June 20, 1933. W. B. WHITNEY ET AL 1,914,875

ELECTRIC SWITCH AND CIRCUIT BREAKER

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Fig. 1.

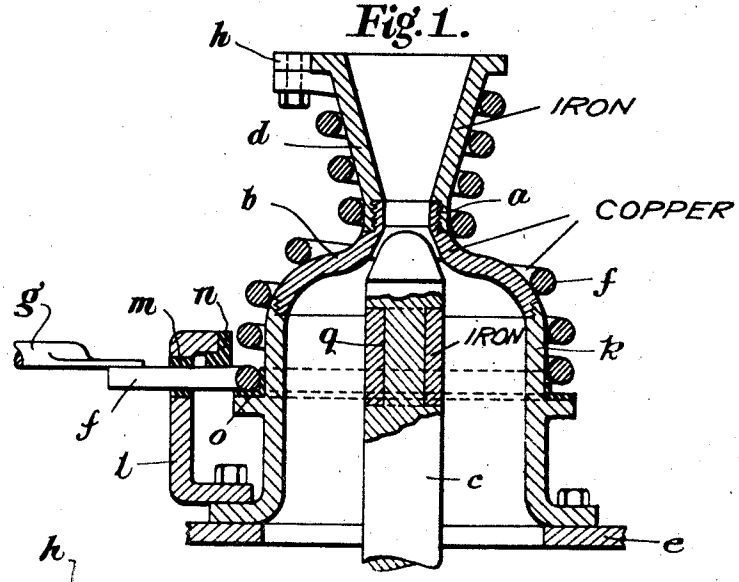
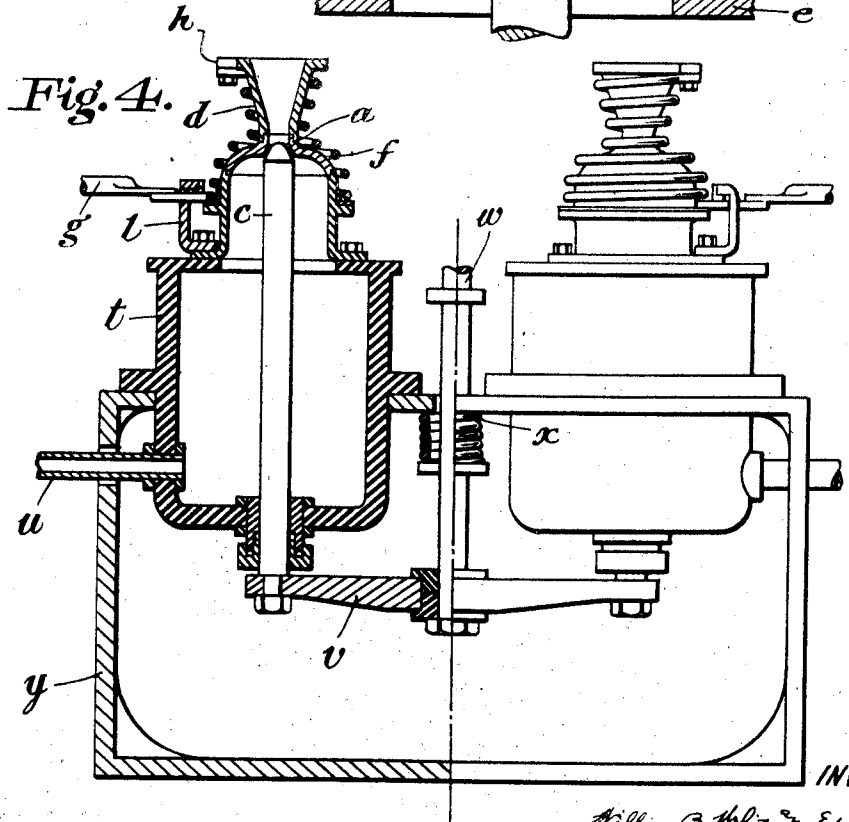



Fig. 4.




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Fig. 2.

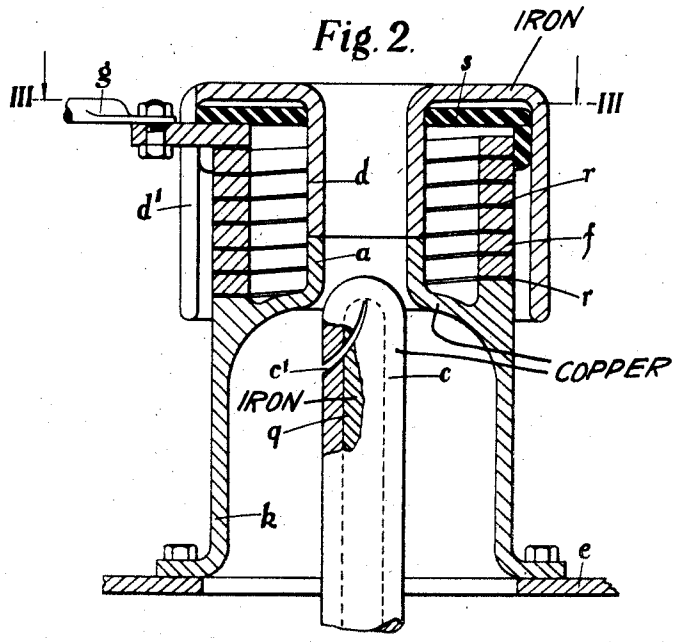
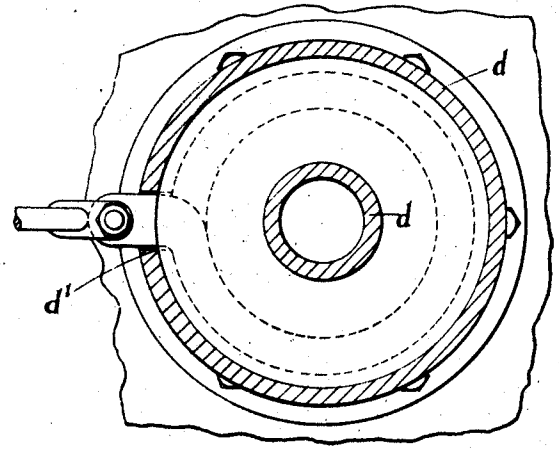



Fig. 3.




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# UNITED STATES PATENT OFFICE

WILLIS BEVAN WHITNEY AND EDMUND BASIL WEDMORE, OF LONDON, ENGLAND, ASSIGNORS TO THE BRITISH ELECTRICAL AND ALLIED INDUSTRIES RESEARCH ASSOCIATION, OF LONDON ENGLAND, A BRITISH COMPANY

## ELECTRIC SWITCH AND CIRCUIT BREAKER

Application filed March 4, 1932, Serial No. 596,854, and in Great Britain March 18, 1931.

This invention relates to electric switches or circuit breakers and more particularly speaking, to electric switches having provision for the supply of a blast of gas or liquid or of a mixture of gas or liquid for the purposes of extinguishing the arc set up when the switch contacts are separated.

It has also been found that in such switches, if an arc is formed and has no inclination to wander, the root of the arc is likely to bite into the surface of the switch contacts more especially near the tip of a solid electrode which tends to produce extreme local heating and increased ionization and makes it more difficult to scour the arc gap effectively of its ions during the time the current passes through its zero value. It is thought that the ease with which an arc is extinguished when contact ceases near a point of zero current is partly due to the absence of any appreciable crater, such as is provided by an arc which has been established long enough to bite into the contact surface. Again in fluid blast switches, only a portion of the blast can come into contact with the highly heated arc track. It is the object of the present invention to eliminate the drawbacks mentioned by causing the arc to move continuously to cool portions of the electrodes so as practically to eliminate any hot spot at the moment the current reaches its zero value and so as to cause better intermixing of the arc and the blast fluid so that the arc products are more effectively cooled and scoured away.

To these ends, means are provided according to the present invention, for setting up a magnetic field which exerts a force tending to subject the arc set up upon separation of the switch contacts, to a rotary motion in an electric switch or circuit breaker provided with means for supplying a blast of fluid when the switch contacts are separated. It is already known to cause the current to be interrupted to pass through a coil for producing rotation of the arc in a switch, but as already mentioned, the present invention is concerned with fluid blast switches or circuit breakers in which for the reasons already set forth, the arc can be extinguished with the use of less fluid in the blast when the arc is moved in the manner described above. Then even, if there is no tendency for the arc to move in the direction of or against the fluid blast the root of the arc is caused to travel around the cooperating switch contacts. The invention is conveniently applicable, however, to switches such as, for example, set forth in the specification of our United States Patent application Serial No. 596,853 of even date, in which means are also provided for controlling the motion of the arc in the direction of movement of the fluid blast.

The main purpose of the magnetic field employed in accordance with the present invention is to rotate the arc, for example, between the inner and outer surfaces of the concentrically placed outer and inner electrodes. A suitable configuration of such a field would be such as to be everywhere perpendicular to a flat or conical surface generated by lines which are the shortest distances between the electrodes. In such a field, the arc would move more or less in its surface only.

In a switch according to the present invention, one or both contacts may be formed so that the current flowing in it to or from the arc follows a helical or spiral path in order to set up the magnetic field for producing rotation of the arc. To produce the rotary effect it is necessary to set up a magnetic field cutting the arc and directed at right angles to the direction of the arc; the above effects may be facilitated or the effect increased by inserting pieces of magnetic material, such as rings or segments of iron in or upon or near the contacts or passageways for the fluid blast so

as to have the effect of concentrating or directing the field.

In order that the invention may be clearly understood and readily carried into effect, three forms of construction in accordance with the invention will now be described by way of example with reference to the accompanying drawings, wherein:—

Figure 1 is a central vertical section of one form of construction;

Figure 2 is a similar view of a second form of construction;

Figure 3 is a sectional plan taken on the line III—III in Figure 2; and

Figure 4 is an assembly view of a switch embodying the construction shown in Figure 1.

The drawings illustrate three constructions and show the upper part of a switch or circuit breaker having provision for the supply of a blast of fluid for the purpose of extinguishing the arc set up when the switch contacts are separated, and the forms of construction illustrated may be used for example to modify the upper part of a circuit breaker as illustrated and described in our United States Patent application Serial No. 180,204 filed April 1st, 1927.

In the form of construction shown in Figure 1, the nozzle or outer switch contact *a* forming the chimney for the escape of the blast fluid, has a part *b* with which the moving contact *c* comes into contact made of copper, while the uppermost part *d* may be made of soft iron. This nozzle contact is bolted to the top *e* of a lower cylindrical chamber to which fluid under pressure is supplied. A helical conductor *f* resembling a coiled spring is joined at its lower end to the leading-in conductor *g* for the current and at its upper end is bolted to the top edge *h* of the chimney. It will be seen that this coil extends downwards varying in diameter so as to conform to, but to be spaced away from, the outer surface of the nozzle contact *a* and its lower cylindrical extension *k* and is insulated from the nozzle contact except at the upper point of attachment. The current through the switch therefore flows through the lead-in conductor *g*, the coil *f* and the parts *d* and *b* of the nozzle contact into the moving contact *c*. Incidentally as the current flows in the same direction in the turns of the coils *f* the force of attraction between them, tends to draw them together and for this purpose the coil at its lower end is supported by a bracket *l* with a bushing *m* of insulating material and insulating block *n* which holds the end of the coil *f* on to a thin ring of insulating material *o*.

The current flowing in the coil *f* sets up a field in a generally axial direction through the nozzle contact *a* and when the moving contact *c* has left the nozzle contact *a* an arc will be struck in the gap between them, cutting the field approximately at right angles. The field will therefore exert a force on the arc tending to rotate it like a wheel spoke around the top of the contact *c* and within the nozzle contact *a*. In order to control or direct the field the contact *c* is shown provided with an insert in the shape of a soft iron ring *q* to improve the alignment of the field in the axial direction.

Figure 4 illustrates the assembly of the embodiment shown in Figure 1, the switch casing constituting a pressure-retaining vessel being indicated at *t* having an inlet pipe *u* for the casing which is to produce the blast. The operating mechanism for the moving contact *c* is of the usual kind including a cross-bar *v*, a guided operating rod *w* encircled by an operating spring *x*, the whole being mounted on a base or framework *y*.

In the form of construction shown in Figures 2 and 3, the nozzle or outer switch contact *a* is again formed with a lower cylindrical extension *k* bolted to the top of the switch chamber *e*. The nozzle contact *a* and the chimney section *d* are in this case made cylindrical so that the top of the moving contact *c* is in this case made hook-shaped and resilient by the provision of a slit *c'*. In this case the iron insert *q* constitutes a soft iron core for the moving contact *c*. The lower cylindrical portion *k* in this case is continued upwardly as an outer wall to form the coil *f*, the wall being helically slit to form the coil *f* and in this case the turns of the coil being spaced apart by thin packing *r* of insulating material. The lead-in *g* for the current in this case is connected to the upper end of the coil *f*. In this construction the upper extension *d* of the nozzle contact *a* is also of soft iron, but it has much the shape of an inverted cup having a slit *d'* at one part of the circumference so that it can be thrust over the conductor forming the upper end of the coil *f*. In order that the iron cup *d* may not come into contact with the edges of the turns of the coil *f*, a flanged ring of insulating material *s* is provided for keeping them apart. In this case the current flowing through the switch and entering the top of the coil *f* flows down through this coil into the nozzle contact *a* and thence to the moving contact *c*. The direction of the field set up by this current is again approximately axial in the region where the arc is to be rotated and it will be seen that at the instant of break it is approximately at right angles to the arc in the gap between the contacts. The reaction of the field upon the arc again provides a tendency to move the arc around in the annular space between the contacts *a* and *c*, and

therefore, results in rotating the roots of the arc.

The invention is not of course, limited to the examples described above, but the construction may be modified in several directions. Thus, the inner moving contact instead of the outer nozzle contact or both may be shaped so that the current in it sets up the field to produce rotation of the arc root. Thus, the inner contact pin may be of helical formation with the internal bore filled with a soft iron plug and the lower part of the outer wall enclosed in a soft iron sleeve to concentrate the field. The conductive tip of the contact is insulated from the iron, for example, by a thin layer of insulating material and the current is led into the lower part of the helical tip by a connection from the lower part of the contact pin.

We claim:—

1. In an electric circuit breaker, the combination of a pair of relatively movable co-operating electrodes, at least one of which is hollow, current connections to said electrodes, a coiled conductor disposed so as to be shielded from the blast within said hollow electrode by a part of said hollow electrode itself and connected to receive the current flowing to said electrodes so as to set up a magnetic field tending to rotate a root of the arc around the surface of one of said electrodes, and means for causing a blast of fluid to come into contact with said surface around which the arc root rotates and to flow through said hollow electrode.

2. In an electric circuit breaker, the combination of a hollow electrode formed with a passageway for venting the hot products produced by the arc, a counter-electrode, current connections to said electrodes, a coiled conductor encircling at least part of the passageway in said hollow electrode and connected to receive the current flowing to said electrodes so as to set up a magnetic field tending to rotate a root of the arc around the surface of one of said electrodes and means for causing a blast of fluid to come into contact with said surface around which the arc root is rotated and to flow through the passageway in said hollow electrode, said coiled conductor being disposed so as to be screened from contact with the arc by said hollow electrode.

3. In an electric circuit breaker, the combination of a switch casing, a hollow electrode formed with a passageway serving as an outlet vent from said casing and shaped as a nozzle or chimney, a counter-electrode co-operating with said hollow electrode to make contact with a surface thereof, actuating mechanism operatively connected with said movable electrode, means for supplying arc-extinguishing fluid to the interior of said casing and thence as a blast, to the arcing surfaces of said electrodes, current connections to said electrodes and a coiled conductor encircling said hollow electrode and connected to receive the current flowing to said electrodes so as to set up a magnetic field tending to rotate a root of the arc around the surface of one of said electrodes acted upon by the blast, said coiled conductor being separated from the arc by said hollow electrode.

4. In an electric circuit breaker, the combination of a switch casing, a hollow electrode formed with a passageway narrowing to a throat and thereafter widening again to form an outlet vent from said casing, an inner movable electrode co-operating with said hollow electrode to make contact with the inner surface thereof, actuating mechanism operatively connected with said movable electrode, means for supplying arc-extinguishing fluid to the interior of said casing and thence as a blast, to the arcing surfaces of said electrodes, current connections to said electrodes and a coiled conductor encircling said hollow electrode and connected to receive the current flowing to said electrodes so as to set up a magnetic field tending to rotate a root of the arc around the surface of one of said electrodes acted upon by the blast, said coiled conductor being separated from the arc by said hollow electrode.

5. In an electric circuit breaker, the combination of an outer hollow electrode, a concentric inner electrode, current connections to said electrodes, a coiled conductor encircling the gap formed between said electrodes upon separation thereof and connected to receive the current flowing to said electrodes so as to set up a magnetic field tending to rotate a root of the arc around the surface of one of said electrodes and means for causing a blast of fluid to come into contact with said surface around which the arc root is rotated and to flow through said hollow electrode, said coiled conductor being disposed so as to be screened from contact with the arc by said hollow electrode and one of said electrodes being formed at least in part of magnetic material disposed to intensify the action of said magnetic field.

In witness whereof we hereunto subscribe our names this 23rd day of February, 1932.

WILLIS BEVAN WHITNEY.
EDMUND BASIL WEDMORE.