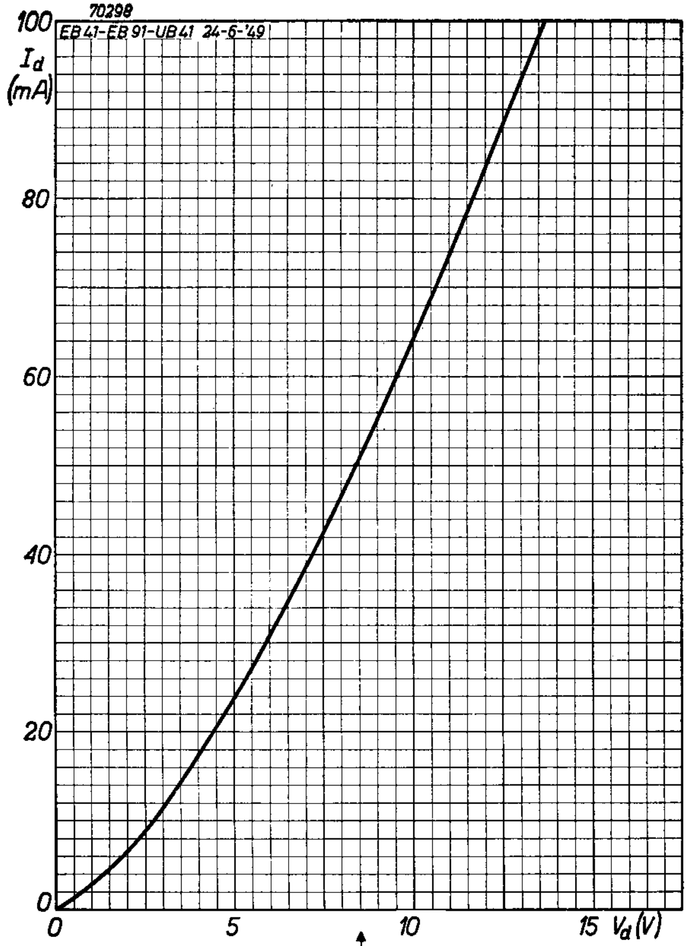

Fig. 7
Anode current plotted against anode voltage for each diode.

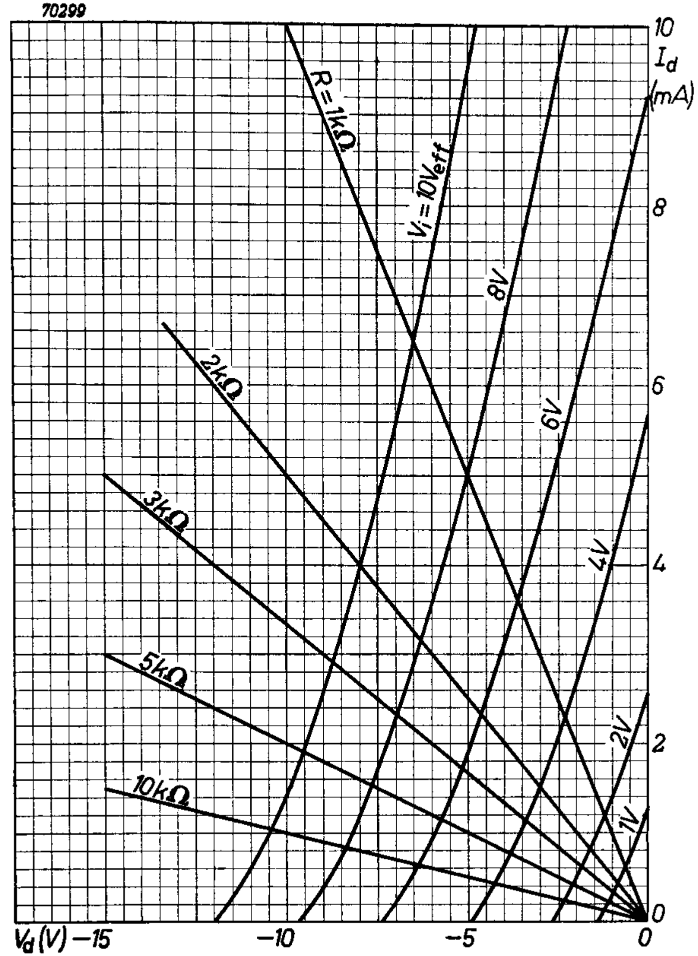

Fig. 8
Output characteristics for each diode, for input voltages between 1 and 10 V.

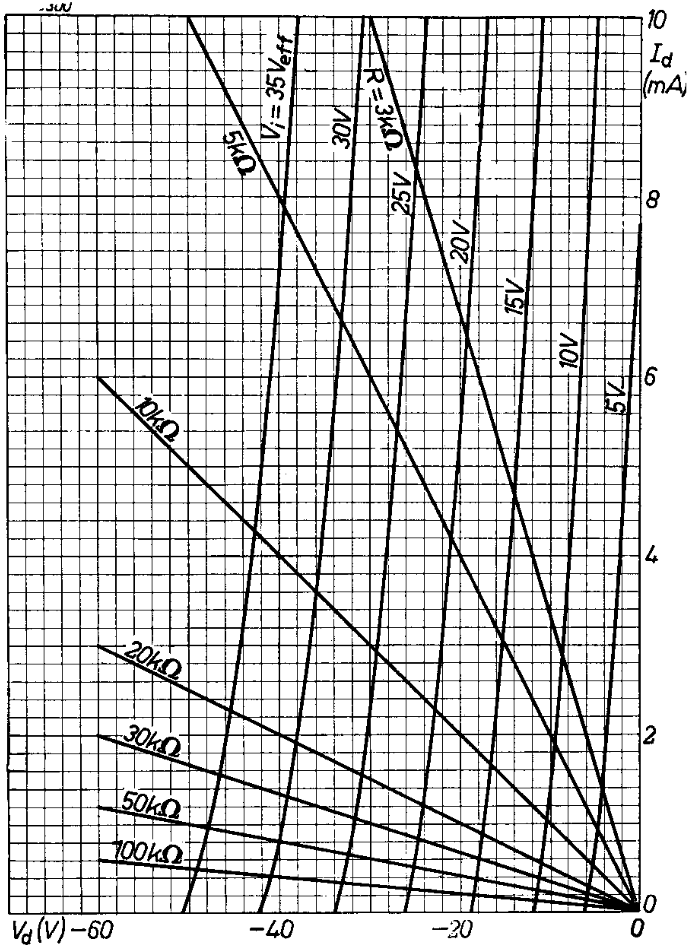

Fig. 9
Output characteristics for each diode, for input voltages between 5 and 35 V.

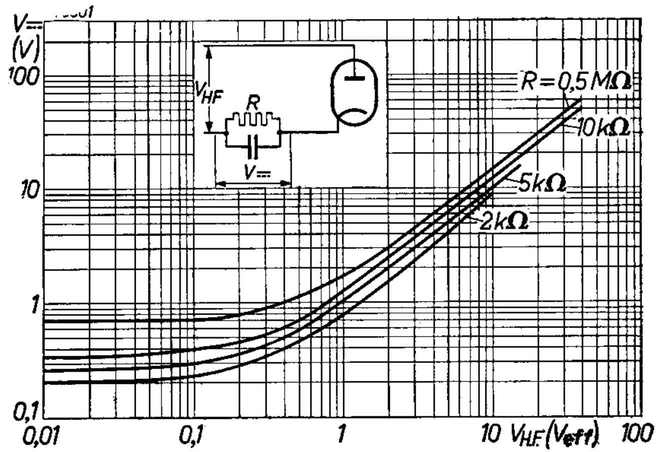

Fig. 10
Direct voltage at the load resistor plotted against the H.F. signal, with the load resistance as parameter. The curves refer to one diode section.