

April 20, 1937.

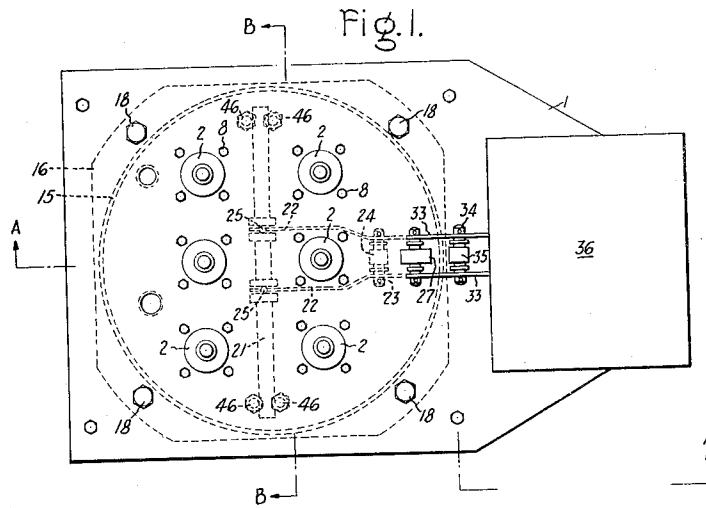
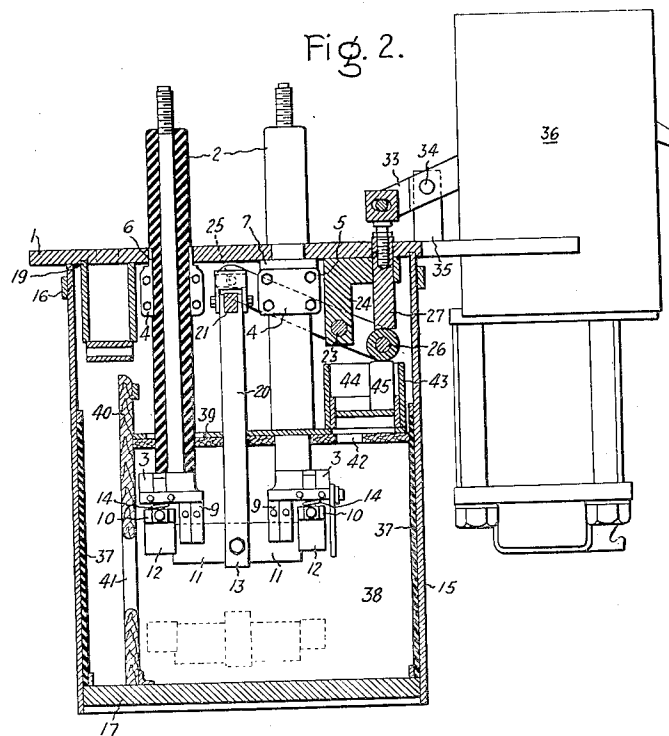
G. R. LANGLEY

2,078,145

CIRCUIT BREAKER

Filed Dec. 12, 1935

2 Sheets-Sheet 1



Inventor:
Gordon R. Langley,
by *Harry E. Dunham*
His Attorney.

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2 Sheets-Sheet 2

Fig. 3.

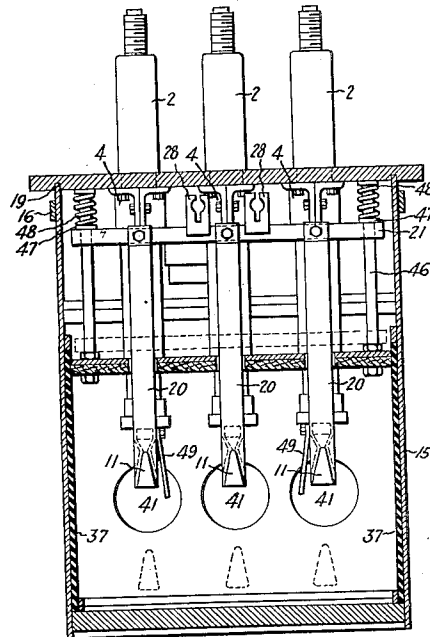
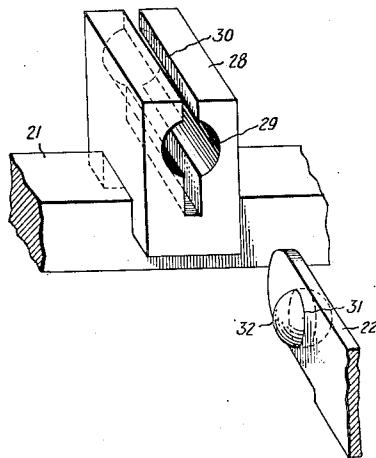


Fig. 4.



Inventor:
Gordon R. Langley,
by *Harry E. Dunham*
His Attorney.

UNITED STATES PATENT OFFICE

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CIRCUIT BREAKER

Gordon R. Langley, Peterborough, Ontario, Canada, assignor to General Electric Company, a corporation of New York

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5 Claims. (Cl. 200—150)

My invention relates to circuit breakers, and more particularly to circuit breakers of the heavy duty type having circuit breaking contacts immersed in an insulating medium such as oil, commonly used for the interruption of heavy currents at high voltages, and wherein the arc drawn in breaking the circuit may create pressures within the circuit breaker ranging to a very high order.

Circuit breakers of the type above referred to have been constructed on the principle that in order to withstand the high pressures generated therein, the walls of the pressure confining container should approach the form of a sphere as closely as is practically possible. To this end, the upper part of the circuit breaker has been made in the form of a dome adapted to be attached to a cylindrical tank, the bottom of which has been dished or bulged outwardly to conform to the generally spherical outline.

Too close adherence to the above principle has resulted in excessive labor costs in the construction of heavy duty circuit breakers. The dome shaped top is in itself costly to manufacture, and because of its shape has increased the difficulty and cost of locating inserts therein. For example, the circuit breaker conductor studs which pass through the dome and are secured thereto, are most readily secured to suitable inserts and the inserts are then welded or otherwise secured in suitable apertures in the dome. The locating of the apertures, which must be done with great accuracy, is rendered difficult because of the shape of the dome, and the welding necessary satisfactorily to secure the inserts in the dome gives rise to strains within the material of the dome which at times distort the spacing of the conductor studs. Furthermore, the provision of means for securing the dome shaped top to the cylindrical tank and the provision of a dished-out bottom for the tank add considerably to the cost of manufacture.

It is an object of my invention to provide an improved circuit breaker of the type above referred to, capable of interrupting heavy currents at high voltages and of withstanding the high pressures generated therein, and which will obviate many of the difficulties encountered in the manufacture of circuit breakers of the prior art.

It is a further object of my invention to provide a circuit breaker, of the type having oil immersed contacts, which will be oil-tight and explosion-proof, which will be economical of manufacture and which will readily permit the accurate location of parts.

It is a still further object of my invention to provide a circuit breaker construction which lends itself to use in metal clad switchgear installations now commonly employed in power distribution stations, for which the circuit breakers must be accurately assembled in order to be interchangeable with other breakers of the same type and rating in the metal clad installation.

My invention will be more fully set forth in the following description referring to the accompanying drawings, 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.

Referring to the drawings, Fig. 1 is a top plan view of a circuit breaker embodying my invention; Fig. 2 is a view, partly in section, on the line A—A of Fig. 1; Fig. 3 is a sectional view on the line B—B of Fig. 1; and Fig. 4 is an enlarged isometric view of an operating element incorporated in the circuit breaker.

In the drawings, Figs. 1, 2, and 3, there is shown a circuit breaker tank having a top member formed of a flat plate 1 of manganese bronze, cold rolled steel, or other suitable material. The plate 1 when suitably selected as to thickness will withstand satisfactorily pressures higher than would be encountered during the operation of the circuit breaker, and at the same time affords a considerable saving in first cost over the dome type structures heretofore used. At the same time the plate 1 may be provided with accurately machined edges to serve as base lines for the location of parts on the plate 1. Suitable apertures are cut in the plate 1 through which the conductor studs 2 pass.

Each conductor stud comprises a conducting rod of copper or similar metal suitably insulated, preferably with a laminated, impregnated insulating material known to the trade as "Herkolite". Each conductor stud 2 is provided at its lower end with a stationary contact structure 3 to be later described, and at its upper end the copper rod of each conductor stud extends beyond the insulation and may be screw-threaded to permit the ready connection thereto of suitable conductors (not shown), or it may be finished otherwise, for instance with a silver contact ferrule for plugging into a socket contact.

Intermediate the ends of each conductor stud 2, the insulation may be partly cut away and a flanged clamping member 4 formed in two halves secured about the conductor stud by means of the bolts 5. Each clamping member 4 is formed with an axially extending portion 6 adapted to fit

snugly within the aperture through which the conductor stud passes, and is also provided with a flange 7 arranged to abut the lower side of plate 1 and to be secured thereto by the bolts 8. An alternative construction would employ a threaded clamping member arranged to screw into the top plate.

The stationary contact structure shown comprises contact fingers 9 and butt contacts 10 which co-operate respectively with wedge shaped portions 11 and butt contact portions 12 of a movable bridging member 13. The stationary contact structures 3 are arranged in pairs, each pair being bridged by one bridging member 13 and all the bridging members are arranged to be operated between their open and closed circuit positions simultaneously by means to be later described.

In the structure illustrated, the butt contacts 10 of the stationary contact structures 3 are biased to their lowermost positions by means of springs 14 and are also arranged to move to a lowermost position during the circuit opening movement of the bridging member such that any arcing between the stationary contact structure 25 and the bridging member occurs between the butt contact portions of the respective members. In this manner, the contact surfaces of the contact fingers 9 are preserved for current carrying duty during the circuit closed position of bridging member 13 and the destruction of the contact surfaces of fingers 9 by arcing is substantially prevented.

The breaker tank 15 is formed in the regular manner from a piece of sheet steel rolled into a cylinder and welded at the edges. A reinforcing and securing band 16 is welded to the outer side of the tank 15 adjacent its upper end and a flat bottom 17 is welded to the inner side of the tank 15 adjacent its lower end. The band 16 and flat bottom 17 are conveniently and economically made by first selecting a substantially rectangular piece of metal plate having the required thickness and strength, and then cutting from said plate a circular aperture equal in diameter to the outer diameter of the tank 15. The width of the cut may be arranged to substantially equal the thickness of the steel sheet used in tank 15, and the remaining circular piece of steel plate thus is adapted to fit within the lower end of tank 15 and is welded thereto to form the bottom thereof.

The outer contour of band 16 may be made as shown in Fig. 1, and in the wider corner portions thereof suitable tapped holes are made for the reception therein of bolts 18 extending through the plate 1 and adapted to secure said plate 1 to tank 15. A suitable annular groove 19 is made in the under side of plate 1 for the reception therein of the upper edge of tank 1 and the groove provided with a gasket to form an oil and pressure-proof joint when the tank 15 is secured to plate 1. It will be apparent that the top plate lends itself readily to the use of a structural steel supporting frame, the plate itself forming the top horizontal frame member. The plate may also be extended to form an economical support for a solenoid or motor operated mechanism indicated generally at 36.

Each of the bridging members 13 is rigidly secured to the lower end of an operating rod 20, the upper end of which is secured to a horizontal cross bar 21. The operating rods 20 and the bridging member 13 are moved in a vertical direction by means of the links 22 pivoted at 23 in an L-shaped bearing member 24 secured to the under side of the plate 1. The links 22 are connected

at one end to the cross bar 21 through a sliding ball connection 25 and at their other end the links 22 are provided with a cross arm 26 arranged to be engaged by the lower end of a plunger 27 operating through registering apertures in plate 1 and bearing member 24.

The sliding ball connection, as is shown most clearly in Fig. 4, comprises a block 28 secured to the cross bar 21 and having a horizontally extending cylindrical hole or slot 29 and a central vertical slot 30 therethrough. The end of each of the links 22 is provided with a circular aperture 31 of a size to receive a steel ball 32 therein, and in assembled relation the end of the link operates in the slot 30 and the ball 32 operates in the cylindrical hole 29. This slidable interlocked connection provides for an arcuate motion of the ends of links 22 while the cross bar 21 and block 28 move in a vertical straight line.

The plunger 27 extends through plate 1 and is connected at its upper end to one end of a link 33, pivoted at 34 in a bearing block 35 on the upper side of plate 1. The other end of link 33 may be connected to any suitable operating mechanism, either manual or electrically operated, mounted conveniently on plate 1 and indicated generally by the rectangle 36. Bearing member 24 is provided with a collar of leather or other suitable material located around plunger 27 so that the plunger moves freely through the collar, but when pressure develops in the tank the collar closes in on the plunger 27 and prevents escape of oil.

The interior of the tank 15 adjacent the contacts of the breaker is lined with a layer 37 of insulating material and, in the embodiment of my invention illustrated, an oil blast chamber 38 is provided enclosing all of the stationary contact structures 3 and bridging members 13. The oil blast chamber 38 comprises a top wall 39 and a side wall 40, the top wall 39 having apertures through which the conductor studs 2 and the operating rods 20 pass, and the side wall 40 being provided with apertures 41 adjacent the end of each bridging member 13. The principle underlying the operation of the oil blast chamber is well understood in the art and further discussion thereof is not deemed necessary. In the embodiment shown, an aperture 42 is provided in the top wall 39, opening into a cylinder 43 mounted on the top of the wall 39, and a piston 44 is mounted to slide vertically in the cylinder 43 for a purpose which will appear more fully hereinafter. The piston 44 and cylinder 43 have a diameter which is relatively large compared with the diameter of the operating rods 20 and the piston 44 is provided with a vertically extending portion 45 arranged under certain conditions to co-operate with the cross arm 26 of link 22.

As is shown most clearly in Figs. 1 and 3, the cross arm 21 and operating rods 20 secured thereto, are guided for movement in a vertical plane by the frame comprising the four rods 46 which are secured at their lower ends to the top wall 39 of chamber 38. The rods 46 are arranged in pairs, one pair at each end of the cross bar 21, and cross members 47 are provided at each end of the cross bar 21 and arranged to co-operate with the rods 46 and guide the cross bar between them. Springs 48 are also provided at the upper ends of rods 46 so arranged that the upward movement of cross bar 21 during the circuit closing operation of the circuit breaker compresses them. When the operating mechanism indicated generally at 36 is released, the springs 48 and 14 operate to

provide an initial impulse in the opening direction to the bridging members 13.

With the foregoing detailed description of the co-operation of parts in the construction of the circuit breaker according to my invention, the operation of the circuit breaker will be readily understood by those skilled in the art. Assuming that the tank 15 is filled with an insulating fluid, such as oil, to a level somewhat higher than the top of the oil blast chamber 38, and that the bridging members 13 are in the circuit open position illustrated in dotted lines in Fig. 2, the circuit breaker is closed by operating the mechanism indicated generally at 36 to depress the plunger 27, thereby, through links 22 and operating rods 20, raising the bridging members 13 to the position illustrated by full lines in Fig. 2. In this position, the wedge-shaped portions 11 of the bridging members 13 engage the contact fingers 9 and depress the butt contacts 10 against the bias of the springs 14. In this position also, the cross bar 21 is at its highest position and compresses the springs 48.

The circuit breaker is held closed by the operating mechanism shown generally at 36, and may be opened by releasing the operating mechanism, either manually or in response to a suitable electrical control. When the operating mechanism 36 is released, the springs 48 and 14 immediately apply an impulse in the opening direction to the bridging members 13, and the bridging members 13 very quickly move to the position illustrated in dotted lines in Figs. 2 and 3. As the butt contacts 10 and 12 separate, an arc is drawn, a relatively high pressure is generated within the chamber 38, and a flow of oil is forced across the arcing contacts and through the apertures 41, thereby minimizing the arcing and giving rapid circuit interruption.

During the circuit opening operation, the occurrence of a relatively high pressure within the chamber 38 gives rise to a pressure differential acting on the operating rods 20 and opposing the opening movement of the bridging members 13. When the opening impulse imparted by the springs 48 and 14 is exhausted, this piston effect on the operating rods 20 may result in a tendency to reclose the circuit breaker and in order to overcome this, there is provided the pressure responsive piston 44 acting within the cylinder 43 in response to an increase of pressure within the chamber 38. The upwardly extending portion 45 of the piston 44 is arranged, when moved upwardly to abut the cross arm 26 of links 22, thus applying a force in the opening direction to the links 22 over-balancing the piston effect on operating rods 20 and serving to hold the bridging members 13 in fully opened position.

In the operation of oil circuit breakers of the type above described, it has occasionally occurred that during the circuit opening operation an arc has struck between the stationary contact structures of adjacent phases. In the circuit breaker construction of my invention, I prevent this occurrence by securing to the inner sides of each of the stationary contact structures 3 of the outermost phases a flap 49 (see Fig. 3) of suitable insulating material extending downward somewhat below the lowermost portion of the adjacent stationary contact structure. As is shown most clearly in Fig. 3, these flaps 49 are secured to the stationary contact structure by means of the bolts already provided for securing this structure to the conductor stud. I have found that this type of barrier is superior to existing types in that the

presence of this insulating flap 49 substantially eliminates any interphase arcing, and, being preferably nonrigid or flexible in construction, is free from the tendency of a stiff barrier to shatter and at the same time is sufficiently supported so that its flexibility does not interfere with the moving parts adjacent.

It should be understood that my invention is not limited to specific details of construction and arrangement thereof herein illustrated, and that changes and modifications may occur to one skilled in the art without departing from the spirit 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 of the liquid-break type comprising a casing including a cylindrical metal portion, a disc-like metal plate secured within one end of said cylindrical portion to form the bottom wall of said casing, a metal reinforcing band, the outer periphery of which is substantially rectangular, secured to the outer peripheral wall of said cylindrical portion at the opposite end thereof and a flat metal plate forming the cover structure of said casing, said plate having a circular groove in registry with the upper end of said cylinder, said plate constituting a unitary support for the complete circuit breaker structure, and means for detachably securing said plate to diagonal portions of said reinforcing band.

2. An electric circuit breaker of the liquid-break type comprising a metal casing, a flat plate provided with a lateral extension forming the cover structure of said casing, lead-in conductor studs mounted in and extending through said cover plate, stationary contacts mounted at the lower ends of said conductor studs, a movable bridging member coacting with said stationary contacts and connected to lever structure supported with respect to said plate within said casing, operating mechanism mounted on said lateral extension exteriorly of said casing, and a plunger connected to said mechanism and guided for vertical reciprocal movement in said plate for engaging within said casing said lever structure.

3. An electric circuit breaker of the liquid-break type comprising a casing, a flat metal plate having a lateral extension forming the cover structure of said casing, lead-in conductor studs mounted in and extending through said casing, stationary contacts mounted at the lower ends of said studs, a movable coacting bridging member operable through a lift-rod to closed and open circuit positions, a lever pivotally supported in depending relation to said plate, said lever operatively connected at one end to said lift-rod and provided at its other end with a roller, an operating mechanism mounted on the lateral extension of said cover plate exteriorly of said casing, a plunger connected to said mechanism guided in said plate for vertical reciprocal movement for engaging said roller and an anti-reclosing device in said casing including a piston adapted to engage said roller.

4. In an electric circuit breaker including relatively movable contacts, and operating mechanism connected to the movable contacts, said movable contacts being guided for reciprocal rectilinear movement, means interconnecting said operating mechanism and movable contacts for transmitting straight line movement thereto comprising a member having a longitudinal slot and a coacting member slidable in and interlocked with respect to said slot, one of said mem-

bers being pivotally mounted so that the other member can be restrained for rectilinear movement.

5 5. An electric polyphase circuit breaker of the liquid-break type comprising a casing, a plurality of pairs of stationary phase contacts mounted in said casing, a plurality of movable coating

bridging members, and means for preventing interphase short circuits between the stationary contacts of separate phases comprising flexible insulating flaps secured to the stationary contact structure and extending to the lower extremities 5 of said stationary contact structure.

GORDON R. LANGLEY.