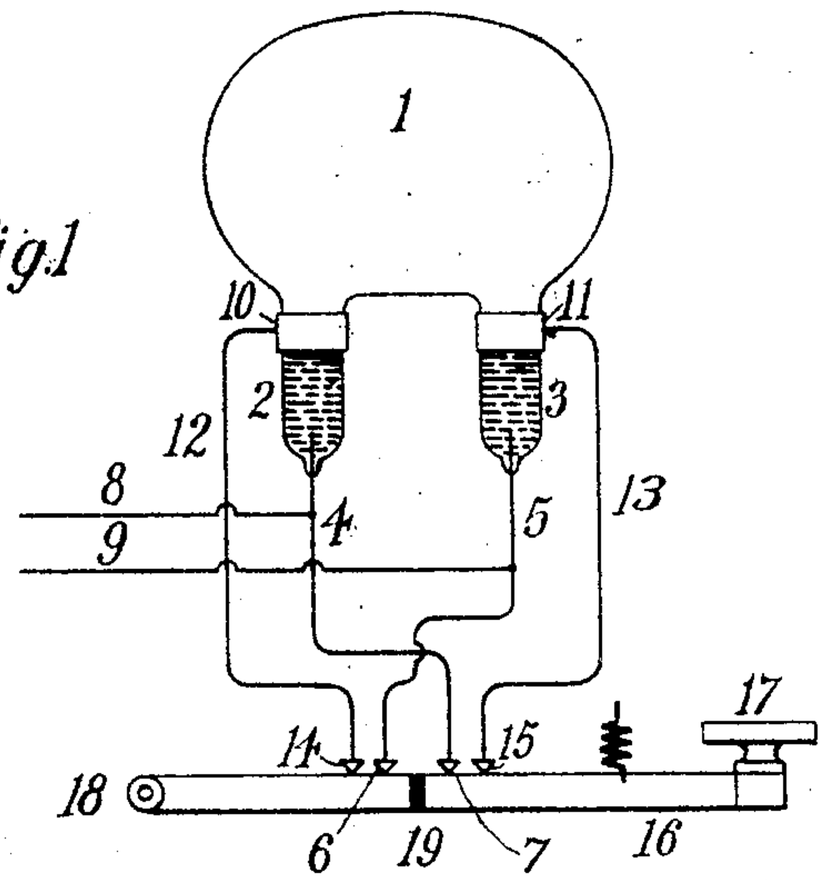
No. 799,050. PATENTED SEPT. 12, 1905.

P. C. HEWITT.

CIRCUIT CONTROLLER.

APPLICATION FILED MAR. 7, 1903.

Fig.1



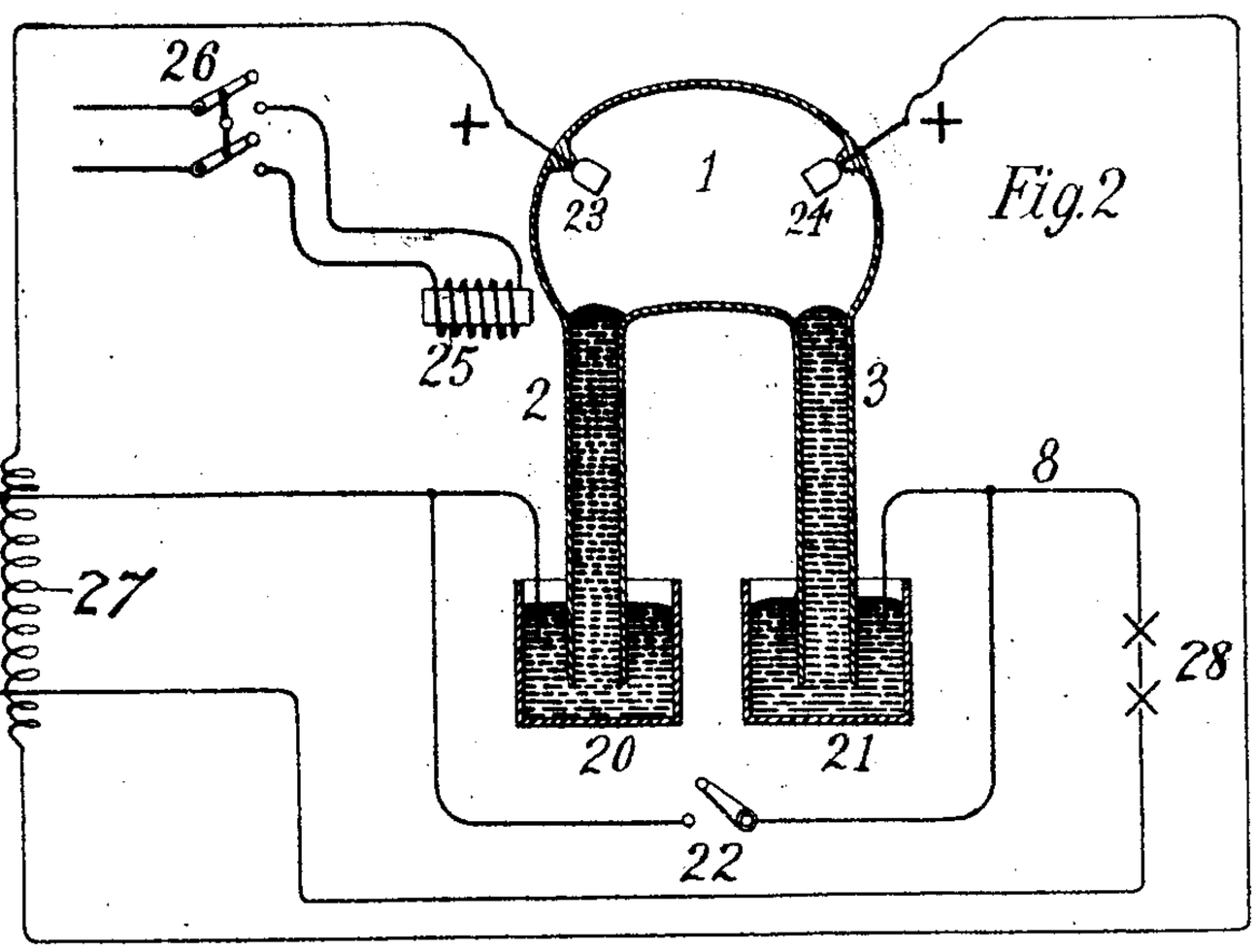
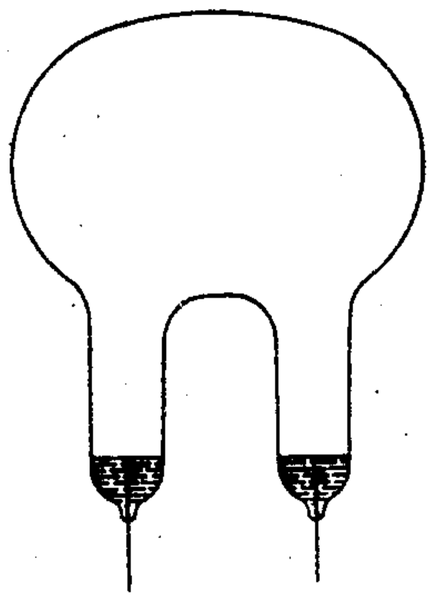


Fig.2

Fig.3



Witnesses:
Wm. F. Capel
Thos. H. Brown, Jr.

Inventor
Peter Cooper Hewitt
by Charles A. Terry Atty

UNITED STATES PATENT OFFICE.

PETER COOPER HEWITT, OF NEW YORK, N. Y., ASSIGNOR TO COOPER HEWITT ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

CIRCUIT-CONTROLLER.

No. 799,050. Specification of Letters Patent. Patented Sept. 12, 1905.

Application filed March 7, 1903. Serial No. 146,652.

To all whom it may concern:

Be it known that I, PETER COOPER HEWITT, a citizen of the United States, and a resident of New York, county of New York, State of New York, have invented certain new and useful Improvements in Circuit-Controllers, of which the following is a specification.

My invention relates to an improved type of electric switch for controlling circuits in which currents of high potential or large quantity are carried.

The invention is applicable to various different classes of electrical circuits and has special advantages in connection with power-circuits or circuits carrying currents of such voltage and quantity as to render it difficult to interrupt the main circuit connections by a switch or circuit-breaker without undue sparking at the contact-plates.

The significant feature of the switch which I have invented is that of introducing into the circuit to be controlled the resistance of a gas or vapor electric apparatus under such conditions as will, for example, stop the current-flow in the circuit without the development of any deleterious sparking and without causing a dangerous rise of potential in any part of the circuit.

In embodying my invention in a working device I may make use of a gas or vapor electric apparatus in which mercury vapor serves as the conducting medium between electrodes inside a sealed container. It is now well known that apparatus of this character has the property of exhibiting at one electrode a reluctance to starting; but when such reluctance is overcome the apparatus will conduct current down to some lower current value, whereupon the reluctance to starting will be reconstructed and a renewal of the starting-pressure has to be applied in order to reëstablish the flow of current. When current is applied to the terminals of the apparatus, an electric strain is produced at or near the electrode in question, and if such strain is increased to a critical point the reluctance is overcome and current begins to flow, as described. The critical strain thus added to the strain created by the application of current to the terminals may be applied through the usual starting-band, which when placed in proximity to the electrode modifies the degree of reluctance to starting. The critical strain may, however, be applied through a supplemental electrode or by other means. In case of an alternating current, where it is desired that impulses of opposite direction should pass through the apparatus, means may be provided for applying the critical strain to a starting-band in the neighborhood of each electrode or to a supplemental electrode or electrodes or the like, whereby the several alternations will be caused to traverse the apparatus after successive operations of the critical strain in breaking down the described reluctance. It has been found that when a starting-band or supplemental electrode with the described connections is present the apparatus will start at a lower line potential than when such devices or their equivalent are not used. Accordingly an apparatus suitably provided with such aids to starting may be operated upon currents of definite potential, provided the potential is high enough to furnish in the first instance the necessary breaking-down strain.

In one of the embodiments of my invention as herein disclosed I include an apparatus of the class described in an alternating-current circuit carrying currents from which it is desired to obtain periodic impulses of high frequency. The potential of the current carried by the circuit is assumed to be high enough to operate the apparatus when the starting-bands or their equivalent are suitably connected with the circuit; but it is assumed that when the starting-bands are disconnected the potential would be insufficient to operate the apparatus. Therefore the operation of the apparatus, and consequently the condition of the circuit in which it is included, is dependent upon whether or not the starting-bands or their equivalent are connected in circuit. I may then control the circuit by means of a simple key, which either opens or closes at will the connections of the starting-bands or whatever devices may be substituted for such bands in actual practice.

In another embodiment of my invention I utilize a gas or vapor apparatus as a means for opening an electric circuit, either direct or alternating, without the formation of an arc or a dangerous rise of potential. In this instance the apparatus is first started by any suitable means, and the rupture of the circuit takes place through the action of a magnet upon the current passing through the gas or vapor electric apparatus. Such rupture may, however, be made by means of heat gener-

ated by the current passed, whereby the potential required to pass current through the apparatus is increased beyond the potential of the line. I have illustrated the apparatus as being placed in a shunt-circuit to a switch, on the opening of which current begins to pass through the vapor apparatus and is then ruptured through the action of a magnet. Under such circumstances the gas or vapor apparatus does not form a part of the work-circuit and only comes into play when the described switch is operated. The apparatus might, however, be included in the work-circuit, as in the case already described. In that case the magnet might be used to prevent starting until the desired moment of starting arrives. The device might then be started after cutting out the magnet, and the subsequent rupture of the current through the action of the magnet might be caused at any desired moment and without injurious effects. The current might be interrupted, as indicated above, by the automatic action of the device itself—that is to say, the immediate action of the current itself upon the vapor or gas may be such as to prevent the current from reëstablishing its flow after it has passed the zero-point. In many instances the discharge at the moment of interrupting the switch connections will be sufficient to cause an initial flow through the device, thus absorbing the discharge-spark, which would otherwise take place at the contact-plates, while the device would prevent the flow of current under the normal pressure of the circuit, so that the flow of current through the circuit would be interrupted at the zero-point of the alternating wave.

In the drawings, Figure 1 illustrates a circuit provided with means for opening and closing connections to the starting-bands. Fig. 2 is a diagrammatic illustration of the magnetically-operated switch, and Fig. 3 illustrates a modification.

Referring to the drawings, 1 represents a container inclosing a conducting gas or vapor, and 2 and 3 are electrodes, which are here shown as being contained in tubular extensions of the container. The lead-wires to the respective electrodes 2 and 3 are shown at 4 and 5, and they terminate, respectively, in contact-pieces 6 and 7. The mains of the work-circuit are illustrated at 8 and 9, these mains being respectively connected to the lead-wires 4 and 5. The starting-bands are shown at 10 and 11, and they are connected by wires 12 and 13 with contact-pieces 14 and 15, respectively. The contact-pieces 6, 7, 14, and 15 are so arranged as to be touched by the shank 16 of a key or circuit-breaker having an operating button or handle 17. The key is pivoted at 18. Its position is regulated at the will of the operator either so that its shank shall be in contact with the contact-pieces already mentioned or out of contact, as the case may be. An insulating-piece 19 divides the shank of the key into two insulated parts, so as to prevent short circuits.

When the parts are in the position illustrated in Fig. 1, each of the starting-bands 10 and 11 is connected with the lead-wire running to the opposite side of the apparatus, and accordingly the conditions are suitable for the creation of a breaking-down strain sufficient to cause the passage of current in both directions through the apparatus, provided the potential on the mains 8 and 9 is high enough. In this case the potential is assumed to be sufficiently high for the purpose, but only under the condition that the starting-bands are connected as described. Should the operator now depress the key and remove the shank from contact with the several contact-pieces, the flow of current through the apparatus would continue only until the zero-point of the wave then passing should be reached, after which no renewed breaking down of the reluctance would take place, the result being that the circuit 8 and 9 would be practically opened.

Referring to Fig. 2, the apparatus is here represented with its electrodes 2 and 3 in the form of columns of mercury, ending in vessels 20 and 21 containing mercury. The length of the shanks in which the columns are contained is made such that atmospheric pressure will carry the inner ends of the columns to a height where they can properly serve as electrode-surfaces. The circuit in this instance, as before, is an alternating-current circuit having a switch 22 interposed in one of the mains 8. The gas or vapor apparatus is included in a shunt around the switch. I here substitute for the starting-bands shown in Fig. 1 two supplemental electrodes 23 and 24, each of which is connected to the circuit on the opposite side of the apparatus. The connections of the supplemental electrodes 23 24 are indicated in Fig. 2, where an alternating-current generator 26 is shown as being connected to the main 8, including translating devices 28 28, while the electrodes 23 24 are connected through an autotransformer 27 with the opposite side of the circuit. As a means for rupturing the circuit I make use of an electromagnet 25, whose circuit is controlled by a switch 26. The effect of the magnet is to deflect the current passing through the apparatus, and I have found that its effect may be made large enough to actually rupture the current and interrupt the flow through the apparatus. In operation when the switch 22 is closed no current passes through the vapor apparatus. On opening the switch 22 the current in the main circuit passes through the conducting-gas in the chamber 1 in alternating phases, it being understood that the current is of sufficient volume and electromotive force to break down the electrode re-

luctance, except when the circuit through the switch 22 is closed. The action as a whole may be described as follows: The switch 22 is opened and current begins to flow through the vapor apparatus, after which the switch 26 is closed, energizing the magnet 25, whereupon the current in the chamber 1 is deflected sufficiently to rupture the circuit.

The magnet 25 may be supplied from any suitable source. It may be replaced by an adjustable permanent magnet, if desired. The action in respect to the effect of the magnet upon the current would be the same if no by-path were provided, as by the circuit including the switch 22—that is to say, if the gas or vapor apparatus were normally a part of the main circuit. In many instances the magnet will not be required, as the discharge occurring at the opening of the switch 22 may be sufficient to cause a current to pass through the vapor-path, although that path is of sufficient effective resistance as not to be penetrated by the normal current upon the circuit, so that the harmful discharge which would otherwise occur at the opening of the switch 22 will be obviated by the passage of the high potential-current through the gas or vapor path, but it will cease upon the potential falling to the normal potential of the circuit.

The modification illustrated in Fig. 3 is simply intended to show an appropriate shape for the vapor apparatus, the form illustrated being given to it for the purpose of making the current pass into the electrodes nearly at right angles to the surface in order to facilitate the action of the magnet upon the current. This is done because it has been found that a magnet will have a greater effect upon the current if its lines of force are arranged as to act upon the current as nearly as possible at right angles to the line of flow.

It is not intended that the present invention should be limited to the control of alternating currents, as it may be readily adapted to the control of direct currents as well.

Manifestly the devices illustrated in Fig. 1 for producing conditions of conductivity and non-conductivity in the gas or vapor might be substituted for those shown in Fig. 2—that is to say, they might be included in a shunt-circuit to a switch or any other device, and they would operate on the same principle in either case.

The method of rendering a gas or vapor apparatus electrically conducting or non-conducting at will is not necessarily confined to the employment of means as herein described for applying a critical strain to the apparatus. For example, the same effect may be produced by means which will suitably affect the physical or chemical conditions of the gas or vapor, rendering the same conducting or non-conducting, as desired.

While the action of the apparatus herein disclosed has been described more particularly with reference to its capacities as a means of stopping the flow of electrical energy in a circuit or circuits, yet it should be understood that the same apparatus is equally well adapted to perform the other functions of an electric switch—that is to say, to start a circuit or circuits into operation. For example, the movement of the key away from the contacts in Fig. 1 has been described as a means of stopping the flow of energy in the mains 1 and 2. The restoration of the key to a position of contact would start the flow of energy again in the said mains.

In a divisional application, Serial No. 168,983, claims are made upon the apparatus herein described.

I claim as my invention—

1. In a system of electrical distribution wherein an inclosed gas or vapor is included, or adapted to be included in the system, the method of starting or stopping the flow of electrical energy, which consists in rendering the said gas or vapor conducting or non-conducting at will with respect to the applied energy.

2. In a system of electrical distribution wherein an inclosed gas or vapor is included, or adapted to be included in the system, the method of starting and stopping the flow of electrical energy, which consists in first rendering the gas or vapor conductive with relation to the applied energy, and afterward making it non-conductive with relation thereto.

3. In a system of electrical distribution wherein an inclosed gas or vapor is included, or adapted to be included in the system, the method of rupturing a circuit carrying a current of high potential or large quantity, which consists in shunting a portion of the current through the conducting gas or vapor, thereby creating a path of determinate resistance in the shunt-circuit, opening the shunted portion of the main circuit and afterward rendering the gas or vapor non-conducting with relation to the energy applied.

4. In a system of electrical distribution wherein an inclosed gas or vapor is included, or adapted to be included in the system, the method of rupturing a circuit carrying a current of high potential or large quantity, which consists in shunting a portion of the current through the conducting gas or vapor, thereby creating a path of determinate resistance in the shunt-circuit, opening the shunted portion of the main circuit, and afterward deflecting the current in the conducting gas or vapor so as to cause a rupture thereof.

5. In a system of electrical distribution wherein an inclosed gas or vapor is included, or adapted to be included in the system, the method of rupturing a circuit carrying a current of high potential or large quantity, which consists in shunting a portion of the current through the conducting gas or vapor, thereby creating a path of determinate resistance in

the shunt-circuit, opening the shunted portion of the main circuit, and afterward magnetically deflecting the current in the conducting gas or vapor so as to cause a rupture thereof.

6. In a system of electrical distribution wherein a conducting gas or vapor is included and electrical energy is caused to traverse the gas or vapor in successive impulses running to or through successive zero-points, by reëstablishing the flow after each zero-point, the method of stopping the flow of energy which consists in preventing the reëstablishment of the current after a selected zero-point.

7. In a system of electrical distribution wherein an inclosed gas or vapor is included in the system and subject to electrical strain by the energy applied at the terminals thereof, the method of starting or stopping the flow of electrical energy, which consists in rendering said gas or vapor conducting or non-conducting at will by applying or withdrawing a critical strain.

8. In a system of electrical distribution wherein an inclosed gas or vapor is included in the system and subject to electrical strain by the energy applied at the terminals thereof, the method of starting and stopping the flow of electrical energy, which consists in rendering the gas or vapor conducting or non-conducting at will by applying and withdrawing a critical strain.

9. The method of interrupting the flow of current through an electric circuit, which consists in shunting the high potential developed at the interruption of the circuit through a gas or vapor path, and developing in that path a resistance sufficient to prevent the continued flow of current therethrough.

10. The method of interrupting the flow of current through an alternating electric circuit, which consists in shunting the high potential developed at the interruption of the circuit through a gas or vapor path, and preventing the reëstablishment of current through that path by the automatic opposition of resistance sufficient to prevent the flow of current of the normal potential of the circuit.

Signed at New York, in the county of New York and State of New York, this 3d day of March, A. D. 1903.

PETER COOPER HEWITT.

Witnesses:
WM. H. CAPEL,
GEORGE H. STOCKBRIDGE.