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CONTROL FOR ELECTRIC VACUUM DISCHARGE APPARATUS

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Fig. 1.

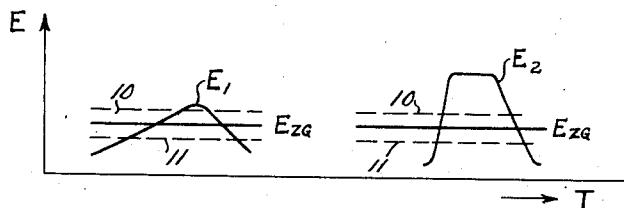
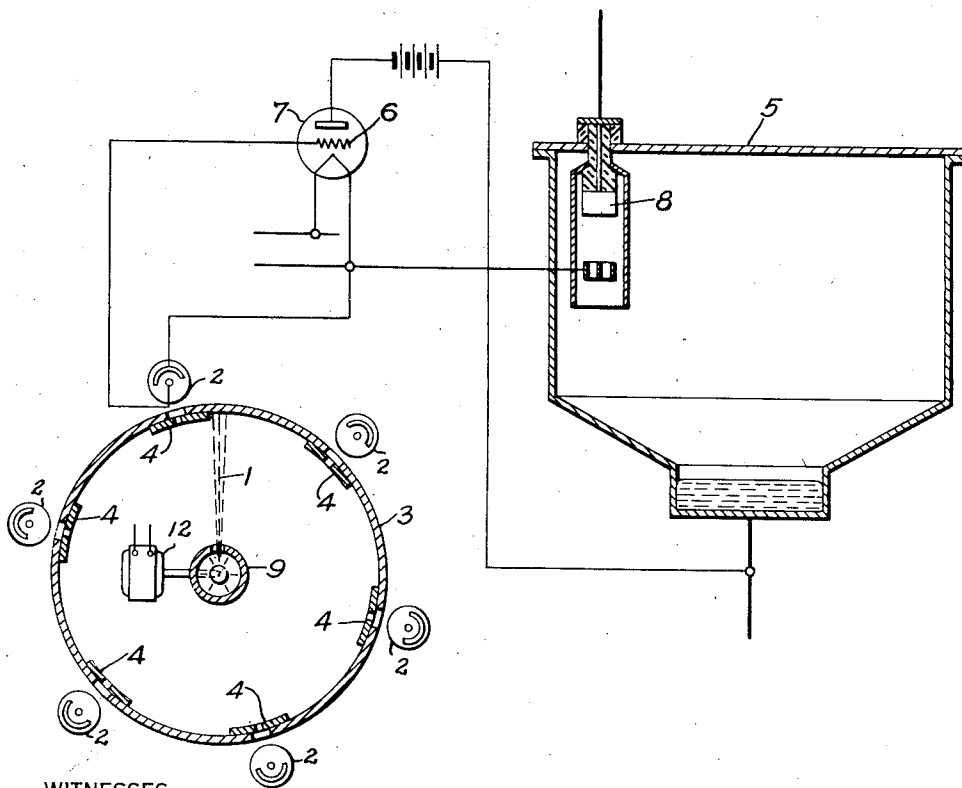


Fig. 2.



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CONTROL FOR ELECTRIC VACUUM
DISCHARGE APPARATUS

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6 Claims. (Cl. 250—41.5)

My invention relates to a control for electric vacuum discharge apparatus.

It is well known that controlled electric vacuum discharge apparatus, such as rectifiers, possess a so-called ignition voltage which must be attained by the control apparatus before the control becomes effective. This ignition voltage is dependent upon the degree of the gas or vapor pressure prevailing in the controlled vacuum discharge apparatus and upon the form of the control anode arrangement. The control voltage is a practically constant magnitude for each individual apparatus. As the vapor density changes with change in load, the ignition voltage depends, among other things, upon the load, an undesirable condition which should be suppressed. At all events, it is desirable, in order to secure accurate control, to construct the apparatus in such a manner that the ignition voltage depends as little as possible on any operating magnitude and that the ignition voltage, therefore, remains substantially constant.

However, keeping the ignition voltage as substantially constant as possible does not alone imply that an accurate control of the apparatus is secured as the control potential impressed on the control electrode must attain the ignition potential. Since, as stated above, the ignition potential varies in magnitude, the ignition characteristics are undesirable in the case where the control voltage rises gradually to the ignition potential.

Figure 1 is a diagrammatic illustration of various control potentials prevailing in discharge apparatus; and

Fig. 2 is a schematic illustration of a conversion system embodying my invention.

Fig. 1 shows two different conditions of voltage. The straight line E_{zg} indicates the value of the ignition voltage, whereas the curve E_1 and E_2 indicate the magnitude and form of the control voltages. Both voltages are plotted against time and it is assumed that the control voltage is constant for the time under consideration, whereas the ignition voltage varies its value.

On the left-hand side of Fig. 1 is illustrated the state in which an uncertain control results. The point of intersection of the control voltage E_1 and the ignition voltage E_{zg} is variable with respect to time, since the curve of the control voltage E_1 intersects the straight line, i. e., the ignition voltage E_{zg} at an angle. On the right-hand side of Fig. 1 are illustrated the conditions which indicate a properly timed operation of the ignition voltage. In this case, the control voltage E_2 intersects the ignition voltage E_{zg} practically

at right angles. The instant within which the ignition is started is, consequently, sharply defined. Also the time of ignition is not materially changed, if, for instance, the ignition voltage undergoes small changes which are indicated by the dotted lines 10—11 below and above the mean value E_{zg} . As will be seen from Fig. 1, if the ignition voltage E_{zg} is by chance greater or smaller by such an amount, the ignition takes place too late or too soon as shown on the left-hand side of the curve of Fig. 1, whereas on the right-hand side the time of ignition is hardly displaced in the event of a change of the ignition voltage.

The object of my invention is to provide a method which ensures an accurate ignition in the manner as shown on the right-hand side of Fig. 1. It has hitherto been customary to produce such ignition voltages by inserting during the variation of the control voltage rotating contact apparatus which suddenly applies and suppresses the control voltage. However, rotating contacts are undesirable accessories in systems which consist after all of static apparatus. In order to avoid such rotating parts, the control of the rectifiers is effected according to the invention by the use of photo-electric cells associated with suitable amplifying tubes, a luminous ray acting as a control means.

The method of control of mercury vapor rectifiers differs as is well known. For instance, in order to secure a variable direct current voltage, the individual anodes of the rectifier are ignited at regular intervals, a time displacement of the entire series of the ignition intervals determining the value of the voltage. In other cases such as, for instance, in the case of a change of frequency, the rectifier anodes are, however, singly controlled at different times; for instance, some in such a manner that they supply their maximum voltage and others in such a manner that they supply only a lower voltage. The interval between the time of ignition is, consequently, different depending upon the form of the curve of output voltage which is desired. In the following, this general case of any interval between the times of ignition of the individual anodes of a vacuum discharge tube is assumed, which case then comprises the special cases that the intervals of ignition are equally distributed as regards time etc.

Fig. 2 shows the manner in which the invention may be, for instance, carried out. Around a diaphragm 3 are disposed photo-electric cells 2 and within the diaphragm 3 the luminous ray 1 moves with uniform velocity. The diaphragm

3 is provided with openings 4 for the passage of the luminous ray at a predetermined time. These openings may be singly adjusted as regards time for each photo-electric cell in accordance with the uniformly rotating luminous ray. The rotation of the luminous ray may be effected by any drive which ensures a uniform rotation with the desired accuracy; for instance, by means of a speed controlled direct-current motor or a synchronous motor 12.

As shown in Fig. 2, the photo-responsive cells 2 are connected in the control circuits of the grid 6 of the respective control valves 7 which supply control voltage to the control grids of the anodes 8 of the main converter 5. For clearness of illustration, only one circuit is shown, as all the control circuits are similar. The light source 9 produces a beam of light which is traversed over the openings 4 in the drum 3 to energize the corresponding photo-electric cell 2, which cell produces an electric impulse which is impressed on the grid 6 of the control valve 7, which then permits the passage of control current to the associated control grid in the main discharge device 5.

All other anodes of the apparatus 5 are connected in the same manner. By displacing the individual openings 4 in relation to one another on the diaphragm 3, the form of curve of the half cycle which is supplied by the rectifier 5 may be adjusted at will and, furthermore, the time of ignition of all electrodes may be changed by shifting the diaphragm 3 for which purpose, if desired, a simultaneous adjustment of the diaphragm openings may be effected. This shifting may be easily effected by the use of corresponding adjusting devices with levers and cams (not shown) of any desired form, thus securing besides the determination of the shape of curve, also the adjustment of the desired voltage value.

I claim as my invention:—

1. A vapor-electric conversion system comprising a multi-valve vapor-electric converter, a control grid associated with each of said valves, a photo-electric device associated with each of said grids for controlling the potential applied thereto, a drum having openings therein said openings being independently adjustable, said photo-electric devices being arranged in cooperative relation with said openings, a source of light providing a beam of light adapted to pass through said openings, and means for successively applying said beam to said openings.

2. A control system for a plurality of vapor electric valves comprising a control electrode for each valve, a source of control potential for said electrode, auxiliary means for controlling the energization of said control electrodes from said source, photo-electric means for controlling said auxiliary means, a light source for actuating said photo-electric means, means for controlling the application of said source to said photo-electric means, said means being adjustable to vary the

individual time intervals between the applications of said source to said photo-electric means.

3. An electric current conversion system comprising a multi-valve vapor-electric converter, a control electrode for each valve of said converter, a source of control potential for said control electrode, an auxiliary valve connected in series between said source and each of said valves for controlling the application of control potential to said control electrodes, a control electrode for each of said auxiliary valves, photo-electric devices for supplying control potential to control said auxiliary valves, a source of light providing a light beam and means for successively applying said light beam to said photo-electric devices at individually adjustable periods.

4. A control system for a multi-valve vapor-electric device comprising a control electrode for each valve of the device, a source of control potential for said control electrodes, a control valve in series with each of said control electrodes for applying potential to said electrodes from said source with a steep front wave form, a photo-electric device associated with each of said control valves, a diaphragm having openings corresponding to said photo-electric devices, means for traversing a light beam over said openings and means for individually adjusting the spacing of said openings whereby the starting time of the individual valves of the converter may be advanced or retarded with respect to each other.

5. A control system for a multi-valve vapor-arc device comprising a control electrode for each valve of the device, a source of control potential for said control electrode, a control valve for applying said control voltage with a substantially square wave form, a photo-electric device for controlling said valve, an apertured diaphragm adjacent said photo-electric device, a rotating light source for periodically applying light to said photo-electric device and means for relatively adjusting said diaphragm and said light source for advancing or retarding the application of said control voltage to said control electrode.

6. A control system for a multi-valve vapor-electric device comprising a control electrode for each valve of the device, a source of control potential for said control electrodes, a control valve in series with each of said control electrodes for applying potential to said electrodes from said source with a steep front wave form, a photo-electric device associated with each of said control valves, a diaphragm having openings corresponding to said photo-electric devices, means for traversing a light beam over said openings, means for individually adjusting the spacing of said openings whereby the starting time of the individual valves of the converter may be advanced or retarded with respect to each other, and means for adjusting said diaphragm whereby the starting time of all said valves may be adjusted simultaneously.

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