

Oct. 12, 1937.

R. R. HOWE

2,095,441

CIRCUIT BREAKER

Filed April 25, 1934

3 Sheets-Sheet 1

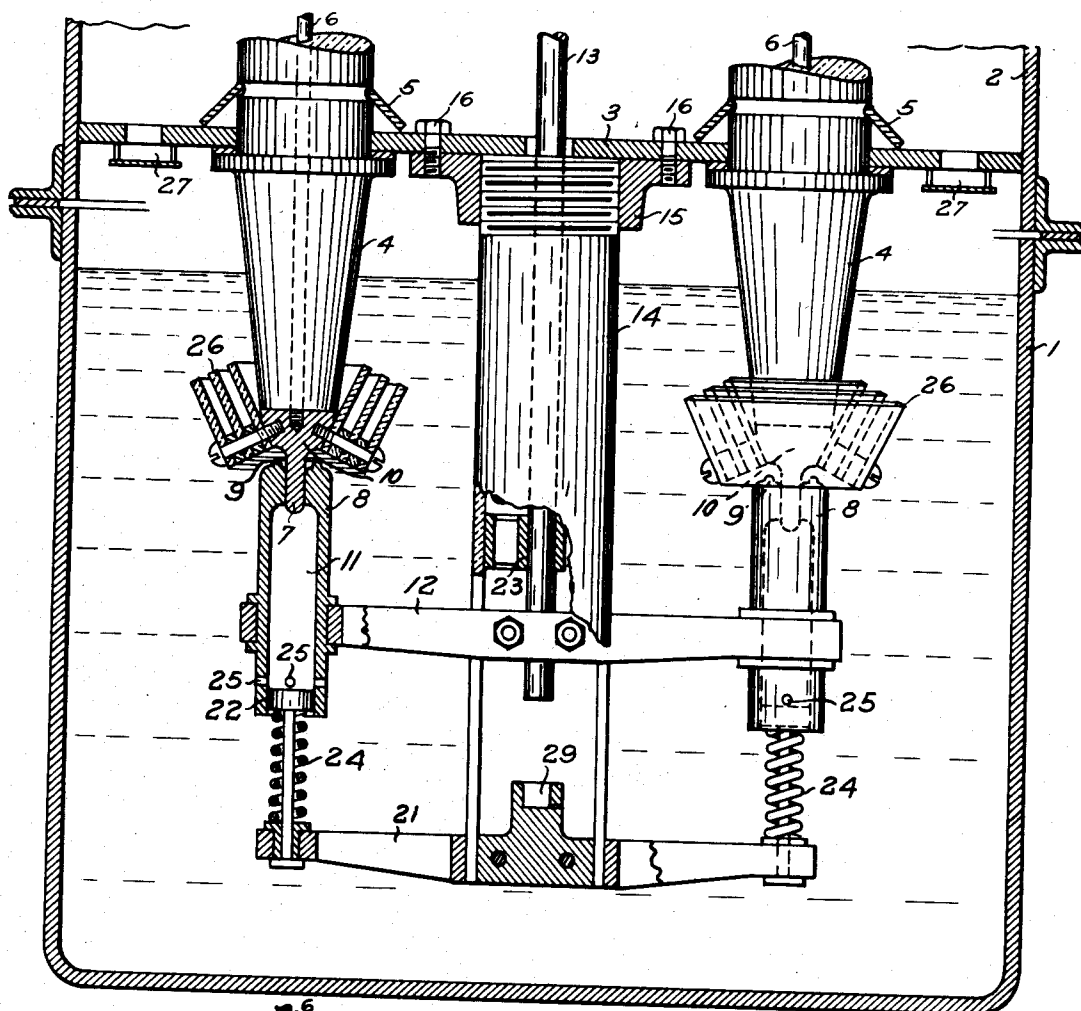


Fig. 1

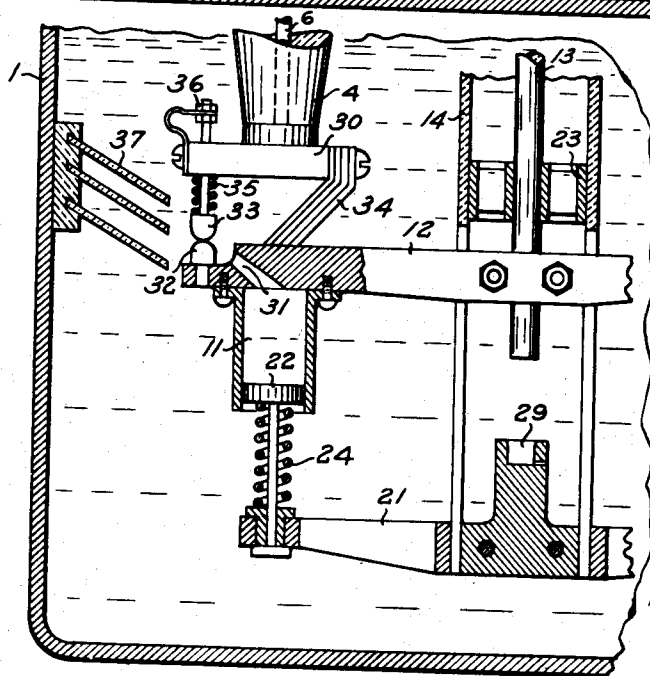


Fig. 2

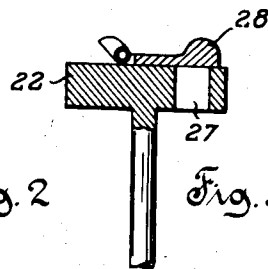


Fig. 3

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3 Sheets-Sheet 2

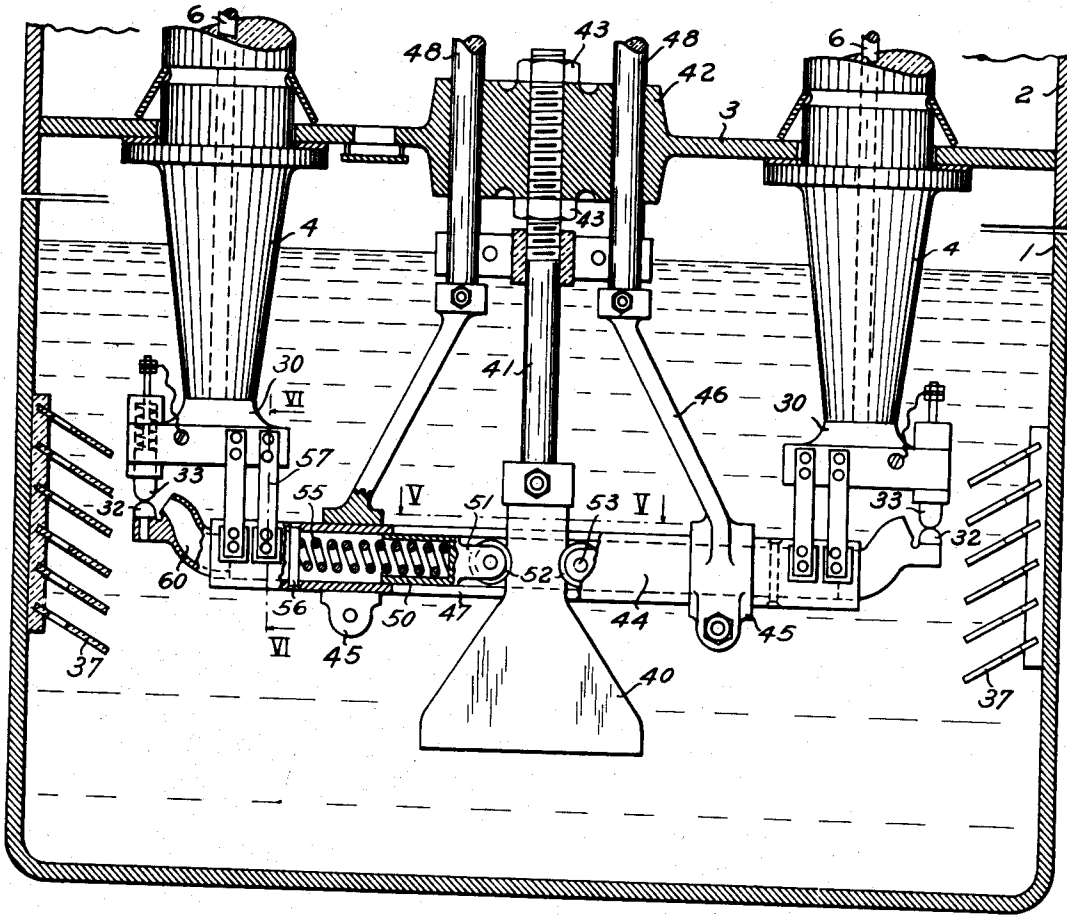


Fig. 4

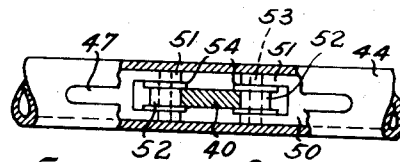


Fig. 5

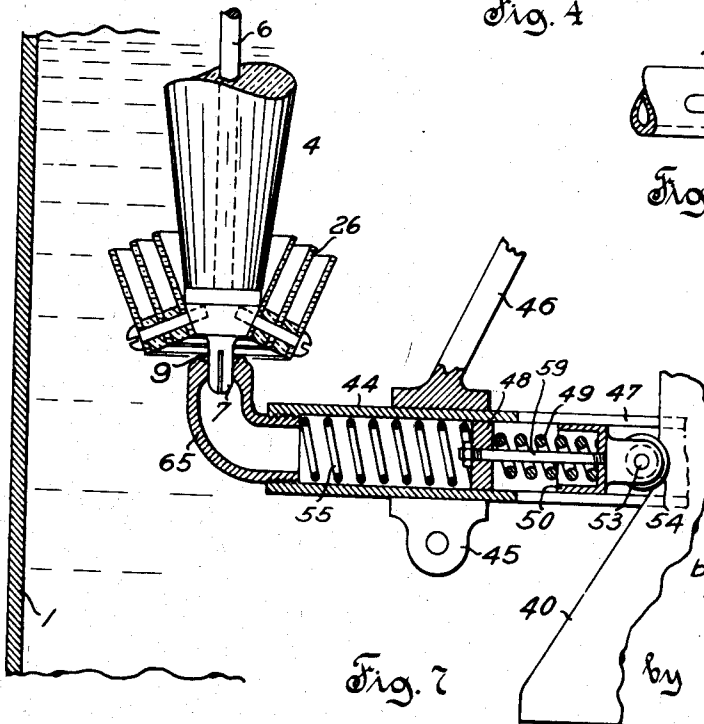


Fig. 7

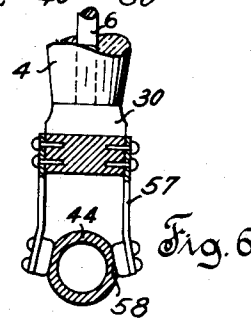


Fig. 6

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3 Sheets-Sheet 3

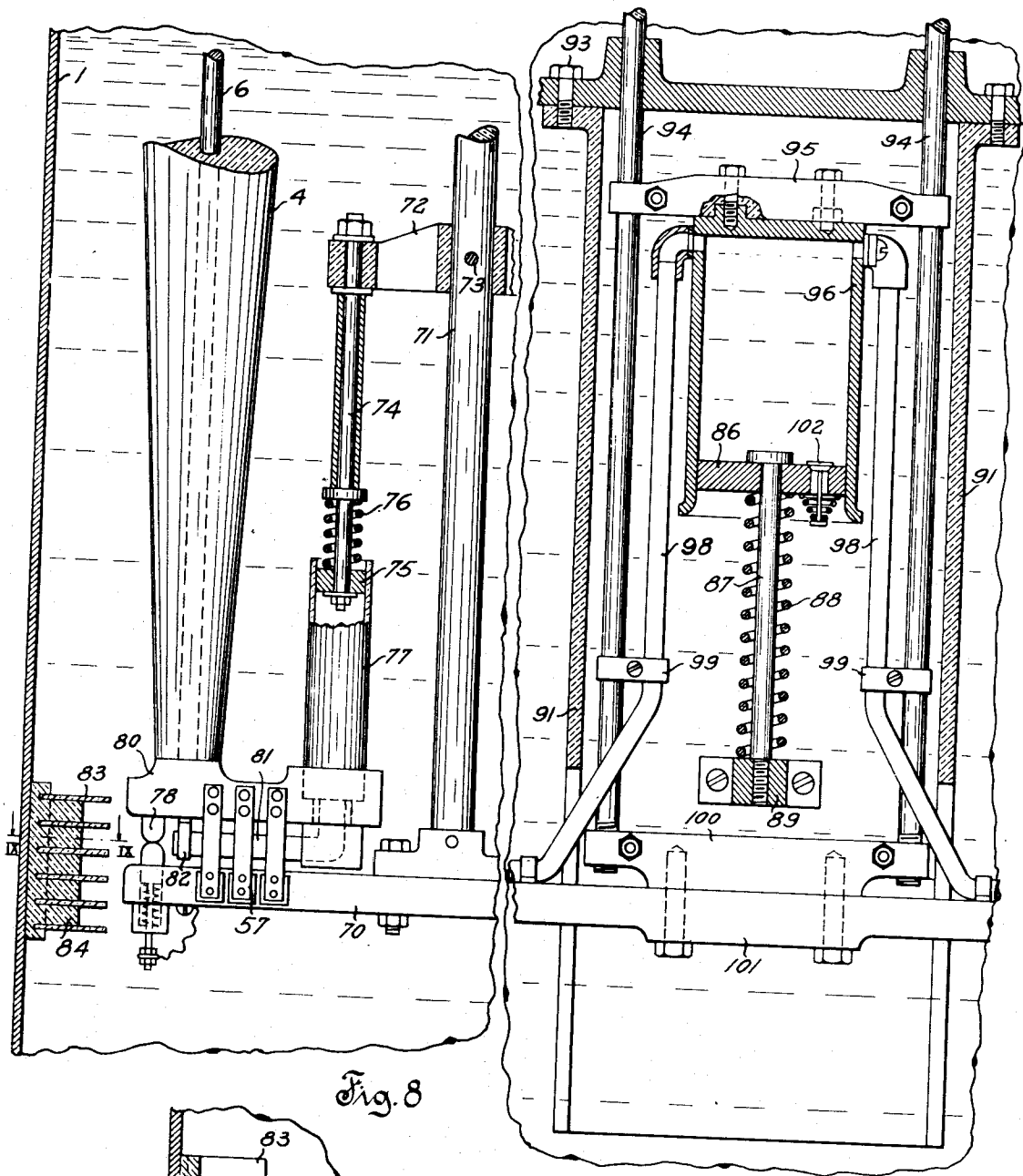


Fig. 8

Fig. 10

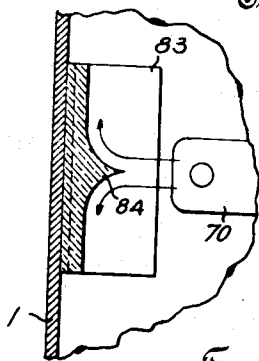


Fig. 9

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UNITED STATES PATENT OFFICE

2,095,441

CIRCUIT BREAKER

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Application April 25, 1934, Serial No. 722,305

11 Claims. (Cl. 200—150)

This invention relates in general to circuit breakers and more particularly to circuit breakers of the fluid break type which are used to interrupt circuits carrying a large amount of energy and in which the arc formed during interruption of the circuit is extinguished in oil or some similar insulating and arc extinguishing fluid.

In circuit interrupters of the above type many attempts have been made to utilize the insulating properties of clean, cool, unionized oil in extinguishing the arc, but great difficulty has been experienced in the introduction of such oil into the gap between the separating contacts at the proper time due to the blast action of the gases generated by the arc. The prior developments attempting to solve this problem have resorted to enclosure of the separating contacts, to the utilization of inefficient and cumbersome pump means, the pump elements of which attempted to push a body of oil in the general direction of the separating contacts, and to pump means in which the pump elements are under tension during the entire normal (circuit closing) condition of the interrupter.

It is, therefore, an object of this invention to overcome these difficulties and to provide an improved method of and means for introducing insulating and arc extinguishing fluid between the separating contacts of a circuit interrupter to efficiently interrupt the circuit.

Another object of this invention is to provide an improved circuit breaker in which the introduction of insulating liquid between the separating contacts may be regulated as to the direction, time of starting and acceleration of the moving liquid so that the insulating liquid available for extinguishing the arc and interrupting the circuit is used in a very efficient manner.

It is also an object of this invention to obtain the above advantages without resorting to enclosure of the separating contacts, thus allowing the generated gases to freely expand and to be easily directed away and removed from the hot arc region, and further to provide a symmetrical, well balanced structure which will divide the generated gas pressure throughout the tank and which structure is so constructed that no additional current paths are formed when the contacts are separated.

It is a further object of this invention to obtain the above advantages by means of a simple, compact interrupter in which the contact and pump means are of unitary construction, easily removable for inspection, adjustment or repair.

These and other objects and advantages are

obtained by this invention, the various novel features of which will be apparent from the drawings and description herein and will be more particularly pointed out in the claims.

Various illustrated examples of the application of this invention are shown in the accompanying drawings, in which:

Fig. 1 is an end view, partly in section and with the tank partly cut away, of a circuit breaker embodying the present invention;

Fig. 2 is a fragmentary view showing a modification of the contact arrangement of the circuit breaker of Fig. 1;

Fig. 3 is an enlarged view of the pistons used in the circuit breakers of Figs. 1 and 2;

Fig. 4 is an end view, partly in section, of another circuit breaker embodying the present invention;

Fig. 5 is a top view of the cam and roller mechanism taken along the line V—V of Fig. 4;

Fig. 6 is a section view of the contact structure taken along the line VI—VI of Fig. 4;

Fig. 7 is a fragmentary view of another embodiment of this invention utilizing a contact structure such as shown in Fig. 1 and an oil impulse means as shown in Fig. 4;

Fig. 8 is a fragmentary end view, partly in section, of another circuit breaker embodying the invention;

Fig. 9 is a top view of the baffle plates taken along the line IX—IX of Fig. 8; and

Fig. 10 is an end view of another piston arrangement which may be used with circuit breakers of this invention.

The circuit breaker shown in Fig. 1 has a tank 1 containing a body of insulating liquid such as oil. A supporting member 3 is removably mounted in the tank in any suitable manner. As shown in this figure, it may be brazed or welded in the removable cover 2. The bushing members 4 are inserted in apertures in the member 3 and are held therein by means of the clamps 5. Contact rods 6 extend through the bushing members and have attached thereto current carrying members 10 having lower portions 7 which are the stationary contacts. Cooperating with the stationary contacts 7 are movable contact members 8 having portions 9 forming arcing tips. The movable contact members 8 are formed on the upper end of cylinders 11 which are carried by a bridging member 12 which in turn is carried by an operating rod 13. The operating rod 13 is connected to contact operating mechanism not shown. A tubular member 14 of insulating material is rigidly fixed to the supporting member 55

3 as by threaded engagement with a member 15 which is attached to the member 3 as by means of bolts 16. The member 14 carries at its lower end a cross member 21 carrying pistons 22 which cooperate with the cylinders 11 to force fresh cool oil between the separating contacts as more fully described hereinafter. The member 14 has a guide member 23 for the contact operating rod 13 and is slotted at its lower end to allow for movement of the bridging member 12.

The pistons 22 are slidably connected to the cross member 21 being biased upwardly by springs 24. By selection of a biasing spring of the proper strength, a predetermined pressure is exerted on the oil or other insulating liquid in the cylinders 11 previously to its introduction between the separating contacts. Further, the slidable connection of the pistons 22 to the cross member 21 insures opening of the contacts upon movement of the operating rod 13, regardless of whether or not the piston becomes jammed in the cylinder, the oil outlet at the top of the cylinder becomes clogged, or any such disabling of the pump means which would otherwise prevent opening of the contacts. Bleeder holes 25 are cut in the lower part of the cylinders 11 to allow refilling of the cylinder 11 upon contact closing movement thereof. Concurrently mounted on the members 10 are frusto-conical plates 26 which direct the arc gases and hot oil upwardly away from the contacts and which extract heat therefrom. Vents such as 27 allow the gases to escape. Pistons 22 have apertures 27 and valve members 28, which, as shown in Fig. 3, allow oil to flow into the cylinders 11 upon upward movement thereof to the contact closing position.

Upon contact opening movement of the operating rod 13, the bridging member 12 and cylinders 11 are moved downwardly. When the contacts 8 have moved past the tips of the contacts 7, arcs are drawn which transfer to the arcing tips 9. Upon first movement of the cylinders springs 24 are compressed, storing up energy so that when the arcs are drawn the oil in the cylinders 11 is forced with a high velocity out of the cylinders and through the arcs. The hot oil and arc gases in the region of the separating contacts are forced through the cooling plates 26, thus drawing cool oil from the bottom of the tank toward the region of the separating contacts. It is thus seen that a body of clean fresh cool oil is forced between the separating contacts as soon as the arc is drawn which at the time of zero current will extinguish the arc and interrupt the circuit.

Due to the symmetrical arrangement of the cylinders 11 and piston members 22, unequal stresses on the contact operating mechanism are avoided and the generated pressures are more evenly divided through the tank. Upon reclosing of the contacts, the cylinders 11 are filled with fresh oil through the apertures 27 and 25 and are thus ready for the next operation. A dash pot mechanism 29 operates in conjunction with the lower end of the rod 13 to avoid a heavy shock upon opening of the circuit.

An important feature of the invention is the unitary construction of the contacts and pump means so that by merely removing the supporting member 3, which is done in the interrupter of Fig. 1 by removing the cover, or by dropping the tank therefrom, the entire unit is available for inspection, repair or adjustment.

The circuit breaker shown in Fig. 2 has a piston 22 and a cylinder 11 operating in much the

same manner as shown in Fig. 1. The bridging member 12 has a slot 31 which directs a stream of oil from the cylinder 11 against and past a contact 32 which is carried by the bridging member 12. Bushing member 4 carries a conducting member 30, connected to the contact rod 6, which carries an arcing contact 33 and a current carrying contact 34. The contact 33 is biased downwardly by a spring 35 and its movement is limited by a stop member 36. Directing and cooling plates 37 direct the movement of the oil and arc gases upwardly away from the contact region and absorb heat therefrom.

Upon downward movement of the bridging member 12 contact between the bridging member 12 and the contact 34 is first broken, the contact 33 remaining in contact with contact 32 until the stop member 36 engages member 30. Upon further movement of the bridging member 12 contacts 32 and 33 separate and an arc is drawn. The first downward movement of the bridging member 12 and cylinder 11 compresses a spring 24 and starts movement of the oil in the cylinder 11 through the slot 31 across the contacts 32, 33 into the cooling plates 37. Thus the movement of the oil has started before actual breaking of the contacts 32 and 33 so that upon the drawing of the arc, cool oil is forced at a high velocity across the moving contact 32 and the arc is extinguished at the time of zero current. The slot 31 is placed in the bridging member 12 so that the stream of oil not only envelopes the moving contact 32 but is in such angular direction that the arc gases and hot oil are blown upwardly away from the moving contact, and sufficient cool unionized oil is introduced between the separating contacts to insulate them at a time of zero current thus extinguishing the arc.

In the embodiment of the invention as shown in Figs. 4, 5 and 6 the supporting member 3 has an enlarged portion 42 which adjustably carries a rod 41 threaded at its upper portion. The rod 41 is held in position by the adjusting nuts 43. Depending from the rod 41 is a cam 40 connected thereto in any suitable manner such as shown by a nut and bolt. The contact bridging member comprises a cylindrical tube 44 carried by arms 46 in some suitable manner so as to be movable therewith as by means of clamps 45. The arms 46 are connected to the operating rods 48 slidably mounted in the enlarged portion 42 of the supporting member. The cylinder 44 has a slot 47 therein through which the cam member 40 extends, so that it may cooperate with rollers 52 of pistons 50. The pistons have bifurcated ends 51 carrying the rollers 52 by means of pins 53, the rollers being flanged as shown at 54 riding over the edges of the cam member 40 so that downward movement of the cylinder 44 imparts longitudinal movement to the pistons. The pistons 50 are biased toward the cam by means of springs 55 held by a stop member such as 56. The contact rods 6 have connected thereto current carrying members 30 which carry the current carrying contact members 57, as shown more clearly in Fig. 6, so that their contact faces cooperate with flattened portions 58 of the cylinder 44. The member 30 also carries a spring biased arcing contact 33 electrically connected thereto. In the end of the cylinder 44 is a nozzle member 60 so shaped that the oil will be forced out of the cylinder in the direction and at a velocity which will most efficiently extinguish the arc. By proper adjustment of the cam member 40 in the member 42 the movement of the oil may

be started simultaneously with or at a time before the breaking of the contacts 33 and 32. By suitably shaping the face of the cam member 40 the desired acceleration of the piston 50 may be attained. Also due to the shape of the cam face the tendency for the breaker to reclose due to the blast action of the arc on the piston is minimized.

As shown in Fig. 7 a cam and piston arrangement shown in Fig. 4 may be applied to contact mechanisms such as shown in Fig. 1. In this figure a nozzle member 65 is threaded into the cylinder 44 providing a stop for the spring member 55. Upon opening of the contacts an arc is drawn between the arcing tip 9 and the fixed contact 7 which is immediately extinguished by the action of the oil forced out of the nozzle at a high velocity across the arc.

Fig. 7 further illustrates how the embodiment of the invention as illustrated in Fig. 4 may be modified to include the safety feature of the invention. The piston 50 has an auxiliary piston 48 slidably held on the rod 59 and biased away from the piston 50 by means of a spring 49. A predetermined pressure is therefore applied to the oil in the nozzle 65 at the time of separation of the contacts. The opening of the contacts, upon movement of the contact operating rods 46, is insured regardless of a possible disabling of the piston 48 or clogging of the oil flow. In the interrupters as shown in Figs. 4 and 7, the cam member 40 may be fixed to the bottom of the tank rather than to the supporting member 3 as shown.

In the embodiment of the invention as shown in Figs. 8 and 9, the bridging member 70 is connected to the operating rod 71, carrying a cross member 72 connected thereto as by a pin 73. Depending from the cross member 72 are rods 74 carrying pistons 75 slidable thereon which cooperate with cylinders 77 to produce an impulse of oil upon contact opening movement of the rod 71. Current carrying contacts 67 connect the bridging member 70 with the member 80 when the breaker is in closed position. Extending from the cylinder 77 to the fixed contact 78 is a pipe 81 held by a clamp 82, the pipe and clamp being of insulation if necessary to prevent the arc from jumping across between the pipe or clamp and the bridging member 70. Directing and cooling plates 83 are connected with the tank side wall but insulated therefrom and are held in spaced relation by spacer members 84 which direct the oil away from the arcing region as shown by the arrows in Fig. 9. Upon movement of the operating rod 71, the piston 75 first compresses the spring 76 and is then forced downwardly into the cylinder 77. Cool oil is thus forced at a high velocity out of the pipe 81 across the fixed contact 78 and the hot oil and arc gases are directed away from the arcing region by the plates 83. Thus the arc drawn is blown off the fixed contact 78 and the circuit is interrupted. The methods as shown in Figs. 2 and 4 wherein the stream of oil is directed against the moving contact and the method shown in Fig. 8 wherein the stream of oil is directed against the fixed contact may be combined to obtain a more efficient circuit interruption.

In the embodiment shown in Fig. 10 a single cylinder and piston are used to supply the impulse for introducing the jets of oil for both sets of breaking contacts (not shown). The piston 86 is biased upwardly by a spring 88 and is slidably carried on a rod 87 suitably fixed to a member

89 carried by a tubular member 91 of insulating material. This tubular member is flanged at its upper end and fastened to the cover member as by studs 93. The operating mechanism rods 94 are connected by an upper cross member 95 which carries a cylinder 96. Pipes 98 which lead the oil to the contacts are connected to the upper end of the cylinder and are clamped to the rods 94 by means of clamps 99. A lower cross member 100 carries the bridging member 101 which carries the moving contact members. Valve member 102 is supplied for the piston so that the cylinder may refill with oil when it moves upwardly.

It is to be understood that changes may be made in the embodiments of the present invention described and illustrated by those skilled in the art without departing from the spirit of the invention or from the scope of the following claims.

It is claimed and desired to secure by Letters Patent:

1. In a circuit interrupter, the combination of a tank containing arc extinguishing liquid, a supporting member removably mounted in said tank, a plurality of bushings carried by said supporting member, a plurality of contact members carried by said bushings, a bridging member, contacts carried by said bridging member and cooperating with said contact members to make and break a circuit, bridging member operating means extending through said supporting member, a stationary member rigidly depending from said supporting member, and means including a piston and cylinder forming pump elements providing for the flow of a jet of arc extinguishing liquid between said contact members and said contacts upon separation thereof, one of said pump elements being carried by said stationary member and the other of said pump elements being carried by said bridging member.

2. A circuit breaker of the impulse type comprising a casing containing arc extinguishing liquid, a supporting member removably mounted in said casing, bushings carried by said supporting member, contact members carried by said bushings, a bridging member having contacts cooperating with said contact members to form two breaks in series, a cam member depending from said supporting member, means whereby said cam member cooperates with said bridging member previously to and during the separation of said contacts and contact members for forcing said arc extinguishing liquid under pressure across the arcing surfaces of said contacts.

3. In a circuit interrupter of the impulse type in which the circuit is made and interrupted by a plurality of pairs of serially connected contacts immersed in a tank of insulating liquid, the combination of a tubular bridging member carrying one of each of said pairs of contacts, a plurality of pistons in said bridging member, means including a cam whereby said pistons cause movement of said insulating liquid within said bridging member upon contact opening movement thereof and nozzle means for regulating the direction and velocity of said moving insulating liquid so that it will be forced across the arcing surfaces of said contacts and extinguish the arcs.

4. In a circuit breaker, the combination of a tank containing insulating and arc extinguishing liquid, a plurality of pairs of contacts immersed in said liquid, a tubular bridging member carrying one each of said pairs of contacts and connecting the same in series, a plurality

of pistons operable within said bridging member, cam means for operating said pistons at a predetermined velocity and acceleration upon contact opening movement of said bridging member to cause movement of said liquid, and means for regulating the direction and velocity of said movement of said liquid so that upon separation of said pairs of contacts and the drawing of an arc therebetween said liquid is forcibly introduced between the separating contacts thereby displacing the hot liquid and arc gases and removing them from the contact region.

5. A circuit breaker comprising a tank containing arc extinguishing liquid, a plurality of pairs of coacting contacts immersed in said liquid, a bridging member serially connecting said contacts, a supporting member mounted in said tank, a stationary insulating member depending therefrom, a piston carried by and movable relative to said stationary member, a cylinder movable with said bridging member and cooperating with said piston and means including an aperture in said cylinder whereby said liquid is forcibly introduced across the arcing surfaces of said contacts.

6. In a circuit breaker the combination of a tank containing insulating liquid, a plurality of pairs of coacting contacts immersed in said liquid, a supporting member removably mounted in said tank, a stationary member of insulating material depending from said supporting member, slots in said stationary member, a conducting bridging member extending through said slots and serially connecting said pairs of contacts, a plurality of cylinders carried by said bridging member, and means including a plurality of pistons associated with said stationary member and cooperating with said cylinders to drive said liquid between said contacts upon separation thereof.

7. In a circuit interrupter of the impulse type in which the circuit is made and interrupted by a plurality of pairs of serially connected coacting contacts immersed in a tank of arc extinguishing liquid, the combination of means for supporting one of each of said pairs of contacts, means for actuating the other of each of said pairs of contacts, means including a piston and cylinder immersed in said liquid for forcing a jet of said liquid between said contacts upon separation thereof and means whereby said contact supporting means, said contact actuating means and said piston and cylinder means are removably supported in said tank as a single unit.

8. A circuit breaker comprising a tank containing arc extinguishing liquid, a plurality of pairs of coacting contacts immersed in said liquid, a bridging member serially connecting said contacts, a supporting member mounted in said

tank, a stationary insulating member depending therefrom, a piston carried by said stationary member, a cylinder movable with said bridging member and cooperating with said piston, means including said piston and said cylinder whereby said liquid is forcibly introduced across the arcing surfaces of said contacts, and means operable upon failure of operation of said liquid introducing means for causing said piston to move relative to said stationary member.

9. In a circuit interrupter of the impulse type in which the circuit is made and interrupted by a plurality of pairs of serially connected contacts immersed in a tank of insulating liquid, the combination of a tubular bridging member having an opening at each end thereof and carrying one of each of said pairs of contacts at each said opening, a plurality of pistons in said bridging member, and means including a cam operable upon the contact opening movement of said bridging member for actuating said pistons to cause movement of a portion of said liquid through said openings.

10. A circuit interrupter comprising a casing containing arc extinguishing liquid, a plurality of pairs of fixed and movable contacts cooperating to draw an arc in said liquid, a movable bridging member supporting and electrically connecting said movable contacts, a stationary member removably supported in said casing, pump means for forcibly introducing said liquid across the arcing surface of one of said contacts, said means including relatively movable elements, one of said elements being carried by said stationary member and another of said elements being carried by said movable bridging member, and means operative under abnormal conditions for operatively disabling said pump means so as to permit separation of said contacts.

11. A circuit interrupter comprising a casing containing arc extinguishing liquid, a plurality of pairs of fixed and movable contacts cooperating to draw an arc in said liquid, a movable bridging member supporting and electrically connecting said movable contacts, a stationary member removably supported in said casing, pump means for forcibly introducing said liquid across the arcing surface of one of said contacts, said means including relatively movable elements, one of said elements being carried by said stationary member and another of said elements being carried by said movable bridging member, and means for resiliently connecting one of said elements to its supporting member whereby said element is biased in the direction of movement thereof relative to the other of said elements.

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Deceased.