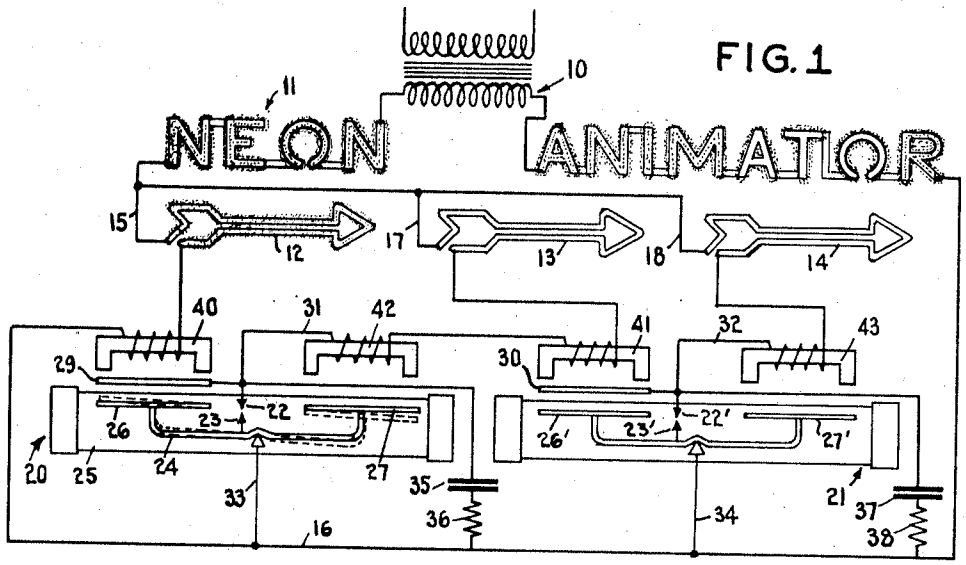
March 30, 1937. W. FOERSTE 2,075,188

FLASHING GASEOUS DISCHARGE LAMP

Filed June 20, 1934 2 Sheets-Sheet 1

FIG. 1



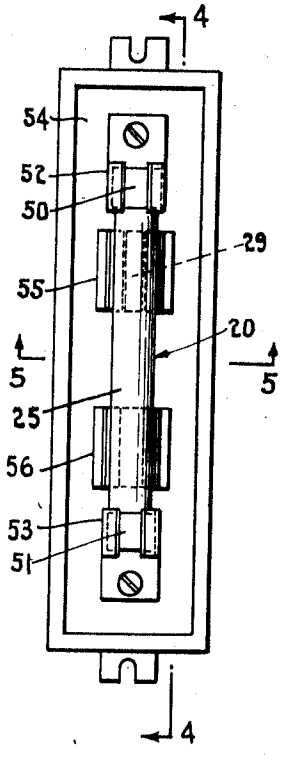


FIG. 3

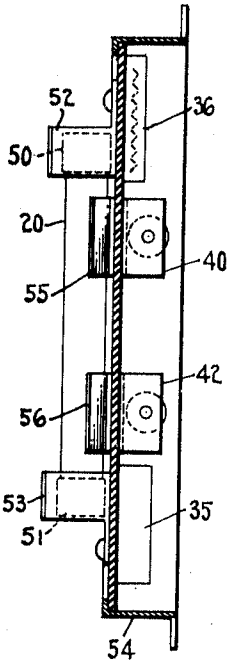


FIG 4

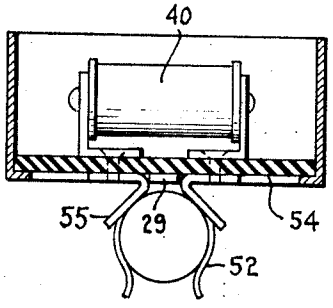


FIG. 5

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March 30, 1937. W. FOERSTE 2,075,188

FLASHING GASEOUS DISCHARGE LAMP

Filed June 20, 1934 2 Sheets-Sheet 2

FIG. 6

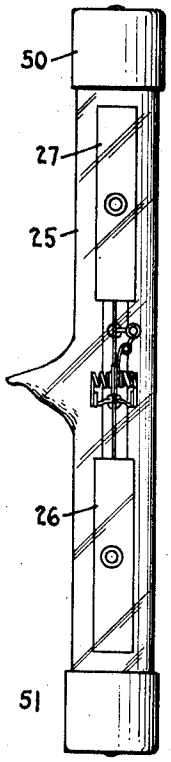


FIG. 7

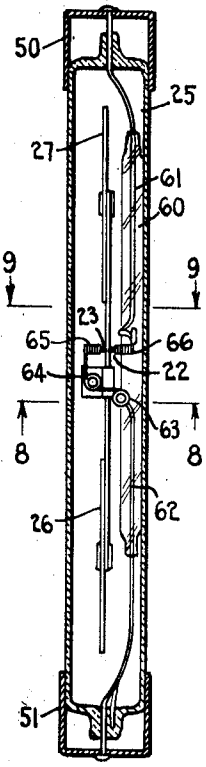


FIG. 10

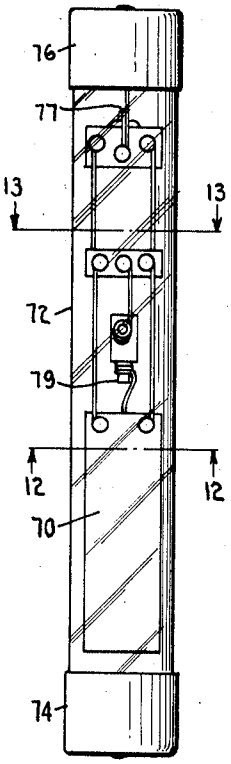


FIG. 11

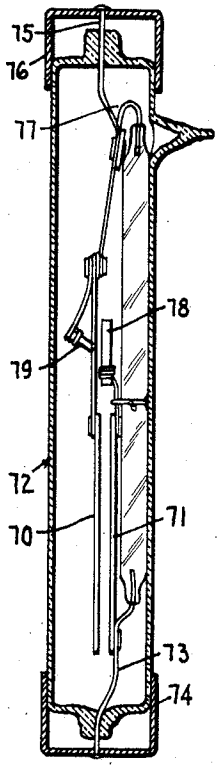


FIG. 8

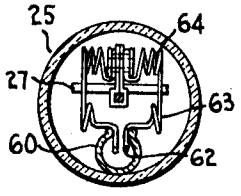


FIG. 9

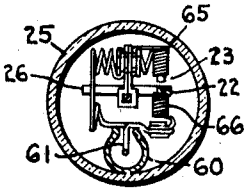


FIG. 12

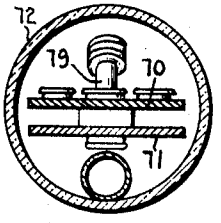
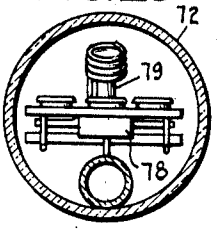


FIG. 13



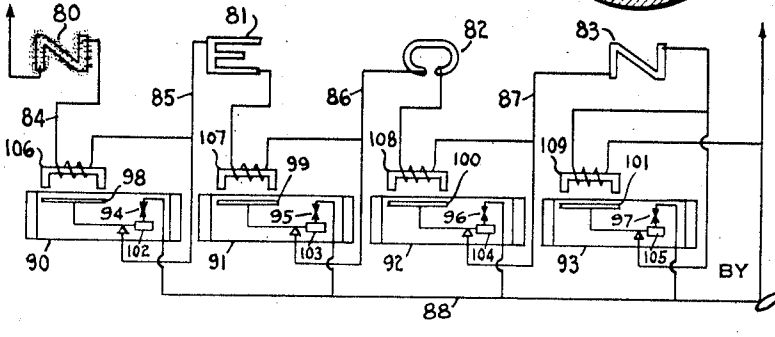


FIG. 2

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UNITED STATES PATENT OFFICE

2,075,188

FLASHING GASEOUS DISCHARGE LAMP

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Application June 20, 1934, Serial No. 731,433

3 Claims. (Cl. 177—346)

The invention relates to a system embodying illumination members of the gaseous discharge lamp type and also to devices for controlling the energization of the lamps. The invention is concerned more especially with so-called "animator" illumination systems contemplating successive illumination of a plurality of associated lamps both with extinguishment of one lamp as a succeeding one is energized, as well as for maintaining illuminated all of the lamps as they are successively energized. As is well known, it is desirable for various reasons to interrupt the current in the secondary circuit of a transformer for operation of animated signs of this type rather than the primary circuit; but difficulty is experienced in the design of a suitable control device for the higher voltages prevailing in such secondary circuit.

The invention has for an object the provision of a simple and effective control device for use in the secondary circuit operating the lamps of either of the aforementioned systems; and a device which operates with low power consumption and which shall possess relatively long life with respect to its contact-making elements.

A further object of the invention contemplates the provision of contact points small in contact area relatively to the area of controlling plates or electrodes which serve to actuate the said contacts, and adapted to avoid vibratory contact therebetween of the frequency of the applied current and caused by electrostatic attraction.

Still another object is the provision of contacts of non-fusible material.

Another object of the invention resides in the provision of a simple mounting member for the control device whereby the same may be readily connected into the secondary circuit; and, also, the provision of associated means for reducing sparking difficulties at the contact element and for minimizing radio disturbances therefrom.

Still another object of the invention resides in the provision of a control device which may be electromagnetically or electrostatically operated or the control effected by both means, the cooperating contact-making elements in all cases being located, preferably, within an evacuated vessel to increase the life of the device and to reduce damage thereto as well as fire hazards.

In carrying out the invention, a plurality of gaseous discharge lamps is arranged to be connected in a novel manner to a suitable source of energy, as the secondary of a transformer; and the individual lamps are controlled also by the novel type of control device such that the lamps of the series may be successively energized to give the appearance of motion, or the energization may be cumulative with respect to the lamps as in so-called "speller" systems.

The novel contact device embodies a preferably evacuated glass vessel within which is mounted a pair of cooperating contact-making elements, one at least of which is movably mounted in the vessel, being connected with a plate or electrode element which may be electrostatically charged or electromagnetically attracted, or both, by suitable means associated with the vessel and generally externally thereof. These means are under the influence of the energy activating the controlled lamps; and in the case of the non-cumulative illumination of the lamps of a series, the different lamps are designed to be successively of lower breakdown resistance in the direction of the desired illumination of the said lamps. In the case of the cumulatively illuminated lamps, the respective lamps are initially connected in both multiple and series to the source of energy and are then successively connected by the novel control devices only in series with one another.

In both systems, when illumination of the final lamp of the series is attained, the control device acts to de-energize, in the former arrangement the last lamp of the series, and in the latter arrangement all of the lamps of the series. The novel arrangement admits also of being associated with permanently illuminated portions constituted by gaseous discharge lamps.

The nature of the invention, however, will best be understood when described in connection with the accompanying drawings, in which:

Fig. 1 is a diagrammatic view illustrating the non-cumulative illumination arrangement equipped with the novel control device.

Fig. 2 is a similar view and illustrates the arrangement for the cumulative illumination.

Fig. 3 is a plan view of the novel control device and mounting member for the same; and Fig. 4 is a longitudinal section thereof taken on the line 4—4, Fig. 3.

Fig. 5 is an enlarged transverse section through the device and mounting member, and taken on the line 5—5, Fig. 3.

Figs. 6 and 7 are respectively a front elevation and a longitudinal section through the evacuated vessel constituting a portion of the control device.

Figs. 8 and 9 are respectively enlarged transverse sections taken on the lines 8—8 and 9—9, Fig. 7 of the drawings.

Figs. 10 and 11 are respectively a front eleva-

tion and a longitudinal section of a modified form of the control device.

Figs. 12 and 13 are enlarged transverse sectional views taken respectively on the lines 12—12 and 13—13, Fig. 10 of the drawings.

Referring to the drawings, more particularly Fig. 1 thereof which is a diagrammatic representation of the particular arrangement for the animated system composed of gaseous discharge lamps operating in succession with the preceding lamp extinguishing as the succeeding one is energized, power for operating all of the lamps is derived from the secondary coil 10 of a transformer; and a display portion 11 is shown associated with the animated portion, being connected in series therewith for permanent display.

This animated portion comprises a plurality of gaseous discharge lamps 12, 13 and 14 which are connected in multiple for successive illumination to produce the effect of motion, and to this end are successively of lower breakdown resistance in the desired direction of illumination. Thus, the lamp 12 is connected through a lead 15 and one of the novel control devices to the common lead 16; the lamp 13 through a lead 17 and a further control device to said common lead; and the lamp 14 through the lead 18 and said further control device also to said common lead—there being required one less control device than the number of lamps operated thereby.

The two control devices 20 and 21 are thus indicated in Fig. 1; and each includes a normally open set of cooperating contact-making elements, the one 22 being indicated as stationary and the other 23 as movable. To this end, the contact 23 may be carried upon a rocking support member 24 movably supported as in being mounted in a vessel 25 which is preferably evacuated to minimize sparking effect at the contact-making elements. These are constructed of non-fusible material such as carbon, graphite, tungsten, etc., or combinations thereof.

The rocking support 24 carries at one end an electrode or armature 26 and at the opposite side of the fulcrum an electrode or armature 27, both electrodes being located in the vessel; and said support member may be constructed of substantially rigid material, or the same may be of a more or less flexible nature to influence the amplitude of oscillation thereof and thereby the control periods, as hereinafter set forth.

One of these two said electrodes 26 and 27 is adapted to be influenced, that is to say, attracted, electrostatically or electromagnetically, or to be subject to both forces. Thus, there may be associated with the electrode 26 of the control device 20 as well as with the similar electrode 26' of the control device 21, and preferably externally of the evacuated vessel, stationary electrodes 29 and 30, respectively. These electrodes are arranged in juxtaposed relationship with the corresponding electrodes 26 and 26', and are of non-magnetic material when the control device embodies also electromagnetic control of the said electrodes, as hereinafter set forth. Provision is made as through the leads 31 and 32, respectively, to connect these electrodes to one side of the line, the juxtaposed electrodes 26 and 26' being connected to the opposite side of the line through the leads 33 and 34, respectively, thereby imparting electrostatic charges of opposite polarity to the said sets of juxtaposed electrodes. The effect of this will be to cause the electrodes of a set to be attracted and to rock the support member 24 accordingly.

A condenser 35, say of .005 mfd. and a series resistance 36, say of 10,000 ohms, may be connected across the cooperating contacts 22—23, and similarly a condenser 37 and resistance 38 about the cooperating contacts 22' and 23', to further reduce the sparking thereat.

The introduction of such condenser will serve also to minimize the voltage applied across the pair of juxtaposed electrodes and thus prevent excessive electrostatic effect therebetween. Furthermore, with respect to the cooperating contacts of a control device, the contacting surfaces thereof should be of minimum area to reduce any electrostatic action therebetween to a minimum so that the same will have no controlling effect upon the juxtaposed electrodes.

In order to obviate radio interference from the operation of control devices of the aforesaid nature, it is desirable to introduce reactors or choking means into the circuits controlling the lamps 12, 13 and 14; and such reactors may serve also to supplement the force moving the support member 24 as in providing for an electromagnetic attraction upon the movable electrode of a juxtaposed set, such as the electrode 26 or 26' which will then be constructed of electromagnetic material. Thus, as indicated in Fig. 1, an electromagnet 40 may be included in series in the lead 15 and an electromagnet 41 in series in the lead 17, the same being located externally of the corresponding evacuated vessels and with their pole pieces in proximity to the corresponding electrodes. A further electromagnet 42 is associated with the one control device 20 and an electromagnet 43 with the control device 21, said electromagnets being located in proximity to the corresponding electrodes 27 and 27' and the former electromagnet 42 being connected in series with electromagnet 41 in the lead 31, and electromagnet 43 being connected in series with the lead 32.

The operation of the system is as follows: When the secondary of the transformer 10 is energized, the sign portion 11 will illuminate and also, as indicated, the lamp 12 of the animated section comprising the lamps 12, 13 and 14, the circuit being directly through the electromagnet 40 to the common lead 16. This causes electrode 26 to be attracted to close the circuit at the contacts 22—23; and in so doing magnet 42 will be energized to attract its electrode 27 to restore the open-circuit condition at the contacts 22—23.

With the closing of the contacts 22—23, the circuit to the lamp 13 was closed; and this lamp having a lower breakdown resistance than the lamp 12, the said lamp 13 will be caused to be energized and the lamp 12 extinguished. At the same time, the electromagnet 41 will be energized thereby to close the contacts 22'—23' for energization of the next-succeeding lamp, as the lamp 14. The electromagnet 43 has also been energized with the closing of the contacts 22'—23' and will cause electrode 27' to be attracted to reopen the said contacts. This causes lamp 14 to be extinguished and restores the original condition for repetition of the cycle, it being appreciated that throughout this action which gives the effect of motion, the portion 11 has remained continuously illuminated and is unaffected by the action of the control devices. The actual period during which a lamp 12, 13 or 14 remains energized may be variously controlled, for example, by making the supporting member 24 more or less flexible to increase its amplitude. The action of a succeeding lamp be-

coming energized and the preceding one becoming extinguished results from the fact that in the use of an alternating current supply, the voltage applied to a lamp drops to zero value from a peak voltage. A lamp of higher striking voltage will therefore be prevented from being energized on the next half cycle due to the fact that the voltage will be prevented from reaching the value necessary to energize said lamp of higher striking voltage, as in the meantime another lamp of lower striking voltage will have attained its required striking voltage, and thus become energized. In other words, there must be sufficient impedance in series with the lamp of lower breakdown voltage to prevent the voltage from rising above the breakdown potential of the lamp of higher breakdown voltage. The impedance and IR drop of the source of supply as well as that of other means included in series with the tube of higher breakdown voltage insures the operation solely of the tube of lower breakdown voltage. A few volts drop, say from 10–15 volts, will serve to accomplish the result and this may readily be obtained by choosing the proper circuit constants.

The novel control device which may comprise an evacuated glass tube **25** is provided with suitable conductive end caps **50** and **51** to afford a cartridge type device which may be snapped into suitable clips **52** and **53** mounted on one side of a panel box **54**, as indicated in Figs. 3 and 4 of the drawings. Furthermore, there extends upwardly from the surface of this panel a pair of pole shoes **55** and **56** representing the electromagnets **40** and **42** or **41** and **43** of a corresponding control device, the said electromagnets for corresponding shoes being located within the panel-box on the opposite side of the cover. In this box portion, furthermore, there may be retained the resistance **36** or **38** and the associated condenser **35** or **37**, the connections to the various members being suitably made in manner well understood. An electrode **29** or **30** may be secured to the outer surface of the panel as between one of the pair of pole shoes, for example the pole shoe **55**.

A convenient way of mounting the contact-making elements, as the elements **22** and **23**, is indicated in Figs. 6 to 9 in which there is shown as secured to the bottom of the evacuated vessel **25** a glass tube **60** containing the lead-in wire **61** as well as the outgoing wire **62**. The latter is doubled upon itself and coiled as at **63** to form a more or less substantially rigid fulcrum and is then continued with a further coiled portion **64** to which is attached electrode **26** for the movable contact **23**. This latter may be retained conveniently by coiling the wire about the same as at **65**; the wire then being continued to afford a support for the electrode **27**. Similarly the lead-in wire **61** may be provided with the coiled portion **66** to retain the opposite and stationary contact element **22**.

In Figs. 10–13, inclusive, a modified form of control device is indicated, the same being solely of the electrostatic type including merely two juxtaposed electrode plates **70** and **71** and both mounted within an evacuated vessel **72**, these plates being designed to be attracted to each other electrostatically. The plate **71** in this embodiment is the stationary one and is connected to the lead-in wire **73** which terminates in the cap **74** about the sealed end of the vessel. Similarly, the lead-in wire **75** is secured to the cap **76** about the opposite sealed end of the vessel and is connected to the flexible end **77** of the support for the movable electrode **70**. A stationary contact element **78**, as of carbon, is designed to cooperate in making contact with a similar contact element **79** carried by the support **77** for the electrode **70**. Thus, when opposite charges are supplied to these electrodes, as through the caps **74** and **76** at the opposite ends of the vessel, the contact elements **78** and **79** will be momentarily attracted and then separated under the action of the flexible mounting **77**, whereupon the cycle is repeated.

This form of control device may be substituted for the one indicated in connection with the system shown in Fig. 1; and it may also be utilized in the system wherein it is desired to cumulatively illuminate the individual lamps of a sign; but it is preferred to utilize the first described type as the action of the modified form is inclined to be extremely rapid. This action may be retarded, however, by suitably weighting the movable element or otherwise increasing its inertia.

In connection with the cumulative illumination system, reference being had to Fig. 2 of the drawings, the various lamps **80**, **81**, **82** and **83** are connected both in series with one another and in multiple as through the leads **84**, **85**, **86**, **87** and the common lead **88**. There is introduced for each of the said lamps a control device of the nature hereinbefore described; but, as indicated, the same is of the first described type and modified slightly in that it operates on a normally closed circuit. To this end there is associated with the respective lamps corresponding control devices **90**, **91**, **92** and **93**, each embodying a normally closed pair of cooperating contacts **94**, **95**, **96** and **97**, the one contact element of a pair being movable through the action of an electromagnetic electrode **98**, **99**, **100**, **101**.

In this form of control device, the electrostatic electrode has also been omitted as well as the second electrode, and the movable elements are counterweighted by the counterweights **102**, **103**, **104** and **105** to normally maintain the respective cooperating contacts closed. Electromagnets **106**, **107**, **108** and **109** are associated with the respective electrodes or armatures **98**, **99**, **100** and **101** to attract the same when an electromagnet is energized and thus open the circuit through the corresponding cooperating contact elements.

In operation, it will be noted that the first lamp **80** will be connected directly and through a circuit of least resistance so that the remaining lamps will be short-circuited and only the lamp **80** illuminated. However, electromagnet **106** will also become energized thereby to open the cooperating contacts **94** so that the current through lamp **80** will be diverted and obliged to pass also through the next lamp **81**, placing the same in series therewith. This, in turn, will cause the current to flow through lamp **81**, electromagnet **107** and the contact elements **94** to illuminate in addition the lamp **81**, and thus continue to complete the cycle.

I claim:

1. In a positive column gaseous discharge tube system, comprising a source of alternating current and a plurality of said tubes of progressively decreasing breakdown voltage: means to connect one terminal of said source to one terminal of each of said tubes and including an impedance device in series, pairs of juxtaposed contacts, one pair for each tube except the one

with the highest breakdown voltage and each pair embodying a stationary and a juxtaposed movable contact element, all of the movable contacts being connected to the other terminal of said source, and electrically operating means adapted for energization of each of the tubes, except the one with highest breakdown voltage, for moving the movable contact elements into contact with a juxtaposed stationary contact element, said electrically operating means for the lamp immediately succeeding the one of highest breakdown voltage being included in circuit with the energizing circuit of the latter, and the successive electrically operating means for succeeding tubes in circuit with the energizing circuit of its immediately preceding tube, together with electrically operating means for separating the contact elements included in circuit with the energizing circuit of the associated lamp.

2. In a positive column gaseous discharge tube system, comprising a source of alternating current and a plurality of said tubes of progressively decreasing breakdown voltage: means to connect one terminal of said source to one terminal of each of said tubes, including an impedance device in series, pairs of contacts, one pair for each tube except the one with the highest breakdown voltage, pivoted levers, one for one contact of each of said pairs, means for mounting said one contact of each pair upon its corresponding lever, and the other of said pairs stationary, means acting upon each lever to maintain the contacts open, separate circuit means to connect the other terminal of each one of said tubes except the first to its associated stationary contact, a pair of magnetically permeable plates on each of said levers, a circuit directly connecting the other terminal of said source to the tube of highest breakdown voltage and including an electromagnetic device for acting upon the magnetic plate of the tube of next lower breakdown voltage to close its associated contact and similar electromagnetic devices in the said separate circuit means of the succeeding tubes except the last one, means to connect all movable contacts to the other terminal of said source, and each of said separate circuit means also including electromagnetic means to act upon the other plate of a lever to open its associated contacts.

3. In a positive column gaseous discharge tube system, comprising a source of alternating current and a plurality of said tubes of progressively decreasing breakdown voltage: means to connect one terminal of said source to one terminal of each of said tubes, including an impedance device in series, pairs of contacts, one pair for each tube except the one with the highest breakdown voltage, pivoted levers, one for one contact of each of said pairs, means for mounting said one contact of each pair upon its corresponding lever, and the other of said pairs stationary, means acting upon each lever to maintain the contacts open, stationary conducting plates, one for, and connected to, each of said stationary contacts to be at substantially the potential thereof, separate circuit means to connect the other terminal of each one of said tubes except the first to its associated stationary contact, a pair of conducting and magnetically permeable plates on each of said levers, and connected to the movable contact to be at substantially the same potential thereof, one of each of said pairs of plates forming an electrostatic area with the associated plate of said stationary plates, a circuit directly connecting the other terminal of said source to the tube of highest breakdown voltage and including an electromagnetic device for acting upon the magnetic plate forming the electrostatic area of the tube of next lower breakdown voltage to close its associated contact and similar electromagnetic devices in the said separate circuit means of the succeeding tubes except the last one, means to connect all movable contacts to the other terminal of said source, and each of said separate circuit means also including electromagnetic means to act upon the other plate of a lever to open its associated contacts.

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