

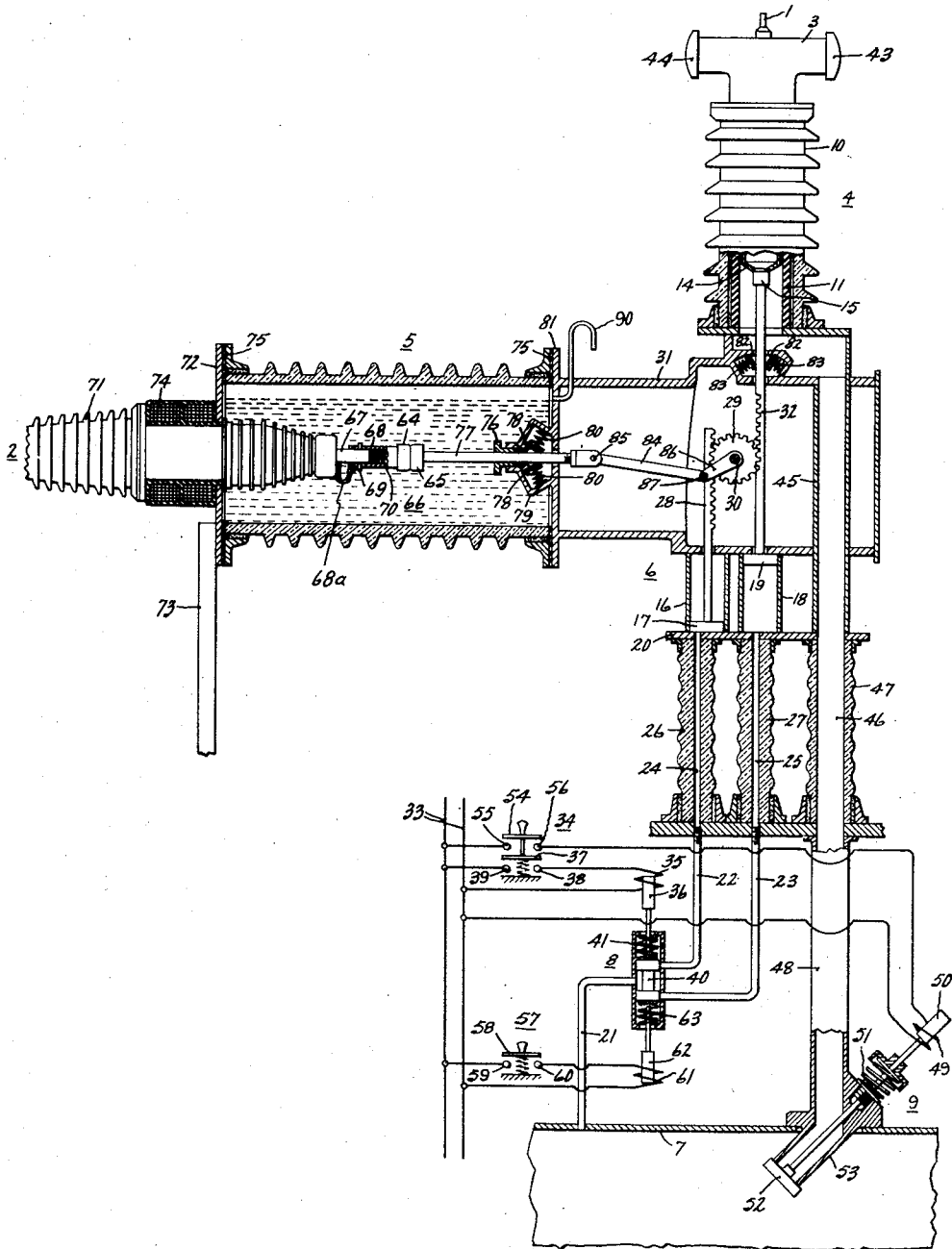
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ELECTRIC CIRCUIT BREAKER

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ELECTRIC CIRCUIT BREAKER

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My invention relates to electric circuit breakers and more particularly to an electric circuit interrupter of the fluid blast type having interrupting contacts and isolating contacts serially arranged with respect to the interrupting contacts.

In circuit breakers, as in other types of electrical equipment, it is customary to provide permanent insulating structure capable of resisting several times normal voltage in order to withstand overvoltages arising from lightning, switching surges and other sources; and in circuit breakers, in addition, a comparable sufficiency of insulation is commonly interposed between the contacts when they are in the open position. Circuit breakers of the gas blast type are often so arranged that the interrupting contacts are separated by action of the gas blast and allowed to reclose when the gas blast is shut off following interruption, the final isolating insulation across the breaker being obtained by means of an associated series switch usually having a visible open-air break.

During the first few cycles following interruption, overvoltages may arise from the operation of the breaker itself, substantially simultaneous operation of another breaker, as at the far end of the line protected by the breaker in question for instance, or possible lightning surges forming subsequent strokes of a multi-stroke lightning flash of which an earlier stroke initiated the fault which caused tripping of the breaker. The importance of maintaining a high value of insulation strength across the two breaks, viz. interrupting and isolating, in combination is, therefore, at least as great at this time as at any other. To insure this requires that the interrupting blast be maintained until the series isolating switch has achieved a substantial fraction of its full contact separation. As the series switch must not separate its contacts before the arc is extinguished, this means either that the blast must be maintained for several cycles after interruption, wasting thereby perhaps several times as much gas as is used in interruption, or that the isolating blade must be moved with extreme speed, thereby setting up excessive accelerating and decelerating forces throughout the blade and its operating mechanism.

In accordance with my invention, I substitute an isolating switch whose contacts separate in a liquid insulating medium of high dielectric strength, such as oil, in place of the conventional air-break isolator. Because a small gap in oil

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produces the equivalent dielectric strength of a large gap in air, the employment of a comparatively slow-moving oil isolator is equivalent to the use of a fast-opening air isolator. Hence, for this reason I am able to reduce the expenditure of extinguishing gas because of the earlier blast cutoff which now is permissible. Moreover, because I seal the isolating contacts in an oil containing chamber, adverse weather conditions, such as cause icing up of exposed contacts, cannot impair their operation.

Accordingly it is an object of my invention to provide a device having interrupting contacts and isolating contacts in series therewith which utilizes the known advantages of the gas blast principle to interrupt the circuit and which also takes advantage of the high dielectric strength of liquid insulating dielectric as a medium for improving the overall dielectric strength of the circuit breaker especially during the critical period which follows the interruption, thereby avoiding the necessity of prolonging the gas blast across the interrupting contacts to protect against the relatively high voltage surges which follow a circuit interrupting operation.

Another object of my invention is the provision of a gas blast electric circuit interrupter which is capable of performing an interrupting and isolating operation without setting up severe strains in the isolating switch or its operating mechanism by utilizing a high dielectric liquid as an isolating medium thereby making high speed acceleration and deceleration of the isolating switch and of its operating mechanism unnecessary.

A further object of my invention is the provision of means for mechanically interlocking one of the interrupting contacts with one of the isolating contacts to insure a coordinated relationship between the interrupting and isolating contacts.

A still further object of my invention is the provision of means for insuring the opening of the interrupting contacts a predetermined time before the opening of the isolating contacts and conversely to insure the closing of the isolating contacts a predetermined time before the closing of the interrupting contacts.

A still further object of my invention is the provision of a circuit breaker having interrupting contacts and isolating contacts wherein the possibility of the isolating contacts becoming inoperative due to icing is avoided.

Further objects and advantages of my invention will become apparent as the following

description proceeds and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of my invention, reference may be had to the accompanying drawing which is a side view partly in section of the mechanism of a circuit breaker embodying my invention.

While the device shown in the drawing is a single pole interrupter, it will be understood that my invention is equally applicable to interrupters having more than one pole.

With reference to the construction shown in the drawing the numeral 1 represents one terminal of the circuit breaker and the numeral 2 is used to designate the point at which the other terminal which is not shown in the drawing would be mounted. Terminal 1 is mounted on a metallic capping member 3 which forms the cover for the interrupting chamber generally designated by the numeral 4. The isolating chamber is represented generally by the numeral 5. A fluid motor generally designated by the numeral 6 is the motivating means for the interrupting and isolating contacts. The fluid motor 6 is operated by pressure fluid supplied from storage reservoir 7. The flow of fluid from reservoir 7 to fluid motor 6 is controlled by the operating valve 8. Arc extinguishing fluid is supplied from reservoir 7 to the interrupting contacts through the blast valve 9.

The interrupting chamber 4 is constructed of a cylindrically-shaped ceramic insulating housing 10 and a cylindrically-shaped insulating casing 11 disposed within the ceramic insulator 10. A fixed contact 14 is mounted inside the insulating casing 11. Movable contact 15 may cooperate with an opening within the lower surface of the fixed contact 14 in such a way as to prevent communication between the spaces above and below the lower portion of the fixed contact 14 when the contacts 14 and 15 are closed as shown in the drawing.

The fluid motor 6 is of a dual cylinder and piston construction comprising contact opening cylinder 16 and its associated piston 17 and contact closing cylinder 18 and its associated piston 19. The cylinders 16 and 18 are supported on a metallic plate 20 which also serves as the lower end wall of the cylinders 16 and 18. The fluid motor 6 is supplied with operating fluid from tank 7 through pipe 21, valve 8, pipes 22, 23, and passageways 24 and 25 formed axially within the ceramic insulators 26 and 27.

Upward opening motion of piston 17 causes its toothed rod 28 which constitutes a rack to move upwardly which in turn rotates gear 29 clockwise about its fixed pivot 30 which is supported by journal engagement with the walls of the metallic enclosing housing 31. Clockwise motion of gear 29 imparts downward motion to the toothed contact rod 32 on which is mounted the movable contact 15.

For controlling the movement of the opening piston 17 and closing piston 19 of the fluid motor 6, I may employ an opening and closing valve control system such as is disclosed in the U. S. Patent 2,255,496 to Wyman which is assigned to the same assignee as this application. However, I have chosen to depict in the drawing a simplified arrangement of this system merely for illustrating the essential elements of my invention.

For the purpose of controlling the supply of pressure fluid to the cylinder 16 through passage-

way 24 and pipe 22, I have shown a source of electric potential 33, a manually operable switch 34, coil 35, and armature 36 associated therewith. Closing of switch 34 causes the bridging member 37 to engage the fixed contacts 38 and 39 thereby completing the circuit through the coil 35. Energization of coil 35 causes upward movement of armature 36 and valve member 40 against the bias of spring 41 thereby admitting pressure fluid from reservoir 7, pipe 21, valve 8, pipe 22, passageway 24 to the underside of piston 17.

Upon separation of contacts 14 and 15, a blast of pressure gas or air is admitted to the inside of insulating casing 11 which flows with high velocity around the movable contact 15 and through the opening in the lower wall of the fixed contact 14 to envelop and extinguish the arc drawn therebetween. Exhaust of this blast and of the products of the arc is accomplished through suitable openings in capping member 3 which openings may be shielded from the weather by any suitable means such as by covers 43 and 44 mounted on capping member 3.

The arc extinguishing blast is supplied to the interrupting chamber within the insulating casing 11 through a passageway 45 in the enclosing housing 31, the passageway 46 in the tubular insulator 47, and pipe 48 proceeding from blast valve 9.

Blast valve 9 is operated by the coil 49, energization of which causes the armature 50 to move downwardly against the bias of spring 51 to cause the disk 52 to move out of seating engagement with the pipe 53.

Where it is desired to have the arc extinguishing blast from reservoir 7 through blast valve 9 and through the associated above-described structure to the interrupting chamber within the insulating casing 11 occur at the same time that the contacts 14 and 15 are parted, the energy for coil 49 conveniently may be supplied from source 33 through bridging member 54 and contacts 55 and 56 of switch 34. With the elementary control arrangement shown, it will be understood that the opening of the control switch 34 to deenergize coil 35 for cutting off the pressure supply to opening piston 17 toward the end of its stroke will also cause an accompanying cutoff for the blast valve 9 because the simultaneous deenergization of blast valve coil 49 will cause the valve disk 52 to reseal under the compression of its spring 51. In many applications, provision would be made for effecting the earliest appropriate cut-off for the blast so as to bring about the greatest conservation of extinguishing gas made possible by the use of the oil isolator of my invention as already pointed out. For producing such earlier cut-off, known means such as a properly timed electrical relay may be provided in the blast valve coil circuit or, alternatively, the valve may be timed to reclose automatically by pneumatic means such as is disclosed, e. g., in U. S. Patent 1,912,024 to Uebermuth which is assigned to the same assignee as this application.

To close the contacts, the switch 57 is used. When switch 57 is closed, bridging member 58 engages contacts 59 and 60 thereby completing the circuit through coil 61. Energization of coil 61 causes armature 62 and slidable valve member 40 to move downwardly against the bias of spring 63 uncovering the opening in valve 8 to pipe 23. Pressure fluid will then be supplied through pipe 21, valve 8, pipe 23, and passageway 25 to the underside of piston 19 which, when the contacts are open, will be in the down position. Pressure

underneath piston 19 will cause contact 15 to move upwardly to engage the fixed contact 14.

Instead of the manually operable switches 34 and 57, an automatically operable device such as a relay responsive to various circuit conditions could be used as will be obvious to those skilled in the art and such as is indicated in the afore-said patent to Wyman.

The isolating contacts 64 and 65 are disposed within the isolating chamber 5 and are submerged in an insulating liquid 66 of high dielectric strength such as oil or other fluid of vastly greater dielectric strength than that of free air. Contact 64 is a relatively fixed contact which is capable of limited axial movement with respect to the conductor 67 by virtue of being mounted on a conducting sleeve 68. A pin 69 secured to the conductor 67 and diametrically extending therethrough serves to limit the travel of sleeve 68 which is constructed with a pair of longitudinally extending slots through which the projecting ends of the pin 69 extend. A compressible spring 70 is interposed between the conductor 67 and the right hand end of the sleeve 68. Electrical contact between sleeve 68 and contact 67 may be made by means of a braid 68a, or by any of a number of other arrangements well known in the art. Conductor 67 extends axially through a porcelain bushing 71 which is mounted on a metallic plate 72 which in turn is secured to a supporting structure 73. I prefer to ground the structure 73 so that a standard bushing transformer 74 conveniently may be mounted on and supported by the bushing 71. This transformer may be used to control relays which in turn could control the functions described above for switches 34 and 57 or for any other desired purpose. An oil-tight gasket 75 is disposed at each end of the interrupting chamber 5.

To prevent the leakage of dielectric liquid 66 from the chamber 5 to the inside of the enclosing housing 31 which normally is air filled at atmospheric pressure, I provide a stuffing-box 76.

Good series electrical conductivity must be provided between the isolating contact 65 and the interrupting contact 15. Accordingly, to insure a good electrical connection between the movable rod 77 on which the contact 65 is mounted and the metallic housing structure 31, I provide a plurality of conducting fingers 78 disposed about the periphery of the rod 77 and within a supporting member 79. A biasing spring 80 for each conducting finger 78 insures a good electrical connection between the rod 77 and the metallic supporting member 79, which may be integrally formed with the metallic end wall 81 of the housing 31. To insure a good electrical contact between the housing 31 and the rod 32, a plurality of conducting fingers 82 are pressed against the outer periphery of rod 32 by means of springs 83. Alternatively, I might employ a flexible electric connection for directly interconnecting isolating contact rod 77 to interrupting contact rod 32.

The circuit through the complete circuit breaker, therefore, comprises the terminal 1, fixed contact 14, movable contact 15, the upper portion of rod 32, fingers 82, housing 31, fingers 78, rod 77, movable contact 65, yieldably mounted contact 64, sleeve 68, braid 68a, conductor 67 and terminal 2, which latter element is not shown.

The isolating chamber 5 is filled with insulating liquid to a suitable level such as is indicated in the drawing and a suitable vent pipe such as 90 may be provided to accommodate

pressure changes within the isolating chamber due to the displacement of fluid by the action of rod 77.

The proper sequence of operation of the isolating contacts 64 and 65 and the interrupting contacts 14 and 15 is accomplished in accordance with my invention by means of the connecting rod 84 which is pivotally mounted at 85 on the right hand end of the reciprocating contact rod 77 and by means of the crank 86 which is secured to the gear 29 and rotatable therewith about the shaft 39. The crank 86 is pivotally secured at its outer end to the right hand end of the connecting rod 84 by a pin 87. It will thus be seen that rod 84 and crank 86 form a toggle which serves as a mechanical variable speed force-transmitting system between the gear 29 and the movable isolating contact 65 and furthermore serves as a positive coordinating means for properly timing in a predetermined sequence the breaking and making of the interrupting contacts 14 and 15 and the isolating contacts 64 and 65. In other words, the rod 84 and crank 86 may be regarded as a mechanical interlock between the interrupting and isolating contacts.

More specifically, when piston 17 is caused to move upwardly by the introduction of fluid under the piston, the movable contact 15 simultaneously moves downwardly due to the rack and gear connection between rods 28 and 32. During this interrupter opening movement, the gear 29 will be rotated clockwise, and because the crank 86 is integrally constructed with respect to the gear 29, both will move simultaneously. This clockwise movement of the crank 86 about its fixed pivot 39 will cause the connecting rod 84 and the crank 86 to pass from the overcenter position upwardly through dead center and beyond. This toggle action will cause the contact 65 to move slightly to the left as the crank 86 approaches dead center thereby displacing the yieldably mounted relatively fixed contact 64 to the left and insuring secure engagement between contacts 64 and 65. As the toggle comprising the rod 84 and the crank 86 passes through dead center during the clockwise movement of crank 86, the contact 65 will begin gradually to move to the right and engagement between contacts 64 and 65 will continue to be maintained during an appreciable angular movement of the crank 86 until the left hand end of the slots in the telescoping sleeve 68 engage the diametrically extending pin 69 mounted on the conductor 67. Thus it will be seen that the isolating contacts 64 and 65 will remain in engagement for a predetermined time after the separation of the interrupting contacts 14 and 15 for, in a sense, they virtually are provided with a long "wipe" compared to the interrupting contacts.

In view of the above detailed description of the cooperative relationship of the various parts for producing a predetermined sequential parting of the interrupting contacts 14 and 15 and the isolating contacts 64 and 65 respectively, it also follows, and will be understood, that the isolating contacts 64 and 65 will be closed a predetermined time before the closing of the interrupting contacts 14 and 15 whenever a closing operation is achieved by introducing pressure below the piston 19. As explained above such pressure causes upward movement of the toothed rod 32 and counterclockwise motion of the gear 29 and the crank 86 during which operation the connecting rod 84 and the crank 86 will move back through dead center and below as the crank

86 rotates counterclockwise. In this reverse rotative closing movement it will be appreciated that the re-engagement of isolating contacts 64 and 65 occurs appreciably before the re-engagement of the interrupting contacts 14 and 15.

In the above described circuit breaker which I have chosen as the embodiment of my invention, that is, where the circuit is re-established by the closing of the interrupting contacts subsequent to the closure of the isolating contacts, it is often preferable that a closing blast be employed. For this purpose I could employ one of several known blast control methods comparable to those discussed herein in connection with the opening blast. Otherwise, I might employ closing blast control schemes comparable to those disclosed in U. S. Patent 2,389,942 to Thumim or U. S. Patent 2,418,739 to Thumim et al., both of which are assigned to the same assignee as the present application.

Thus it will be seen that by my invention adequate isolation is accomplished primarily by the insulating action of the high dielectric liquid soon after the isolating contacts are separated thereby making unnecessary a prolonged and wasteful blast of gas between the interrupting contacts. Furthermore it will be obvious that because of the high dielectric strength of the liquid insulating material this desirable result may be achieved by opening the isolating switch at relatively low speeds thereby avoiding excessive accelerating and decelerating forces throughout the switch blade and its operating mechanism. Also it will be apparent that my invention affords precise and accurate means for operating the interrupting and isolating contacts in the proper sequence and at the same time protects the isolating contacts against the possibility of becoming inoperative due to icing.

While I have shown and described a particular embodiment 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. In an electric circuit breaker of the fluid blast type, relatively movable interrupting contacts, isolating contacts serially arranged with respect to said interrupting contacts, actuating means for imparting opening movement to said interrupting contacts, means for supplying a blast of gas to said interrupting contacts to extinguish the arc drawn therebetween upon separation thereof and to prevent the reestablishment of the arc immediately after interruption thereof, means coordinated with said actuating means for imparting controlled opening movement to said isolating contacts during the entire opening movement of said actuating means and operable to separate said isolating contacts after separation of said interrupting contacts and interrupt-

tion of the arc drawn therebetween during a circuit opening operation of said circuit breaker, a substantially fluid tight weatherproof chamber enclosing said isolating contacts, and an isolating medium in said chamber of dielectric strength substantially greater than atmospheric air.

2. In an electric circuit breaker of the fluid blast type, relatively movable interrupting contacts, isolating contacts serially arranged with respect to said interrupting contacts, means for imparting opening movement to said interrupting contacts, a source of gas under pressure, means for supplying a blast of gas from said source to said interrupting contacts to extinguish the arc drawn therebetween upon separation thereof and to prevent the reestablishment of the arc immediately after interruption thereof, means movable in accordance with movement of said means for imparting opening movement to said interrupting contacts and operable to separate said isolating contacts after separation of said interrupting contacts and interruption of the arc drawn therebetween during a circuit opening operation of said circuit breaker, a substantially fluid tight weatherproof chamber enclosing said isolating contacts, and an insulating liquid of dielectric strength substantially greater than atmospheric air in which said isolating contacts are submerged at all times.

3. In an electric circuit breaker of the fluid blast type, relatively movable interrupting contacts, a substantially fluid tight chamber containing fluid of substantially higher dielectric strength than atmospheric air, isolating contacts serially arranged with respect to said interrupting contacts and disposed in said chamber, said isolating contacts being immersed in said fluid at all times, means for imparting opening movement to said interrupting contacts, a source of gas under pressure, means for supplying a blast of gas from said source to said interrupting contacts to extinguish the arc drawn therebetween upon separation thereof and to prevent the reestablishment of the arc immediately after interruption thereof, and means movable in accordance with the opening movement of said interrupting contacts and operable to separate said isolating contacts after separation of said interrupting contacts during a circuit opening operation of said circuit breaker.

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