Nov. 15, 1932. A. COHN ET AL 1,887,545

ELECTRICAL SWITCHING APPARATUS

Filed April 1, 1930

Fig. 1.

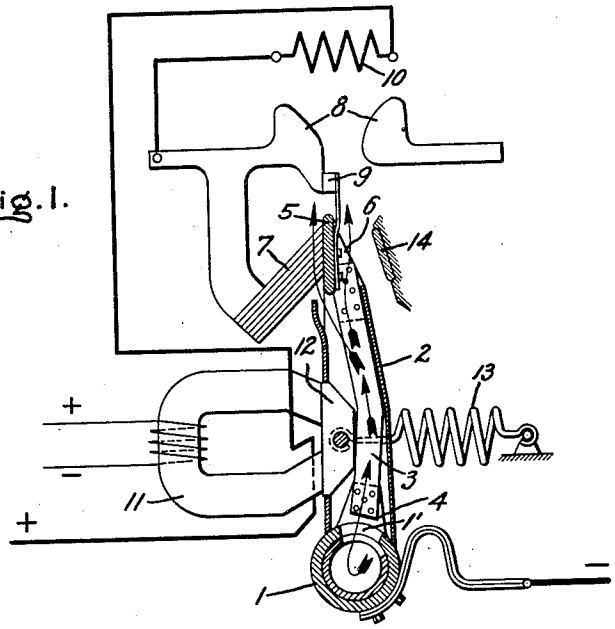
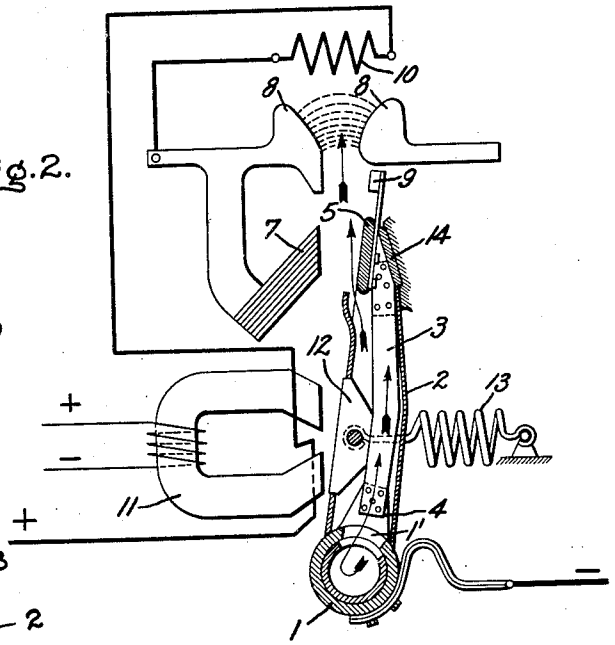


Fig. 2.



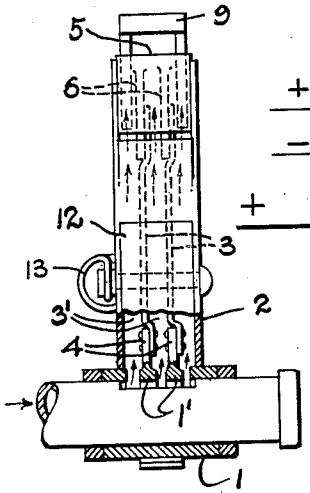


Fig. 3.

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UNITED STATES PATENT OFFICE

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ELECTRICAL SWITCHING APPARATUS

Application filed April 1, 1930, Serial No. 440,836, and in Germany June 29, 1929.

Our invention relates to electrical switching apparatus, and more particularly to high speed switching apparatus whose moving parts in particular are of small mass as normally compared with the current traversing the switch.

In the case of conducting parts of switches wherein the heat generated by current traversing the same is dissipated simply by radiation, or conduction to other parts, the mass of these conducting parts necessarily increase with higher current ratings, so that in the case of large capacity switches, the dimensions and mass thereof are generally considerable. Consequently the opening speed of switches having high current ratings, due to the inertia of the moving parts, may be but a fraction of that of comparatively small switches. The problem of constructing switches for power currents, with a high opening speed accordingly involves difficulties because of the great masses to be moved.

In accordance with the present invention, these difficulties are obviated to a great extent by subjecting the parts of the switch traversed by the current, and particularly the movable parts, to the effects of a continuous cooling current of fluid, as air or gas. By means of this auxiliary cooling for causing more rapid dissipation of heat, it is possible to make the switch parts much smaller than in the case of switches which are not so cooled, thereby enabling the opening speed of power current switches to be appreciably increased by reason of the lower inertia of the moving switch parts.

Further in accordance with the invention, the current of cooling fluid is so guided that it aids the magnetic blow-out effect generated by the blow-out coil during the switch opening operation, thereby shortening the arcing period which is essential in high speed switches. By directing the current of cooling gas across the arc, rapid de-ionization of the arcing space is obtained, which effectively prevents reignition of the arc, and under certain circumstances may even render a magnetic blow-out unnecessary.

Apart from the above mentioned technical advantages in switching apparatus constructed in accordance with our invention, economic advantages also are present. For example, the over-all dimensions of the switch are considerably reduced, and the cost and the space occupied thereby are accordingly diminished. This reduction in size likewise applies to the arc-quenching devices, such as the arcing contacts and arcing horns, since these parts conduct the arc for a shorter time, and the heating and burning thereof is therefore less. Also the number of windings of the blow-out coil and the dimensions of the arcing chute may be maintained lower because the blow-out field is effectively aided by the current of cooling fluid.

Our invention will be more fully set forth in the following description referring to the accompanying drawing, and the features of novelty which characterize our invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

Referring to the drawing, Fig. 1 is an elevational view, partly in section, of a switch in the closed position thereof constructed in accordance with our invention, Fig. 2 illustrates the switch in the open position and Fig. 3 is a side view, partly in section, of the movable switch member.

The supporting structure of the movable switch member comprises a tubular member 1 of conducting material having a channel-like enclosing structure 2 mounted thereon and in communication therewith through an opening 1'. The tubular member 1 is rotatably mounted and is electrically connected to the current lead 3 by suitable means, as the lug 4. The lead 3, which is disposed within and longitudinally of the channel-like structure 2, is electrically connected at its other end to the movable contact member 5 by the connecting lug structure 6. A stationary brush contact 7 is adapted to be engaged by the contact 5 for completing the circuit when the switch is in its circuit closing position. The usual arcing horns 8, a secondary or arcing contact 9, and a magnetic blow-out coil 10 connected to the contact 7 and in series with the circuit to be interrupted, are provided for handling the arc formed

upon opening of the switch, in a well-known manner.

For controlling the switch a holding magnet 11 whose armature 12 is mounted upon the movable switch member 2, is disposed in operative relation to the movable switch member and is normally opposed by a tension spring 13 tending to rotate the movable switch member in a clockwise or opening direction.

As will be noted particularly in Fig. 1, the upper or free end of the structure 2 is open and the contact 5 is disposed approximately midway across the opening so that passages or vents are formed on opposite sides thereof. One of these passages is adapted to be closed by a stop member 14 when the switch is in its open circuit position, as illustrated in Fig. 2.

The operation of the device is the following:

The cooling fluid for removing heat from the switch parts and for aiding interruption of the arc, is introduced by means of a suitable source of pressure through the fluid passage within the hollow tubular member 1 to the movable switch structure 2. The source of pressure may be a fan or blower (not shown) adapted to force a continuous current of cooling fluid into the tubular member 1. It then divides and flows along both sides of the current leads 3, of which there are two in the present arrangement, as shown in Fig. 3 the leads being parallel with each other and spaced to form channels or fluid passages 3′ in the movable switch member 2. The individual currents of air or other cooling fluid accordingly flow upwardly through the movable switch member as generally indicated by the arrows in the longitudinal direction of the current leads 3 and are then divided by the contact 5, when the switch is closed as shown in Fig. 1, so that one stream flows mainly along and on the point of contact between the movable contact member 5 and the fixed contact 7, whereas the other stream flows over the back of the movable contact 5 and the secondary contact 9. The currents of cooling fluid take the above described courses only when the switch is in the closed position (Fig. 1), i. e. when the magnet 11 attracts its armature 12 with sufficient force to overcome the tension of spring 13.

When the armature 12 is pulled away from the holding magnet by the spring 13 due to weakening of the magnetic attracting forces by an excess of current in the line, or if the switch is opened in any other manner, the movable switch member assumes the position illustrated in Fig. 2 and the cooling fluid is directed and blown into and across the arc which is driven upwardly between the arcing horns 8, by the magnet field of the blow-out coil 10. Thus the magnetic blow-out effect on the arc is effectively supported, and the arc chamber is immediately cleared of the arc gases, i. e., it is rapidly de-ionized. The de-ionization is further accelerated after the opening movement has been started, due to the fact that the current of air passes through the arcing space or chamber at high velocity. This high velocity is attained since the air current, which previously passed along the back of the fixed contact 5 and the secondary contact 9, is shunted by the closure of the rear passage in the movable switch-member by the stop member 14, to the front passage. The air flow is therefore restricted so that it can only take the path indicated by the arrows in Fig. 2, its velocity being thereby appreciably increased.

In order to increase the cooling effect, cooling flanges may be suitably mounted on the terminal pieces 5 and 7 extending into the air current; also the fixed contact 7 or the movable contact 5 may be provided with cooling channels in order that the contacting surfaces between these parts, which extend along the contacts in the direction of the current, may be more effectively cooled.

It shall be understood that the cooling fluid may comprise air, or any other suitable gas having a high capacity for carrying off heat, or an intensive capacity for ionization, or having both of said properties.

What we claim as new and desire to secure by Letters Patent of the United States:

1. High speed switching apparatus for power currents comprising fixed and movable conducting parts, means guiding a cooling fluid through the movable conducting parts to carry away heat therefrom, means for directing said cooling fluid across the arc formed upon opening of the switch, and means for restricting the flow of the cooling fluid and thereby increasing the velocity thereof across the arc when the switch is in its open circuit position.

2. High speed switching apparatus for power currents comprising movable switch structure, current leads disposed within and enclosed by said structure, said leads extending longitudinally of the movable structure and spaced from each other to form fluid passages within the same, and a contact member mounted at the free end of said structure, said fluid passages communicating with the contact whereby flow of cooling fluid through said structure and around the current leads and contact is permitted.

3. In high speed switching apparatus for power currents comprising fixed and movable contacts, supporting and cooling structure for the movable contact comprising a rotatable tubular member having a fluid passage therein, enclosing structure mounted upon the tubular member and in communication with the fluid passage in the tubular member, and current leads disposed and forming fluid

passages within the said structure connecting the tubular member with the movable contact, said fluid passages arranged to guide a current of cooling fluid from the tubular member through said structure and around the current leads to exhaust around the movable contact.

4. High speed switching apparatus for power currents comprising fixed and movable contacts, mounting structure for the movable contact having fluid passages therein, the movable contact being related to said passages in the closed position of the contacts so that flow of the cooling fluid is directed around both the fixed and movable contacts and at the point of contact thereof, and means for diverting flow of the cooling fluid when the switch is in its open circuit position for restricting the flow thereof solely across the space between the fixed and movable contacts.

5. Switching apparatus for power currents comprising fixed and movable conducting parts, said movable part including a plurality of conductor leads forming with an enclosing casing a plurality of fluid passages, and means coacting with said movable part controlling flow of fluid through said passages in accordance with the circuit controlling position of said movable part.

In witness whereof, we have hereunto set our hands this 7th day of March, 1930.

ALFRED COHN.
WILHELM HERDEN.