Jan. 13, 1959 J. D. WOOD 2,868,927

SOLENOID INTERRUPTER

Filed May 3, 1956 3 Sheets-Sheet 1

FIG. 1

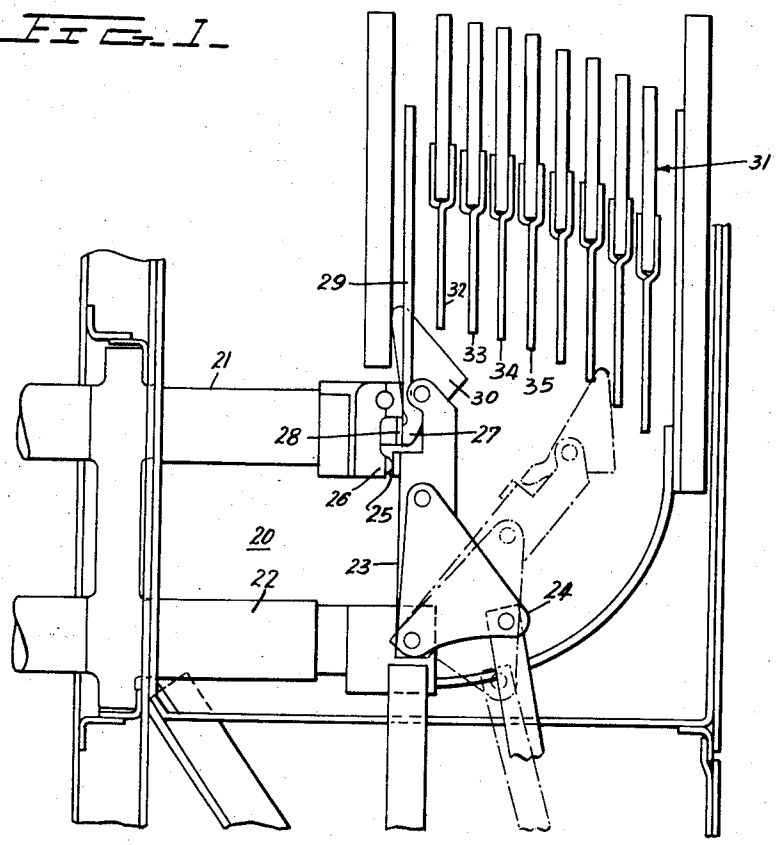
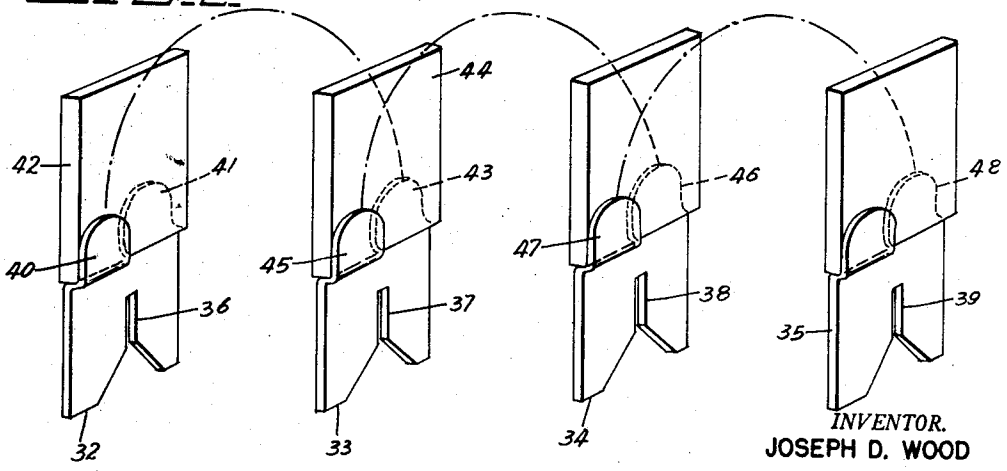



FIG. 2




INVENTOR.
JOSEPH D. WOOD

BY Ostrolenk, Faber, Gerb & Soffen

ATTORNEYS

Jan. 13, 1959 J. D. WOOD 2,868,927

SOLENOID INTERRUPTER

Filed May 3, 1956 3 Sheets-Sheet 2

FIG. 3a

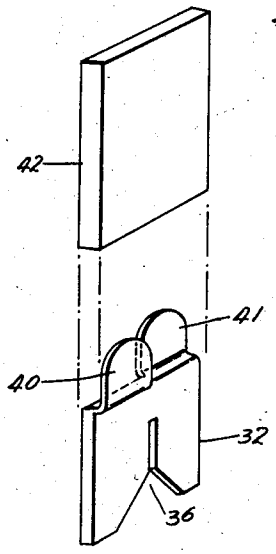



FIG. 3b

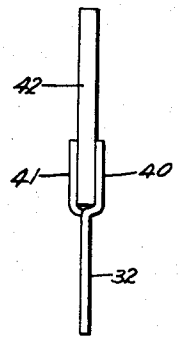



FIG. 3c

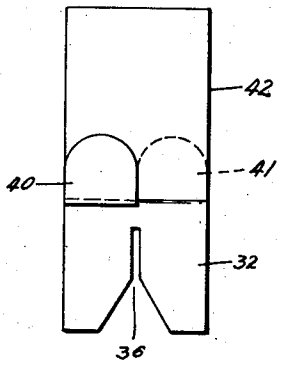



FIG. 4a

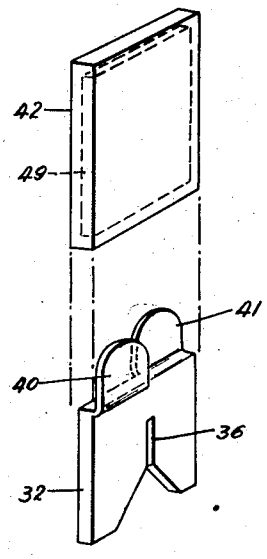



FIG. 4b

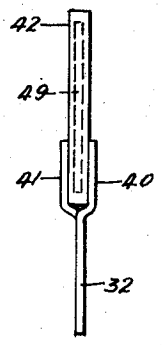
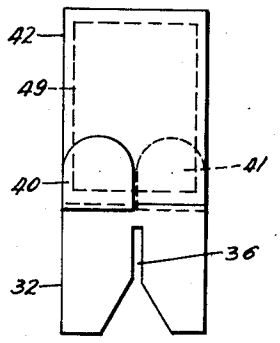



FIG. 4c




INVENTOR.
JOSEPH D. WOOD

BY
Ostrolenk, Faber, Gerb & Soffen
ATTORNEYS

Jan. 13, 1959 J. D. WOOD 2,868,927

SOLENOID INTERRUPTER

Filed May 3, 1956 3 Sheets-Sheet 3

FIG. 5a.

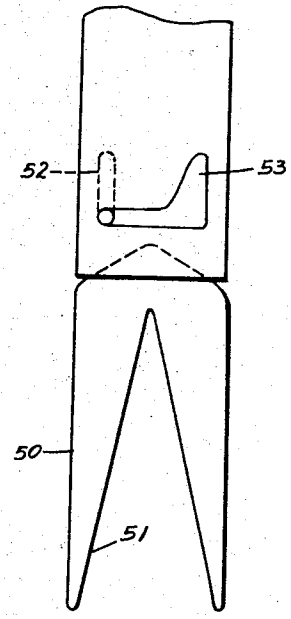



FIG. 5b.

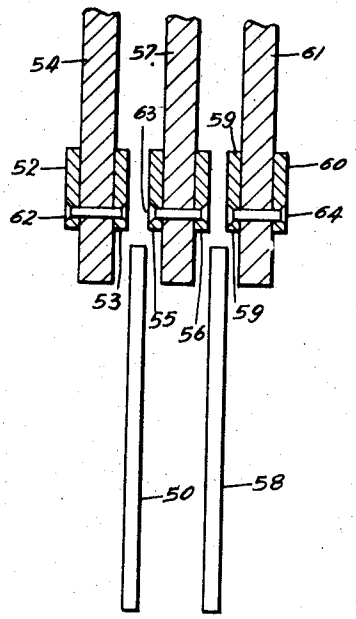



FIG. 6a.

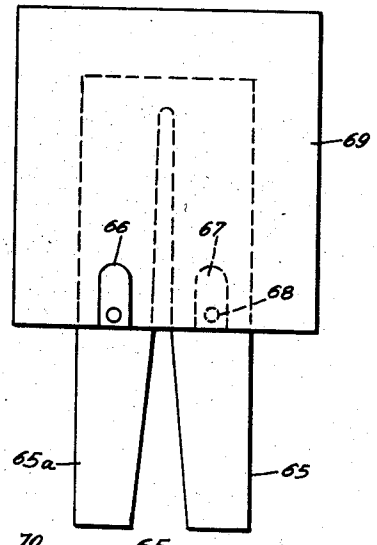
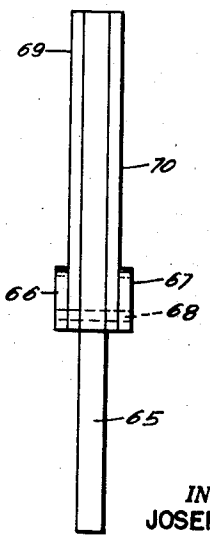



FIG. 6b.



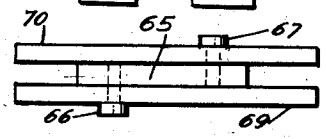




FIG. 6c.

INVENTOR.
JOSEPH D. WOOD

BY Ostrolenk, Faber, Gerb & Soffen

ATTORNEYS

United States Patent Office

2,868,927

Patented Jan. 13, 1959



2,868,927

# SOLENOID INTERRUPTER

Joseph D. Wood, Wayne, Pa., assignor to I-T-E Circuit Breaker Company, Philadelphia, Pa., a corporation of Pennsylvania

Application May 3, 1956, Serial No. 582,415

3 Claims. (Cl. 200—144)

My invention relates to an interrupting means for circuit breakers and is more specifically directed to an arc plate construction for circuit breaker interrupting chambers which will force the arc to take the shape of a solenoid.

As is well known in the art and as may be seen with reference to copending application Serial No. 322,027, filed November 22, 1952, circuit interrupting means effectively interrupt an arc by elongating this arc so as to increase its impedance and by cooling the arc. This elongation has, in the past, been accomplished by many means such as by providing arc plates having tapered slots to squeeze the arc where the slots between adjacent plates are displaced from one another so as to force the arc to travel in a sinusoidal path.

In accordance with my invention, however, the arc is forced to take the shape of a solenoid so as to thereby provide a substantial increase in arc length for a given volume of an interrupting chamber. Furthermore, it is well known that a current traversing a solenoid shape will have a substantially increased inductance which is a very desirable property to be imparted to an arc in an interrupting chamber.

Specifically, I provide an arc plate construction wherein an iron plate is utilized to take the arc away from a moving contact drawing out the arc and then conducting the arc current from the iron plate to a pair of protruding ears which may be positioned on opposite sides of an insulating plate. These protruding ears are then further constructed to be displaced from one another in the direction of the plane of the insulating plate and the adjacent ears of adjacent insulating plates are similarly positioned to be displaced from one another along the plane of the insulating plates.

Hence, once the arc has been transferred from the moving contact through the iron plate and to the protruding ears, the arc current will travel in the shape of a solenoid in view of the displaced construction of the protruding ears with respect to their corresponding insulating plates. That is to say, the arc may be brought up to the arcing chamber by means of the blow-out coil or because of its own magnetic field will eventually travel between the tips of the protruding ears. Hence the arc current will perform a U-type motion in travelling from the protruding ears on opposite sides of an insulating plate and will then form another type of U-shaped motion in travelling to the protruding ear of an adjacent insulating plate so as to complete a full turn of a solenoid which is formed in travelling throughout the plurality of arcing plates in the arcing chamber.

I have found that there are many variations of my novel invention that my be utilized. By way of example, the iron plate which receives the arc from the separating contacts may be directly fastened to the iron protruding ears or, if desired, may be positioned in spaced relationship with the iron protruding ears so that a subsequent arc will transfer the arc current from the iron plate to its associated protruding ears.



Furthermore I have found that I can appreciably increase the inductance of the solenoid shaped arc by embedding a ferromagnetic material within the insulating plate and isolated from the iron protruding ears and plate.

Accordingly, a primary object of my invention is to provide arcing plates for an interrupting chamber which will force the arc to take a solenoid shape.

Another object of my invention is to force an arc to take a solenoid shape by providing an iron plate for taking the arc from a pair of separating contacts and transferring this arc to a pair of protruding ears which straddle an insulating plate, these ears being so constructed as to force the arc in moving from plate to plate to perform a solenoid type of motion.

A further object of my invention is to provide arc plates for an arcing chamber which force the arc to move in a solenoid type of motion wherein insulating members interposed within the solenoid motion carry ferromagnetic material therein which is insulated from the arc and operate to increase the inductance of the arc.

A still further object of my invention is to provide an arc plate for an interrupting chamber which forces the arc to travel in a solenoid type of motion wherein an iron plate utilized to take the arc from the disengaging contacts has a slot therein through which the movable contact may pass in its motion to a disengaged position.

These and other objects of my invention will become apparent from the following description when taken in connection with the drawings, in which:

Figure 1 shows a partial view of a circuit breaker adapted with the interrupted means of my novel invention.

Figure 2 specifically shows the arcing plate of my novel invention and the manner in which they impart a solenoid shape to an arc current.

Figure 3*a* shows an exploded perspective view of the arc plate of Figure 2.

Figure 3*b* shows a side view of the arc plate of Figure 3*a*.

Figure 3*c* shows a front view of the arc plate of Figure 3*a*.

Figure 4*a* shows an exploded perspective view of an arc plate similar to that of Figure 3*a* wherein the insulating portion has a plate of ferromagnetic material embedded therein.

Figure 4*b* shows a side view of Figure 4*a*.

Figure 4*c* shows a front view of Figure 4*a*.

Figure 5*a* shows still another embodiment of my invention wherein the arc plate and protruding ears are connected to one another by means of the arc.

Figure 5*b* shows a side view of Figure 5*a* for a plurality of arc plates.

Figure 6*a* shows a still further embodiment of my invention.

Figure 6*b* shows a side view of Figure 6*a*.

Figure 6*c* shows a top view of Figure 6*a*.

Referring now to Figure 1, it is seen that a circuit breaker seen generally at **20** is comprised of a first terminal **21** and a second terminal **22** which are bridgeably connected by the contact arm **23**. Contact arm **23** which has an operating assembly **24**, the details of which may be more fully seen in conjunction with copending application Serial No. 545,956, has a movable contact **25** which is movable into and out of engagement with the stationary contact **26** of terminal **21**. When the contact **25** of the contact arm **23** is moved to the disengaged position as seen in the dotted lines of Figure 1, the movable contact **25** will disengage and then the arcing contact **27** will subsequently disengage so as to draw an arc between the arcing contact **27** and its cooperating contact **28** attached to terminal **21**.

This arc, when formed, is then transferred from the arcing contact **28** to the arc runner **29** and the arcing horn **30** of the movable contact structure connected to the arm **23**. The arc is then elongated as the movable contact arm **23** is moved to its disengaged position and, if desired, blow-out means such as that described in copending application Serial No. 545,956, filed November 9, 1955, could be utilized to drive the arc into the arc chamber which is generally seen at **31**. As the arc is drawn out as seen in conjunction with Figure 1 and more specifically in Figure 2, the arc comes into contact with the iron plates **32**, **33**, **34** and **35** since the arc horn **30** moves through slots **36**, **37**, **38** and **39** of the plates **32** through **35**.

It is these arcing plates to which my novel invention is directed and as will be seen hereinafter, their construction is such as to force the arc to follow a solenoid shape. The construction of the arc plates of Figures 1 and 2 may be more specifically seen in conjunction with Figures 3*a*, 3*b* and 3*c* where it is seen that the iron plate **32** is provided with a first and second protruding ear **40** and **41** respectively, which are positioned on opposite sides of the insulating plate **42**.

As then seen in Figure 3*b*, the insulating plate **42** abuts the iron plate **32** and as then seen in Figure 3*c*, the ears **40** and **41** are positioned to be displaced from one another in a direction along the insulating plate **42**.

Clearly the construction associated with each of plates **33**, **34**, and **35** of Figure 2 proceeds in an identical manner as that of plate **32** as described in conjunction with Figures 3*a*, 3*b* and 3*c*.

Referring now to Figure 2, it is seen that upon disengagement of the contacts of Figure 1 and the appearance of an arc thereacross, that this arc will be transferred to iron plates **32** through **35** and then to the tips of the protruding ears such as **40** and **41** in view of the tendency of the arc to rise in the arc chamber. The path of the arc is then seen in Figure 2 as going from protruding ear **40** of plate **32** to the protruding ear **43** of plate **37** which is positioned to be displaced from ear **40** along the direction of the plane of the insulating plate **42**.

Hence the arc will perform a U-type motion in going from ear **40** of plate **32** to ear **43** of plate **33**. The arc will then travel from ear **43** through the material of plate **33** and around the insulating plate **44** of the ear **45** to thereby perform still another U-type motion which will complete a single turn of the solenoid.

In a like manner, it is then seen that the arc proceeds from the ear **45** of plate **33** to ear **46** of plate **34**, ear **47** of plate **34**, ear **48** of plate **35**, and so on.

As another feature of my novel invention, I have found that I can substantially increase the inductance of the solenoid described above in conjunction with Figure 2 by embedding ferromagnetic material within the insulating plate as may be seen in conjunction with Figures 4*a*, 4*b* and 4*c*.

More specifically, Figures 4*a* through 4*c* show the plate **32** of Figures 2 and 3*a* through 3*c* wherein the insulating plate **42** has been adapted to have a plate **49** of ferromagnetic material embedded therein. Hence by envisaging the structure of Figures 4*a* through 4*c* in conjunction with the structure of Figure 2, it may be seen that ferromagnetic material will be positioned internally of the solenoid to thereby increase its inductance. Similarly, by embedding the ferromagnetic material **49** within the insulating plate **42**, the solenoid shape will not be short-circuited.

A still further embodiment of my invention may be seen in conjunction with Figures 5*a* and 5*b* in which it is seen that an iron plate **50** having a slot **51** therein for receiving the travel of a movable contact is electrically isolated from the protruding ears such as ears **52** and **53** of insulating plate **54** and ears **55** and **56** of insulating plate **57**. In a like manner, the iron plate **58** is insulated



from ears **55** and **56** of insulating plate **57** and ears **59** and **60** of insulating plate **61**.

However, the protruding ears which may be of iron for each of the insulating plates are connected together as may be seen in Figure 5*b* in which the connecting means **62** both connects and fastens ears **52** and **53** of insulating plate **54** while connecting means **63** and **64** serve the same function for their corresponding protruding ears **55**, **56**, and **59**, **60** respectively.

The embodiment of Figures 5*a* and 5*b*, however, will operate in substantially the same manner as did the embodiment described in conjunction with Figures 2 and 3*a* through 3*c* with the exception of the iron plates **50** and **58** being connected to their corresponding protruding ears through a small arc.

If desired, the insulating plates **54**, **57** and **61** of Figure 5*b* could be constructed so as to have ferromagnetic material embedded therein as has been described in conjunction with Figures 4*a* through 4*c*.

It is to be noted at this point that while the iron plates have been described as having a slot therein, that this slot need not be utilized and that the arc could be transferred from the disengaging contacts to the iron plate by any other desired means. Similarly, the arc plates need not be positioned perpendicular to the arc as has been described herein, but, if desired, could have been positioned parallel to the arc with the design of the protruding ears slightly altered so as to obtain the desired solenoid shape for the arc current.

A still further embodiment of my novel invention is now seen in conjunction with Figures 6*a* through 6*c*. In this embodiment, it is seen that the iron plate **65** having an elongated slot **65***a* therein connected to the protruding ears **66** and **67** by means of the metal fastening means **68** and the insulating spacers **69** and **70** are positioned so as to force the arc to travel in the desired solenoidal shape. Here again, it is seen more specificially in Figure 6*c* that the protruding ears **66** and **67** are positioned in a displaced relationship along the plane of the insulators **69** and **70** which could be of a glass mica material so as to cooperate with these insulators in providing the solenoid arc current.

Although I have here described preferred embodiments of my invention, many modifications and variations will now be apparent to those skilled in the art. I prefer, therefore, to be limited, not by the specific disclosure herein, but only by the appended claims.

I claim:

1. An interrupting chamber adapted to interrupt an arc drawn between a pair of disengaging contacts; said interrupting chamber comprising a plurality of spaced iron plates, a corresponding plurality of spaced insulating plates, and a corresponding plurality of pairs of protruding ears; each of said pair of protruding ears extends through one of said corresponding insulating plates to be electrically connected to one another and to be positioned on opposite sides of said corresponding insulating plate and in spaced relationship with one another along the plane of said insulating plate; said iron plates being positioned in substantially parallel plane relationship with said insulating plates and in arcing relationship with one of said protruding ears of each insulating plate adjacent to said iron plate; said iron plates being further positioned to transfer arcs between said contacts to said protruding ears to impart a solenoid shape to said arcs.

2. An interrupting chamber adapted to interrupt an arc drawn between a pair of disengaging contacts; said interrupting chamber comprising a plurality of spaced iron plates; a corresponding plurality of spaced insulating plates and a corresponding plurality of pairs of protruding ears; each of said pair of protruding ears extends through one of said corresponding insulating plates to be electrically connected to one another and to be positioned on opposite sides of said corresponding insulating plate and in spaced relationship with one another along the plane of said

insulating plate; said iron plates being positioned in substantially parallel plane relationship with said insulating plates and in arcing relationship with one of said protruding ears of each insulating plate adjacent said iron plate; the adjacent protruding ears of adjacent insulating plates being displaced from one another along the plane of said insulating plates; said iron plates being further positioned to transfer arcs between said contacts to said protruding ears to impart a solenoid shape to said arcs.

3. An interrupting chamber adapted to interupt an arc drawn between a pair of disengaging contacts; said interrupting chamber comprising a plurality of iron plates each having a pair of protruding members, an insulating plate for each of said iron plates; said iron plates being positioned to have an arc between said pair of disengaging contacts transferred thereto; each of said iron plates extending into its corresponding insulating plates and having its protruding member extending through said last mentioned insulating plates; said iron plates being further adapted to transfer said arc to said pairs of protruding members; each of said pairs of protruding members being



positioned on either side of one of said insulating plates and being spaced from one another along the plane of said insulating member; adjacent protruding members of adjacent insulating plates being displaced from one another along the plane of said insulating members; said arc being driven in a solenoid type of motion when traveling along successive protruding members.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 2,227,134 | Hara | Dec. 31, 1940 |
| 2,293,487 | Bartlett | Aug. 18, 1942 |
| 2,575,730 | Sandin et al. | Nov. 20, 1951 |
| 2,584,570 | Frink | Feb. 5, 1952 |
| 2,654,012 | Cellerini | Sept. 29, 1953 |
| 2,668,890 | Latour | Feb. 9, 1954 |
| 2,707,739 | Latour | May 3, 1955 |

FOREIGN PATENTS

| | | |
|---|---|---|
| 547,549 | Germany | Mar. 26, 1932 |
| 439,025 | Great Britain | Aug. 26, 1941 |

UNITED STATES PATENT OFFICE

# CERTIFICATION OF CORRECTION

Patent No. 2,868,927 January 13, 1959

Joseph D. Wood

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 6, line 21, list of references cited, under "FOREIGN PATENTS", for the patent number "439,025" read -- 539,025 --.

Signed and sealed this 11th day of July 1961.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents

# UNITED STATES PATENT OFFICE

# CERTIFICATION OF CORRECTION

Patent No. 2,868,927 January 13, 1959

Joseph D. Wood

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 6, line 21, list of references cited, under "FOREIGN PATENTS", for the patent number "439,025" read -- 539,025 --.

Signed and sealed this 11th day of July 1961.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents