Oct. 22, 1946. F. M. TERRY 2,409,723

OIL CIRCUIT BREAKER

Filed Dec. 23, 1943

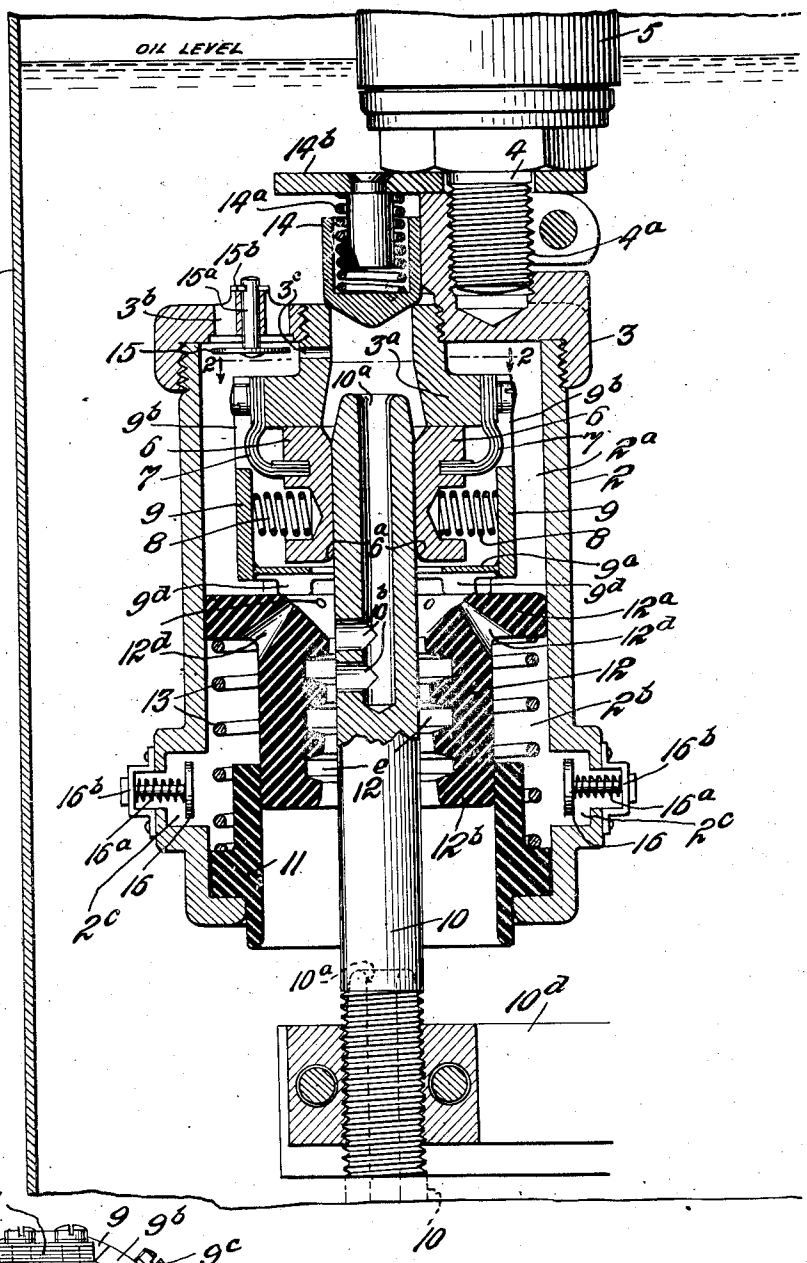


Fig. 1.

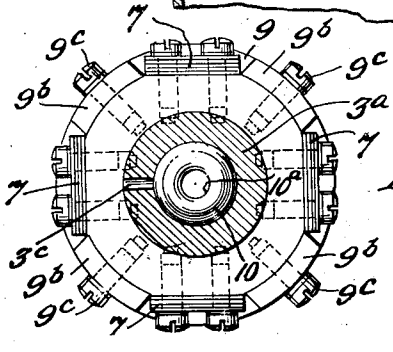


Fig. 2.

INVENTOR.
FRED M. TERRY
BY
Lawrence K. Sager
his ATTORNEY

Patented Oct. 22, 1946 2,409,723

UNITED STATES PATENT OFFICE

2,409,723

OIL CIRCUIT BREAKER

Fred M. Terry, Jackson Heights, N. Y., assignor to Realty and Industrial Corporation, a corporation of New Jersey

Application December 23, 1943, Serial No. 515,333

5 Claims. (Cl. 200—150)

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This invention relates to oil switches or circuit breakers and particularly to a contact assembly which is adapted to be immersed in oil. The improvement is adapted to be incorporated in circuit breakers of various types having any desirable form of operating mechanisms and automatic controls.

This application is a continuation in part of my pending application Serial No. 490,164, filed June 9, 1943.

In prior circuit breakers having explosion chambers, high pressure created by the arc is utilized to cause a turbulance of hot oil and vapors near the arc. The high pressure of such structures imposes severe mechanical shocks and strains on the associated parts. This is due to the large released interrupting energy which is dependent upon the duration of the arc, the arc voltage and the value of the interrupted current. This energy is transformed within the chamber into heat and pressure.

By the present improvement this arc energy is greatly decreased and the pressure and heating are reduced. This results in a minimum deterioration of the contacts and in a reduction of mechanical shock with less strain on the parts and a more quiet operation. The improved contact assembly can be used in the usual oil tank where several may be associated and also, by reason of the above advantages, the contact assembly with its enclosing explosion chamber may be individually housed in separate oil containers of small size. Such containers may be in the form of casings of tubular or cylindrical form of small diameter and may be made of insulating material as the mechanical shocks and strains imposed thereon are small. These small individual containers have the advantage of requiring only a few per cent of the amount of oil necessary in the usual tank thereby reducing the fire hazard as well as saving space and weight.

A feature of the invention relates to an improved structure whereby a comparatively small elongated passage or throat is provided through which the movable contact is withdrawn and which throat is caused to move in the direction of movement of the movable contact upon formation of the arc. In that manner an increased number of arc interruptions is caused to take place within the throat particularly in the case of light current interruptions and high voltages. And in view of the fact that the arc is extinguished most effectively in the throat, the said movement of the elongated throat serves to confine the foot portion of the arc within the throat

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during the period of the arc travel and of its existence. Also by a proper action of the oil at and within the movable throat, an improved extinguishing action is obtained.

The main object of the invention is to provide an improved contact assembly which will rapidly and effectively extinguish the arc between the contacts when the breaker is opened. Another object is to quench the arc by forcing cool oil under pressure across the arc in a direction and in a manner that will quickly extinguish it. A further object is to provide a simple and compact form of structure which may be readily assembled. Another object is to provide a structure which will be durable under long continued use and to provide a relationship of parts which will maintain good electrical contact when the breaker is closed and preserve the contacting surfaces from objectionable deterioration. Other objects and advantages of the invention will be understood from the following description and accompanying drawing showing one embodiment thereof.

Fig. 1 is a vertical section of the contact assembly showing the relationship of the various parts and showing the contacts in their closed position; and Fig. 2 is a section on line 2—2 of Fig. 1. Although only one contact assembly is shown, it will be understood that two or more may be grouped together in an oil tank and that the movable contacts of the group may be operated by a common means.

Referring to Fig. 1, a portion of the oil tank 1 is shown having an oil level approximately as indicated. The contact assembly is enclosed within a metal cylinder 2 having a threaded engagement at its upper end with a metal head 3. The device is supported by the incoming lead or conductor 4 enveloped by an insulator 5 which is supported by the cover or head of the oil tank in the usual manner. The lower end of the conductor 4 is threaded as shown at 4a and thereby engages and supports the head 3 as well as making electrical contact therewith. The stationary contact of the device is formed by a series of conducting segments 6 angularly positioned around the central axis of the cylinder. These contacts are electrically connected with an inwardly projecting terminal 3a threaded at its upper portion for engagement with the head 3, the connection being made by a series of laminated or flexible conducting strips 7. Each contact segment 6 is pressed inwardly by a spring 8 seated at one end in an opening formed in the outer side of the segment and at its opposite end

against a circular plate 9 carrying an inwardly extending plate 9a at its lower portion which extends under a portion of the contact segments 6 without limiting their freedom of yieldable movement. The ring 9 is provided with spaced downward projections 9d. The ring 9 is supported in fixed position by spaced strips 9b extending upwardly from the ring 9 and fixed at their upper ends by bolts 9c to the outer rim of the terminal 3a. The inner faces of the contact segments 6 form the contact surfaces which are engaged by the movable contact and have lower rounded edges 6a for permitting easy entrance of the movable contact when the latter is moved to its closed position. The contacts then move outwardly against the pressure of the springs 8 and thus insure good electrical engagement with the movable contact. The lower faces of the contact segments form the arcing surfaces.

The movable contact 10 is in the form of a circular rod actuated in any suitable manner and is shown in the closed position of the breaker. It is shown as having a central longitudinal opening 10a in its upper portion, although in some cases this opening may not be formed. At the lower portion of this central passage 10a are openings 10b which are angularly spaced around the rod and extend outwardly through the movable contact. The lower end of the movable contact is shown electrically and mechanically connected to a cross bar 10d in the usual manner for closing the circuit when the contact is raised to the position shown in the drawing.

The movable contact passes freely through a central opening of a base portion 11 of suitable insulating material which rests in fixed position on the lower inturned portion of the cylinder 2.

A differential piston 12 of insulating material is introduced between the base 11 and the stationary contact segments 6. The upper portion or head 12a of the piston fits slidably within the cylinder 2. A hollow cylindrical portion 12b of the piston of reduced diameter extends downwardly from the central portion of the head and slidably engages the inside circular wall of the base 11. The movable contact 10 passes freely through the central portion of the piston. A series of angularly spaced openings 12d which converge towards the center of the unit are formed in the upper portion of the piston where the cylindrical part 12b joins the piston head and these openings are inclined in a direction toward or below the lower ends of the contact segments 6. A compression spring 13 is introduced between the underside of the head of the piston and the base 11, the lower portion of the spring encircling the upper portion of the base having a reduced diameter. This spring tends to move the piston to the position shown in the drawing against the lower faces of the projections 9d formed on the lower edge of the ring 9. The interior surface of the portion 12b of the piston which forms a throat, is provided with a series of cavities or pockets shown in the form of vertically spaced circular indentations 12e forming corrugations. The piston divides the casing into two chambers or spaces, one of which 2a is the arcing chamber above the piston and the other of which 2b is an oil chamber below the piston head and between the piston and the casing.

The central portion 3a of the head 3 is provided with a central opening normally closed at the top by a pressure valve 14. A spring 14a seats at one end against the valve head and at its other end

against a supporting strip 14b fixed to a top portion of the cylinder head. A normally open vent or check valve is also located in the cylinder head at one side and is shown in the form of a disk 15 having a stem 15a passing upwardly through the head and held in place by a cross pin 15b at the upper end of the stem. The disk 15 is opposite the inner ends of a series of angularly spaced openings 3b in the head. This valve is quickly closable upon slight increase in pressure within the cylinder, being biased to its open position shown by gravity or by spring pressure. A passage 3c in the terminal 3a connects the space within the terminal with the upper portion of the interior of the casing. In the lower portion of the cylinder 2 and communicating with the space between the outside of the piston 12 and the cylinder is a series of angularly spaced openings 2c. These openings normally permit free passage of oil from the oil container to the said space but are closed by check valves 16 upon increase of pressure in said space to prevent the outward passage of oil. The valves are shown as having a disk normally held in open position by a spring 16a encircling the stem, the spring engaging the disk at one end and a cross strip 16b at its other end, the ends of the strip being fixed to the outside of the boss formed on the cylinder.

In the opening movement of the breaker, the contact 10 is moved downwardly and when it separates from the lower ends of the contact segments 6, an arc is formed between the upper end of the movable contact and the lower faces of the contact segments. This causes an increase in pressure within the enclosing casing which builds up and tends to force the differential piston downwardly against the pressure of the spring 13 and in the direction of movement of the contact 10. The result is that the foot or lower portion of the arc, particularly in the case of light current interruptions and high voltages is kept at or within the throat of the piston 12 as the contact is moved downwardly. The pressure within the cylinder tends to force the oil into the throat and the movement of the piston also causes oil streams from the oil chamber or space between the portion 12b of the piston and the cylinder 2 to be forced through the openings 12d against and across the arc at the throat. This gives an effective action on the arc throughout its travel and existence tending to extinguish it. A further favorable action occurs by reason of the oil existing in the pockets or indentations 12e between the corrugations of the interior wall of the piston. This cool oil in these pockets is not forced out by the pressure, and as the upper end of the contact 10 finally moves down through the piston and throat, the presence of this cool oil adjacent the arc further aids in smothering and extinguishing the arc. The fully open position of the contact 10 is indicated by dotted lines at the lower portion of Fig. 1; and before the upper end of the contact has passed out of the piston 12 the arc has been extinguished.

When the passage 10a and openings 10b are provided in the movable contact, an additional action takes place in that the pressure within the arcing chamber caused by the formation of the arc tends to force oil down through the passage 10a and out through the openings 10b; and when one or more of the openings 10b have passed below the portion 12b of the piston, oil is forced against the arc at the upper end of the contact and into the passage 10a and out

through the openings 10*b*. These passages in the movable contact may not be provided in some cases, as the extinguishing of the arc may be sufficiently effective without their additional action.

The arcing thus occurs in the upper arcing chamber which is enlarged in its volume as the differential piston moves downwardly for forcing the oil across the path of the arc and also occurs in the throat of the piston. The downward movement of the piston is limited by the under side of the piston head engaging the uppermost portion of the base 11. During the opening movement the check valves 16 are closed which prevents the escape of oil through them. Likewise upon increase of pressure in the upper chamber, the valve 15 is closed which prevents the escape of oil from the upper oil chamber. If the pressure in this chamber should increase beyond a predetermined amount, the relief valve 14 will open and prevent any undesirable excessive pressure increase. The greater the value of the current to be interrupted, the greater will be the pressure in the arcing chamber and the greater will be the force and more rapid the flow of the quenching oil. When the valve 14 opens upon the pressure attaining a predetermined value, this gives another outlet of the oil from the arcing chamber which increases the flow of oil across the arc. This valve thereby aids in extinguishing the arc, particularly when most needed at the interruption of high amperage. Also by centrally positioning the relief valve in the head 3 in alinement with the contacts, there is a flow of oil, when the relief valve opens, from the openings 12*d* across the arcing tips of the stationary contacts 6 and out through the central opening of the head 3. This flow of oil cools the tips of the contacts and aids in maintaining them in good condition.

After the extinguishment of the arc, the pressure in the arcing chamber is reduced as there is a free passage of the oil from this chamber through the portion 12*b* of the piston to the tank. The reduction of pressure permits the vent valve 15 to open and the gases formed in the arcing chamber and within the terminal 3*a* may then quickly escape through the openings 3*b* and 3*c*. Also upon the reduction of pressure, the spring 13 will return the piston to the position shown in the drawing against the projections 9*d*; and during this action, the check valves 16 open to permit free passage of the oil from the tank into the lower oil chamber of the casing. In the opening of the breaker, the arcing takes place between the lower faces of the contact segments 6 and the top of the movable contact and any deterioration of these surfaces due to the arcing does not affect the contact engaging surfaces between the segments and outside of the movable contact. This insures the maintenance of good electrical contact between the movable and stationary contacts when the breaker is in closed position.

Instead of using the contact assembly in the position shown, it may be used in any position; and if used in the reversed position from that shown the head 3 would then become the bottom of the cylinder instead of the top and the movable contact would then enter the top instead of from below.

Although a particular embodiment of the invention has been disclosed, it will be understood that various other modifications may be made to fulfill special requirements and conditions without departing from the scope of the invention.

I claim:

1. An oil circuit breaker comprising a stationary contact, a movable contact, an enclosing casing, a differential piston within the casing forming an oil chamber at one end of the casing and an arcing chamber at the other end of the casing, said piston having a central opening forming a throat through which the movable contact passes to engage the stationary contact, said piston also having an opening for the passage of oil from the oil chamber to the arcing chamber against the arc at said throat, said opening being directed towards said stationary contact, and said piston being movable in the direction of the movable contact in its opening movement by the pressure in the casing.

2. An oil circuit breaker comprising a stationary contact, a movable contact, an enclosing casing, a differential piston within the casing forming an oil chamber at one end of the casing and an arcing chamber at the other end of the casing, said piston having a central opening forming a throat through which the movable contact passes to engage the stationary contact, the interior surface of said throat having cavities formed therein to form oil pockets, said piston also having an opening for the passage of oil from the oil chamber to the arcing chamber against the arc at said throat, said opening being directed towards said stationary contact, so that immediately upon creation of an arc extinguishing fluid through said openings is directed thereagainst, and said piston being movable in the direction of the movable contact in its opening movement by the pressure in the casing.

3. An oil circuit breaker comprising a stationary contact, a movable contact having a passage therethrough, an enclosing casing, a differential piston within the casing forming an oil chamber at one end of the casing and an arcing chamber at the other end of the casing, said piston having an opening substantially directed at the stationary contact for the passage of oil from the oil chamber to the arcing chamber against the arc and through said passage in the movable contact and moving to increase the volume of the arcing chamber upon the formation of the arc and said piston having an additional opening for the passage of said movable contact through the piston for engagement with said stationary contact when the breaker is closed, and means for returning said piston to its initial position.

4. An oil circuit breaker comprising a stationary contact, a movable contact for making connection with the stationary contact, said movable contact having a passage therethrough, an enclosing casing, a differential piston within the casing for forming an oil chamber at one end of the casing and an arcing chamber at the other end of the casing, said piston having a series of angular openings directed towards said stationary contact for providing communication between said chambers, said piston being movable upon the formation of the arc to force the oil from the oil chamber into the arcing chamber and against the arc and through said passage in the movable contact, and means for returning said piston to its initial position.

5. An oil circuit breaker comprising a stationary contact, a movable contact for making connection with the stationary contact, said movable contact having a passage therethrough, an enclosing casing, a differential piston within the casing for forming an oil chamber at one end of the casing and an arcing chamber at the other

end of the casing, said piston having a central cylindrical portion extending from the head of the piston of smaller diameter than the head of the piston and through which cylindrical portion the said movable contact passes, said piston having a slidable engagement between the head of the piston and said casing and a slidable engagement between said cylindrical portion and an open end portion of said casing, said piston having an opening for the passage of oil and movable upon the formation of the arc to force the oil from the oil chamber through said opening in the piston into the arcing chamber and against the arc and through said passage in the movable contact, said movable contact having an outlet passage for the oil from said passage in the movable contact positioned opposite the interior of said cylindrical portion of the piston when the breaker is closed.

FRED M. TERRY.