Aug. 25, 1931. R. RÜDENBERG 1,820,710

HIGH SPEED OIL CIRCUIT BREAKER

Filed April 9, 1927

Fig.1.

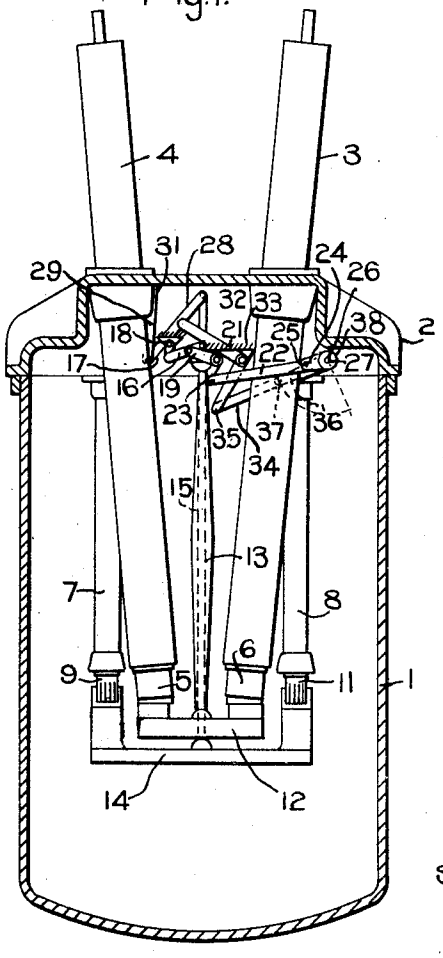


Fig.2.

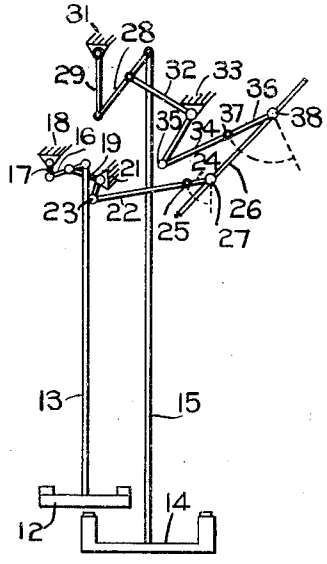
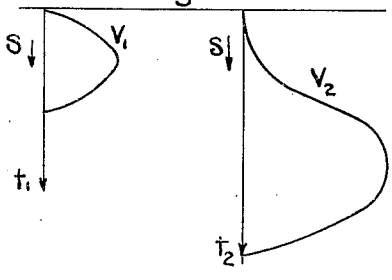


Fig.3.



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UNITED STATES PATENT OFFICE

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HIGH SPEED OIL CIRCUIT BREAKER

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My invention relates to circuit interrupters and particularly to the high-speed contact members therefor.

One object of my invention is to provide a circuit interrupter with main and auxiliary contact members that shall open a circuit at high speed.

Another object of my invention is to provide the main and auxiliary contact members of a circuit interrupter with independent supporting and actuating mechanisms.

A further object of my invention is to provide a common operating member for transmitting motion to the independent actuating mechanisms that operate the contact members.

In any circuit-opening device having main and auxiliary contact members, the main contact members are arranged to completely open before the auxiliary or arcing contact members are separated. This sequence of operation eliminates arcing from the main contact members on opening, so that a good contact surface therebetween in the closed position is guaranteed.

Heretofore, the arcing and main contact members of an oil-immersed circuit interrupter have been supported on a single lift rod and resiliently connected to each other in such manner that the main contact members open first and are followed by the arcing contact members. This required a very heavy member for the main moving contacts with the additional hinged or otherwise flexible supports for the auxiliary contact members together with the necessary biasing elements to assist in the speed of opening of the said auxiliary contact members. The inertia of the heavy moving contact members, with the resistance offered by the biasing means, opposes the initial opening movement of the contact members and retards their speed of separation.

In order to obtain a high rate of opening speed, the moving masses must be as small as possible. It is for this reason that my invention employs separate lift-rods for the contact members, whereby the contact members themselves constitute the greatest mass of material to be moved. This is especially true of the main contact members which must be of relatively large area in order to reduce the temperature rise therein. If a linkage mechanism is provided, in accordance with the present invention, between the main and the arcing contact members, it is necessary to use only relatively small accelerating and retarding forces for the heavy main contact members, and the relatively light arcing contact members may be moved much faster than would otherwise be the case.

In practicing my invention, different lever systems, connected to a common actuating means, are employed for the two sets of contact members. Relative rate of speed and sequence of movement in the two sets of contact members is obtained by the predetermined selection of the fulcrum points and the relative length of the connecting links and levers of the lever systems.

In the accompanying drawings,

Figure 1 is a view of a circuit interrupter showing the main and auxiliary contact members and operating levers with the tank and cover in sections.

Fig. 2 is a schematic view of an arrangement of the operating levers in prospective, and

Fig. 3 is a time curve comparing the relative speed and time of opening of the main and auxiliary contact members.

Referring to Figures 1 and 2 of the drawings, my invention comprises, in general, a tank 1 having a cover 2 thereon, main contact bushings 3 and 4 mounted in the cover 2 and having their ends disposed within the tank 1 and terminating in the stationary main contact members 5 and 6. The supporting members 7 and 8 for the stationary auxiliary

contact members 9 and 11 are electrically connected in parallel circuit with the bushings 3 and 4.

The stationary main contact members 5 and 6 are bridged by the main contact member 12, that is supported by its lift-rod 13. The stationary auxiliary contact members 9 and 11 are bridged by the auxiliary contact member 14 that is likewise supported by its lift-rod 15. The main contact member 12 is of much greater bulk than auxiliary contact member 14, as the load is carried continuously by the former when the circuit interrupter is in operation. The auxiliary contact member 14 is much lighter and is utilized to rupture the circuit and arc incident to the opening of the circuit interrupter after the main contact member 12 is completely opened, thereby protecting it from damage due to arcing.

The lift-rod 13 for the main contact member 12 is pivotally supported on one end of a link 16 that is hingedly supported at its other end to a link 17 that is flexibly suspended from a fulcrum 18. A bell-crank 19 is pivotally supported at a fulcrum 21 and has one arm pivotally disposed near the mid-point of link 16. The other arm of the bell-crank 19 is hingedly attached to the end of a link 22 at the point 23. The other end of the link 22 is attached to the end of an arm 24 at point 25, the arm 24 being rigidly supported by a shaft 26 at the point 27. The points 23, 25 and 27 are in line, as shown on the drawings, thereby constituting a holding toggle to retain the main contact member in the operating or closed position.

The lift-rod 15 for the auxiliary or arcing contact member 14 is supported by a similar mechanical arrangement in which the lift-rod 15 is hingedly attached to a link 28 that has its other end pivotally supported by a flexible suspension link 29 that, in turn, has its other end pivotally disposed on the fulcrum 31.

Bell-crank 32 is pivoted on a supporting fulcrum 33 and has one arm pivotally disposed on a link 28 in proximity to its mid-section. Another arm of the bell-crank 33 is hingedly connected to a link 34 at a point 35. The other end of the link 34 is pivotally attached to an arm 36 at a point 37. The arm 36 is rigidly supported on the shaft 26 at a point 38. The points 35, 37 and 38, being in line in the closed position of the circuit interrupter, constitute a toggle for retaining the secondary arcing contact 14 in the operating position of the circuit interrupter.

Assuming the circuit interrupter 1 to be in the closed position shown in Fig. 1, the contact members 12 and 14 are held in their closed positions by the toggles constituted by the link 22 and the arm 24 and by link 34 and arm 36 having the points 23, 25 and 27 in the former and the points 35, 37 and 38 of the latter in a direct line.

Upon a counter-clockwise movement of the shaft 26, the points 25 and 37 of the arms 24 and 36 are moved out of line with the points 23, 25 and 35, 38, respectively, and the contact members 12 and 14 are released. A further turning movement of the shaft 26 operates the links 22 and 34, the bell-cranks 19 and 32 and the links 16 and 28 which, in turn, completely opens the contact members 12 and 14 by the movement of the lift-rods 13 and 15.

By a predetermined choice of the lengths of the arms 24 and 36, the bell-crank 19 and 32, the links 22, 34, 16 and 28, and of the positions of the fulcrums 18, 21, 31 and 33, the relative speed and sequence of operation of the contact members 12 and 14 may be predicted. The arrangement, chosen for the Figures 1 and 2 of the attached drawings, is graphically shown in Fig. 3 in which S is the distance passed over, and V1 and V2 the speed of opening of the main and auxiliary contact members, respectively. It will be seen that the main contact member 12 has an opening speed V1 that increases quickly to a maximum value while the opening speed V2 of the auxiliary contact member 14 remains small as long as the main contact member 12 is being accelerated. During this time, the initial movement of the auxiliary contact member 14 is small and will not be sufficient to permit its separation from the stationary auxiliary contact members 9 and 11 until after the main contact member 12 has completely parted from the main stationary contact members 5 and 6. After the separation of the main contact member 12, the auxiliary contact member 14 becomes accelerated, as represented by curve V2 in Fig. 3 of drawings, to quickly separate from the auxiliary contact member 9 and 11, thereby interrupting the circuit, in circuit interrupter 1, at high speed without damage to the stationary or moving contact members 5, 6 and 11.

Accordingly, my invention overcomes the difficulty experienced in circuit interrupters that have the speed of opening of the contact members retarded because of the inertia of the masses of the contact members and the operating mechanism. By the use of individual lift rods, the contact members that I employ are made of lighter material, the heaviest part of which will be the main contact member, the size of which is limited to a sufficient cross-sectional area to prevent its heating while in operation. By using separate systems of transmission levers to operate the different lift rods and by keeping the moving masses of the circuit interrupter as small as possible, I am able to obtain any sequence or relative speed in the operation of the main and auxiliary con-

tact members. By choosing the lengths of the links and bell-crank arms, as in Figures 1 and 2 of the attached drawings, I am able to obtain quick opening of the main contact member and a high speed of operation of the auxiliary contact member, resulting in the interruption of the circuit at high speed without damage to the main stationary contact member or to the main moving contact member.

It is to be understood that such changes in the formal arrangement and connection of the component parts of my invention may be made as shall fall within the scope of the appended claims.

I claim as my invention:

1. In a circuit interrupter, the combination with separate supporting means for main and arcing contact members, independent leverage means for connecting the supporting means to a common transmission mechanism, whereby the operation of the main and arcing contact members occurs in a predetermined sequence of movement and speed by means independent of each other.

2. In a circuit interrupter, the combination with separate supporting means for main and arcing contact members, a plurality of lever systems for independently connecting the supporting means to a common transmission mechanism, whereby the operation of the main and arcing contact members occurs in a predetermined sequence of movement and speed by lever systems that are independent of each other.

3. In a circuit interrupter, the combination with separate supporting means for main and arcing contact members, a plurality of linkage systems comprising separate mechanical elements for independently connecting the supporting means to a common transmission mechanism, whereby the operation of the main and arcing contact members is accomplished by the linkage systems that are independent of each other.

4. In a circuit interrupter, the combination with main and arcing contact members and independent lift rods for their support, a plurality of systems of mechanical elements joining the independent lift rods to a common operating means, whereby the main and arcing contact members are operated independently and relatively to each other by the common operating means.

5. In a circuit interrupter, the combination with main and arcing contact members and independent lift rods for their support, mechanical elements forming distinct lever systems connected to each of the lift rods, an energy-transmission mechanism common to the lever systems, whereby, upon the actuation of the energy transmission mechanism, relative movements in sequence and speed are imparted to the main and arcing contact members.

6. In a circuit interrupter, the combination with main and arcing contact members, a separate lift rod for their support, a transmission mechanism having independent mechanical means associated therewith for operating each of the separate lift rods independently of each other whereby the contact members operate in a relative sequence with predetermined speeds.

In testimony whereof, I have hereunto subscribed my name this 1st day of March 1927.

REINHOLD RUDENBERG.