United States Patent [19]

Miller

[11] **3,890,258**

[45] **June 17, 1975**

[54] **ELECTRIC CIRCUIT BREAKER WITH SERIES CONNECTED INTERRUPTING AND ISOLATING BREAKS**

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[73] Assignee: **General Electric Company**, Philadelphia, Pa.

[22] Filed: **June 28, 1974**

[21] Appl. No.: **484,181**

[52] **U.S. Cl.** ..... **200/150 R**; 200/147 R

[51] **Int. Cl.** **H01h 33/68**

[58] **Field of Search** ..... 200/150 R

[56] **References Cited**

UNITED STATES PATENTS

2,580,354	12/1951	Leeds	200/150 R
3,028,466	4/1962	Phillips	200/150 R

Primary Examiner—Robert S. Macon

Attorney, Agent, or Firm—J. Wesley Haubner; William Freedman

[57] **ABSTRACT**

An electric circuit breaker comprises an isolating break connected in series with an interrupting break and opening after the interrupting break has opened to interrupt the circuit therethrough. Each break comprises relatively movable contacts, and one of the isolating contacts is mechanically coupled to a movable one of the interrupting contacts. A movable blade member carries the other isolating contact. Opening spring means responsive to the initial portion of a blade-opening stroke drives the interrupting contacts apart and also drives the first isolating contact in follow-up relation to the second isolating contact. The isolating contacts are constructed in such a manner that they provide a current-sensitive coupling between the switch blade and the movable interrupting contact structure that is of such a design that at high currents the switch blade can pull the movable interrupting contact structure with it during the interrupting operation, thus assuring that the movable interrupting contact structure will keep up with the movable blade during this interval.

8 Claims, 3 Drawing Figures

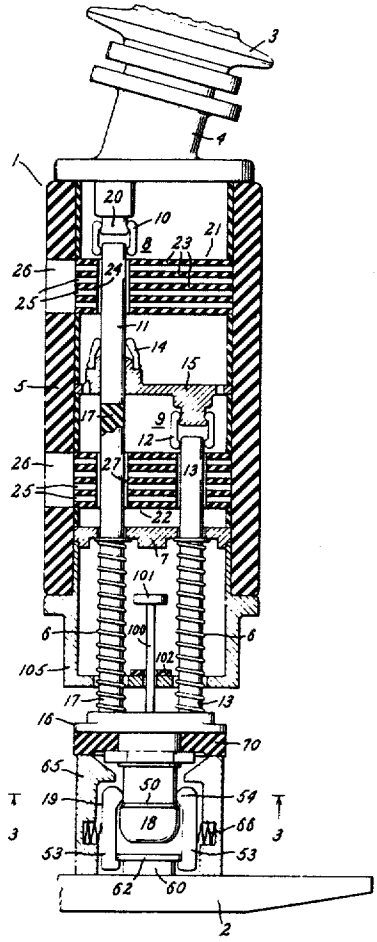


Fig. 1.

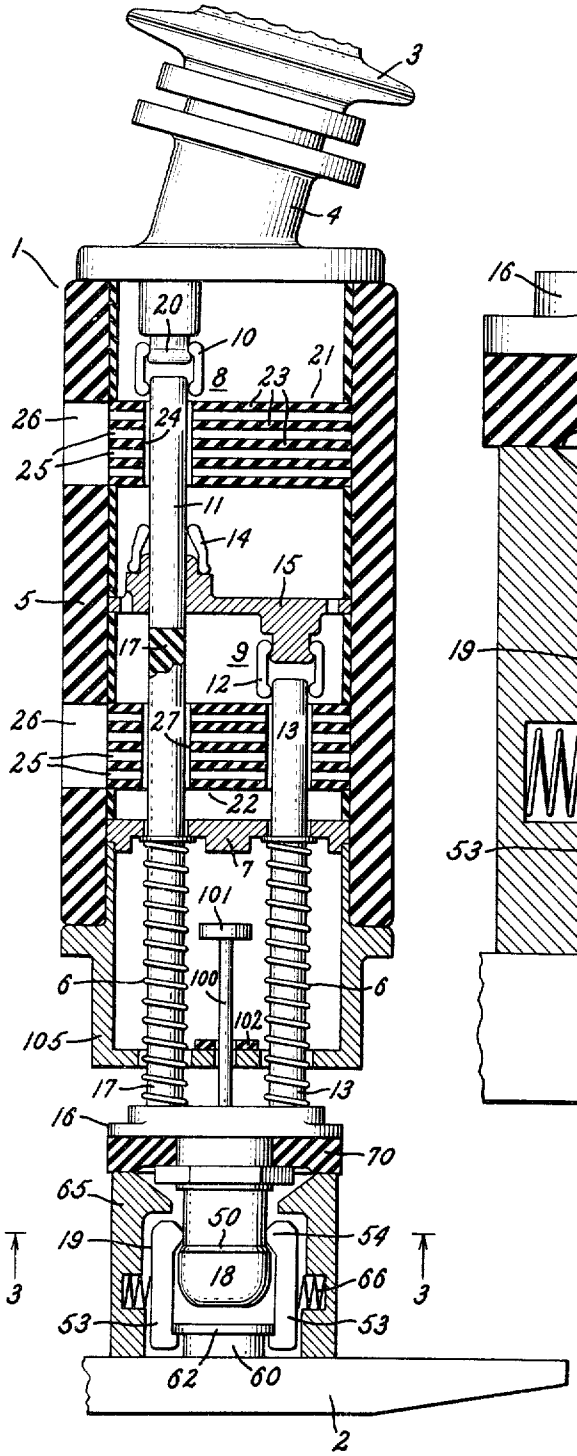


Fig. 2.

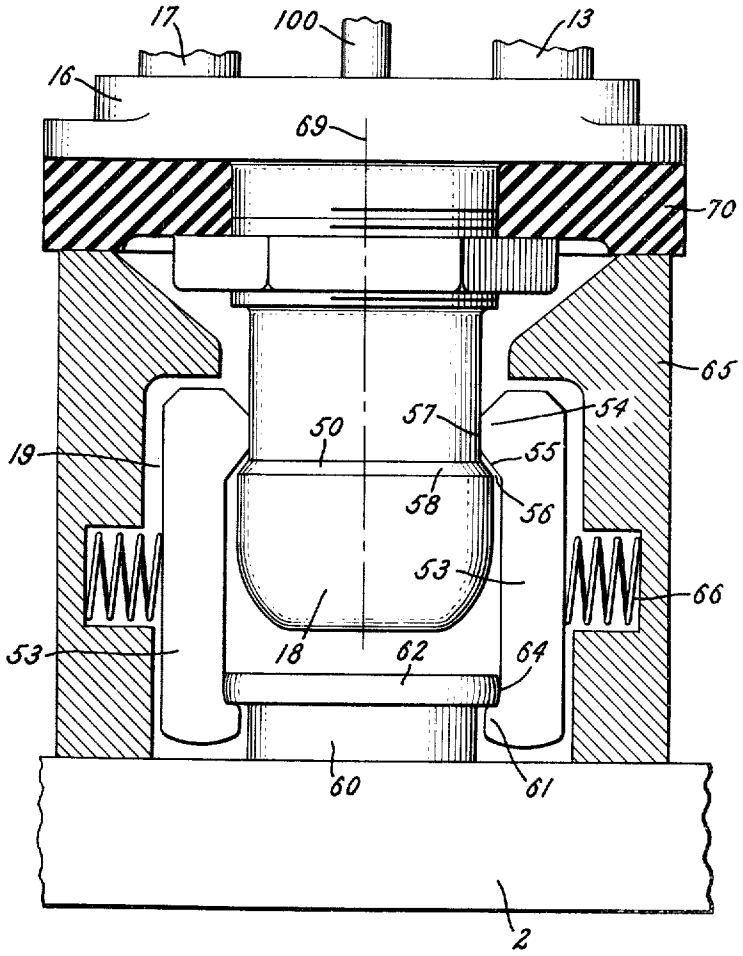
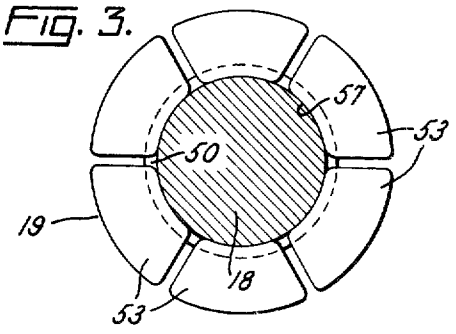


Fig. 3.



ELECTRIC CIRCUIT BREAKER WITH SERIES CONNECTED INTERRUPTING AND ISOLATING BREAKS

BACKGROUND

This invention relates to an electric circuit breaker of the type which comprises an isolating break connected in series with one or more interrupting breaks, the isolating break opening after the interrupting break or breaks have opened to interrupt the circuit.

The following references are of interest with respect to this invention: U.S. Pat. Nos. 2,261,008-Van Sickle, et al; 2,445,442-Leeds; 2,465,203-Cumming; and 2,580,354-Leeds.

In a typical circuit breaker of this type, each of the interrupting breaks comprises movable interrupting contact structure which is biased by suitable spring means toward open position but is held in closed position by closing force applied through a blade member that controls the isolating break. This movable interrupting contact structure also carries one of the contacts of the isolating break. During a normal opening operation, when the blade member is moved through the initial portion of its opening stroke, the spring means moves the movable interrupting contact structure in follow-up relationship to the blade member, thus opening the interrupting breaks and maintaining the isolating break closed. Thereafter, the movable interrupting contact structure is stopped, following which, further opening movement of the blade member opens the isolating break.

I have observed that when a circuit breaker of this type attempts to interrupt very high currents (e.g., alternating currents exceeding 100,000 amperes peak value), the above-described spring means may not be able to drive the movable interrupting contact structure sufficiently fast to keep up with the blade member. More specifically, if the interrupting contacts include finger contacts that grip a sliding contact member with a force that varies directly with current, the resulting frictional load can retard the movable interrupting contact structure to such an extent that the rapidly-moving blade moves ahead of the movable interrupting contact structure. This moving-ahead is very undesirable since it can result in premature opening of the isolating break, thereby causing harmful arcing at the isolating break.

SUMMARY

An object of my invention is to assure that the movable interrupting contact structure will be able to keep up with the movable blade member despite the added opposition encountered at very high currents to follow-up motion of the movable interrupting contact structure.

Another object is to attain the objective of the preceding paragraph without interfering with the ability of the circuit breaker to develop the desired isolating gap following opening of the interrupting breaks.

One way of attaining these objectives is by increasing the size of the opening spring means, but this approach is disadvantageous because, among other things, it may necessitate increasing the size of the closing mechanism in order to provide sufficient force for closing at the desired speeds against the opposition of the larger opening spring.

Accordingly, another object of my invention is to attain the previously-recited objectives without the necessity of increasing the size of the opening spring.

In carrying out my invention in one form, I construct the isolating contacts of the interrupter in such a manner that they provide a current-sensitive coupling between the switch blade and the movable interrupting contact structure that is of such a design that at high currents the switch blade can pull the movable interrupting contact structure with it during the interrupting operation, thus assuring that the movable interrupting contact structure will keep up with the movable blade during this interval. This coupling comprises a shoulder on one of the isolating contacts and fingers forming a part of the other of the isolating contacts having portions engaging such shoulder in a manner such as to interfere with relative motion of the isolating contacts in a disengaging direction. The finger portions are urged into engagement with the shoulder during circuit-breaker-opening with a force varying in magnitude directly with the value of current through said isolating contacts. This force opposes relative motion of the isolating contacts in a disengaging direction, thus allowing the isolating contacts to disengage without substantial interference from the coupling only after the current through said isolating contacts has fallen to a predetermined level indicative of circuit interruption at the interrupting contacts.

BRIEF DESCRIPTION OF DRAWING

For a better understanding of the invention, reference may be had to the following description taken in conjunction with the accompanying drawing, wherein:

FIG. 1 is a sectional view of a circuit breaker embodying one form of the invention.

FIG. 2 is an enlarged sectional view of a portion of the circuit breaker of FIG. 1 and, specifically, the isolating contact structure thereof.

FIG. 3 is an enlarged sectional view along the line 3—3 of FIG. 1.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to FIG. 1, the circuit breaker shown therein comprises an interrupter 1 which is illustrated as being an oil-blast interrupter of the general type described and claimed in U.S. Pat. No. 2,749,412-McBride, et al., and No. 3,028,466-Phillips, both assigned to the assignee of the present invention. This interrupter 1 is mounted, along with another similar interrupter (not shown), inside a relatively large oil-filled enclosing tank. The two interrupters are electrically connected in series by a reciprocable blade contact 2 similar to that shown, for example, in U.S. Pat. No. 1,548,799-Hilliard or in U.S. Pat. No. 2,445,442-Leeds, et al.

The interrupter 1 is supported within the oil-filled tank from an insulating bushing structure 3 having a central conductor stud (not shown) to which a conductive adapter 4 is suitably secured in a known manner. Adapter 4 is arranged to cooperate with suitable tie bolts (not shown) which structurally interconnect the interrupter unit 1 and the adapter 4.

The interrupter 1 comprises a tubular insulating casing 5 enclosing a plurality of interrupting breaks 8 and 9 electrically connected in series. Each of these breaks comprises two separable contacts relatively movable

between engaged and disengaged positions. In FIG. 1 they are shown in the engaged or closed position. The upper break 8 comprises a relatively fixed contact assembly 10 and a relatively movable rod-type contact 11. The fixed contact assembly 10 is preferably of the conventional cluster type comprising a plurality of conductive fingers urged radially inwardly by suitable resilient means (not shown). In a corresponding manner, the lower break 9 comprises a similar fixed contact assembly 12 and a relatively movable rod-type contact 13. The breaks 8 and 9 are electrically connected in series by means of suitable current-transfer contacts 14 forming a sliding contact assembly and a transversely-extending contact-support member 15. For supporting the movable interrupting contacts 11 and 13 and for interrelating them for simultaneous movement so as to draw a pair of simultaneously-occurring arcs, there is provided a common cross head 16 of conducting material to which the lower rod contact 13 is directly secured and to which the upper rod contact 11 is suitably fixed by means of an interconnecting insulating rod 17.

In order to complete the electrical circuit through the interrupter and to provide an isolating contact arrangement for the interrupter, there is provided at the lower end of the interrupter a pair of separable isolating contacts 18 and 19. Isolating contact 18 takes the form of a conductive probe mechanically and electrically connected to the cross head 16; and isolating contact 19 takes the form of a tubular assembly secured to the movable switchblade 2 and embracing the conductive probe 18. These isolating contacts will be described in more detail hereinafter.

From the above description, it will be apparent that the electrical circuit through the interrupter extends from the adapter 4 through the conductor 20, through the upper interrupting contacts 10, 11, through the current transfer contacts 14 and the transfer member 15, then through the lower interrupting contacts 12, 13, the cross head 16, the isolating contacts 18, 19, and finally through the switchblade 2 and to the cooperating interrupter (not shown), which is disposed at the opposite end of blade 2.

The movable interrupting contacts 11 and 13 are biased toward a disengaged, or open, position with respect to their mating stationary contacts by means of compression-type opening springs 6. These opening springs 6, which surround rods 17 and 13, bear at their upper ends against a stationary plate 7 and at their lower ends against the movable cross head 16. Hold-close forces transmitted through the blade 2 prevent the springs 6 from discharging while the circuit breaker is closed, as shown in FIG. 1.

A circuit-opening operation is produced by driving the switchblade 2 rapidly downward. This allows the opening springs 6 to force the cross head 16 together with the movable interrupting contacts 11 and 13 rapidly downward so as to draw a pair of circuit-interrupting arcs in the regions where these contacts part from their mating stationary contacts. After a predetermined downward movement, the cross head 16 is blocked by suitable stop means 100–102 from following the switchblade 2. The switchblade 2, however, continues moving downwardly and, as a result, establishes an isolating break between the contacts 18 and 19, as will soon be described in more detail.

The stop means of the preceding paragraph is shown in schematic form only and, as such, comprises a rod 100 coupled to cross head 16 and extending freely through a bottom portion 105 of the interrupter casing. A piston-like member 101 is fixed to the top end of rod 100. When the cross head 16 reaches a predetermined point in its opening travel, the piston member 101 strikes a stationary abutment 102, thereby terminating opening travel of the cross head 16 and interrupting contacts 11 and 13 and blocking further follow-up motion of isolating contact 18 with respect to its mating isolating contact 19, as above described.

Stop means more suitable for a commercial circuit breaker of this type is shown in FIG. 2 of the aforesaid McBride, et al., U.S. Pat. No. 2,749,412. The stop means shown in FIG. 2 of that patent also includes suitable guide means for guiding the movable contact structure and the cross head 16 along a straight-line vertical path during its opening and closing motion. In one form of the invention, I include this stop means and guide means of the McBride et al patent in the illustrated interrupter.

Adjacent to the serially-related interrupting breaks 8 and 9 are a pair of arc-extinguishing units in the form of baffle stacks 21 and 22 of a conventional design. Baffle stack 21 is formed of a plurality of superposed apertured baffle plates 23 of insulating material, which together provide a central interrupting passageway 24 and a plurality of vertically-spaced, angularly-aligned exhaust passages 25 radiating therefrom. When a high current arc, say, of short circuit proportions, is drawn within the passageway 24 in response to separation of contacts 10 and 11, the arc reacts with the surrounding oil to produce pressure within the oil-filled casing 5, and such pressure is effective to force a blast of dielectric fluid and arc products through the slots or exhaust passages 25 and out of the registering exhaust port 26 formed in the adjacent wall of casing 5. The pressure and flow conditions present during this interval aid in extinguishing the arc. The lower baffle stack 22 generally corresponds to upper baffle stack 21 except that baffle stack 22 is provided with an opening 27 through which reciprocates the insulating portion of the upper rod contact 11.

For simplicity, certain details of the preferred form of interrupter have been omitted from the drawing and description. In this respect, it is common to provide the interrupter with a pump to aid in interrupting low currents and pressure-responsive exhaust valves for controlling flow through exhaust ports 26. These features can be of any suitable conventional design such as shown, for example, in the aforesaid Phillips U.S. Pat. No. 2,927,986.

The interrupter of the aforesaid Phillips patent differs in structure from the above-described interrupter primarily in the construction of its isolating contacts. In the Phillips patent, these isolating contacts are simple butt contacts. A problem has been encountered with this prior art design which the present invention overcomes.

More specifically, when interrupting very high current with such prior art interrupter, I have found that damaging arcing sometimes occurs between the isolating contacts when they are separated during opening. My studies of this problem have revealed that under these very high current conditions, the opening springs 6 may not always be capable of driving the movable interrupting contacts 11 and 13 in an opening direction at a sufficiently high speed to keep up with downward-

ly-moving switch blade **2**. A factor that appears to be primarily responsible for this inability is that the sliding contact assemblies (e.g., those at **10, 12** and **14**) in the interrupter **1** act to retard opening motion of the movable interrupting contacts under these very high current conditions. Each of these sliding contact assemblies comprises a cluster of fingers disposed in circular array and forming an expansible tubular subassembly. The magnetic effect of high current through such a tubular subassembly causes it to contract, and thus to grip the movable contact structure, with a force varying directly with the square of the current. This high gripping force opposes the opening springs **6** and thus prevents the springs from consistently driving the interrupting contacts at the desired high speed under very high current conditions. This condition becomes even more aggravated if the movable contact structure has been roughened by prior high current arcing. Another aggravating factor is that the magnetic opening force on the blade **2** is increased under these very high current conditions (because of the U-shape of the overall current path through the circuit breaker), thus increasing the speed of the blade **2** and making it even more difficult for the interrupting contacts **11** and **13** to keep up with the blade **2.**

One way of overcoming this problem is to increase the size of the opening springs **6** so that they can drive the movable interrupting contacts **11** and **13** at a higher rate despite the magnetic opposing forces developed at high currents. This, however, is not a satisfactory solution to the problem because it would usually require that the closing mechanism size be increased to provide sufficient force for closing at the desired speeds against the opposition of the larger opening springs.

My solution to this problem eliminates the need for larger opening springs and, in effect, utilizes a portion of the electromagnetic energy in the system to overcome the increased restraining force developed in the magnetically-affected contact assemblies **10, 12** and **14** of the interrupter. More specifically, I couple the blade **2** to the movable interrupting contacts **11** and **13** during the periods of high current, thus transfering force out of the blade back to the interrupting contacts. The gross effect of such coupling is that as the current level increases, the blade **2** which, at low currents, was pushed by the springs **6,** acts at high currents to pull on the interrupting contacts and thus to accelerate them away from their magnetically-restrained positions.

For effecting this coupling between blade **2** and interrupting contacts **11** and **13,** I construct the isolating contacts **18** and **19** so that the isolating contacts themselves are capable of acting as a current-sensitive coupling. More specifically, the probe **18** of the upper isolating contact is provided with an annular shoulder **50** that encircles the central longitudinal axis of the probe, and the tubular lower isolating contact **19** is made up from a plurality of fingers arranged in circular array (as shown in FIG. **3**) to form a tubular subassembly. As best seen in FIG. **2,** each of the fingers **53** has a radially inwardly projecting portion **54** with a beveled face **55** that is arranged to engage the shoulder **50** during the opening operation. When the circuit breaker is fully-closed as shown in FIGS. **1** and **2,** there is a small clearance space **56** between the working surfaces **58** of the shoulder **50** and the beveled face **55** of finger **53.** During this fully-closed period, current is conducted between the isolating contacts through an arcuate inner surface **57** on each finger that engages the outer periphery of probe **19.** But after a small amount of downward movement of blade **2** relative to probe **18,** beveled surface **55** on each finger engages the inclined working surface of the shoulder, transferring at least some of the current to these surfaces. Thereafter, opening continues with surfaces **55** and **58** in engagement. It will be understood that surfaces **55** are arcuate so as to conform to annular surface **58** as viewed from the plane of FIG. **3.**

When downward motion of the probe **18** is terminated (by the piston **101** of FIG. **1** engaging stationary abutment **102,** as above described), continued downward motion of blade **2** carries the fingers **53** downwardly with respect to probe **18,** causing beveled surfaces **55** to slide on working surfaces **58** of the shoulder. This, in effect, expands the tubular subassembly **19,** allowing it to slide along the enlarged lower end portion of the probe **18,** after which subassembly **19** separates from probe **18** to open an isolating gap therebetween.

The fingers **53** of isolating contact **19** are mounted at their lower ends on a conductive support **60.** Radially inwardly extending projections **61** on the fingers **53** fit beneath an enlarged head **62** on support **60.** Current is conducted between fingers **53** and support **60** via the outer periphery **64** of the head. Surrounding the isolating contact assembly **19** is a tubular housing **65** suitably fixed to blade **2.** Springs **66** located between tubular housing **65** and the fingers **53** urge the fingers radially inwardly to maintain good contact between the fingers and the support **60** under low-current conditions and to provide added contact pressure between the fingers **53** and the probe **18,** especially under low-current conditions.

Under high-current conditions, the current through the tubular subassembly **19** develops relatively high magnetic forces tending to contract the subassembly about the probe **18.** This high magnetic force urges the beveled surfaces **55** of the fingers **53** into high-pressure engagement with the working surfaces **58** on shoulder **50,** thus assuring that a good coupling will be maintained between isolating contacts **18** and **19** during high-current opening conditions. Stated in another way, tubular subassembly **19** must expand in order to free itself from the interference to downward disengaging movement imposed by shoulder **50,** but the magnetic force tending to contract the tubular subassembly opposes such expansion, thus maintaining a good coupling between isolating contacts **18** and **19** under high-current opening conditions and, specifically, a good coupling that opposes relative motion of the isolating contacts in a disengaging direction.

By the time the stop means **101, 102** has been engaged to terminate downward motion of isolating probe **18,** the circuit through the interrupting breaks **8** and **9** has been interrupted and current through the isolating contacts is at a very low level. As a result, there is no longer any substantial magnetic force forcing the fingers **53** into engagement with probe **18.** With this magnetic force removed, the tubular assembly **19** can easily expand to allow uncoupling and relative disengaging motion of isolating contacts **18** and **19** when the probe **18** reaches the end of its opening strike. The removal of magnetic force in this manner relieves the surfaces **55** and **58** of much of the wear that would otherwise

occur when these surfaces slide on each other during uncoupling.

On a normal opening operations, the isolating contacts **18, 19** are moving at a relatively high velocity just prior to the point at which motion of contact **18** is terminated by stops **100, 102,** and the resulting sharp impact facilitates uncoupling of the disconnect contacts. Sometimes, however, it is necessary to slowly open the circuit breaker for maintenance purposes, and this sharp impact is not available. To assure prompt uncoupling under even these circumstances, in one embodiment, I provide the surfaces **55** with a plated coating of a conductive material that has good anti-weld properties, for example, silver-lead containing 5 percent lead. In this same embodiment, the probe is coated with pure silver plate.

A factor that controls the effectiveness of the coupling and the ease of uncoupling is the angle that the working surfaces **58** of the shoulder and the working surface **55** of the fingers make with respect to the path of movement of the isolating contacts **18, 19** prior to their separation. Such path of movement may be considered as coinciding with central longitudinal axis **69** of the disconnect contact or probe, **18.** The working surfaces **55** and **58** make an acute angle with respect to this axis and in one preferred form of the invention an angle of about 35°. With an angle present such as this, I am able to use materials of low coefficients of friction for the surfaces **55** and **58** and yet provide a relatively high force for coupling the two disconnect contacts together so long as high currents flow therethrough. In effect, the angle accounts for a large portion of the total coupling force, and variations in the coefficient of friction produce only small variations in the total coupling force.

It is to be noted that each of the fingers **53** can hold the shoulder **50** independently and because of the inclined nature of the working surface of the shoulder can slide a short distance on such surface without releasing its hold on the shoulder. This slight sliding and the fact that working surfaces **55** and **58** match (i.e., they are disposed at substantially the same acute angle with respect to axis **69**) allow all the fingers **53** to properly engage the working surfaces **58** despite slight misalignment of the inclined surfaces **55** on the fingers with respect to each other. It will thus be apparent that my coupling is not highly tolerance sensitive.

Closing of the circuit breaker is effected by driving the switch blade **2** upwardly from its fully-open position (not shown). At a predetermined point in the upward closing stroke of blade **2,** the top of isolating contact **19** engages the lower end of the then-stationary probe **18,** thereby expanding the isolating contact **19** and allowing its fingers **53** to slide upwardly along the outer surface of probe **18** as the blade **2** continues moving upwardly. Further upward movement of blade **2** and isolating contact **19** with respect to probe **18** allows the projecting portions **54** of fingers **53** to be driven radially inward behind shoulder **50,** following which the top end of tubular housing **65** engages a buffer **70** fixed to the probe **18.** Further upward motion of switch blade **2** is transmitted to probe **18** through housing **65** and buffer **70,** thus carrying the isolating contacts **18** and **19** together into their position of FIG. **1** and also carrying the cross head **16** and movable interrupting contacts **11** and **13** into their closed position of FIG. **1.** When the switch blade **2** reaches the end of its upward closing stroke, it is latched by suitable conventional means (not shown) in its elevated position.

By way of example and not limitation, my invention has been successfully applied to a circuit breaker that is rated at 230 KV and 63,000 amperes. Such a circuit breaker is called upon to interrupt peak currents considerably in excess of 100,000 amperes. This circuit breaker has three interrupting breaks in each interrupter, as is shown for example in FIG. **4** of the aforesaid McBride, et al., U.S. Pat. No. 2,749,412. Its switch blade **2** has a total stroke of about 20 inches and the interrupting contacts a total stroke of about 4 inches. A resistor, such as shown at R in the McBride, et al., patent, shunts the interrupting breaks, and thus there is a small residual current through the isolating contacts via the resistor when the interrupting breaks have completed their interrupting action.

While I have shown and described particular embodiments of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from my invention in its broader aspects; and I, therefore, intend in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

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

1. An electric circuit breaker comprising:

a. a pair of separable interrupting contacts relatively movable between engaged and disengaged positions,

b. opening spring means biasing a movable one of said interrupting contacts from an engaged position toward a disengaged position,

c. first and second isolating contacts electrically in series with said interrupting contacts and relatively movable between engaged and disengaged positions, said first isolating contact being mechanically coupled to said movable interrupting contact,

d. a movable blade member carrying said second isolating contact and providing a path through which closing force is applied to said movable inerrupting contact during circuit-breaker closing,

e. means for driving said blade and said second isolating contact through an opening stroke during circuit-breaker opening,

f. said opening spring means being responsive to the initial portion of the opening stroke of said blade: (i) to drive said movable interrupting contact out of engagement with the other of said interrupting contacts and (ii) to drive said first isolating contact in follow-up relationship to said second isolating contact,

g. stop means for blocking further disengaging motion of said movable interrupting contact after said movable interrupting contact has moved through predetermined opening travel and for blocking further follow-up motion of said first isolating contact, thereby causing continued opening travel of said blade to separate said isolating contacts,

h. and means for coupling said blade to said movable interrupting contact during the initial portion of said opening stroke so that opening force can then be transmitted from said blade to said movable interrupting contact through said coupling means,

i. said coupling means comprising a shoulder on one of said isolating contacts and fingers forming a part

of the other of said isolating contacts having portions engaging said shoulder in a manner such as to interfere with relative motion of said isolating contacts in a disengaging direction,

j. said finger portions being urged into engagement with said shoulder during circuit-breaker opening with a force varying in magnitude directly with the value of current through said isolating contacts, said force opposing relative motion of said isolating contacts in a disengaging direction.

2. The circuit breaker of claim **1** in which said shoulder has working surfaces engaged by said finger portions, each of said working surfaces being disposed at an acute angle with respect to the path along which said disconnect contacts move prior to separation thereof.

3. The circuit breaker of claim **2** in which:

a. said shoulder is of a generally annular configuration surrounding a longitudinal axis located centrally of said annular shoulder,

b. said fingers are mounted in generally circular array about said longitudinal axis to form an assembly of generally tubular configuration that tends to contract in diameter in response to the magnetic effect of high currents passing therethrough, thus increasing the force urging said finger portions into engagement with said working surfaces during increased currents.

4. The circuit breaker of claim **1** in which:

a. said shoulder is of a generally annular configuration surrounding a longitudinal axis located centrally of said annular shoulder,

b. said fingers are mounted in generally circular array about said longitudinal axis to form an assembly of generally tubular configuration that tends to contract in diameter in response to the magnetic effect of high currents passing therethrough, thus increasing the force urging said finger portions into engagement with said shoulder during increased currents.

5. The circuit breaker of claim **2** in which the surfaces of said finger portions engaging said working surfaces of said shoulder are each disposed at substantially the same angle as the engaged working surface with respect to the path along which said isolating contacts move prior to separation thereof.

6. The circuit breaker of claim **1** in which said stop means is so located that the circuit through said interrupting contacts is normally interrupted at said interrupting contacts before said finger portions begin sliding along said working surfaces during relative disengaging motion of said isolating contacts after said stop means has become effective.

7. The circuit breaker of claim **2** in which said stop means is so located that the circuit through said interrupting contacts is normally interrupted at said interrupting contacts before said finger portions begin sliding along said working surfaces during relative disengaging motion of said isolating contacts after said stop means has become effective.

8. The circuit breaker of claim **3** in which said stop means is so located that the circuit through said interrupting contacts is normally interrupted at said interrupting contacts before said finger portions begin sliding along said working surfaces during relative disengaging motion of said isolating contacts after said stop means has become effective.

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