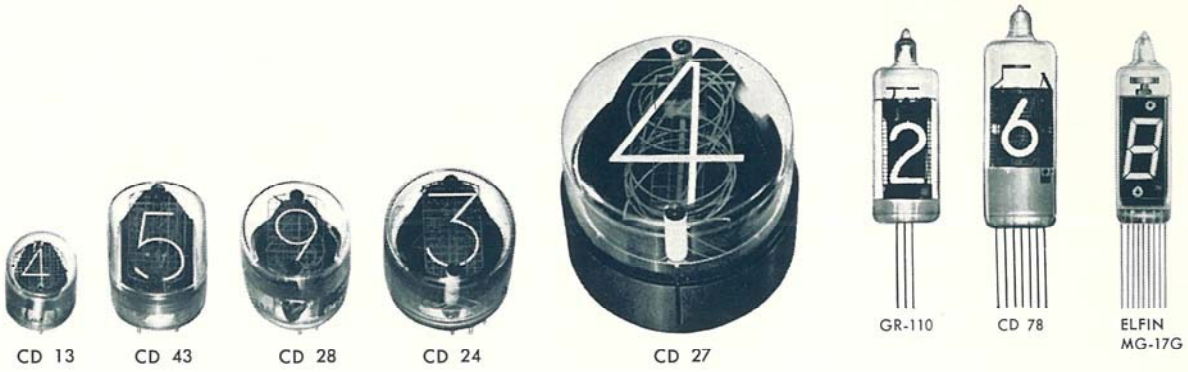
RODAN

INDICATOR TUBE

+ − × ÷ 1234567890 KC KV KΩ 1234567890 % °C PH
567890 % °C PH + − × ÷ 1234567890 KC KV KΩ 1234
KC KV KΩ 1234567890 % °C PH + − × ÷ 1234567890
+ − × ÷ 1234567890 KC KV KΩ 1234567890 % °C PH
567890 % °C PH + − × ÷ 1234567890 KC KV KΩ 1234
KC KV KΩ 1234567890 % °C PH + − × ÷ 1234567890
+ − × ÷ 1234567890 KC KV KΩ 1234567890 % °C PH
567890 % °C PH + − × ÷ 1234567890 KC KV KΩ 1234
KC KV KΩ 1234567890 % °C PH + − × ÷ 1234567890
+ − × ÷ 1234567890 KC KV KΩ 1234567890 % °C PH
567890 % °C PH + − × ÷ 1234567890 KC KV KΩ 1234
KC KV KΩ 1234567890 % °C PH + − × ÷ 1234567890
+ − × ÷ 1234567890 KC KV KΩ 1234567890 % °C PH
567890 % °C PH + − × ÷ 1234567890 KC KV KΩ 1234
KC KV KΩ 1234567890 % °C PH + − × ÷ 1234567890
+ − × ÷ 1234567890 KC KV KΩ 1234567890 % °C PH
567890 % °C PH + − × ÷ 1234567890 KC KV KΩ 1234
KC KV KΩ 1234567890 % °C PH + − × ÷ 1234567890

INDICATOR TUBE



RODAN Indicator Tubes are consist of a common anode and individual metallic cathodes which are formed in the shape of numerals (0 - 9) or special symbols such as +, −, %, etc.
RODAN Indicator Tubes are all electronic gas-filled, cold-cathode display devices.
Application of a negative voltage to the selected cathode element with respect to the common anode causes around the element to ionize and glow beautifully in neon red color.
The minimum supply voltage should be 170V DC, however, the use of higher voltage is available with an appropriate series resistor recommended.

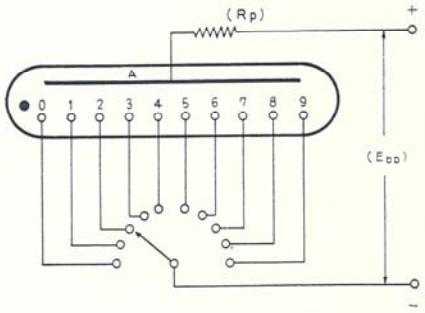
Features :

1. High brightness illumination in neon red color.
2. Low cost and power requirement and all electronic design providing high speed operation.
3. Long life and less mounting place of any other readout devices.
4. Bigger size tubes are mechanically reinforced with metallic or plastic shield fitted on its bottom.
5. All DC operation making simple drive circuit possible.
6. Lightest weight and simple mounting.

Switching Systems:

Rotary switches
Electromagnetic relay circuits
Beam switching tubes
Trigger tubes
Transistors
Decatrons

Basic Circuit



(Rp) : Series Resistor (kΩ)
(Ebb) : Anode Supply Voltage (Vdc)

INDICATOR TUBE

RODAN

D.C. Operation

	CD 11	CD 12	CD 13	CD 14	CD 15	CD 20	CD 21	CD 22	CD 23	CD 24	CD 25	CD 27	CD 28	CD 38
Indication	0～9	0～9	0～9	+ − × ÷	V, mV kV	Ω, MΩ kΩ	μF, pF	A, mA μA	S, mS μS. Kc	0～9	0～9	0～9	0～9	0～5
Anode Supply Voltage (Vdc) Min.	170	200	170	170	170	170	170	170	170	170	170	200	170	170
Ionization Voltage (Vdc) Max.	170	170	170	170	170	170	170	170	170	170	170	170	170	170
Cathode Current (mA dc)	2.5	5	0.9	2.5	2.5	2.5	2.5	2.5	2.5	2.25	2.5	10	1.8	2.5
Power Consumption per Electrode (W)	0.5	1	0.2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.4	0.5
Outline Drawing	A-4	A-7	A-1	A-4	A-4	A-4	A-4	A-4	A-4	A-3	A-6	A-8	A-2	A-4
Dimensions of Socket (Unit mm)	B-5	B-6	B-1	B-5	B-5	B-5	B-5	B-5	B-5	B-4	B-3	B-6	B-2	B-5
Pin Connections	C-1	C-2	C-3	C-4	C-5	C-6	C-7	C-8	C-9	C-10	C-15	C-2	C-11	C-12
Recommended Anode Series Resister for Supply Voltage (kΩ)														
170 Volts	10		33	10	10	10	10	10	10	10	18		15	10
200 Volts	22	12	65	22	22	22	22	22	22	24	22	5	35	22
250 Volts	42	22	120	42	42	42	42	42	42	47	43	10	65	42
300 Volts	62	32	180	62	62	62	62	62	62	68	62	15	100	62

	CD 40	CD 42	CD 43	CD 47	CD 66	GR-111a	GR-116	GR-110	GR-211	MG-17G	MG-19B
Indication	0～5	0～5	0～9	0～9	0～9, •	0～9, •	0～9, •	0～9, •	0～9	0～9, •	0～9, •
Anode Supply Voltage (Vdc) Min.	200	200	170	250	170	170	175	170	200	180	180
Ionization Voltage (Vdc) Max.	170	170	170	200	170	170	170	170	170	160	160
Cathode Current (mA dc)	5	10	2.25	25	2.25	2.25	3	1.9	5	0.35	0.5
Power Consumption per Electrode (W)	1	2	0.5	5	0.5	0.5	0.5	0.3	1	—	—
Outline Drawing	A-7	A-8	A-5	A-17	A-12	A-11	A-13	A-9	A-16	A-14	A-15
Dimensions of Socket (Unit mm)	B-6	B-6	B-3	B-6	—	—	—	—	—	—	—
Pin Connections	C-13	C-13	C-15	C-2	C-19	C-17	C-22	C-16	C-14	C-20	C-21
Recommended Anode Series Resister for Supply Voltage (kΩ)											
170 Volts			18		20	20	180V 15	190V 27			
200 Volts	12	5	24		24	24	20	33	12	200* 360**	130* 360**
250 Volts	22	10	47	5.1	47	27		230V 47	22	330* 620**	270* 620**
300 Volts	32	15	68	6.8	68	68			32		

Pulse Operation

(Time Sharing Operation)

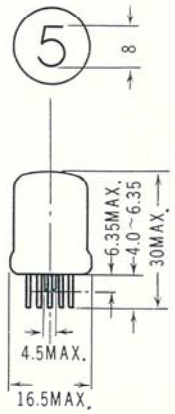
	CD 78	GR-110	GR-111pa	GR-116	MG-17G	MG-19B
Indication	0～9, •	0～9, •	0～9, •	0～9, ••	0～9, •	0～9, •
Anode Supply Voltage (Vdc) Min.	170	190	190	175	190	190
Ionization Voltage (Vdc) Max.	170	170	170	170	170	170
Cathode Current (mA dc)	7.2	5	5.5	14	1.2	1.5
Power Consummption per Flectrode (W)	—	0.1	—	0.3	—	—
Outline Drawing	A-10	A-9	A-11	A-13	A-14	A-15
Dimensions of Socket (Unit mm)	—	—	—	—	—	—
Pin Connections	C-18	C-16	C-17	C-22	C-20	C-21
Recommended Anode Series Resister for Supply Voltage (kΩ)						
190 Volts	5.6	6.8	5			
200 Volts	210V 7.5	9.1	7	2.5	43* 120**	36* 110**
250 Volts		230V 15	18	235V 5	82* 240**	68* 200**
300 Volts			27			100* 300**

Each cathode is ignited by transistor, reduce value of Rp (or Rk) by 10% ～30% and set Ik to standard value of cathode current (mA DC).

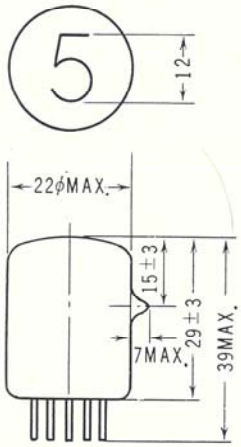
*: (Rk), Charactors
**: (Rk), Decimal point

INDICATOR TUBE

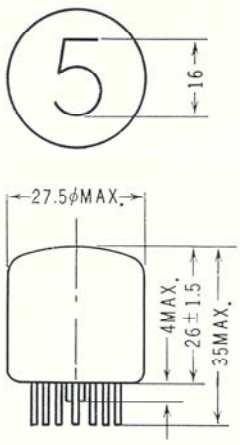
Dimensions of Tubes Electrodes (Charactors) (Unit mm)



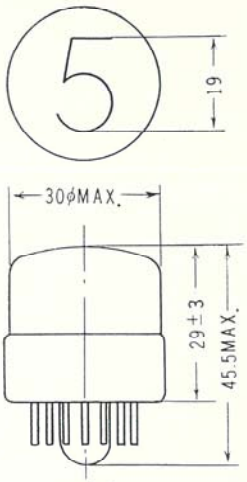
A-1
(CD 13)



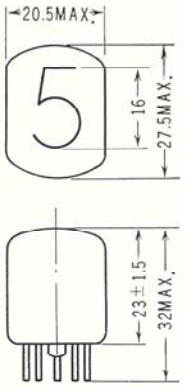
A-2
(CD 28)



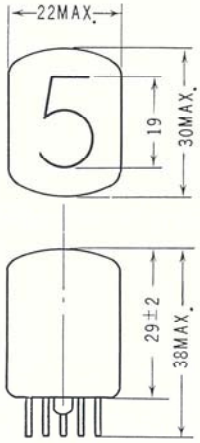
A-3
(CD 24)



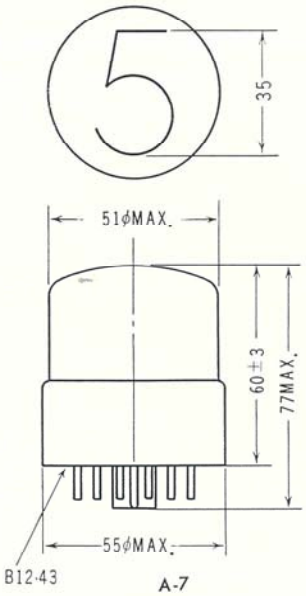
A-4
(CD 11)



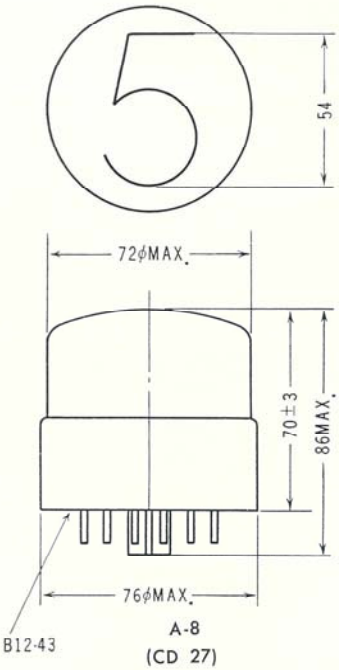
A-5
(CD 43)



A-6
(CD 25)

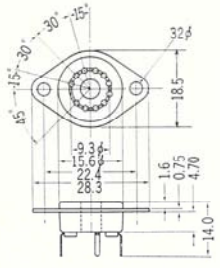


A-7
(CD 12)

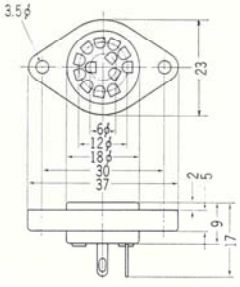


A-8
(CD 27)

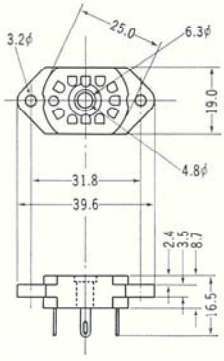
Dimensions of Sockets (Unit mm)



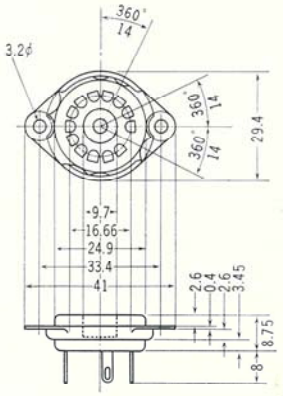
B-1
(TSM-11P)



B-2
(TSM-13P)



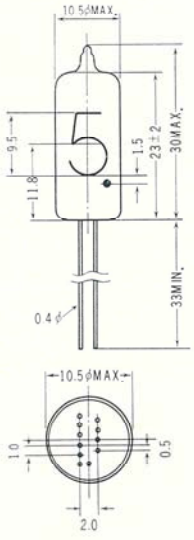
B-3
(TSR-11P)



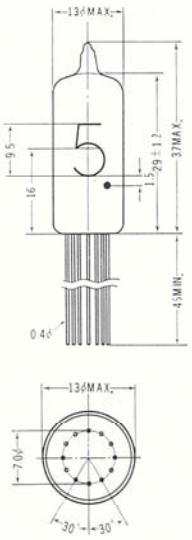
B-4
(TSB-13P)

INDICATOR TUBE

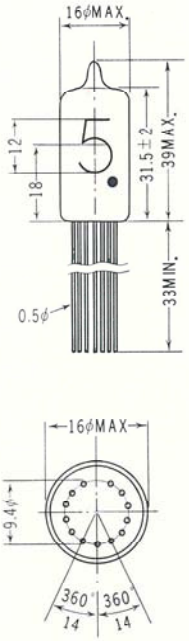
RODAN



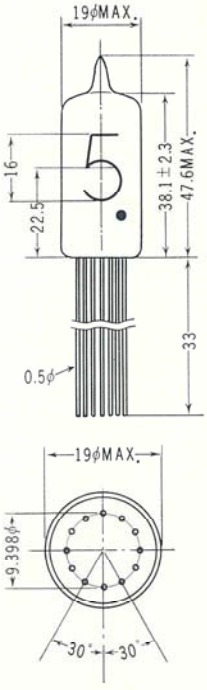
A-9
(GR-110)



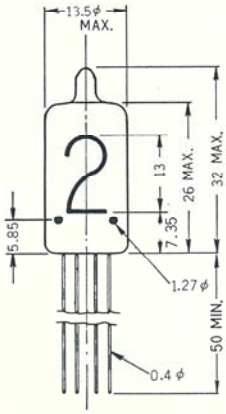
A-10
(CD 78)

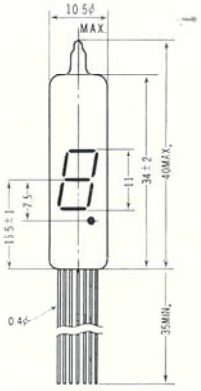


A-11
(GR-111a)

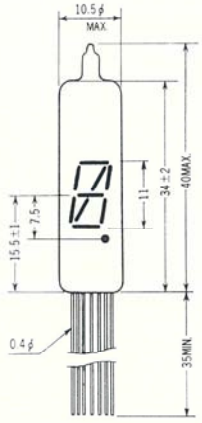


A-12
(CD 66)

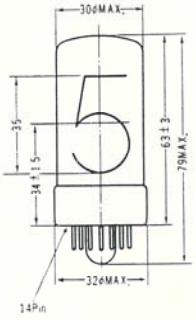




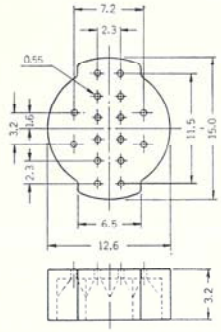
A-14
(MG-17G)



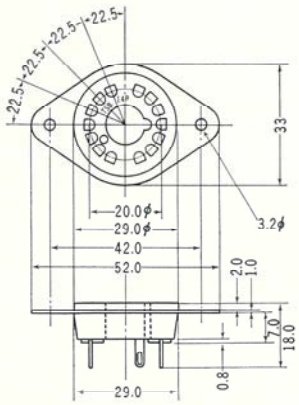
A-15
(MG-19B)



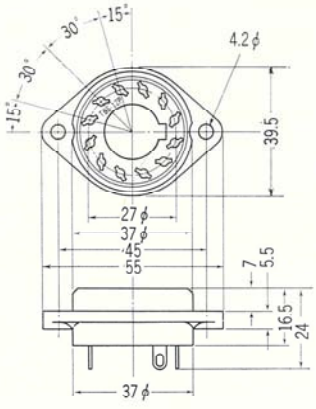
A-16
(MG-211)



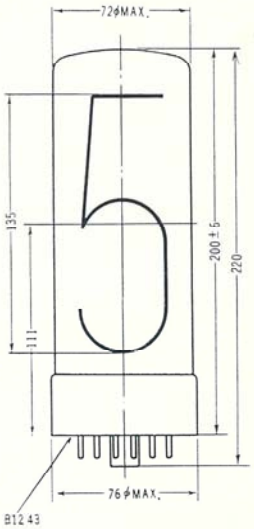
A-13
(GR-116)



B-5
(TSB-14P)



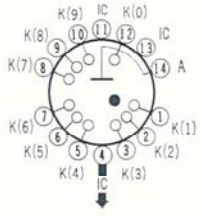
B-6
(TSB-12P)



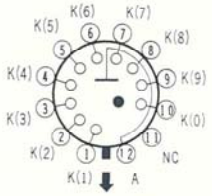
A-17
(CD 47)

INDICATOR TUBE

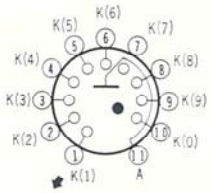
Pin Connections



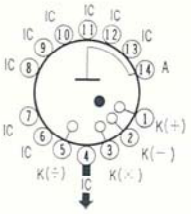
C-1
(CD 11)



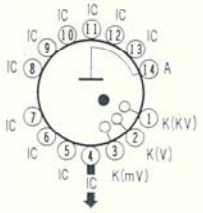
C-2
(CD 12, CD 27, CD 47)



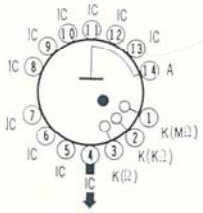
C-3
(CD 13)



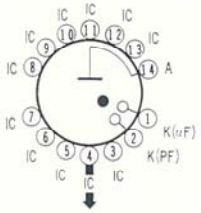
C-4
(CD 14)



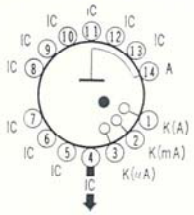
C-5
(CD 15)



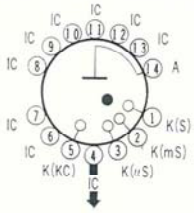
C-6
(CD 20)



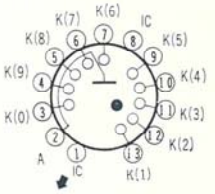
C-7
(CD 21)



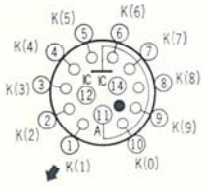
C-8
(CD 22)



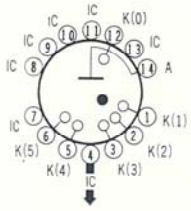
C-9
(CD 23)



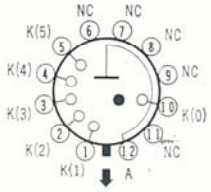
C-10
(CD 24)



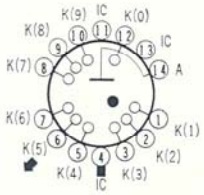
C-11
(CD 28)



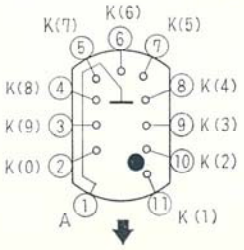
C-12
(CD 38)



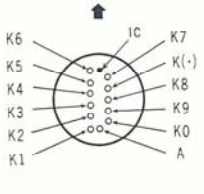
C-13
(CD 40, CD 42)



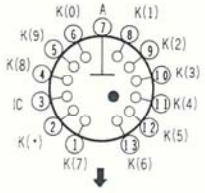
C-14
(GR-211)



C-15
(CD 25, CD 43)



C-16
(GR-110)



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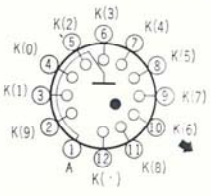
(GR-111)



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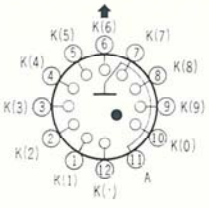
(CD 78)



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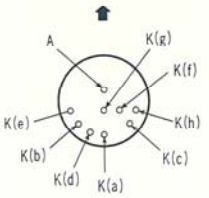
(CD 66)



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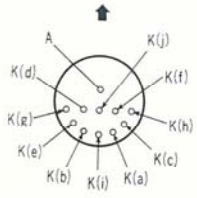
(MG-17G)



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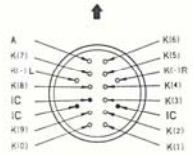
(MG-19B)



C-22
(GR-116)

Design deltails subject to change without notice.

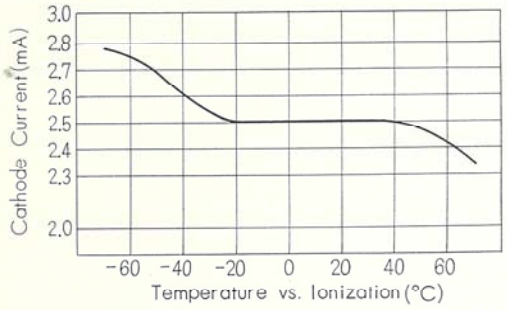
INDICATOR TUBE

RODAN

Type	Approximately
CD 11	200,000 hour
CD 12	500,000 hour
CD 13	100,000 hour
CD 27	500,000 hour
CD 28	150,000 hour
CD 24	200,000 hour

Fig. 1 Estimated life (in hour)

(a) Temperature VS. Anode Current



(b) Temperature VS. Anode Voltage

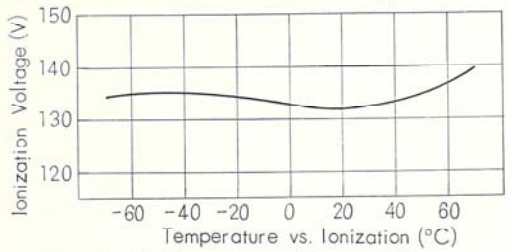


Fig. 2 Temperature Characteristics of the CD11

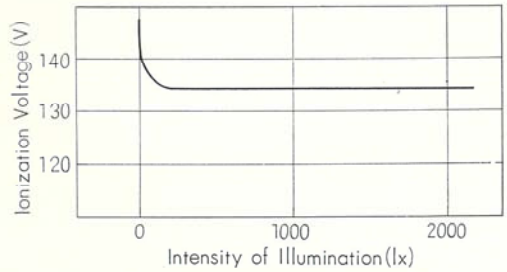


Fig. 3 Intensity of Illumination VS. Ionization Voltage

Life of Indicator Tubes

The life of indicator tubes ends by the disconnection of figure electrodes (cathodes), which is caused mainly by sputtering. In practical use, it depends upon the conditions of each cathode; the characteristics spread, the discharge current, rectifier conditions of the power supply, and the period of usage of each electrode differs greatly from each other even in frequent changeover.

Therefore, the life of each cathode varies widely. Long life indicator tubes are so designed that the sputtering is reduced substantially; therefore, under severe conditions such as continuous indication and frequent changeover, at least 25,000 hours of operation is expected in each cathode of the CD11. If each cathode is switched on and off within a few hours operation, estimated life is more than 200,000 hours. In case of the CD12 and CD27, longer life is expected. (Refer to Table 1.)

CIRCUIT CONDITIONS

Ionization Voltage

Anode supply voltage should be more than ionization voltage. Ionization voltage also depends upon ambient brightness and temperature. So it is necessary to take these factors into consideration in determining the anode supply voltage (Ebb).

A few makers indicate the minimum anode supply voltage. It is recommended to use higher voltages, if circuit design permitting. Excess glow occurs by more than 300V operation, so that it is recommended to select Ebb in the range between 190-290V.

Cathode Current

If the cathode current is too small, clear and sufficient indication of figures is not expected, and contrary, if it is too great, the life is reduced and discharge occurs on lead wires and inner supporting. The area of each figure cathode differs from each other; therefore minimum current for each cathode is not the same. Each maker indicates the standard current according to the characteristics spread and variation of each tube, which vary in a single tube depending upon each figure cathode.

Moreover, recommendable anode series resistance is given in conjunction with anode supply voltage, conform to the specification imposed by each maker in circuit design. (Refer to other characteristics.) The voltage varies linearly with the resistance, therefore, in the use of voltages other than the specified value, calculate the resistance value by the proportional principle.

Temperature Characteristics & Photoelectric Phenomenon

The cathode current and ionization voltage are plotted against temperatures in Fig. 2 (a)-(b), however, at ambient temperatures lower than $-30°C$, life is reduced by large current. The photoelectric phenomenon data is given in Fig. 3. Delay in ionization time will appear when the indicator tube is operated in dark place.

Other Characteristics

In the fundamental circuitry, each cathode except the ignition electrode is separated, however, when electronic elements such as transistors are used for changeover, each cathode is biased positively. The positive bias characteristics are given in Fig. 4. Select the voltage to use tubes in B region. Rxs are connected to the anode for changeover by resistance variation and improvement of transistor circuits. (Refer to Fig. 5.) Therefore, when rated current flows through the ignition electrode, current flows through Rxs too. The potential drop across the anode resistor (Rp) increases; therefore, Rp should be slightly smaller than the value specified in the fundamental circuit. The Ebb is plotted against the Rp when the cathode current (Ik) is fixed at the standard value and Rx at 1.5 MΩ. Measure the cathode current (Ik) in Fig. 5.

The spread of positive bias of cathodes of the CD 11.

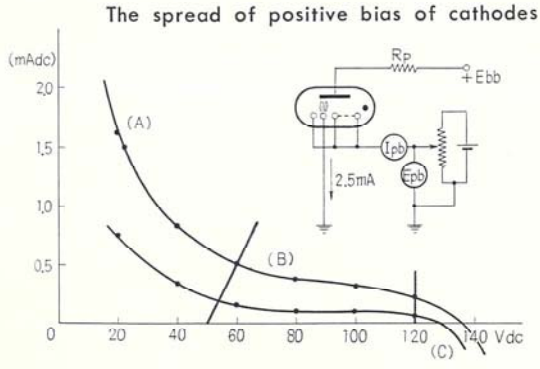


Fig. 4

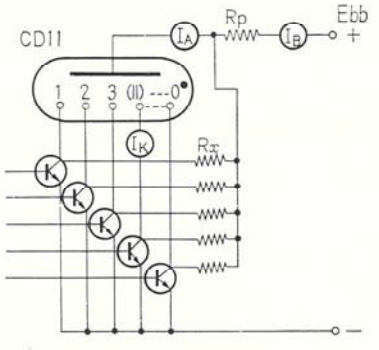


Fig. 5

Table 2. Ebb and Rp in Transister Control

Type		CD 11		CD 24		CD 28	
	I_B and R_P Unit	I_B mA	R_P KΩ	I_B mA	R_P KΩ	I_B mA	R_P KΩ
Ebb Vdc	Condition	Rx=1.5MΩ	Ik=2.5mA	Rx=1.5MΩ	Ik=2.25mA	Ik=1.8mA	Ik=1.8mA
170		3.5	7	3.3	7	2.8	10
200		3.5	16	3.2	17	2.8	20
250		3.5	30	3.2	30	2.8	40
300		3.5	45	3.2	45	2.8	60

NOTE: 1. 2SD-134 Transistors are used. 2. The circuit showh in Fig. 5 should be used.

APPLICATIONS OF INDICATOR TUBES

Fundamental applications are as fallows.

A. MECHANICAL METHODS

(1) Changeover Switch Control

The fundamental circuit shows in first page is used without modification as a simple indicator circuit. They are used in channel indicating devices when the changeover switch is operated synchronously with other changeover switches fitted in other circuits. (Refer to Fig. 6).

(2) Relay Selection Circuit

Relays are arranged in a tree branch fashion. The Lighting of a specified figure is attainable by the combination of on and off states of relays which are arranged in 4 rows and operated selectively. This circuitry is binary coded decimal notation conversion by relays and discontinuous equilibrium type. This method is also adopted in digital voltmeters.

B. THE METHOD BY SEMICONDUCTORS AND ELECTRONIC TUBES

(1) Control by Transistors

NPN-type transistors are connected to the cathodes of a discharge tube as shown in Fig. 8. The transistors are in the OFF-state normally by biasing their bases with negative potential (W $-1\sim-4$ volts). Positive potential is applied to a single transistor to render it in the ON-state by a specifying signal, thus, discharge is controlled. It is desirable to use transistors whose collector-emitter breakdown voltage (Vee) is higher than 80 volts.

(2) The Method for Providing Counting Function

The circuit of the all-transistor unit with IC is shown in Fig. 9. The unit is compact and power consumption is small with high practicability and low price. The units are available under the model name PU-1002 and PU-1005.

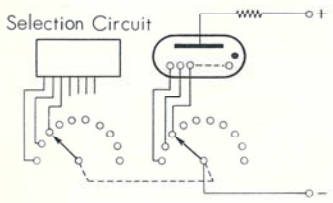


Fig. 6

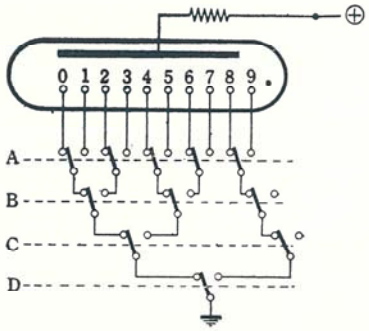


Fig. 7

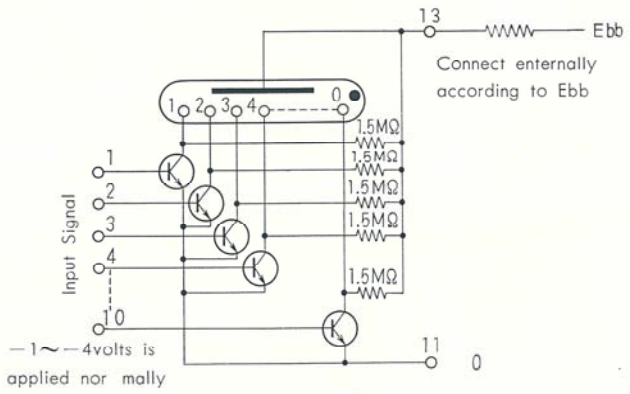


Fig. 8

C. CHARACTERISTICS CURVE AND OPERATION CONDITION

Maximum, standard, and minimal currents, and minimal anode supply voltage are specified as ratings of indicator tubes. The characteristics spread of each tube is included in the maximum and minimal currents. The current does not affect the life of tubes as is the case in incandescent type tubes.

The purpose of indicator tubes is to cover cathodes with glow. Therefore, it is necessary that current density per unit area exceed a specified value. When the current is too small, partial glow will occur.

When cathode current increases, maintaining voltage Eb across tubes increases too. Therefore, supply voltage Ebb and load resistor R shall be determined by V-I characteristics diagram (refer to Fig. 10) where load line is given by connecting A point (the center of Eb distribution) and B (representing Ebb), considering rated voltage, thus, R is calculated by

$$R = \frac{B - C}{Ik}$$

When Ebb is selected high, the gradient of the load line (R_1) increases. Thus, the currents of each cathode tend to be equal and current spread is reduced.

In designing the power supply, attention shall be paid at least the output voltage should not be lower than a minimum anode supply voltage in fluctuation.

Smoothed pulsating current is used, however. pulsating current of half and full waves, can also be used. In this case, current flows during the period when the voltage exceeds the ionization voltage. Therefore, excess current will flow at peaks, when R is determined by effective or average voltage (rms).

When pulsating current is used, peak value shall be confirmed. In the case of half wave, R shall be selected to be slightly greater than the value which allows the maximum rated current to flow to prevent currents from exceeding the absolute maximum rated current. In the case of full wave, R shall be selected approximately to be the value that allows the maximum current. When square wave is used, tubes designed for pulse operation shall be used.

In pulse operation, load resistance and the standard current are specified in 1 kHz and 1/10 duty cycle operation. The duty cycle, however, is likely to be shorter than 1/10 in conjunction with the number of figures in practice.

The way in which the load resistance is derermined is the same as in direct current (DC operation). In pulse operation, average current is small. Therefore, tubes are designed to function correctly when the average current is sufficient to maintain the brightness intensity of glow discharge. Ionization voltage is designed to be high generally and anode resistance is small. Thus, the increase of the voltage drop in terms of the current is small.

Pulse width is rated to be 0.1m secs. min. In some tubes, however, it is shorter than the value. As stated in the section concerned with the ionization sufficiently long clock is desirable to eliminate delay in voltage.

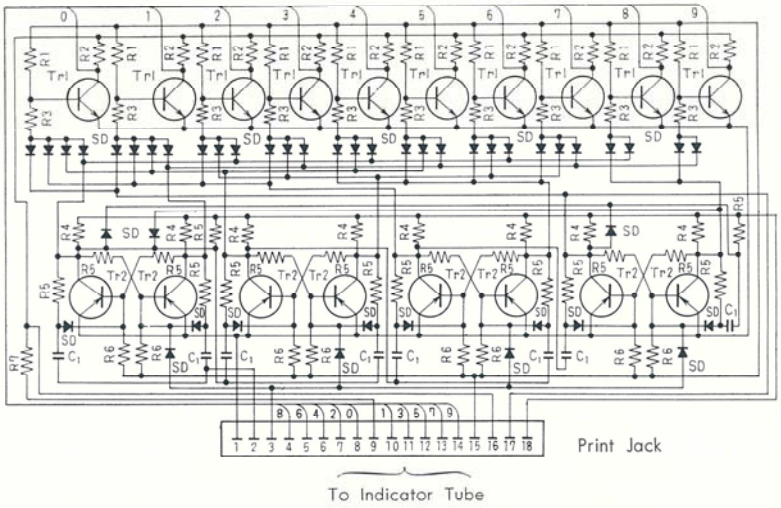


Fig. 9

V-I Characteristics

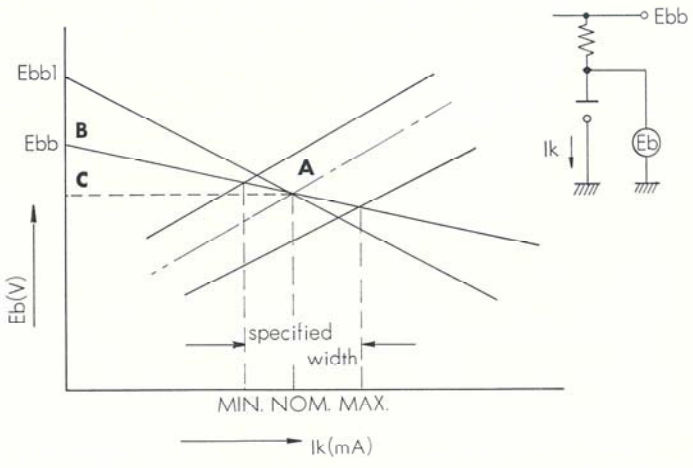


Fig. 10

NUMERICAL INDICATOR TUBES

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