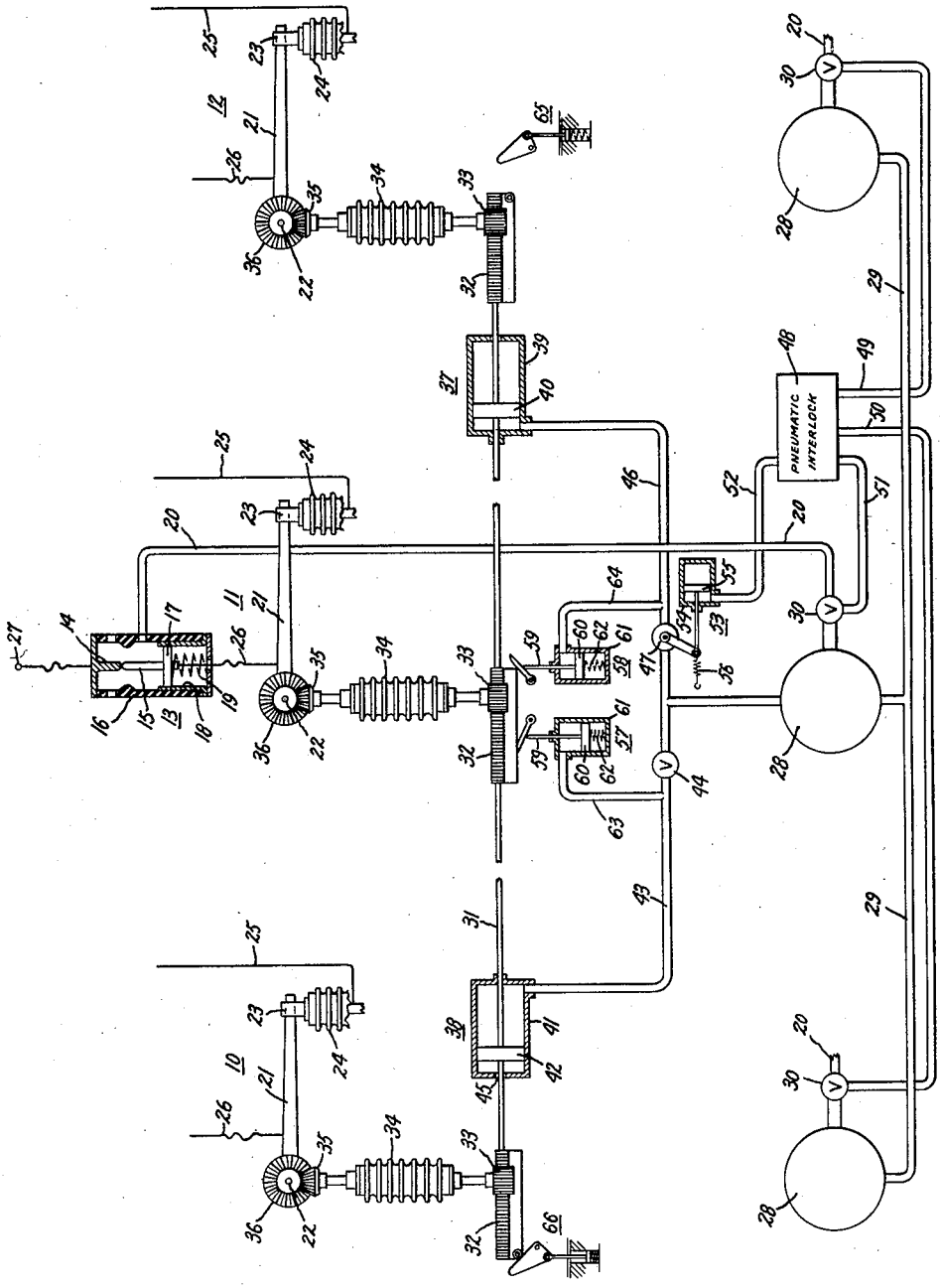
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CIRCUIT BREAKER OPERATING MECHANISM

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CIRCUIT BREAKER OPERATING MECHANISM

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1 Claim. (Cl. 200—18)

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My invention relates to operating mechanisms for electric circuit breakers and more specifically to operating mechanisms for high voltage circuit breakers of the type disclosed in Rankin Patent 2,306,186, or copending application Boisseau and Beall Serial No. 570,006, filed December 27, 1944, both assigned to the same assignee as the present application. My invention is an improvement on copending prior application of Carl Thumim and myself, Serial No. 367,789, filed November 29, 1940.

In recent years to eliminate fire hazard numerous circuit breakers have been designed which do not utilize oil or other inflammable liquid for arc extinguishing purposes, but instead employ a blast of fluid such as air or other gas, to extinguish the arc formed during the circuit interrupting operation.

When so-called air blast or fluid blast circuit breakers are used for interrupting high voltage power circuits, such for example as a 138 kv. circuit, the necessity of providing sufficient electrical clearance between the phases or poles of such circuit breakers, which are usually multi-pole breakers, requires that a plurality of single-pole units be provided. These single-pole units are operated so as to act as a single polyphase circuit breaker.

Generally such high voltage circuit breakers comprise a set of arcing contacts and a set of disconnecting contacts serially arranged with said arcing contacts for each pole of the circuit breaker. The disconnecting or isolating contacts are generally operated as a unit immediately following interruption of the circuit by the arcing contacts. For very high voltage circuits it may be necessary to have an electrical clearance between each pole of the multi-pole or polyphase breaker of 20 or more feet and it is obvious that if an operating mechanism of the conventional linkage type is employed that a very heavy, complicated operating mechanism would be required to operate the disconnecting contacts as a unit when the circuit has been interrupted at the arcing contacts.

It is an object of my invention to provide a new and improved operating mechanism for such high voltage breakers which is simple and compact and foolproof in operation.

It is another object of my invention to provide a new and improved operating mechanism for a high voltage circuit breaker which is readily adapted for use with a fluid operating means and furthermore may readily have applied thereto the various locking and retarding means required

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to be used with circuit breaker operating mechanisms.

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 in which the single figure thereof diagrammatically illustrates the operating mechanism of my invention as applied to a multi-pole high voltage circuit interrupter.

Referring now to the drawing, I have illustrated my invention as applied to a high voltage polyphase circuit breaker comprising a plurality of single-pole units, generally indicated at 10, 11 and 12. Each of these single pole units comprises an interrupting unit 13. For the sake of simplicity only one interrupting unit associated with the pole 11 has been illustrated in the drawing, but it will be understood that each of the poles 10 and 12 also includes such a unit.

This unit might be constructed in accordance with the disclosure of the above mentioned Rankin patent, or preferably in accordance with copending application, Serial No. 570,006 referred to above. However, since the structural features of the interrupting units 13 form no part of the present invention, only the essential features thereof are schematically illustrated. Each of the interrupting units, such as 13, includes a pair of relatively movable contacts 14 and 15, the latter being a retractable pin type contact while the former is a stationary contact.

These contacts are mounted in an insulating arc extinguishing structure 16. Preferably the retractable pin type contact 15 is connected to a fluid motor which I have illustrated as comprising a piston 17 mounted for reciprocal movement in a cylinder 18. Suitable biasing means such as a spring 19 may be provided for constantly urging retractable pin type contact 15 to the closed circuit position where it engages stationary contact 14. The contact structure of interrupting head 13 is in many respects similar to that disclosed in Biermann Patent 2,084,885, assigned to the same assignee as the present application.

Relative separation of the contacts 13 and 14 in each arc extinguishing structure 16 is obtained by introducing fluid under pressure through conduits 20 which causes the fluid motors comprising pistons 17 and cylinders 18 to operate. Specifically, with reference to pole 11, this fluid under

pressure forces piston 17 to move downwardly in cylinder 18 against the bias of spring means 19. This fluid also flows past the arc drawn between relatively movable contacts 14 and 15 so that this arc is subjected to the quenching effect of the high pressure atmosphere and consequently is rapidly interrupted by the resulting fluid blast. As soon as the fluid under pressure in conduit 20 is cut off from its source of supply, spring means 19 forces retractable pin type contact 15 to re-engage with stationary contact 14 to reclose the circuit at these interrupting contacts.

In order to complete the circuit interrupting operation of circuit breakers using retractable pin type contacts, it is necessary to provide isolating or disconnecting contacts in series therewith which will isolate the circuit subsequent to the operation of the interrupting contacts, but before they reclose by providing a sufficient electrical clearance to prevent any restriking of the arc. Accordingly, in the drawing I have illustrated disconnecting arms 21, one associated with each pole 10, 11 and 12 of the polyphase circuit interrupter. Disconnecting arms 21 are each rotatable about a horizontal axis 22 and move in a vertical plane. The free end of each disconnecting arm 21 is adapted to engage a stationary contact 23 mounted on a suitable insulator 24. The stationary contact 23 of each pole of the circuit interrupter is connected to one terminal of an associated electric circuit 25. The disconnecting contact arms 21 are electrically connected to one of the relatively movable contacts as by means of a conductor 26, for example, while the other of the relatively movable contacts is electrically connected to line terminal 27. It will be seen therefore that an arrangement is provided in which a plurality of interrupting contacts and a plurality of isolating contacts are connected in series relation.

In order to supply fluid under pressure to the conduit 20 of each interrupting unit to operate interrupting contacts 14 and 15 and to provide a blast of fluid such as air for arc extinguishing purposes at the various interrupting units, I provide a source of fluid under pressure which is illustrated as three separate reservoirs 28, one associated with each pole of the polyphase circuit interrupter. These reservoirs are preferably interconnected as indicated at 29 for free and rapid interchange of air. The conduits 20 for the poles 10, 11 and 12, only partially shown insofar as the poles 10 and 12 are concerned, are connected to their associated reservoirs through suitable blast valves 30. If desired, these blast valves may be constructed in accordance with the disclosure of Patent 2,315,991, Thumim, granted April 6, 1943, and assigned to the same assignee as the present application. The reservoirs 28 are preferably supplied with fluid under pressure, such as air, from suitable compressor means (not shown).

Although each pair of relatively movable interrupting contacts 14 and 15 is individually operable in response to the fluid pressure from conduits 20 supplied to the respective interrupting heads 13, it would be desirable to operate such a polyphase circuit breaker as a single unit. To this end the disconnecting arms 21 for each pole 10, 11 and 12 should be simultaneously operated to either the open or closed position. Instead of the complicated linkage mechanisms used to interrelate the separate poles of a polyphase circuit breaker heretofore I have, in accordance with my invention, provided a simple longitudinally reciprocal operating rod 31 which extends between the outermost poles 10 and 12 of the circuit interrupter and which will permit any spacing such as 20 or more feet between poles. At each end of operating rod 31 is a rack 32. A similar rack 32 is also provided intermediate the ends of rod 31. These racks are adapted to engage spur gears 33 which through suitable insulating members 34 are drivingly connected to bevel gears 35 which mesh with bevel gears 36 rotatably mounted with disconnecting arms 21 about axes 22. It will be obvious that movement to the right of rod 31 as viewed in the drawing, will cause the racks 32 to rotate spur gears 33 and to cause simultaneous opening of the disconnecting contacts of all of the poles of the multipole circuit breaker through simultaneous operation of disconnecting arms 21.

Any suitable means may be provided for causing reciprocal movement of operating rod 31. In view of the fact that a fluid blast circuit breaker has been illustrated necessitating a source of fluid under pressure, a fluid operated means for operating rod 31 is preferable. A single fluid motor could be provided with means to operate it in either direction for moving rod 31. However, I have discovered that if only tensile forces are applied to operating rod 31, which is very long, a much lighter and cheaper operating mechanism results. Accordingly, I have provided two fluid motors, a circuit breaker opening motor 37 and a circuit breaker closing motor 38 mounted so as to be connected one at either end of operating rod 31. In the drawing I have illustrated these fluid motors as connected just inside the racks 32 at the extreme ends of rod 31 so that a compression force is applied to a very short portion of rod 31. In view of the shortness of this portion to which compression force is applied and in further view of the fact that a force sufficiently great to operate only one pole of the circuit breaker is applied to this portion of operating rod 31 whereas a tensile force sufficient to operate at least two poles is supplied to the majority of operating rod 31, a relatively small operating rod may be employed. If desired the fluid motors 37 and 38 may be attached to the extreme ends of operating rod 31 so that only a tensile force is applied to operating rod 31. The circuit breaker opening fluid motor 37 comprises a cylinder 39 within which is reciprocally mounted a piston 40 directly attached to operating rod 31. Similarly, circuit breaker closing fluid motor 38 comprises a cylinder 41 within which is reciprocally mounted a piston 42 directly connected to operating rod 31.

In order to close the disconnecting contacts fluid motor 38 may be operated by having the working face of piston 42 subjected to fluid under pressure supplied thereto from one of the reservoirs 28 through conduit 43 and circuit breaker closing valve 44, which has been schematically illustrated. The other side of piston 42 is subjected only to atmospheric pressure by virtue of the opening 45 in cylinder 41.

In order to operate circuit breaker opening fluid motor 37 the working face is subjected to fluid under pressure supplied to cylinder 39 from one of the reservoirs 28 through a conduit 46 and a circuit breaker opening valve 47. It is essential that the arcing contacts 14 and 15 in each of the interrupting units associated with poles 10, 11 and 12 of the circuit breaker are separated and a blast of arc extinguishing gas be present adjacent the separated contacts be-

fore the disconnecting arms are operated. Since each of the sets of disconnecting contacts are individually operable, a suitable interlocking means should be provided between circuit breaker opening control valve 47 and the blast valves 30. Such an interlocking means is disclosed and claimed in my prior joint patent application (Serial No. 367,789, filed November 29, 1940) referred to above. For simplicity the details of this interlocking scheme are not shown in the drawing and reference may be had to the above mentioned patent application for the detailed description of the interlocking scheme. In the drawing I have schematically illustrated a pneumatic interlock generally designated at 48, which is connected to each of the blast valves 30 by conduits 49, 50 and 51. A third conduit 52 is also connected to the pneumatic interlock 48. The pneumatic interlock functions in such a manner that it will not permit any fluid under pressure to enter conduit 52 until all the blast valves 30 are open and fluid under pressure is present in conduits 20 thus assuring that a blast of fluid is supplied to each of the interrupting units when fluid under pressure is permitted in conduit 52. Conduit 52 is connected to a fluid motor 53 comprising a cylinder 54 and a piston 55. Piston 55 is connected to operate valve 47 which is biased to the closed position by a spring 56. With this arrangement circuit breaker opening valve 47 cannot be operated to the open position to cause simultaneous operation of all the disconnecting arms 21 until a blast of fluid under pressure is assured at all of the interrupting units, or in other words until the arcs are extinguished at all of the interrupting contacts.

It is usually desirable to lock the operating mechanism of an electric circuit breaker in either its closed or its open position. The locking means for this purpose must be such that they are released prior to the application of any force of the operating mechanism. The operating mechanism of my invention lends itself very well to the application of such locking means and in the drawing I have illustrated schematically a lock open means 57 and a lock close means 58 arranged in close proximity to the rack 32 associated with pole 11 of the multi-pole circuit interrupter. These locking means 57 and 58 are identical and each comprises a locking member 59 connected to a piston 60 reciprocatingly mounted within a cylinder 61. A spring 62 biases the locking member 59 so as to move into a locking position. The cylinder 61 of lock open means 57 is connected by means of a conduit 63 to conduit 43 so that whenever the circuit breaker closing valve 44 is open fluid under pressure will be admitted to cylinder 61 of lock open means 57 to move locking member 59 to its released position. The cylinder 61 of lock closed means 58, on the other hand, is connected by means of a conduit 64 to conduit 46 whereby member 59 is moved to its released position whenever circuit breaker opening valve 47 is open. The locking members 59 of lock open means 57 and lock close means 58 are adapted to engage the ends of rack 32. With the circuit breaker in the closed position as indicated in the drawing, member 59 of lock closed means 58 engages the right end of rack 32 of pole 11 and holds the circuit breaker closed. Upon opening of valve 47 lock close means is immediately released and is maintained in the released position by the lower surface of rack 32 until the circuit breaker is again moved to the closed position. Similarly, lock open means 57 is held in the released position by rack 32 of pole 11 until the circuit breaker reaches its open position whereupon locking member 59 of lock open means 57 engages the left end of rack of pole 11. Lock open means 57 is immediately released to permit movement of operating rod 31 whenever circuit breaker closing valve 44 is opened. The above described lock open means are broadly disclosed and claimed in my prior copending joint application, Serial No. 317,564, filed February 6, 1940 and assigned to the same assignee as the present application.

If desired suitable dashpot means generally indicated at 65 and 66 in the drawing may be provided, one at either end of operating rod 31. The dashpot means 66 will be engaged by the rack 32 of pole 10 to cushion the operating mechanism as the circuit breaker reaches its closed position. Similarly the dashpot means 65 is engaged by the rack 32 of pole 12 to cushion the operating mechanism as the circuit breaker reaches its open position.

In view of the detailed description included above, the operation of the circuit breaker operating mechanism embodying my invention will be obvious to those skilled in the art. When fluid under pressure is supplied to fluid motor 37 operating rod 31 is moved to the right and substantially all of the operating rod has a tensile force applied thereto so that a relatively light rod may be employed even though the rod may be 40 or more feet long. Similarly, during the circuit breaker closing operation fluid motor 38 applies a tensile force to substantially all of operating rod 31.

For simplicity in the drawing I have not disclosed the control scheme for controlling the operation of the various valves and the like, which control scheme is disclosed and claimed in copending application Serial No. 565,834, filed jointly for B. S. Beall, E. J. Frank, R. W. Lowery and me on November 30, 1944 and assigned to the same assignee as the present application.

It will be seen that with my invention the complicated operating mechanisms required of prior art constructions may be entirely eliminated and a very simple, compact arrangement provided.

Although I have disclosed a particular embodiment of my invention, it will be obvious to those skilled in the art that modifications may be made without departing from my invention, and I intend in the appended claim 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:

In an arrangement for causing simultaneous operation of all of the poles of a polyphase electric circuit breaker having a plurality of poles spaced a substantial distance apart and each including a pair of relatively movable contacts, the combination of a long relatively light reciprocally movable operating rod extending between the most remote of said plurality of poles, means for moving said rod in one direction to operate simultaneously said relatively movable contacts only by applying a tensive force to said rod near one end thereof, means for moving said rod in the other direction to operate simultaneously said relatively movable contacts only by applying a tensive force near the other end of said rod, a plurality of racks mounted in spaced relationship on said rod, a separate gear mechanism interposed between each rack and a correspond-

ing pair of relatively movable contacts, and means engaging one of said racks to hold said relatively movable contacts in the open and closed positions said last-named means being automatically operable to permit movement of said rack whenever said contacts are operated.

ALEXANDER C. BOISSEAU.

REFERENCES CITED

The following references are of record in the file of this patent:

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Number	Name	Date
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