H. R. STUART.

CIRCUIT INTERRUPTER.

APPLICATION FILED FEB. 6, 1906.

981,816. Patented Jan. 17, 1911.

Fig. 1.

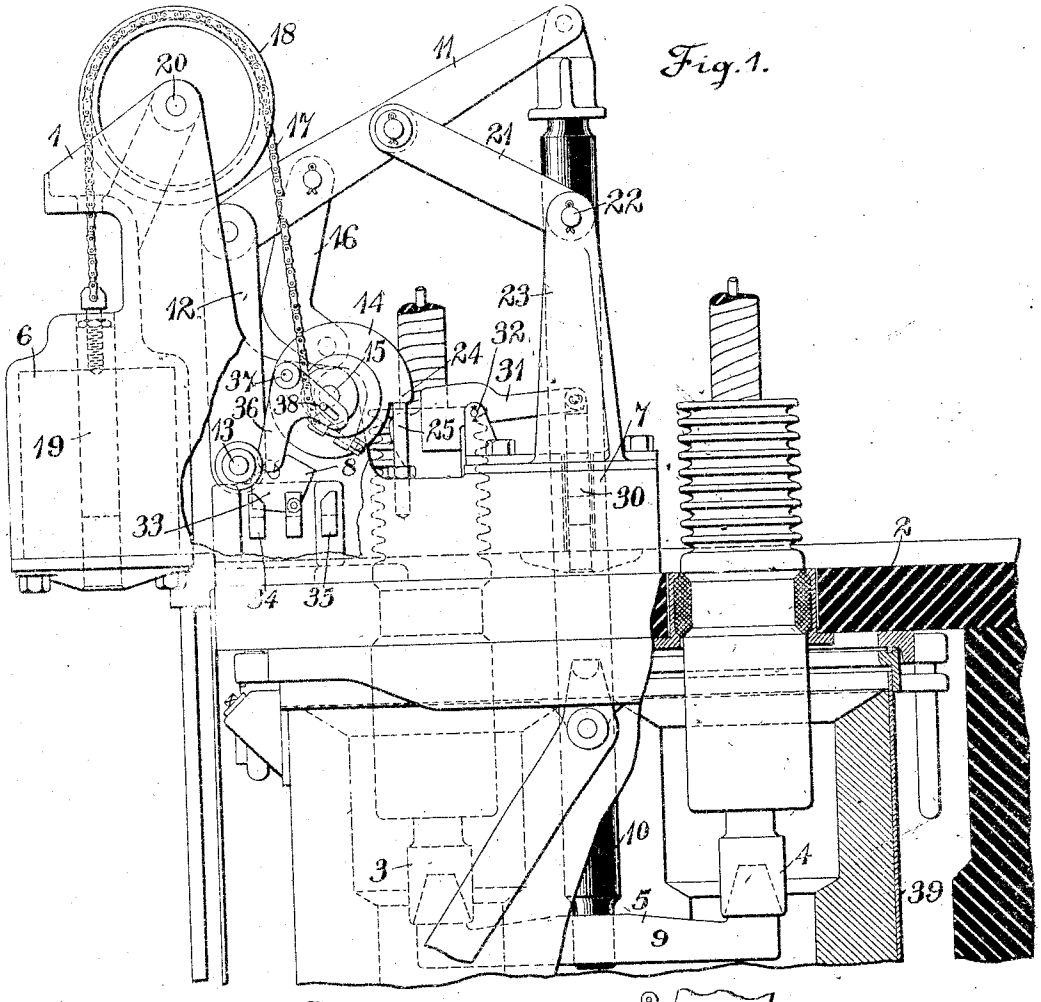


Fig. 2.

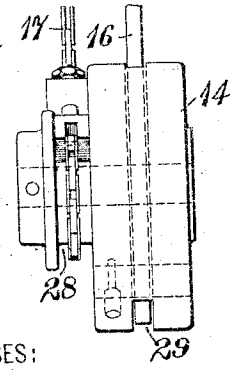
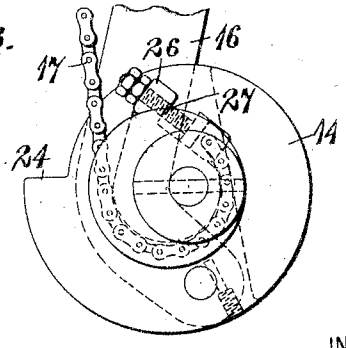


Fig. 3.



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CIRCUIT-INTERRUPTER.

981,816. Specification of Letters Patent. Patented Jan. 17, 1911.

Application filed February 6, 1906. Serial No. 299,761.

To all whom it may concern:

Be it known that I, HARVE R. STUART, a citizen of the United States, and a resident of Wilkinsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Circuit-Interrupters, of which the following is a specification.

My invention relates to electric circuit interrupters, and it has for its object to provide a circuit interrupter for relatively high-voltage circuits, which may be electro-magnetically closed with a minimum expenditure of energy and automatically tripped under predetermined conditions, and which shall embody such operating mechanism that the engagement of the contact members and also the opening of the circuit may be effected with the least possible injury to the interrupter.

When a circuit-breaker or similar device is designed for relatively high-voltage service, the stroke or range of movement of the movable contact member is necessarily considerable, and if it is operated by an electro-magnet, the movable core member of the magnet is usually so arranged that the air-gap is relatively large when the circuit interrupter is open and decreases to zero as the interrupter closes the circuit. Since the design of the magnet and the energy supplied thereto must necessarily be adequate to start the movable parts from rest when the maximum air-gap exists, as the air-gap decreases, the pull exerted by the magnet is very much increased, so that the moving parts to which the core member is attached are given a rapid acceleration, which tends to injure the contact members when they are brought together. Furthermore, the weight of the moving contact members, which are separated at a similar rate of acceleration, by reason of the action of gravity, is sufficient to injure the interrupter if they are brought to rest suddenly.

In order to avoid injurious shocks, a resilient stop has sometimes been provided, to be engaged by the movable member at each end of its stroke, but these devices only partially obviate the difficulty.

According to my present invention, a specially advantageous means is employed for so connecting the movable contact member to the core of the actuating magnet that the mechanical leverage decreases as the moving contact member approaches the stationary members, thereby compensating for the increase in the pull exerted by the magnet and maintaining the force, which is applied directly to the movable contact member, substantially constant until the end of the stroke, when a slight increase is permitted in order to bring the contact members firmly into engagement. The mechanical connection between the parts is further arranged to impede their downward movement after the tripping device has operated to open the circuit. Small resilient stops may also advantageously be employed for preventing any slight shock which would otherwise occur.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 is a partial side elevation of a circuit interrupter constructed in accordance therewith, and Figs. 2 and 3 are detail views of parts of the operating mechanism shown in Fig. 1.

Referring to the drawings, the circuit interrupter illustrated therein comprises a frame 1, which is mounted upon an insulating slab or base 2, a pair of stationary contact members 3 and 4, a movable contact member 5, an operating electro-magnet 6, a tripping magnet 7 and an auxiliary switch 8.

The stationary and movable contact members may be of any well known construction, preferably comprising arc-breaking contact members and current-carrying contact members, and may be arranged to operate in oil or other insulating fluid. The movable contact member 5 comprises a bridging contact 9, which engages the stationary contact members 3 and 4 and completes electrical connection between them and is supported by an operating rod 10 of insulating material, one end of which is rigidly fixed to the bridging contact member 9 and the other end of which is pivotally connected to one end of a link 11, the other end of said link 11 being pivotally connected to the upper end of a link 12, the lower end of which is pivotally supported on the frame 1 by means of a stationary pin shaft 13. A cam 14 is rotatably mounted upon a shaft 15, which is parallel to the shaft 13 and is also mounted upon the frame 1. The cam 14 is connected to the link 11 by an angle link 16, the latter being pivotally connected to the link 11 at a point near the junction of the links 11 and

12. The cam 14 is actuated by a chain 17, which passes over a sheave 18 and is attached to a movable core member 19 of the electro-magnet 6. The sheave 18 is rotatably mounted upon a shaft 20 which is mounted upon the frame 1, parallel to the shafts 13 and 15. One end of a guide link 21 is pivotally attached to a projection 23 of the frame 1 by means of a shaft 22, and its other end is pivotally attached to substantially the middle point of the link 11.

The cam 14 is provided with a notch 24 which engages a stop 25 in order to limit the extent of its travel, in one direction, to a point that corresponds to the closed position of the interrupter. One extremity of the chain 17 is attached to a projection 26 on the cam 14, which is relatively near its center of rotation, by an adjusting screw 27, and it is adapted to engage a groove 28 in the periphery of the cam, which is eccentric or spiral in contour, so that, when the circuit interrupter is in its open position, the chain is partially wrapped about the cam within the groove, as shown in Figs. 2 and 3, so that the point of tangency with the surface of the groove is at a materially greater distance from the center of the cam than the point at which it is attached to the projection 26. By this means, the pull exerted through the chain, by the electro-magnet, to rotate the cam, is first applied at a considerable distance from the center of rotation, and, as the cam rotates and the air-gap in the operating electro-magnet decreases, the pull along the chain is applied to the cam at a point which continually moves toward the center of the cam along the spiral groove, so that the leverage is gradually decreased. The surface of the groove 28 which is engaged by the chain may obviously be so arranged that the angular force tending to rotate the cam is substantially constant.

Although the point of tangency between the chain and the groove 28 of the cam is relatively close to the center of rotation when the circuit interrupter is closed, it is slightly more separated therefrom than the point of tangency when the interrupter is approaching its closed position, and, consequently, an increased force is exerted at the end of the stroke to bring the contact members firmly into engagement. This feature is of considerable importance when the usual yielding cup and cone contact members are employed.

The link 16 is adapted to engage a groove 29, as the cam rotates, and is eccentrically connected to the cam so that the point of connection is moved from a position substantially under the shaft 15 to one substantially over it. In this way, a considerable movement of the link 11 and of the movable contact member 5 is effected by a relatively slight rotative movement of the cam at the mid position of its travel and a considerably increased movement of rotation of the cam is required for a similar motion of the movable contact member near each extremity of its travel.

With the aforesaid arrangement, the speed of the movable contact member is gradually decreased as the lower limit of its travel is approached and, consequently, a severe shock is obviated and, by means of the cam and chain, the closing of the interrupter is also advantageously effected.

When the circuit interrupter is closed and the notch 24 on the cam 14 engages the stop 25; the point of connection between the links 11 and 16 is above and a little to one side of the point of connection between the link 16 and the cam, so that the cam is given a tendency to rotate against the stop and the breaker is held in this position.

A movable core member 30 of the tripping magnet 7 is pivotally connected to one end of a lever 31, which is fulcrumed upon a shaft 32. The opposite end of the lever 31 is adapted to engage the notch 24 on the cam 14, and when sufficient energy is applied to the winding of the tripping magnet 7, by reason of overload or other abnormal conditions, the cam 14 is rotated by the lever 31 through a slight angle which is sufficient to carry the point of connection between the link 16 and the cam a little to the other side of the point of connection between the links 11 and 16. When this relation exists, the combined weight of the moving contact member 5, the rod 10 and the link 11 is sufficient to continue the rotation of the cam in the same direction until the movable contact member reaches the limit of its travel.

The auxiliary switch 8 comprises a movable blade 33, which may engage either of a pair of similar contact members 34 and 35 and is actuated by a bell crank arm 36 which is fulcrumed upon a stationary shaft 37, and one arm of which engages the blade 33 while the other arm is slotted to engage, by a lost motion connection, with a pin 38 which projects from the cam 14. The length of the bell crank arms and the arrangement of connections are such that the switch blade 33 is thrown from engagement with the contact member 35, when the circuit interrupter is open, into engagement with the contact member 34, when the interrupter is closed. This switch may control an electrically operated indicating device which may indicate, at a distant point, the position occupied by the circuit interrupter, in a well known manner. The stationary and movable contact members, 3, 4 and 5 may preferably be oil-immersed in a tank 39.

I claim as my invention:

1. In a circuit breaker, the combination with stationary contact members, a movable

contact member, tending to occupy its open circuit position by reason of the attraction of gravity, and an electro-magnet which exerts a rapidly increasing pull for bringing the contact members into engagement, of an interposed mechanical connection between the electro-magnet and the movable contact members, whereby the pull exerted on the movable member is constant until the end of its stroke, when it is slightly increased to bring the members forcibly into engagement.

2. In a circuit interrupter, the combination with movable and stationary contact members and an operating electro-magnet, of means for applying a closing force to the movable member which is constant until the end of its movement, when it is slightly increased to bring the members into engagement.

3. In a circuit interrupter, the combination with stationary and movable contact members and an operating electro-magnet, of means for applying a closing force to the movable member which is constant until the end of its movement, when it is slightly increased to bring the members into engagement, said means comprising a cam, connecting links between the cam and the movable member and a chain which connects the armature of the electro-magnet and the cam together and coöperates with the cam surface.

In testimony whereof, I have hereunto subscribed my name this 30th day of January 1906.

HARVE R. STUART.

Witnesses:
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BIRNEY HINES.