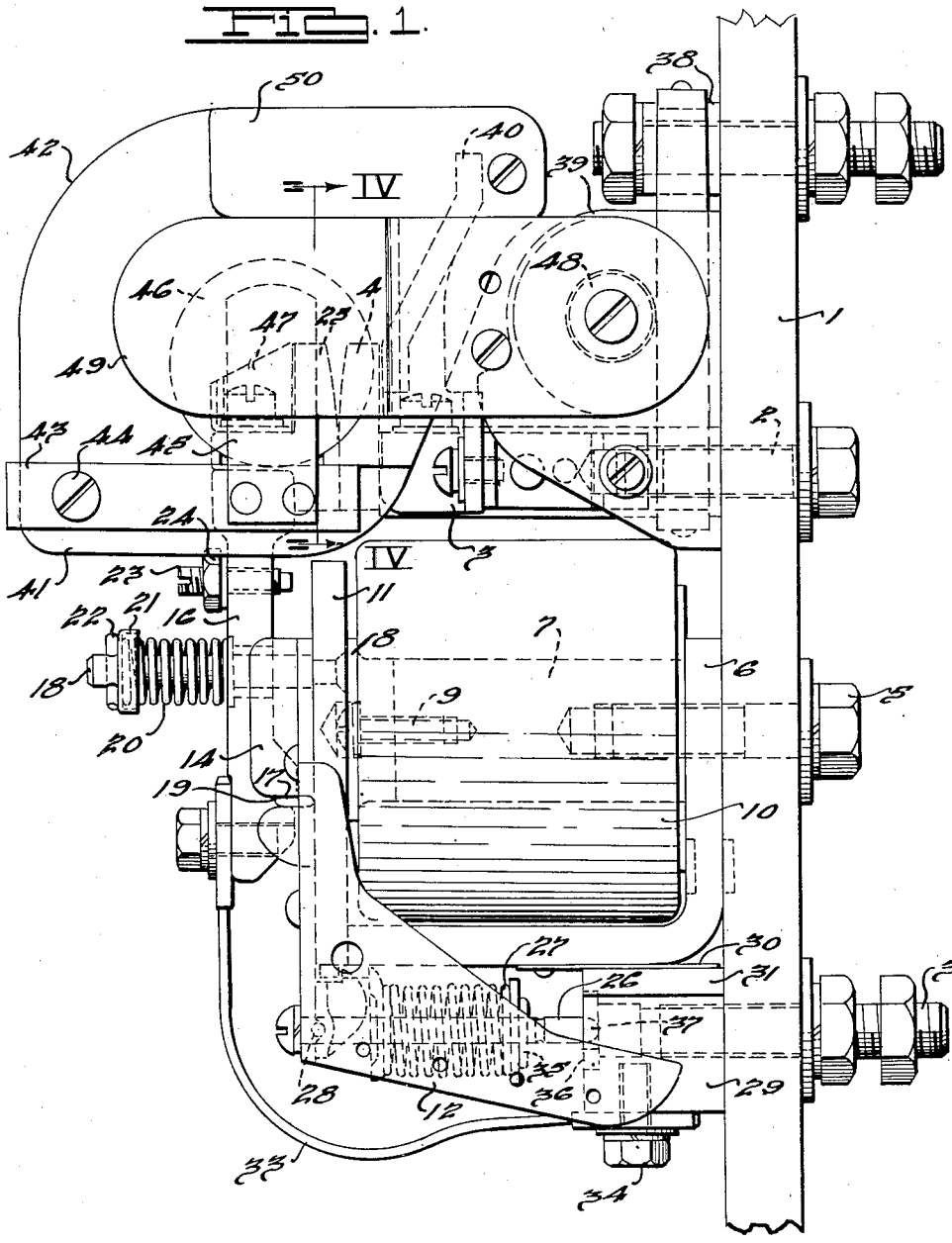
Sept. 16, 1941. W. J. HUDSON 2,255,886

ELECTRIC SWITCH

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Fig. 1.



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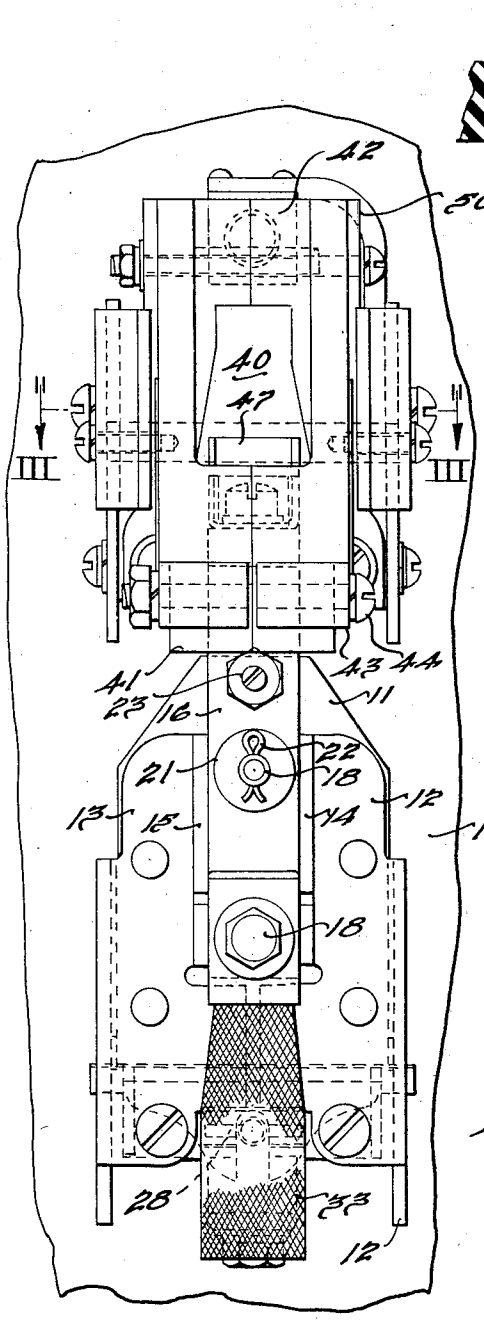


FIG. 2.

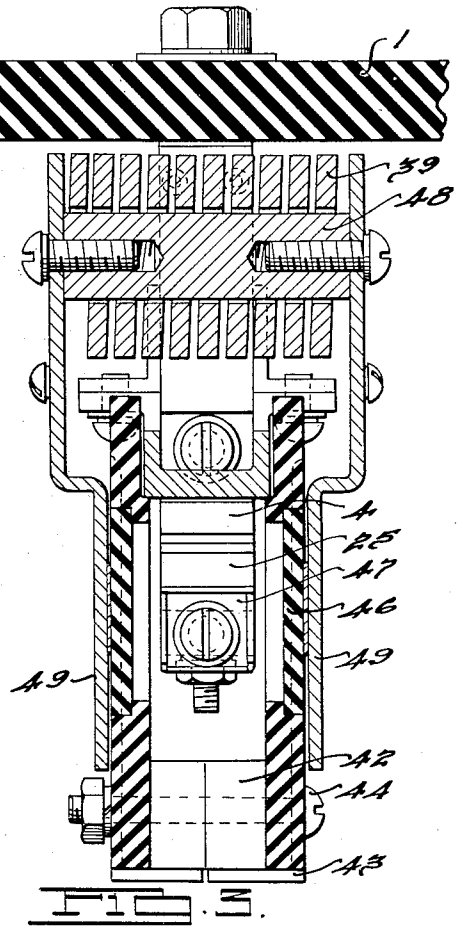


FIG. 3.

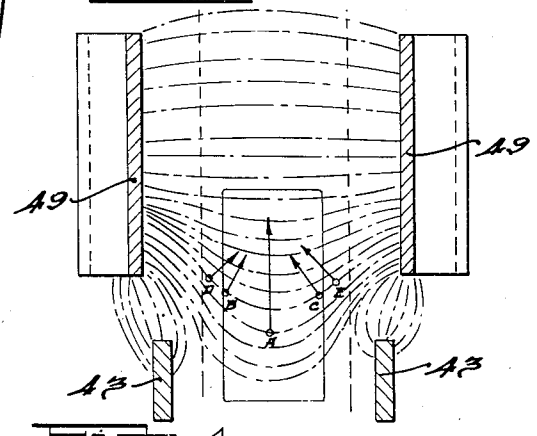


FIG. 4.

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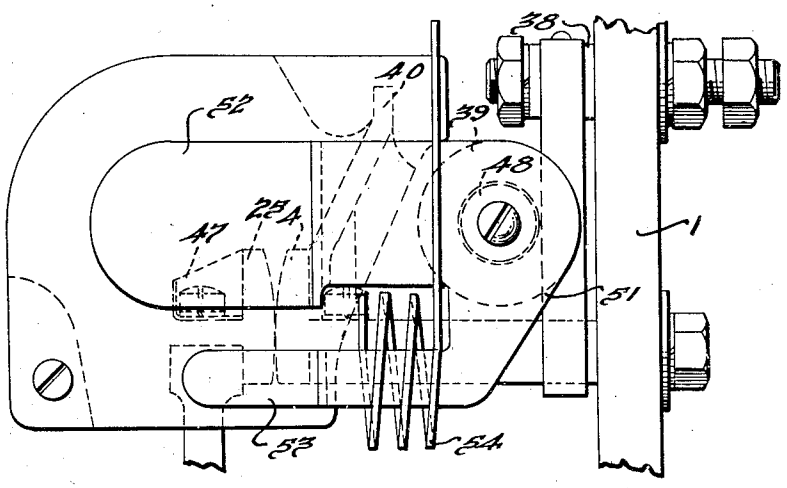


FIG. 5.

FIG. 6.

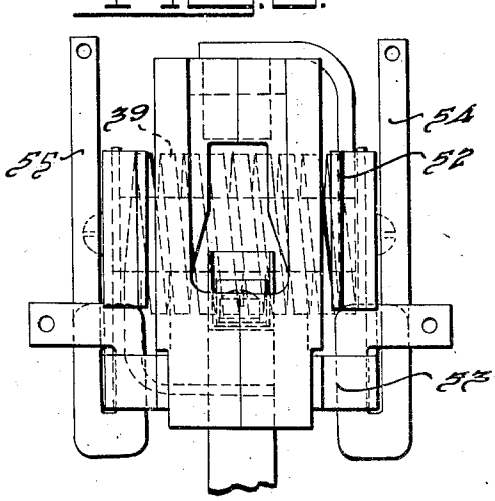
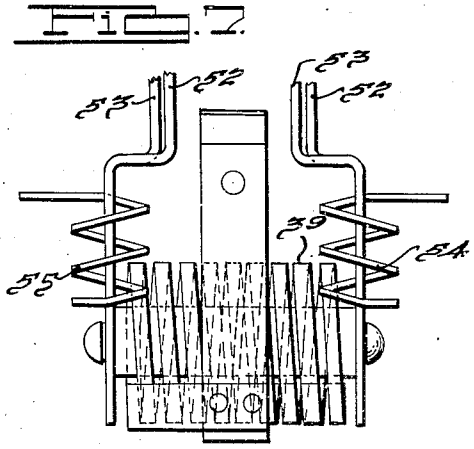


FIG. 7.



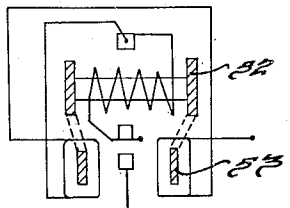


FIG. 8.

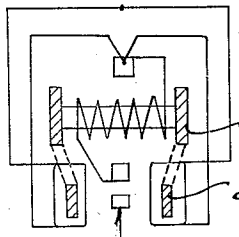


FIG. 9.

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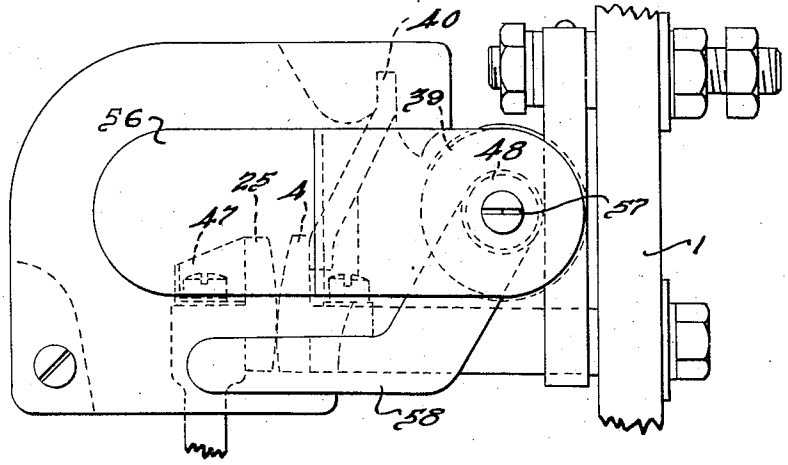


FIG. 10.

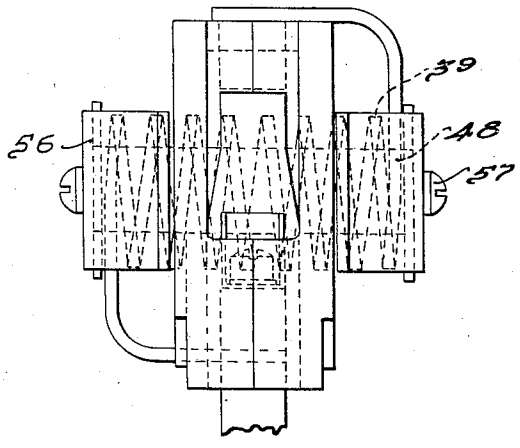


FIG. 11.

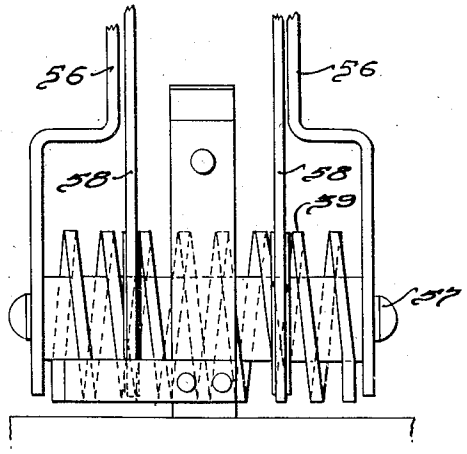


FIG. 12.

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UNITED STATES PATENT OFFICE

2,255,886

ELECTRIC SWITCH

William John Hudson, Milwaukee, Wis., assignor to Square D Company, Detroit, Mich., a corporation of Michigan

Application December 10, 1938, Serial No. 245,011

8 Claims. (Cl. 200—147)

This invention relates generally to arc controlling devices and more particularly to magnetic blow out devices for contactors and other electric circuit controlling devices.

The use of magnetic blowouts for arcs drawn between co-operating contacts when the current flow therethrough is interrupted is well known in the art. Consider the arc as a North-South line in a horizontal plane being acted upon by a magnetic field in which all the lines of force are horizontal East-West lines. The effect of the action of these lines of force is to cause a movement of the arc straight upward. Any production of arcs and magnetic fields having the same relative directions as described above will always result in a motion of the arc perpendicularly to the point of initiation; there will be no tendency on the part of the magnetic field to produce any motion other than the one described. Thus, if the arc chances to be drawn at the extreme edge of a contact, its path will be along this extreme edge as it travels upward and the tendency will be to melt and vaporize more contact material than if the path were along the center of the contact, for a sharp edge is more easily heated than a flat surface. A magnetic field such as observed above acting upon an arc bowing outward in a horizontal plane cannot influence it so as to produce a sidewise motion and cannot prevent the arc from impinging upon the surfaces of the confining insulating barriers; the arc striking these insulating barriers will often result in the gradual burning away of the barrier material in the regions opposite the contacts.

An object of this invention is to control the path of the arc and to hold the arc centrally of contacts and arc chute so as to prevent contact by it with the supplementary parts and thus materially lessen the possibility of damage to said elements.

According to the present invention, the control of the arc position is attained by the production of a magnetic field having curved lines of force in the region of arc initiation, the concavity of said curved lines being directed upward.

Since the motion imputed to the arc by the magnetic field is everywhere perpendicular to the direction of the lines of force, it is apparent that with a magnetic field composed of curved lines of force a lateral control of the arc is obtained. The curved lines of force impel the arc toward the center of the concavity of the magnetic field regardless of point of initiation. Thus a definite bias is given the arc away from the edges and toward the center of the contacts as it travels upward, consequently resulting in less burning of the contacts, elimination of burning of the barrier material and a more efficient rupturing of the arc.

Another object of the invention is to provide an improved and more efficient form of magnetic blowout device for an electric contactor.

Another object of the invention is to increase the arc-rupturing capacity of a contactor by the provision of a magnetic blowout having rugged and simple means for laterally controlling the arc.

Another object is to provide for longer life of the contacts and insulating barrier or chute in an electric contactor by lateral control of arcs drawn between the contacts.

Another object of the invention is to provide an arc chute mounted between the side plates of a magnetic blowout and having two L-shaped brackets fitted into recesses in the sides and near the lower edge thereof; the brackets together with the through bolt connecting them providing a magnetic path which affects and distorts the magnetic field between the side plates to impart a definite curvature thereto.

Another object of the invention is to provide a magnetic blowout having split side plates; the side plates having an upper and lower extensions, with the upper extensions serving as main pole pieces for the blowout coil and the lower extension carrying auxiliary coils wound in a direction which will provide a magnetic potential that opposes that of the main coil; the flow of the flux from the upper extensions with their higher magnetic potential to the lower extensions with their lower magnetic potential creating a distorted magnetic field which will provide lateral control of the arc.

Another object of the invention is to provide a magnetic blowout having auxiliary plates disposed upon a blowout core with the auxiliary plates including less turns of the blowout coil therebetween. The number of turns of coil corresponding to the sections into which the auxiliary plates divide the core determine the relation of the magnetic potentials of the auxiliary side plates to each other and to the main side plates. The combined magnetic field will be one provided with curved lines with the concavity upward to obtain lateral control of the arc.

Other objects and features of the invention will be readily apparent to those skilled in the art from the following specification and appended drawings illustrating certain preferred embodiments of the invention in which:

Figure 1 is a side elevational view of an electric contactor embodying the invention.

Figure 2 is a front elevational view of the contactor.

Figure 3 is a detailed sectional view on the line III—III of Figure 2.

Figure 4 is an enlarged detailed sectional view along line IV—IV of Figure 1 indicating the form taken by the magnetic field.

Figure 5 is a side elevational view of a modification.

Figure 6 is a front elevational view of the modification shown in Figure 5.

Figure 7 is a bottom view of the modification shown in Figure 5.

Figure 8 is a schematic wiring diagram for the auxiliary coils of the modification of Figure 5.

Figure 9 is an alternative schematic wiring diagram for the auxiliary coils of the modification of Figure 5.

Figure 10 is a side elevational view of another modification of the invention.

Figure 11 is a front elevational view of the modification shown in Figure 10.

Figure 12 is a bottom view of the modification shown in Figure 10.

In the preferred form of the invention illustrated in Figures 1–4 inclusive, there is shown a supporting plate 1, upon which is mounted a stationary contact post 2, which adjustably carries a contact holder 3, having secured thereon a stationary contact 4. Rigidly secured to the plate 1, as by a stud 5, is an operating magnet assembly formed by an L-shaped piece 6 and a cylindrical core 7, terminating at the pole piece 8 which is secured to the core 7 by means of a stud 9. About the core 7 is disposed an energizing coil 10 for effecting the switching operation of the contactor parts. Located at the front of the operating magnet is an armature member 11. Rigidly connected to the armature member 11 are a pair of generally L-shaped brackets 12 and 13. The front faces of the brackets 12 and 13 are provided with flanges 14 and 15 spaced from each other to guide a contact carrying finger 16. The flanges 14 and 15 are notched to receive a rocker pin 17 which is elongated in cross-section and received in said slot, is limited to a disassembling movement parallel to the slot. A spring guide 18 is rigidly mounted on armature member 11 and is received within an enlarged opening in the contact carrying finger 16. A notch 19 in the back face of the finger 16 receives the forward portion of the rocker pin 17 to form a fulcrum or axis for rotation of the contact carrying finger relative to the armature. A compression spring 20 is disposed about the spring guide 18 biasing the finger 16 toward the armature and is maintained in place by a washer 21 and a pin 22 on the spring guide 18. An adjusting screw 23 threaded into the finger 16 and bearing against the armature 11 and having a locking nut 24 is provided for varying the normal position of the contact carrying finger relative to the armature. A movable contact 25 is mounted at the end of contact finger 16 in position to cooperate with stationary contact 4. Beneath the operating magnet and passing through the face of brackets 12 and 13, spring guides 26 are provided having compression springs 27 disposed thereupon. The compression spring 27 exerts a biasing force on the spring guide 26 and the brackets 12 and 13 which are pivoted about transverse pin 28 to bias the armature into its pivot and also for rotation to its extreme "off" position.

Rigidly mounted on the back plate 1 is a conducting portion 29 insulated from the L-shaped magnetic member 6 by an insulating sheet 30. The conducting portion 29 is provided with arms 31 which engage the back ends of the brackets 12 and 13 when the armature assembly is in its extreme "off" position. The conducting portion 29 and the arms 31 form a rigidly mounted massive abutment engaged by the brackets 12 and 13, rigid with the armature 11, to absorb the shock incident to the abrupt stopping of the armature in its extreme position. A stud 32 which mounts the conducting portion 29 extends through to the back of plate 1 and is adapted to be put in conducting relation with a terminal not shown, at the back of the insulating plate 1.

A woven flexible conducting web 33 is rigidly connected at one end to the contact carrying finger 16 and extending beneath the magnetic circuit and armature biasing spring has its other end rigidly connected to the conducting portion 29, by means of a stud 34.

The conducting portion 29 is provided with a generally central opening 35 in which is disposed an insulating guide 36 receiving and guiding the free end 37 of the spring guide pin 26, thus guiding the movement of this end of the pin in response to movement of the armature member 11 upon energization or deenergization of the coil 10.

Upon the supporting plate 1 is mounted an upper terminal 38 having connected thereto one end of a blowout coil 39. Rigidly secured to the contact holder 3 is an arc horn 40 which also serves as a mechanical support for an insulating arc chute 41 about the cooperating contacts.

The arc chute 41 is formed of joined halves of refractory insulating material and serves to confine the arc and to limit the direction of the hot gases to an upward and outward motion through the provided opening 42 in the face of the arc chute. The arc chute is provided at its sides and near the lower edge thereof with recesses into which two L-shaped brackets 43 are fitted; a through bolt 44 definitely holds the brackets 43 against motion in any direction.

The brackets 43 serve as clamps to secure the segments of the arc chute 41 together. Each bracket 43 is provided at the end thereof nearest the contacts 4 and 25 with a thin non-magnetic piece 45, said piece 45 being directed upward and serving to secure in place a removable insulating disc 46, this disc 46 being so disposed as to facilitate the use of the best refractory insulating material at the points of greatest heating.

The movable contact 25 is provided with an arc horn 47 to lessen damage to its retaining stud.

Within the blowout coil 39 is a cylindrical core 48 having attached to its opposite ends a pair of horizontally spaced side plates 49 of magnetic material which act as pole pieces for the blowout flux and are disposed, as shown, at the opposite sides of the arc chute and cooperating contacts and also serve as additional mechanical supports for arc chute 41. At the upper edge of the arc chute 41 and on the sides thereof is provided a ledge formation 50 which rests upon side plates 49 and tends to support arc chute 41 in position. The blowout assembly is rigidly secured to the contact post 2.

The arc chute 41 is mounted in position intermediate the side plates 49 of the blowout magnet.

The L-shaped brackets 43 are fitted in recesses at the sides and lower edge thereof of the arc chute 41; the top surfaces of the brackets, so positioned, are directly below and at a relatively short distance from the lower edges of the side plates 49. The brackets 43 and the through bolt 44 are constructed of magnetic material and provide a low reluctance magnetic path. The presence of a magnetic path of this type adjacent to the magnetic field disposed between side plates 49, which normally is composed of horizontal lines of force, will affect the latter field to cause the normal magnetic field to become distorted and to assume the form indicated in Figure 4.

If the arc is initiated at the center of the contact as at A in Figure 4, it will be forced straight upward on the lines of force. If it is initiated at the edge of the contact as at B or C, the force acting upon it will be perpendicular to the direction of the lines of force at such point and the arc will thus be driven toward the center of the air space as well as being forced upwardly. If the central part of the arc should bow outward to a point D or E beyond the contacts, it would be forced back to the center of the space between the contacts by the action of the lines of force.

It is readily apparent that the magnetic bracket and bolt assembly could be replaced by a single magnetic U-strap or combination of differently shaped magnetic pieces if properly located to give a similar magnetic effect, and could be supported otherwise than by the arc chute without departing from the spirit of the invention.

Figures 5 to 7 inclusive illustrate a modification of the invention. The side plates 49 and the L-shaped brackets 43 with the through bolt 44 of the preferred embodiment being replaced by a split side plate 51 provided with upper and lower extensions 52 and 53; the upper extensions 52 serving as main pole pieces for the blowout coil 39, and the lower extension 53 are adapted to carry auxiliary coils 54 and 55. The auxiliary coils 54 and 55 are wound about the lower extension 53 in such a direction as to set up a magnetic potential which opposes that of the main coil within their common magnetic path. Thus the lower extension 53 of each pole is at a lower magnetic potential than the upper extension 52 and the flux will flow from the upper extension 52 to the lower extension 53 creating a field form similar to that shown in Figure 4 and producing the same effect upon an arc as does the preferred embodiment. Coils 54 and 55 may be designed so as to carry the full load current and are then to be connected in series with each other and with the main blowout coil as depicted in Figure 8. Or, if coils 54 and 55 are designed to carry but half the load current, they are then connected in parallel with each other and in series with the main coil as shown in Figure 9. By varying the design of the coils 54 and 55, the amount of distortion of the field can be regulated.

Figures 10 to 12 inclusive illustrate another modification. The side plates 56 are essentially the same as side plates 49 used in the preferred embodiment. But here the blowout core 48 is formed of three sections, the two outer provided with openings generally centrally thereof and the center section being provided with generally centrally threaded holes at each end thereof to receive studs 57. Auxiliary side plates 58 are inserted between turns of the blowout coil 39 and attached to the core 45 at point of jointure of core segments by means of the studs 57 which pass through the holes through the outer core sections and through openings in auxiliary side plates 58 and are received by the threaded openings in the center core portions.

The relation of the magnetic potentials of the auxiliary side plates 58 to each other and to the main side plates 56 is determined by the number of turns of coil corresponding to the three sections into which the blowout core 48 is divided by the insertion of the auxiliary plates 58. The combined magnetic field obtained will be of the same general shape as shown in Figure 4 and performing the same function and producing the same effect as the magnetic field described in the preferred embodiment. The degree of distortion can be controlled by variations in design of the coil and magnet parts.

While certain preferred embodiments of the invention have been specifically disclosed, it is understood that the invention is not limited thereto as many variations will be readily apparent to those skilled in the art and the invention is to be given its broadest possible interpretation within the terms of the following claims.

What is claimed is:

1. In an electric circuit controlling device, a pair of contacts, means to move one of said contacts relative to the other to effect opening and closing, an arc chute disposed about said contacts, a blowout coil to produce a magnetic flux about said contacts to effect a blowing out of any drawn arc, and a low reluctance magnetic path provided by a generally U-shaped magnetic circuit so disposed about the contacts as to produce a distortion downwardly of at least some of the normally horizontal lines of force adjacent to the contacts so as to bias the drawn arc to the center of the arc chute.

2. In an electric controlling device, stationary and movable contacts, means for effecting movement therebetween, magnetic pole pieces at opposite sides of said contacts, a blowout coil producing a magnetic field between said pole pieces for the expulsion of any arc drawn between said contacts, and a generally U-shaped magnetic circuit disposed about the contacts beneath said pole pieces so as to produce an upward concavity of the normally horizontal lines of force of the magnetic field in the region of the contacts so as to impart a lateral bias to the drawn arc.

3. In an electric circuit controlling device, relatively movable contacts, means for moving the contacts to effect switching operation, an arc chute disposed about said contacts and having an opening in the face thereof to provide for the escape of formed gases, a blowout structure including magnetic pole pieces attached to a magnetic core about which a series coil is wound to produce a normally transverse magnetic field to obtain expulsion of any arc drawn between said contacts, and a low reluctance magnetic path including pole pieces disposed below the bottom edges of the side plates and distorting the normally horizontal lines of force of the magnetic field downwardly so as to bias the arc not only upwardly but also laterally.

4. In an electric circuit controlling device, a pair of contacts, means to move one of said contacts relative to the other to effect opening and closing of the circuit, main magnetic pole pieces at opposite sides of the contacts, a blowout coil to

produce a magnetic flux between said pole pieces for blowing out an arc drawn between the contacts and means magnetically connected to said pole pieces and having auxiliary pole pieces at different magnetic potentials than said main pole pieces to produce an auxiliary flux between said main and auxiliary pole pieces to effect a distortion of the main flux whereby lateral control of the arc is secured.

5. In an electric circuit controlling device, stationary and movable contacts, means for effecting relative movement therebetween, a magnetic core, a blowout coil wound thereupon to produce a magnetic field for the expulsion of any arc drawn between said contacts, main magnetic pole pieces attached to said core and extending at opposite sides of said contacts, and auxiliary pole pieces attached to said main pole pieces and carrying auxiliary coils effecting a difference in magnetic potential between said main and auxiliary pole pieces and producing auxiliary fields therebetween whereby the normal field between said main pole pieces is distorted, at least in the region of the contacts, and lateral control of any arc drawn between the contacts is secured.

6. In an electric circuit controlling device, relatively movable contacts, means for effecting relative movement between said contacts to effect switching operation, an arc chute disposed about said contacts, a magnetic core, a blowout coil wound thereupon producing a magnetic flux about said contacts to effect a blowing out of any arc drawn between the contacts, magnetic split side plates, serving as pole pieces, connected to said core and disposed at opposite sides of said contacts, a blowout coil wound about said core and producing a transverse magnetic flux between the upper pole pieces of said side plates, auxiliary coils wound about the lower arms of said split side plates and producing local magnetic flux between the upper and lower pole pieces of each side plate to distort downwardly the normally horizontal lines of force at least adjacent to the contacts so as to bias the drawn arc to the center of the arc chute.

7. In an electric circuit controlling device, stationary and movable contacts, means for effecting movement of the movable contact to open and close the circuit, a magnetic core, a blowout coil wound thereupon to produce a magnetic field for the expulsion of any arc drawn by the contacts, main side plates secured to the magnetic core disposed at opposite sides of the contacts, and auxiliary side plates embracing less turns of the blowout coil disposed upon the magnetic core and extending adjacent to the main side plates, the said less turns producing a difference in magnetic potential between said main and auxiliary side plates to establish local magnetic fields therebetween and effect a distortion of the normal transverse field between the main side plates whereby a lateral bias is imparted to any arc drawn between the contacts.

8. In an electric circuit controlling device, a pair of contacts, means to move one of said contacts relative to the other to effect opening and closing of the circuit, an arc chute disposed about said contacts, a magnetic core, a blowout coil wound thereupon to produce a magnetic flux about said contacts to effect a blowing out of any arc drawn therebetween, main side plates secured to the magnetic core and disposed at opposite sides of the contacts, and auxiliary side plates secured to the magnetic core and embracing a less number of turns of the blowout coil to produce a difference in magnetic potential between said main and auxiliary side plates and local magnetic fields therebetween whereby there is effected a downward distortion of the normally horizontal lines of force between the main side plates, at least in the region adjacent to the contacts, to thereby laterally bias any arc drawn to a central position within the arc chute.

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