Dec. 23, 1941. E. J. FRANK 2,267,400

ELECTRIC CIRCUIT BREAKER

Filed Jan. 30, 1940

Fig. 1.

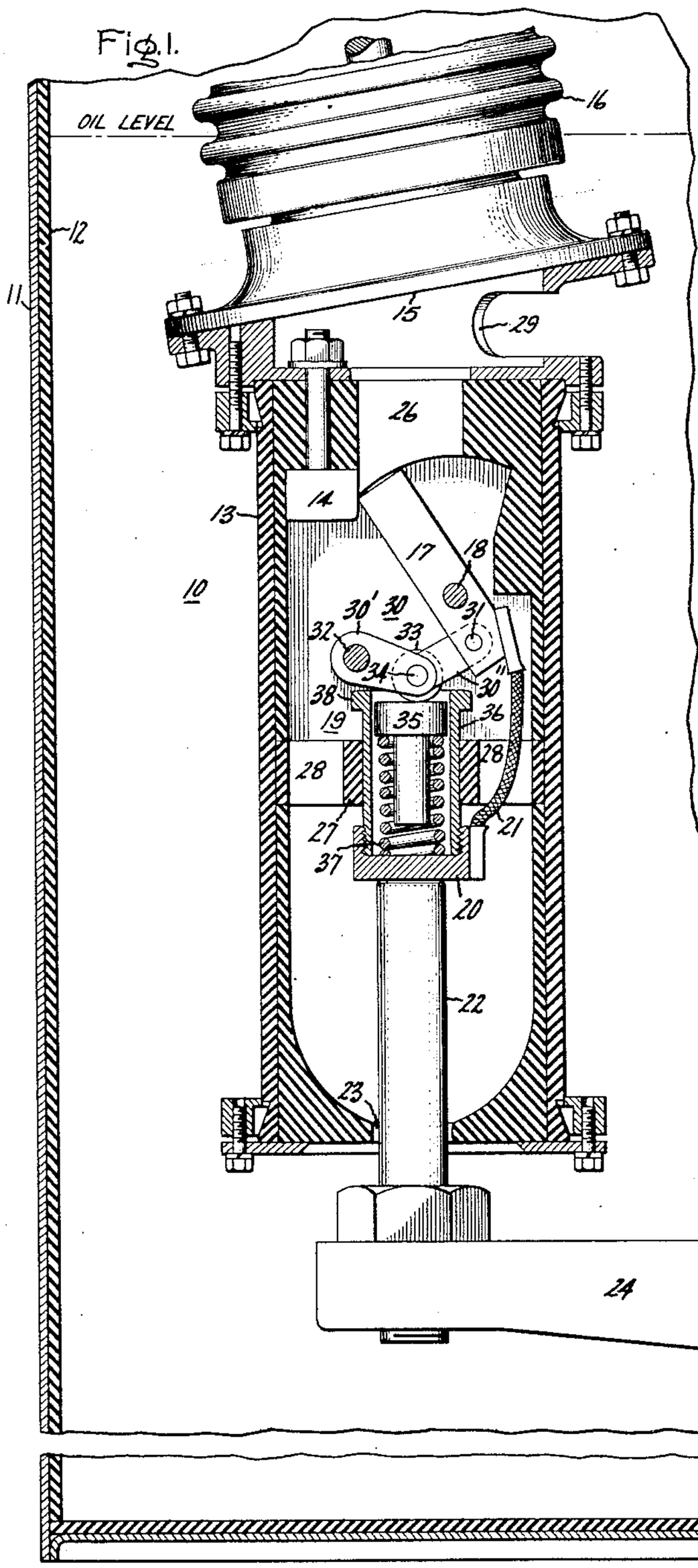


Fig. 3.

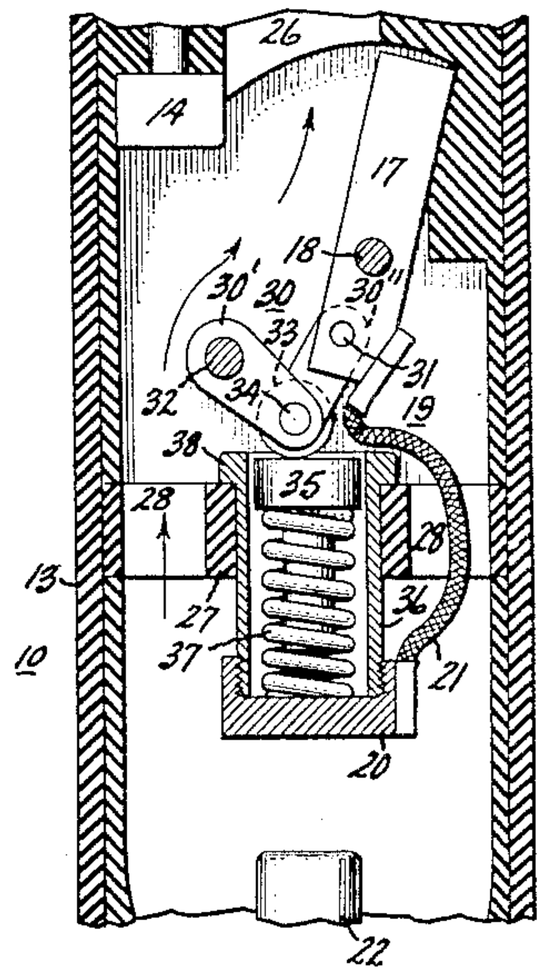
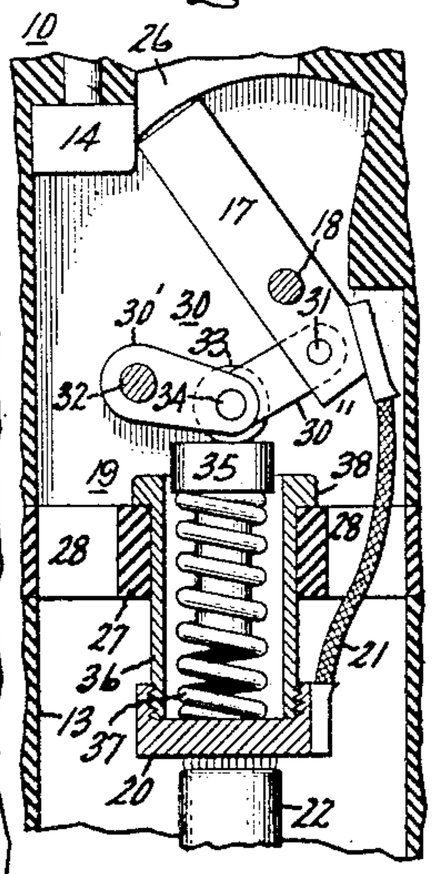


Fig. 2.



Inventor:
Edward J. Frank,
by Harry E. Dunham
His Attorney.

Patented Dec. 23, 1941 2,267,400

UNITED STATES PATENT OFFICE

2,267,400

ELECTRIC CIRCUIT BREAKER

Edward J. Frank, Yeadon, Pa., assignor to General Electric Company, a corporation of New York

Application January 30, 1940, Serial No. 316,347

5 Claims. (Cl. 200—150)

My invention relates to electric circuit breakers and more particularly to high-voltage circuit breakers of the fluid-pressure operated type.

Circuit breakers have been proposed wherein relative movement of the contacts is obtained either directly or indirectly by means of fluid under pressure. These fluid-pressure operated circuit breakers are of several types, for example, those wherein air or other fluid is maintained under pressure and controlled by valves or other suitable means both for operating the circuit breaker and for providing a fluid blast for arc-extinguishing purposes and those circuit breakers wherein a blast of fluid, such as oil, is formed within the circuit breaker at the time of circuit interruption both for producing relative movement of the contacts and also for supplying the necessary fluid blast for arc-extinguishing purposes. In many fluid-operated circuit breakers and particularly where the fluid is used to provide a fluid blast for arc-extinguishing purposes in addition to operating the circuit breaker to the open position, a reduction of fluid pressure results immediately after the initiation of the opening operation so that there tends to be a stalling of the relative movement of the contacts which prevents the satisfactory operation of the circuit breaker. This is particularly true wherein spring means are provided for returning the relatively movable contacts to the closed position after circuit interruption has been accomplished. In such cases, a decreasing fluid pressure is opposed by an increasing spring pressure whereby improper operation of the circuit breaker results with the consequent damage not only to the circuit breaker but to the associated apparatus which it is designed to protect. In accordance with my invention, the disadvantage enumerated above is eliminated.

Accordingly, it is an object of my invention to provide a new and improved electric circuit breaker which will overcome the disadvantage set forth above in connection with fluid-operated circuit breakers.

It is a further object of my invention to provide a circuit breaker of the fluid-operated type wherein the means for returning the contact to the circuit-closing position performs a dual function by also providing wiping and cushioning means for the contacts.

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 following drawing wherein Fig. 1 is an elevational view partly in section of one pole of a high-voltage electric circuit breaker embodying the present invention; Fig. 2 represents a particular step in the operation of the circuit breaker illustrated in Fig. 1; and Fig. 3 represents still another step in the operation of the circuit breaker illustrated in Fig. 1.

Although my invention is applicable to any of the fluid-operated types of circuit breakers whether the fluid be air, oil, or any other suitable fluid, I have illustrated my invention for simplicity in disclosure and description as applied to a tank-type high-voltage circuit breaker of the oil-blast type wherein pressure generated by arcing at one part of the circuit is utilized for directing a blast of arc-extinguishing fluid through a series arc at another part of the circuit, these arcs being successively formed, and more particularly as applied to a circuit breaker of the type disclosed in United States Letters Patent No. 2,134,572 granted October 25, 1938, to the assignee of the present invention upon an application of William E. Paul.

The circuit breaker illustrated in Fig. 1 comprises a unitary structure 10 embodying one pole of a tank-type oil circuit breaker which is mounted wthin a suitable tank 11 having an insulating liner 12. Tank 11 is filled with a suitable arc-extinguishing liquid, such as oil for example, to the level indicated. The unitary structure 10 which may readily be installed or removed from tank 11 comprises an insulating casing or cylinder 13 forming a pressure-confining chamber which is filled with a suitable arc-extinguishing liquid, such as oil, by virtue of the level indicated in tank 11. The breaker contact structure mounted within casing 13 comprises a fixed or terminal contact 14 electrically connected to the conducting adapter structure 15 associated with the insulating bushing 16, a gate contact 17 pivoted at 18 and normally biased by a suitable mechanism 19 into contacting engagement with the fixed contact 14, an intermediate butt contact 20 electrically connected by flexible lead 21 to gate contact 17, and a movable rod contact 22 which reciprocates within the throat 23 at the end of pressure-confining chamber 13. Movable rod contact 22 and a corresponding member associated with the other pole of the circuit breaker, not shown, are interconnected

by a bridging member 24. The bridging member 24 is operated vertically by a lift rod 25 arranged to reciprocate in the usual manner within tank 11 for opening and closing the circuit breaker.

The power circuit is completed in the closed position of the breaker illustrated in Fig. 1 through the conductor passing through insulating bushing 16, conducting adapter structure 15, fixed terminal contact 14, coacting movable gate contact 17, flexible lead 21, intermediate butt contact 20, rod contact 22, and bridge 24 which is suitably connected to the other side of the power circuit through a unitary structure similar to 10.

The upper part of casing 13 is provided with a pressure relief passage 26 within which pivoted gate contact 17 is located so as normally to close the passage. Casing 13 is divided into two parts by a barrier 27 provided with suitable openings 28. When sufficient pressure builds up within the lower part of casing 13, as will be described hereinafter, the gate contact 17 is pivoted clockwise against the pressure of biasing mechanism 19, thereby opening the power circuit. Concurrently a blast of oil is released through the chimney-like passage 26 for arc-extinguishing purposes since the only path of egress for fluid pressure generated in the lower part of pressure-confining chamber 13 prior to the withdrawal of rod contact 22 from throat 23 is through chimney 26 and out into tank 11 through opening 29 in the conducting adapter structure 15.

In order to provide a negative spring gradient or diminishing pressure mechanism relative to the opening movement of pivotally-mounted gate contact 17, mechanism 19 is provided which comprises a toggle 30 including links 30' and 30''. One end of toggle 30 is connected to pivotally-mounted gate contact 17 at 31 while the other end of toggle 30 is supported by fixed pivot 32. The knee of toggle 30 is provided with a roller 33 freely mounted on toggle knee pin 34. Roller 33 is adapted to engage with member 35 arranged to reciprocate within sleeve 36 but biased against roller 33 by means of spring 37 located within sleeve 36. Intermediate butt contact 20 is attached to the lower end of sleeve 36 and spring means 37 is confined between intermediate butt contact 20 and reciprocally-mounted member 35. Sleeve 36 is provided with a flange 38 so that it may be supported in an opening in insulating barrier 27 with respect to which it is movable. The mechanism 19, therefore, performs a dual function in that, first, it provides a wiping and cushioning effect for intermediate butt contact 20 and rod contact 22 and, secondly, provides a diminishing pressure means for opposing the opening movement of contact 17 so that there is no danger of contact 17 stalling in some intermediate position by virtue of the fact that a drop in pressure after the initial blast occurs.

The operation of the circuit breaker disclosed will be explained with reference to Figs. 1, 2 and 3 which illustrate three different positions during the operating cycle of the circuit breaker. When the circuit breaker is in the closed position, as illustrated in Fig. 1, rod contact 22 has forced intermediate butt contact 20 and, hence, also sleeve 36 upwardly to the position shown, compressing spring 37 so that the maximum spring pressure is applied against roller 33. This pressure is intensified by virtue of the near toggle attitude of links 30' and 30'' of toggle 30. Therefore, pivotally-mounted gate contact 17 is forced tightly against stationary contact 14 so as to carry continuously the breaker current.

Upon opening the breaker, lift rod 25 and bridging member 24 are moved downwardly, carrying with them rod contact 22. Spring 37 forces intermediate butt contact 20 to move downwardly with rod contact 22 for the duration of its "wipe" or travel after which flange 38 of sleeve 36 engages with barrier 27 as indicated in Figs. 2 and 3. Thereafter, rod contact 22 separates from intermediate butt contact 20 and an arc is drawn therebetween as indicated in Fig. 2. Meanwhile gate contact 17 and toggle links 30' and 30'' of toggle 30 have remained unchanged in their initial position although the spring pressure against roller 33 has decreased by an amount equivalent to the spring gradient multiplied by the "wipe" distance. As soon as an arc is drawn between intermediate butt contact 20 and rod contact 22, pressure is generated in the lower chamber below barrier 27 in casing 13. This pressure invades the upper chamber of casing 13 through relief openings 28 in barrier 27. The spring 37, toggle 30, gate area and leverages are so designed in conjunction with one another that gate contact 17 will be forced open in response to a predetermined pressure in the upper part of cylinder 13 since, until rod contact 22 is withdrawn from throat 23 of casing 13, there is no place for the pressure generated to escape except through relief passage 26 and, hence, this predetermined pressure forces gate contact 17 to the open position shown in Fig. 3, causing toggle 30 to assume the position shown thereby somewhat increasing the compression of the spring 37.

For successful interruption of the main arc between gate contact 17 and fixed contact 14, it is essential that gate contact 17, once opened, should remain so until the arc thus drawn is effectively severed by the oil blast which passes up through relief passage 26 and out into tank 11. The gate contact 17 and mechanism 19 of my invention are peculiarly adapted to serve this end for the gate contact, while opening up in response to the oil pressure generated within casing 13, is resisted by a diminishing force from mechanism 19, resulting from the behavior of toggle links 30' and 30'' of toggle 30. Considering this action, it will be noted that, during the opening of gate contact 17, roller 33 is moving downwardly to recompress spring 37. However, this increasing spring force is offset by the decreasing effective moment arm about the gate contact pivot member 18 as toggle link 30'' and the lower arm of gate contact 17 move toward their near toggle position assumed when the gate contact 17 is fully open, as shown in Fig. 3. In this position, a force equivalent to only ten to fifteen per cent of that required to initiate the opening of the gate of contact 17 is sufficient to maintain the gate contact in the fully opened position. This comparatively slight resisting force is, however, sufficient to reclose gate contact 17 after the internal pressure has subsided. Therefore, by the arrangement just described, a diminishing fluid pressure will be opposed by a diminishing closing force, thus assuring that gate contact 17 is moved to the fully open position of Fig. 3. It will, of course, be understood by those skilled in the art that rod contact 22 continues moving downwardly until it has been withdrawn from throat 23 so as to provide an isolating con-

tact for the circuit breaker. As soon as the pressure has subsided, gate contact **17**, by virtue of the force acting on toggle **30** is moved to the closed position across relief passage **26**.

While I have shown and described a particular embodiment of my invention as applied to one type of electric circuit breaker, 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, aim 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 of the fluid-blast type comprising a pressure-confining casing and a movable contact contained within said casing operable to the open position in response to a fluid blast, a source of fluid pressure for producing said blast, and a spring-biased toggle mechanism opposing the opening movement of said contact structure, said toggle mechanism being so constructed and arranged that the force opposing the opening movement of said contact structure decreases with said opening movement so that the complete opening of said circuit breaker is assured even though a decrease in said fluid blast occurs during said opening movement of said contact.

2. In an electric circuit breaker, the combination comprising a plurality of relatively movable contacts associated with a pressure-confining casing, a source of fluid pressure for producing a fluid blast to cause relative movement of said contacts for circuit-interrupting purposes, and means for opposing the opening movement of said relatively movable contacts with a diminishing force to insure that stalling of said relatively movable contacts at other than the fully open position will not occur even though a decrease in said fluid blast occurs during said opening movement.

3. In an electric circuit breaker, the combination comprising a plurality of relatively movable contacts, means likely to provide a decreasing force with time for causing a separation of said contacts for circuit-interrupting purposes, and means for opposing with a diminishing force the separation of said contacts so that complete opening of said circuit breaker is insured even though the force produced by said first-mentioned means decreases considerably during the separation of said relatively movable contacts.

4. An electric circuit breaker of the fluid pressure operated type comprising a pressure-confining casing containing an arc-extinguishing fluid and a relatively movable contact structure adapted to form two breaks in series in said fluid, means including one of said breaks for producing a fluid pressure for operating said contact structure to cause said second break, and a spring-biased toggle mechanism for opposing the operation of said contact structure and the formation of said last-mentioned break with a diminishing force, said toggle mechanism being so constructed and arranged as to provide a cushioning means for the contacts forming the first of said breaks.

5. An electric circuit breaker of the oil-blast type comprising a pressure-confining casing containing an arc-extinguishing liquid, said casing being vertically positioned and having a chimneylike exhaust passage at the upper part thereof, and relatively movable contact structure adapted to form two breaks in series in substantially vertical alignment in said liquid including a movable contact normally biased to the closed circuit position by means of a toggle mechanism which is so constructed and arranged that the force biasing said movable contact to the closed position decreases with the opening movement of said contact so that complete opening of said circuit breaker is assured, said contact being positioned in said passage so as to close the same in said closed circuit position, and means at one of said breaks for creating arc pressure in the lower part of said chamber for opening said biased contact and driving an arc-extinguishing liquid blast through said passage and the arc at that point.

EDWARD J. FRANK.