Dec. 13, 1949 W. J. LEWIS 2,491,010

ELECTRIC SWITCH HAVING ELECTROMAGNETIC ARC EXTINGUISHING MEANS

Filed July 27, 1945 2 Sheets-Sheet 1

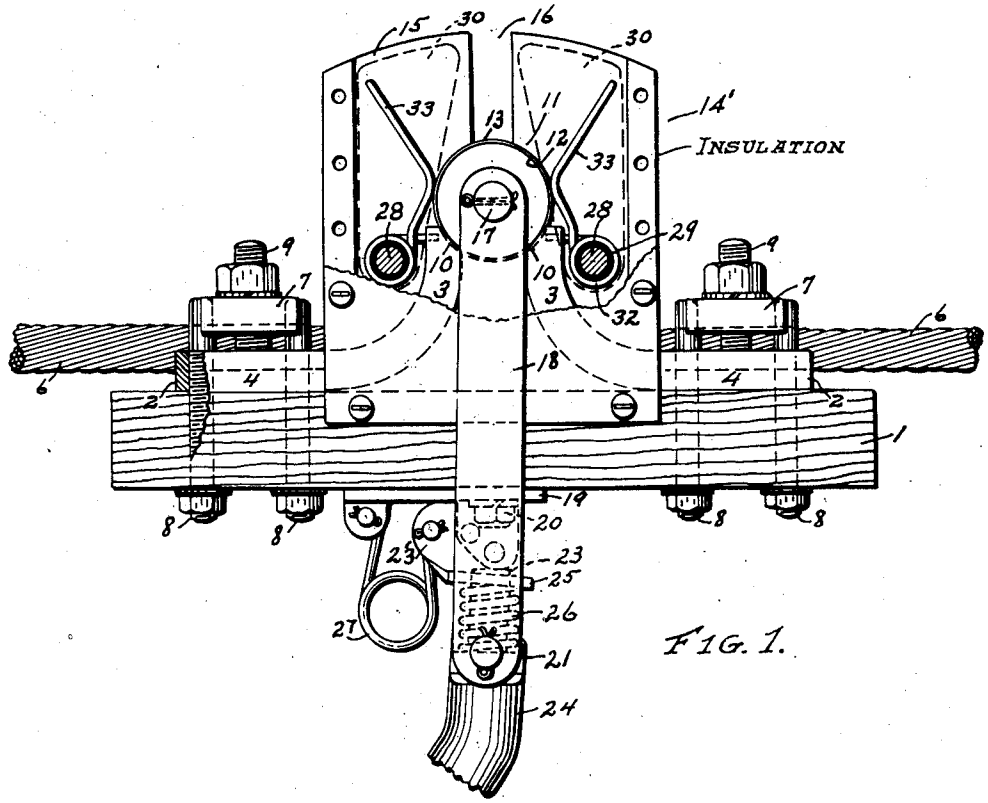

FIG. 1.

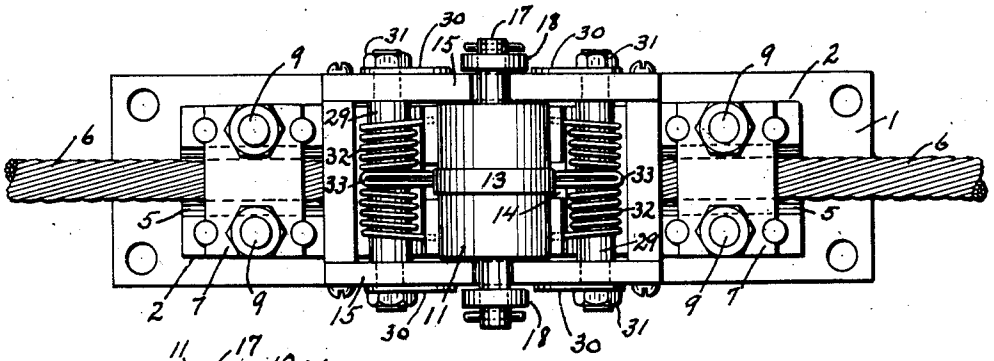

FIG. 2.

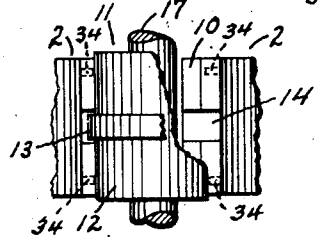

FIG. 6.

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ELECTRIC SWITCH HAVING ELECTROMAGNETIC ARC EXTINGUISHING MEANS

Filed July 27, 1945 2 Sheets-Sheet 2

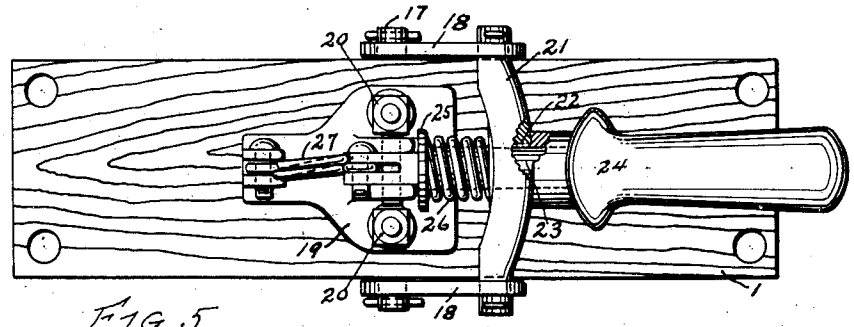

FIG 5

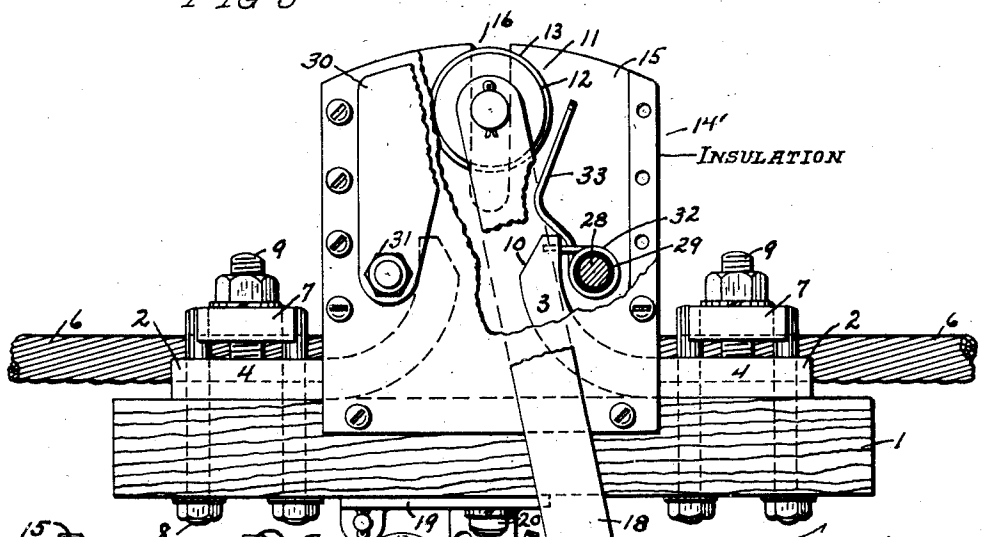

FIG 4

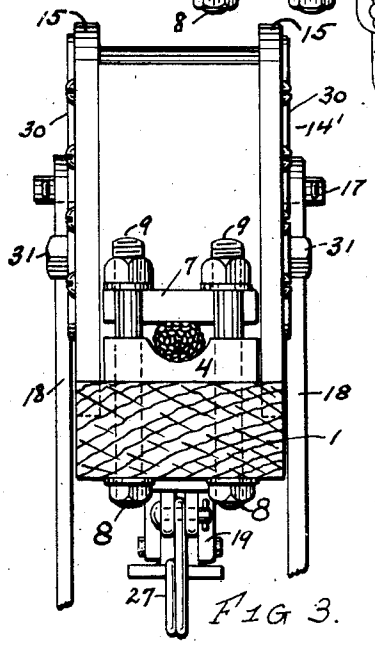

FIG 3.

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2,491,010

ELECTRIC SWITCH HAVING ELECTROMAGNETIC ARC EXTINGUISHING MEANS

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Application July 27, 1945, Serial No. 607,335

13 Claims. (Cl. 200—147)

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My invention relates to electric switches and in particular to switches to carry a sustained load of high amperage and to break the load in an efficient manner.

One object of my invention is to provide a switch having rigid, non-flexible and stationary main contacts with oblique or beveled contact surfaces.

Another object is to provide a switch with main and auxiliary contacts and a single contactor and so related to each other that both sets of contacts are connected and disconnected by the one contactor.

Another object of my invention is to so arrange the several contacts that when the switch is closed both sets of contacts will be closed by the same contactor at the same time and when the contactor has opened the main contacts the auxiliary contacts will still be closed until the contactor has nearly reached its fully open position.

Another object is to provide a chute and means associated with the chute to guide the contactor along a predetermined path in moving to and from its closed position with the axis of the contactor parallel to the contact surfaces.

Another object is to provide a switch operable to its open and closed positions by a manually operable toggle mechanism to effect positive pressure between the contactor and main contacts.

Still another object of my invention is to provide a switch in which the pressure between the contacts and contactor when closed will increase through expansion of these parts if these parts tend to heat.

Another object is to provide an electro-magnetic blow-out associated with each contact and supported by the chute within the chute.

A still further object is to provide a switch with an electro-magnetic blow-out having a pair of coils connected by an arcing horn arranged to be engaged by the contactor which opens and closes the main contacts whereby the horn will be engaged by the contactor when the switch is closed and for a portion of the movement of the contactor toward its open position.

Another object of my invention is to provide an electro-magnetic blow-out with an energizing coil and an arcing horn connected thereto the horn and coil formed from material of relatively high ohmic resistance and resiliency metal.

Another object is to provide an electro-magnetic blow-out with an energizing coil and an arcing horn and in which the coil acts as a torsional spring and so connected to the arcing horn as to yieldingly hold the horn in position to be engaged

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by the contactor for the main contactor when moving to and from its open and closed positions.

Another object is to provide a switch with main and auxiliary contacts and a single contactor to be in engagement with both main and auxiliary contacts at the same or different times, the contactor provided with a contact ring of dissimilar metal thereto to engage the auxiliary contacts, the ring formed of a non-arcing metal and the auxiliary contacts having a relatively high ohmic resistance.

The invention is exemplified in the combination and arrangement of parts shown in the accompanying drawing and described in the following specification, and it is more particularly pointed out in the appended claims.

In the drawing:

Fig. 1 is a side view in partial section of my invention, showing the same in closed position.

Fig. 2 is a top plan view of Fig. 1.

Fig. 3 is an end view in elevation of Fig. 1.

Fig. 4 is a side view in partial section of my invention, showing the same in open position.

Fig. 5 is a bottom view of Fig. 4.

Fig. 6 is a top fragment view of Fig. 1 showing only the contactor and two contacts to more clearly show certain features as later explained.

In the preferred embodiment of my invention the switch proper is usually mounted on a base 1 which may be of wood, composition or marble, etc., or in connection with a trolley sectionalizing device.

The contacts 2 are shown as formed from heavy copper bar, or of cast copper having upturned portions 3 and other portions 4 for attachment to the base 1.

Each portion 4 has a groove 5 formed in the upper side to receive a portion of the end of the conductors 6. A clamping member 7 is associated with each portion 4 and has a groove to receive a conductor end and clamp the conductor to the portion 4.

The contacts 2 are each held stationary in position on the base 1 by the four bolts 8 which are threaded into the portion 4 and project above the portions to guide the clamping members 7 (Figs. 1 and 2) and the clamping members 7 are clamped onto the conductors by the stud bolts 9 which are welded to the portion 4.

The contacts 2 are rigid or non-flexible; have their portions 3 beveled as shown in Figs. 1 and 4. The beveled surface 10 forms the contact surface for the contactor 11.

The contactor 11 is an elongated cylinder of

copper, formed from a bar of rolled copper, or cast and turned to proper diameter. By beveling the contact surface 10, the pressure thereon is multiplied and this pressure may be varied by varying the angle of the contact or bearing surface as for instance, if the toggle mechanism exerts a pressure of 200 pounds when the switch is closed then if the contact faces 10 are 30 degrees to a vertical plane through the axis of the contactor the pressure between the contactor and each contact surface 10 will be 200 pounds, if however this angle is only 15 degrees, the pressure per contact face will be 387 pounds.

When the switch is required to be opened under a heavy current where a magnetic blow-out is required, the contactor 11 is provided with an integral ring shown as 13 encircling the surface 12. When used it is preferred to make this ring 13 of brass, a composition of copper high in zinc. I have tried rings of iron, copper, and other conductive metals but at present prefer the ring of brass.

The contact ends of the contacts 2 must each be formed with a notch 14 when the ring 13 is used, see Fig. 6.

To protect the switch operator and adjacent parts of the switch from the arc formed when the switch is opened, I provide an arc chute 14' of insulating material which is secured to the base 1 by screws or other means of attachment.

The opposite side walls 15 are each provided with a slot 16 in which is mounted the axle 17 for the contactor 11 and movable when the switch is moved to its open and closed positions. The contactor is free to rotate upon the axle 17 and thereby change its relation to the contacts whenever the switch is opened or closed. This distributes the points of arcing over the surface of the contactor which is relatively large. The slot 16 causes the contactor to move in a straight line relative to the contacts.

The mechanism for operating the contactor comprises the links 18 attached to the ends of the axle 17. To the base 1 is secured an attachment 19 by means of the bolts 20. The lower end of the links 18 are connected by a yoke 21, which has an opening 22 through which projects the stud 23—23' which has one end secured to the handle 24 and the other end pivotally secured to the attachment 19.

Between the yoke 21 and the flange 25 encircling the stud portion is a spring 26 which is compressed when the switch is closed, to provide the pressure desired between the contactor and the contacts. When the switch is open the spring 26 may not be sufficiently effective to maintain the switch freely open, therefore an auxiliary spring 27 is used for this purpose.

The main spring 26 is so located that it is not affected by any heat at the contacts and has enough stored energy when the switch is closed to provide a quick-break when the handle is pushed open by an open hand and will completely open the switch without the aid of spring 27.

Since the above described operating mechanism works on the toggle principle, positive and constant contact is maintained between the substantially rigid contacts and the contactor, also the spring 27 aids in holding the switch closed.

When the switch is provided with magnetic blow out means, transversely disposed soft iron pins 28 are mounted in apertures extending through the members 15 and act as the cores of the blow-out magnet and each core is surrounded

by insulation 29. On the outer face of the members 15 are the pole pieces 30 of the blow-out magnet. The pole pieces butt against the end faces of the core 28 and are secured in position by the nuts 31.

Surrounding each core 28 and its insulating cover 29 is the magnet coil 32 with its projecting horn 33. The coil and horn are formed of a continuous length of Nichrome wire. This wire is preferably formed of a metal having relatively high ohmic resistance coupled with high strength and resistance to bending and composed of nickel, chromium and iron in which the iron content does not exceed 30%. This composition is known to the trade as "Nichrome" and will be so termed hereafter. Using "Nichrome" the wire possesses resiliency, and this length is doubled back upon itself from its middle point to form the horn and contact 33. The ends of the bent back portions for a distance back from the end bight of the horn are then coiled upon a mandrel to form the coils proper to fit over the insulation 29 and which are wound in a direction whereby the ampere turns will not oppose each other. This gives a pair of coils positioned one on each side of the horn 33 (Fig. 2) connected by the horn. The free ends of the coils 32 are positioned in holes 34 (Fig. 6).

The coils and their free ends and the horn 33 are so related that when in position the coils which act as torsion springs are stressed sufficiently to cause the intermediate bight of the horn to engage ring 13 on the surface 12 of the contactor 11 when the contactor is in its closed position and to engage the ring for a time after the contactor has disengaged the contacts 3.

The device as disclosed, but without the blow-out coils 32 and horns 33, is quite practical as the reaction of the magnetic fields set up upon opening the switch will cause the arcs to move out away from the switch. However the switch may be opened under a greater current flow if the magnetic blow-out attachment is used.

It should be observed that the contactor and the operating mechanism is not energized while the switch is open.

The relation between the horns 33 and contactor 11 is such, that the engagement between the contacts 3 and contactor 11 is broken before the horns break engagement with the contactor ring 13, thus the load current then flows through the coils 32 thus fully energizing the same and producing magnetic fields between the oppositely disposed poles 30 before any arc is formed.

The arcing horns 33 which might also be termed contact-horns are so arranged that the circuit is broken between them and the contact ring 13 of main contactor 11 and the arcs thus formed are in series. The instant the arcs are formed they are acted upon by the already established magnetic fields.

The coils and horns being of Nichrome wire, will offer ohmic resistance to the flow of current upon the main contactor 11 breaking with the contacts 2 since the coils and horns are in series and connected by the contactor ring 13 when the break takes place.

Nichrome wire is exceptionally well adapted to serve for the coils 32 and horns 33 since it has high strength and resistance to bending even in an annealed state. It can also withstand high temperatures which may be necessary as the coils and horns must be able to carry full load current at the time of opening the switch.

Also the coils are energized just prior to the

engagement of the contactor 11 with the contacts 2 at the time of closing the switch.

The contactor may be other than circular in cross-section as for instance it may have only three sides, the cross-section being triangular; in fact the contactor may have any number of evenly disposed faces to meet requirements, from three to an infinite number (a circle) but I prefer the shape shown. In any case I prefer to make the contact ring 13 circular. The said faces may be flat or curved.

The contactor 11 has a large exposed surface thus maintaining a low temperature while carrying a larger current.

The contactor being of the roller type, free to rotate or pivot on its axle 17, its engagement with the contact surfaces 10 is very likely to change with each opening and closing of the switch, thus distributing any arcing quite evenly over the entire surface 12; this is due to the contactor 11 not engaging both contact-horns 33 or contact surfaces 10 at exactly the same time, a condition which may be intentional.

While I have referred to the contactor as being formed from a bar of rolled copper or cast solid and turned to proper diameter, the contactor may be formed from rolled or drawn tubing or cast tubing turned to proper diameter. This gives increased radiating surface.

Tests have shown that compared to a switch of the conventional type using a flat blade operating between spring clips, a switch constructed as disclosed herein, is superior to the knife-blade switch especially in maintaining a lower temperature for the same current flow and time.

Any heat generated in the contactor and the contacts when closed will only tend to expand these parts thereby increasing the contact pressure.

The switch without a magnetic blow-out may be used for sectionalizing circuits, particularly in mines, where the switch is seldom opened except in case of emergency.

The construction of the operating mechanism is such that there is a substantially even pull at both ends of the contactor when closed thereby assuming uniform contact with each contact for the full width thereof.

The contactor and contacts are of considerable mass and of high electrical conductive metal, copper, they offer a short current path and have a high thermal capacity, positive pressure between the parts and large radiating surface, all of which go to make up a highly efficient switch.

I wish it to be understood I do not desire to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

I claim:

1. An electric switch comprising a pair of rigid contacts, support means to hold the contacts in spaced and insulated relation, each contact having a beveled contact surface forming a V-shaped relation, a rigid contactor movable to two positions, a closed position in which the contactor engages and electrically connects the contact surfaces and an open position in which it disengages and disconnects contact surfaces, toggle mechanism having spaced arms attached to the ends of the contactor and extending to a point below the support means whereby the contactor is supported and moved to its two positions and means whereby the arms are secured to the support means and are manually operated, separate spring means yieldably holding the contactor in either its closed or its open position respectively, an insulated chute positioned between the said arms to protect the operator from any arc formed when the switch is opened under load and means associated with the chute cooperating with means associated with the contactor to guide the contactor in a straight line in moving to either of its positions.

2. In an electric switch having a stationary contact and a movable contactor, a magnetic blow-out comprising a core of magnetic material, pole pieces of magnetic material secured to the ends of the core, an energizing coil surrounding the core in insulated relation thereto, one end of the coil arranged to be connected to a source of electric energy, an elongated yieldable arcing horn electrically connected to the other end of the coil and interposed in the path of and adapted to engage said contactor, the arcing horn formed with means between its ends arranged to engage said contactor, whereby the circuit through the coil from the source of energy may be completed, the coil and horn formed of a continuous length of resilient, relatively high resistance wire.

3. An electric switch comprising a pair of rigid spaced contacts provided with obliquely disposed contact surfaces forming a V-shaped opening, means to secure the contacts in spaced and insulated relation, each contact provided with an auxiliary contact electrically connected thereto, a contactor to engage the obliquely disposed contact surfaces and connect the contacts in series, the contactor comprising a rigid solid member of metal having a plurality of contact faces and means to mount the contactor to rotate upon its axis, the contactor also provided with a contact ring secured to the surface thereof to engage the auxiliary contacts, means secured to the last said means to move the contactor and ring toward and into engagement with the contacts, the movement of the contactor being parallel to the first said contact surfaces and in a straight line.

4. An electric switch comprising, a pair of rigid immovable contacts, each contact provided with a beveled contact surface and both surfaces forming a V-shaped opening therebetween, an open top chute of insulating material enclosing the said contact surfaces, blow-out means associated with each contact, each blow-out means comprising a core positioned within the chute and supported by the sides thereof, magnetic poles outside the chute and secured to the ends of the cores, each core provided with energizing coil means, each coil means having one end mechanically and electrically connected to its associated contact, the other end of each coil being connected by an elongated contact-horn, the contact-horns provided with contact means intermediate the ends thereof, rigid elongated roller type contactor of relatively high electrical conductivity with its longitudinal axis parallel to the axes of the cores and positioned within the chute, the chute provided with guide means on opposite sides thereof and the ends of the contactor positioned in the said guide means whereby the contactor is guided into engagement with the contact surfaces and with the contact means on the contact-horns to connect the contacts and simultaneously connect the contact-horns, the guide means also arranged to guide the contactor in its movement away from the contacts whereby the contact means on the contact-horns will remain in engagement with contactor after it has disengaged the contact surfaces on the contacts for a

portion of its movement away from the said surfaces, the said coils and contact-horns being formed from a resilient metal of relatively low conductivity whereby the contact-horns are held in yieldable engagement with the contactor and means to manually operate the contactor into and out of engagement with the contact surfaces and with the contact-horns.

5. An article of manufacture comprising a contact member for a switch arranged to be engaged by a reciprocable contactor, a magnetic blow-out means associated with the contact, the blow-out means comprising a magnetizable core, an energizing coil surrounding the core in insulated relation thereto, an arcing horn projecting away from the contact, said horn being fixed to and supported by the coil, the horn provided with means engageable by the contactor when in engagement with the contact, the coil formed of resilient material having its other end connected in fixed relation to the contact whereby the coil will act as a torsion spring and yieldingly hold the arcing horn in the path of the moving contactor whereby the arcing horn will be engaged by the contactor as it moves into and out of engagement with the contact.

6. An electric switch comprising a pair of insulated rigid contacts having spaced ends and each end having a beveled contact surface forming obliquely disposed contact surfaces, a single elongated rigid metallic contactor arranged to rotate on its longitudinal axis, the axis being parallel to the contact surfaces and the contactor movable to its closed position to engage the contact surfaces and electrically connect the contacts and to its open position to disengage the contact surfaces, means to move the contactor to said positions, each contact provided with magnetic blow-out means engageable by the contactor, the blow-out means being so constructed and arranged relative to the contacts and said contactor that the blow-out means will be in electrical engagement with both the contacts and contactor as the contacor moves to its open position after disengaging the contact surfaces and before the contactor reaches its fully open posititon, whereby the blow-out means will be energized and extinguish any arc formed between the contactor and the blow-out means after the contactor disengages the blow-out means.

7. An electric switch comprising a pair of insulated rigid metal contacts having adjacent ends and each end provided with a contact surface, a rigid metal contactor movable to an open position disengaged from said contact surfaces and also movable to a closed position to engage the contact surfaces and electrically connect the contacts, means to move the contactor to its two positions, including spring means to determine the pressure between the contacts and the contactor, magnetic blow-outs including coils and arcing horns, the coils mechanically and electrically attached to the contacts and the horns mechanically and electrically connected to their respective coils intermediate the ends thereof and arranged to be in yieldable engagement with the contactor intermediate the ends of the horn as the contactor makes a portion of its movement from its closed to its open position whereby the blow-out coils are energized when the contactor disengages the contacts and any arc formed between the contactor and the horns is extinguished.

8. An electric switch comprising a pair of spaced contacts having adjacent contact faces, a rigid roller type contactor to move into and out of engagement with the contact faces whereby the contacts are connected and disconnected, magnetic blow-out means for each contact including a pair of coils electrically connected to their contact, and an arcing horn in series with and resiliently supported by the coils, a contact ring associated with the contactor to be yieldably engaged by the said horns intermediate their ends as the contactor moves into and out of engagement with the contact faces whereby any arc formed at the disconnecting of the said contact ring and the horns will be extinguished.

9. In an electric switch comprising a pair of contacts provided with contact surfaces, a contactor to engage the surfaces to electrically connect the contacts, insulating means on which the contacts are mounted in spaced and insulated relation, means to operate the contactor into and out of engagement with the contact surfaces, the combination with the contactor of magnetic blow-out means to extinguish any arc formed upon opening the switch, the blow-out means comprising a pair of horns arranged to be in engagement with the contactor immediately after the contactor disengages the contact surfaces, the blow-out means also provided with energizing coils formed from resilient wire and having one end connected to the contacts and held in fixed relation thereto whereby the coils function as torsional springs and the other end of the coils connected to the horns whereby the horns are yieldably held in said engagement with the contactor and the coils are energized when the contactor breaks engagement with the contact surfaces.

10. In a switch provided with a contactor reciprocably movable to two positions, a magnetic blow-out comprising a core of magnetic material, a pole piece secured to each end of the core, a pair of energizing coils surrounding the core in insulated relation thereto, the extreme ends of the coils arranged to be connected to a source of electric energy and an elongated arcing horn connecting the inner or adjacent ends of the coils, the coils and horn formed from a continuous length of resilient wire and the horn arranged to be engaged by the contactor when it is one position and to be free of the contactor when in its other position.

11. In a switch having insulated main contacts and a reciprocably movable contactor for connecting and disconnecting said contacts, a magnetic blow-out comprising a core of magnetic material, pole pieces of magnetic material secured to the core to set up a magnetic field therebetween when energized, coils surrounding the core to magnetically energize the core, the outer or extreme ends of the coils arranged to be connected to a source of electrical energy, and an elongated contact-horn electrically connecting the inner adjacent ends of the coils and provided with means intermediate its ends to be engaged by said movable contactor after said main contacts are disconnected, whereby circuit through the coils and energizing of the core is maintained after the main contacts are disconnected and any arc formed at said intermediate means on disengagement from said contactor is extinguished.

12. An electric switch comprising a pair of rigid contacts provided with obliquely disposed contact surfaces and held in spaced and insulated relation, a rotatable rigid contactor to engage and electrically connect the contact surfaces, a contact ring of dissimilar metal secured to the

contactor, manually operable means connected to each end of the contactor to maintain the contactor parallel to the contact surfaces and to move it into and out of engagement with the contact surfaces, a chute of insulating material enclosing the contact surfaces and the contactor, the walls of the chute provided with slots and the contactor provided with means positioned in the slots to guide the movement of the contactor in a straight line toward and away from the contact surfaces, a magnetic blow-out attachment associated with each contact on opposite sides of the contactor and each attachment provided with a magnetic core and coil thereon electrically connected to the adjacent contact and arranged to be energized upon the contactor breaking engagement with the contact surfaces, the blow-out attachments provided with horns adapted to be engaged by the ring on the contactor after the contactor has disengaged the contact surfaces whereby the circuit from contact to contact is maintained through the contactor and its contact ring and the blow-out attachments during a portion of the movement of the contactor from its closed position to its open position, the said magnetic cores supported by the walls of the chute and magnetic plates secured to the outer faces of the chute and secured to the ends of the cores whereby a magnetic flux is set up to extinguish any arc formed upon opening the switch.

13. An electric switch comprising a pair of

spaced insulated contacts, a contactor movable into and out of engagement therewith, blow-out means comprising an integrally-formed resilient horn and coil mechanically and electrically connected to each of said contacts, said blow-out means being adapted to yieldably engage said contactor after disengagement thereof from said contacts, an insulated chute surrounding said contacts and blow-out means, and guideways in said chute for guiding said contactor into and out of engagement with said contacts and blow-out means.

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