No. 716,848. Patented Dec. 23, 1902.

R. H. READ.

MODE OF EXTINGUISHING ELECTRIC ARCS.

(Application filed Apr. 19, 1902.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

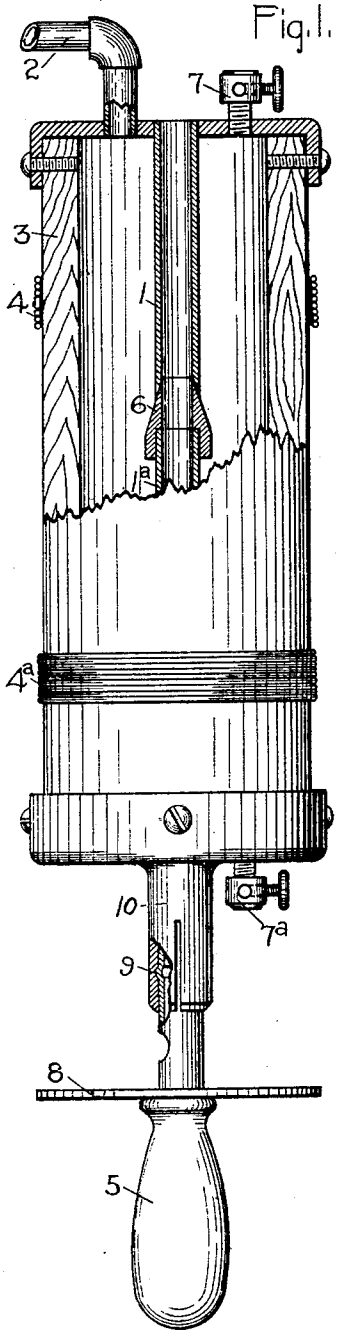
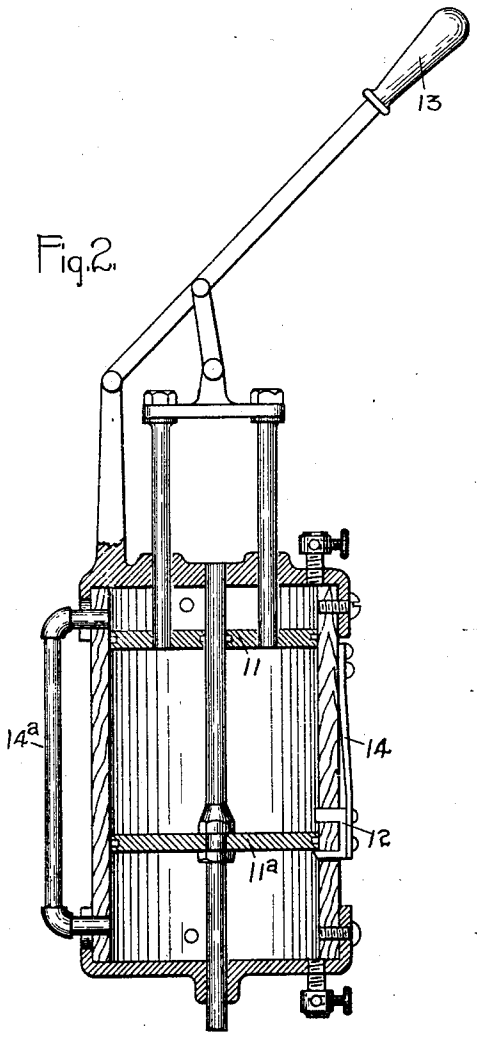


Fig. 2.



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(No Model.) 2 Sheets—Sheet 2.

Fig. 3.

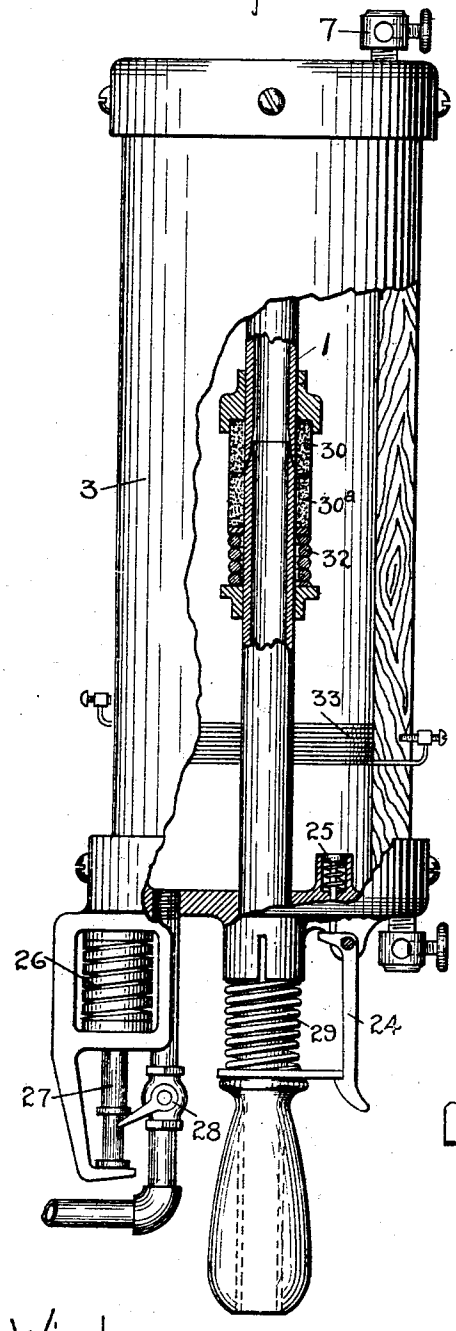


Fig. 4.

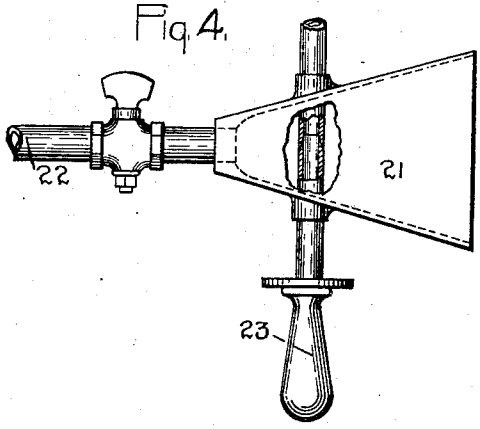


Fig. 5.

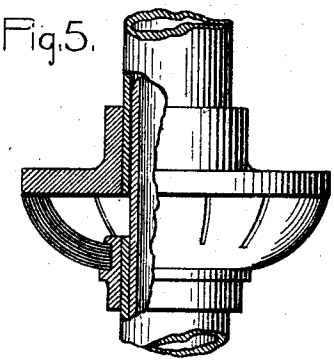
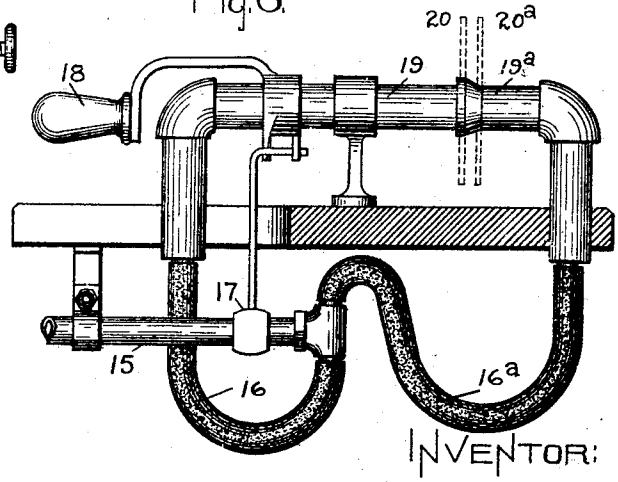


Fig. 6.



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UNITED STATES PATENT OFFICE.

ROBERT H. READ, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

MODE OF EXTINGUISHING ELECTRIC ARCS.

SPECIFICATION forming part of Letters Patent No. 716,848, dated December 23, 1902.

Original application filed April 3, 1901, Serial No. 54,122. Divided and this application filed April 19, 1902. Serial No. 103,673. (No model.)

To all whom it may concern:

Be it known that I, ROBERT H. READ, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Modes of Extinguishing Electric Arcs, (Case No. 2,841,) of which the following is a specification.

This application is a division of my pending application, Serial No. 54,122, filed April 3, 1901.

In rupturing electric circuits, and particularly those in which heavy currents of high voltage are carried, special means must be provided for guarding against damage from the destructive arcs following the separation of the points of contact. Various methods have been employed to reduce this damage, most of them involving a quick and long separation of the opening-points to reduce the amount of material volatilized by the arc during the time of opening or separation.

For direct-current circuits the magnetic circuit-breaker has proven most effective. In this type of instrument the contacts are separated in a strong magnetic field, which gives a lateral thrust to the gaseous conductor which constitutes the arc, and thus removes the vapor from the separated points and extinguishes the arc. The points of contact are, however, even in these types more or less damaged, and it is the usual practice to open the circuit on a pair of shunt-contacts composed of carbon and which may therefore be renewed from time to time, the main break being at a pair of auxiliary contacts separated at a slightly-earlier time than the shunt-contacts and which are therefore relieved of material damage. For alternating-current work, however, the magnetic circuit-breaker has not proven effective, since the rapidity of alternation does not give a uniform directive tendency to the arc-gases, and it has been common, therefore, in rupturing alternating currents to provide a long quick break, thus necessitating considerable storage-room for the rupturing device, or to open the circuit under oil or similar liquid insulator, which quenches the arc.

The present invention has for its object the extinguishment of an arc of high potential and large amperage, whether formed by direct or alternating current, involving simple means, reliability, and safety of circuit rupture, and minimum damage to the contacts.

The fundamental feature of the invention comprises the delivery across the points of contact of an insulating fluid which will effectively remove the arc-gases and lower the temperature of the contact-points, and to this end a stream of insulating fluid is caused to traverse the space between the separating-points of contact, and the arc-gases are confined to a definite path to promote their effective removal from the neighborhood of the points of contact.

The most effective means I have yet found for carrying out the invention involves the employment of hollow or tubular contacts through or across which is driven at the moment of separation a strong blast of air, the column of air in movement being confined to a definite channel to prevent spreading of the arc-gases and the possible maintenance or reëstablishment of the arc. The movement of the air may be established by pressure or suction, but preferably by pressure, as a greater delivery of air and a greater cooling effect on the electrodes may be effected within a definite interval of time by the greater speed of movement possible with higher than atmospheric pressures. I therefore prefer to employ hollow contacts inclosed within an air-tight chamber in communication with a source of compressed air, which is put in communication with the chamber just before the electrodes part, thereby delivering across the tubular points of contact a rapidly-moving stream of insulating fluid, which carries with it the arc products, stretching the arc in the tubes until it snaps, and removing from the neighborhood of the separating-electrodes all volatile matter which could serve as an electric conductor and at the same time absorbing heat from the contacts and reducing the temperature, so that the amount of metal volatilized is very materially reduced. I find in practice that such an

organization is extremely effective in interrupting arcs of high, low, or intermediate potentials and of all strengths of current, arcs of ten thousand volts and upward being handled with as great facility as arcs of lower potential and all evidence of flame outside of the tube being avoided.

The invention is not limited to air as an insulating medium, but other gases, or even insulating liquids, may be employed, if desired. Wherever the device is to be employed, however, in connection with a system where a reservoir of compressed air may be maintained, air as a medium of extinguishment may be deemed preferable. Other modes of establishing movement of an insulating medium across the contacts, however, are easy of employment and fall within the scope of the present invention.

The invention therefore comprises a mode of extinguishment of electric arcs by causing a stream of insulating fluid to move across the arc while the electrodes are being separated in such a way as to remove all of the arc-gases from the neighborhood of said electrodes.

It comprises also a method of extinguishing arcs by squeezing the arc-gases into a contracted channel at or near the electrode ends.

The invention comprises also other features the novelty of which will be more particularly hereinafter set forth, and indicated in the claims.

No claim is herein made to the apparatus for carrying out the improvements, said matter being embodied in the original application, of which the present application is a division, as above noted.

In the accompanying drawings, which illustrate several typical ways of carrying out the invention, Figure 1 is a side elevation, partly in section, of a hand-operated arc-extinguishing device involving the invention as practiced with a source of gaseous pressure. Fig. 2 is a sectional elevation of a type which is self-contained, in which the pressure is effected by the operator in opening the circuit. Fig. 3 is an elevation, partly broken away, of an automatic circuit-breaker involving the features of the invention. Fig. 4 illustrates another type. Fig. 5 shows a modified form of contact, and Fig. 6 is a typical representation of several modes of practicing the invention.

In the type shown in Figs. 1, 2, 3, and 6 tubular contacts are employed, which I have found most effective in practice, as they give a definite direction to the movement of the insulating fluid and insure a rapid movement of the same, though fairly good results may be obtained with a device of the character shown in Fig. 4. It has heretofore been proposed to employ an air-blast, for example, to extinguish the arc by placing in the neighborhood of the arc a pipe or nozzle for delivering a thin stream of air across the arc-contacts. This method, however, finds an early limit with heavy currents of high potential. The arc-stream being made up of gaseous matter is extremely sensitive to air-currents, and the eddy currents developed in the neighborhood of the arc by such a mode of delivery permit the volatile matter to swirl about the electrodes and form branch paths for the maintenance of the current. One of the distinctive features of my procedure is the absolute removal of all gaseous matter from the neighborhood of the arc, thereby rupturing the same from sheer inability of a current to maintain itself without conducting material of some kind between its terminals.

In the device illustrated in Fig. 1, for example, the electrodes 1 1^a, one of which may be fixed and the other movable, meet within a closed chamber, with which communicates a pipe 2, communicating with a source of compressed air. The containing vessel may be formed of wood and, as shown at 3, is a stout wooden tube, which may be guarded against splitting or warping by a wire winding 4 4^a on the outside. The tubular contacts are open to the external atmosphere, the movable one being provided with an insulating-handle 5 for separating the contacts. The contacts, either or both, may be provided with an arcing-tip 6, of brass or other good conducting metal. The meeting edges of the contacts are tapered to effect a good joint of high conducting power, and, if desired, they may be split to permit slight yielding and establish a wide area of contact. The wooden casing 3 may be provided with metal heads lagged fast by screws, on which may be mounted binding-posts 7 7^a for the circuit-leads. A point of discharge for the air from the movable terminal may be formed above a fiber disk 8 on the handle. If the air-pipe be put in communication with the interior of the closed chamber 3 and the contacts 1 1^a be separated, air will be driven radially in all directions across the arcing-space, squeezing the arc into the tubes and stretching it out in both directions, thereby preventing any material pitting of the contacts and removing all conducting matter from the space between the two electrodes, thus effectively extinguishing the arc. With currents of considerable voltage and amperage the extinguishment of the arc is accompanied by a report similar to a small pistol-shot, and often a faint bluish-white-colored flame may be seen at or near the ends of the discharge-point for the arc-gases; but the rapidity of extinguishment of the arc is so great that almost no pitting is made on the points of contact.

It is not absolutely essential that the containing-box 3 should be absolutely air-tight; but it should be sufficiently so to insure the delivery of a rapidly-moving stream of air across the contact-faces.

In a device of the type shown in Fig. 1 means should be also provided for latching

the contacts in engagement, so as to maintain a good contact while the circuit is closed. Any suitable means of effecting such a result may be adopted. No attempt has been made in the illustrations to show any refinement in this particular, a small catch, such as a ridge 9 on the movable tube engaging with the elastic jaws of the guide 10, being shown merely by way of illustration.

In cases where a source of compressed air is not available any other mode of delivering pressure, so as to cause a transmission of air across the faces of the contact, may be provided. For example, in Fig. 2 a movable piston 11 may be employed to compress the air within the chamber around the tubular contacts and a spring-actuated latch 12 be employed to release the companion piston 11^a, carrying the coöperating tubular contact. Thus when the handle 13 is depressed the air between the contact-points is compressed, and after attaining a pressure sufficient to overcome a spring 14, controlling the catch 12, the piston 11^a will be forced down, separating the contacts and permitting the compressed air to escape through the tubes, thereby extinguishing the arc. In raising the handle 13 again the air behind the piston 11 is compressed, thereby putting pressure on the under side of the piston 11^a by means of the connecting-pipe 14^a and shifting the electrodes into contact. Any other mode of insuring by the first movement of the operating-handle a forcible compression and a subsequent separation of the contacts might be used with advantage. Such an organization would be of service in practicing the invention in connection with switches or hand-operated circuit-breakers of any kind. Either pressure or suction may be employed.

In Fig. 6, 15 represents a pipe which may be connected with a pressure or suction pump or reservoir which communicates with two flexible pipes 16 16^a through a cock 17, controlled by a handle 18, connected with the movable contact 19. Thus a movement of the handle separates the contacts 19 19^a, opens the cock 17, and applies pressure or suction to the pipes 16 16^a. In this type no box is employed around the tubular contacts, the atmospheric air in the case of suction passing across the contact-faces in radial directions and drawing the gaseous products of the arc through the tubes. In the case of pressure being applied to the pipe 15, barriers 20 20^a, of insulating material, may be mounted on the adjacent contacts to confine the gases to a definite path of expulsion. No insulating-lining for the tubular contacts is found necessary, as the gases are so effectively removed from the separating surfaces of contact that the only substance existing between them is the column of air or other insulating fluid in motion, which being an insulator of course effects the extinguishment of the arc.

In Fig. 4 the contacts are inclosed within a box open to the atmosphere at one end, communicating with a pipe 22, communication being established or disestablished by a key, which may be controlled in any suitable way. When the movable contact is operated by the handle 23, the gaseous pressure being already established, the column of insulating fluid is driven in the confined channel insured by the box 21 across the arc, driving all gaseous matter away from that neighborhood and insuring a rupture of the circuit.

In Fig. 3 is shown a form of automatic circuit-breaker involving the invention. In this the upper contact 1 is shown as fixed in conductive relation to a brass head carrying a binding-post 7 and the movable contact sliding in a split guide in a manner similar to the construction shown in Fig. 1, but held closed by a spring-latch 24, engaging the handle. The latch may be released by a pin connected to a small piston 25 on the inside of the box when pressure is delivered to the chamber. The pressure may be controlled by a series coil 26 in series relation to the contacts. The coil in case of overload may operate an iron plunger 27 and turn a valve 28, putting the source of compressed air in communication with the box 3, containing the circuit-terminals. After the pressure reaches a predetermined point the piston 25 unlatches the detent 24, permitting a spring 29 to force open the tubular contacts and insure a delivery of air into the tubes, thereby extinguishing the arc.

With very heavy currents in order to prevent repeated operation from damaging the contact-faces auxiliary contacts may be employed—as, for example, two carbon or other conductive tubes 30 30^a, one of which may be set solidly in a head inclosing one of the contacts and the other elastically seated on a helical spring 32 on the other contact, being so adjusted as to come into engagement before the contact-faces of the tubes. This insures the final opening of the circuit on the carbon tubes and avoids any roughening of the faces of the contact-tubes under continuous use.

To prevent any deposition of moisture in the tubes, a heating-coil 33 may be placed within the wooden box, its terminals being secured to binding-posts on the outside, so that a current of suitable voltage may be applied to it to keep the inside of the chamber free from moisture. The box may be lined with refractory material, if desired, for which sheet-asbestos may be employed or a molded compound of magnesia or other refractory material.

If desired, a bridging-contact composed of laminated copper or phosphor-bronze may be employed to carry the current when the circuit is closed, the ends of the tubular contacts being permitted to take the arc. Such an arrangement is indicated in Fig. 5, the parts

being so arranged that the laminated bridge opens contact earlier than the meeting faces of the tubes.

Other gases than air may be employed, especially where the apparatus is self-contained and where for that reason it becomes desirable to store pressure by means within the compass of the device itself. Such matter is not, however, herein described or claimed, being made the basis of other companion applications—as, for example, Serial No. 66,460, filed June 29, 1901, and Serial No. 69,893, filed July 27, 1901.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The method of extinguishing electric arcs, consisting in stretching the arc by a stream of insulating fluid and squeezing it from all sides into a contracted duct leading away from the electrodes.

2. The method of extinguishing electric arcs, consisting in forcing the arc-gases away from one or both electrodes in an axial direction.

3. The method of extinguishing electric arcs, consisting in forcing the arc-gases in opposite directions axially of the electrodes.

4. The method of extinguishing electric arcs, consisting in forcing the arc-gases away from one or both electrodes in an axial direction and squeezing them into a contracted duct or channel.

5. The method of extinguishing electric arcs, consisting in causing a stream of insulated fluid to pass radially in all directions across an electrode when the electrodes separate, and stretching the arc until it breaks by removing the arc products in a closed path away from the electrodes.

6. The method of extinguishing electric arcs, consisting in causing a stream of insulating fluid to pass radially in all directions across an electrode when the electrodes separate, and squeezing the gaseous arc products into a contracted channel.

7. The method of extinguishing electric arcs, consisting in causing a stream of insulating fluid to pass radially in all directions across both electrodes when separating, and forcing the arc-gases along the electrodes into the atmosphere.

In witness whereof I have hereunto set my hand this 17th day of April, 1902.

ROBERT H. READ.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.