Jan. 12, 1932. C. THUMIM 1,841,162

SWITCH OPERATING MECHANISM

Filed April 18, 1930

Fig. 1.

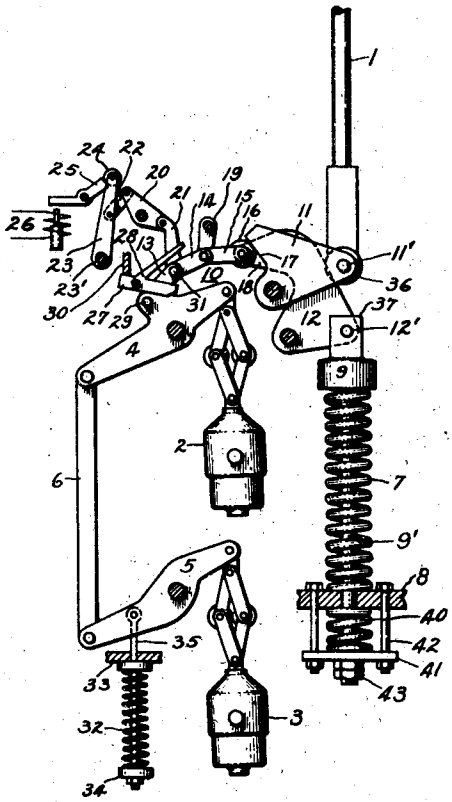


Fig. 2.

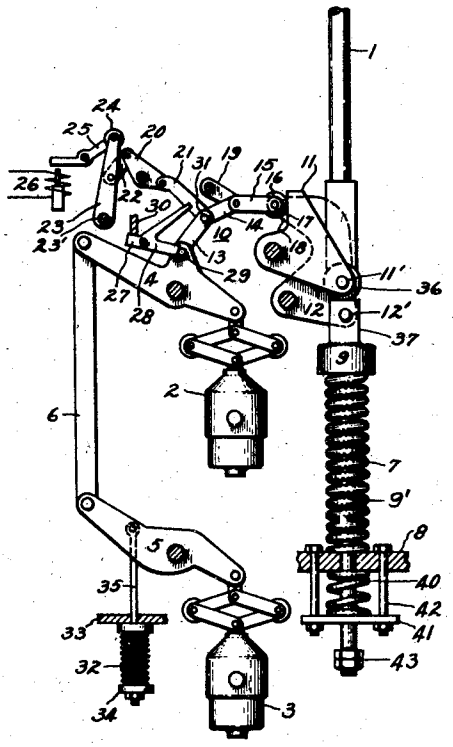
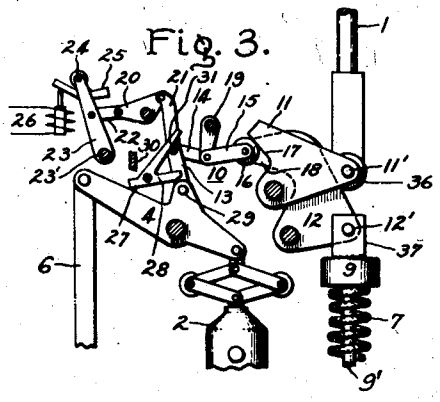


Fig. 3.



Inventor:
Carl Thumim,
by Charles V. Mullen
His Attorney.

Patented Jan. 12, 1932 1,841,162

UNITED STATES PATENT OFFICE

CARL THUMIM, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

SWITCH OPERATING MECHANISM

Application filed April 18, 1930. Serial No. 445,479.

My invention relates to high speed switch operating mechanism for large capacity circuit breakers, and more particularly to operating mechanism of the type wherein a spring charging or energy storing operation is effected during the switch closing operation for causing subsequent opening of the circuit breaker.

In the operation of large capacity circuit breakers having moving parts of great mass, as in high voltage oil switches, it is important that the switch opening movement be initiated at high speed in order quickly to clear the circuit without, however, setting up excessive mechanical stresses in the apparatus due to the opening impact. It is also important that the forces tending to cause the switch opening movement shall be effective immediately to initiate movement of the switch parts in response to actuation of the tripping mechanism.

It is an object of my invention to provide an improved switch operating mechanism which shall have means for applying a large force to initiate high speed opening movement of the switch immediately in response to tripping of the switch.

It is a further object of my invention to provide a switch operating mechanism of the aforesaid type having means for effecting the switch closing and energy storing operations simultaneously and at different speeds.

It is a further object of my invention to provide an improved switch operating mechanism which shall be compact, simple and rugged in construction, and efficient in operation.

My invention will be more fully set forth in the following description referring to the accompanying drawing, and the features of novelty which characterise my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

Referring to the drawings, Fig. 1 is a view showing switch operating mechanism embodying my invention in the open circuit position; Fig. 2 is a view of the mechanism in the closed circuit position, and Fig. 3 illustrates the tripping operation of the mechanism.

The switch operating mechanism embodying my invention comprises in the present instance a switch operating member, as the rod 1, adapted for reciprocal vertical movement to cause opening and closing of a circuit breaker, or breakers, (not shown). The specific operating mechanism herein described is particularly adapted for operating large capacity oil circuit breakers having a high voltage rating and comprising movable parts of appreciable mass. For the purpose of imparting circuit closing movement to the rod 1, there is provided actuating means, as the electric motors 2 and 3 operatively connected to the pivoted arms 4 and 5 respectively by the well-known centrifugal or fly-ball operating linkage. The arms 4 and 5 are joined at corresponding ends by the bar 6, thereby insuring uniform movement of the actuating means when the motors 2 and 3 are energized.

Operatively connected to the actuating means in a manner hereinafter described is an energy storing device for imparting opening movement to the rod 1 comprising a compression spring 7 bearing at one end on a fixed support 8 and at its free end on a movable member 9 provided with a guide rod 9′ extending centrally of the spring 7 and freely through the fixed support 8.

Means interconnecting the actuating means and the switch operating rod and energy storing device comprise a collapsible thrust-transmitting structure generally indicated at 10 and a pair of cranks 11 and 12 connected respectively as at 11′ and 12′ to the switch rod 1 and the member 9 of the energy storing device. The thrust-transmitting structure 10 comprising a compound toggle 13—14—15, is provided with a roller 16 permanently attached to crank 12 by means of a pin and adapted to engage the corresponding face of the crank 11.

It will be noted that the pivotal center of the crank 12 is at a greater distance from the roller 16, which represents the point of application of force, than the pivotal center of the crank 11 thereby providing greater

mechanical advantage for the crank 12. The roller 16 therefore must have relative movement with respect to the associated arm of the crank 11, and to this end the crank 11 is provided with a cam face 17 along which the roller 16 may slide while at the same time engaging the crank 12 to which it is pinned. The cam face 17 may assume any suitable shape for the purpose of controlling the closing speed of the switch.

The toggle structure is adapted to be restrained in a thrust-transmitting position by a pivoted guide link 19 and a linkage connected to the central pivot of the toggle 13—14 and to tripping mechanism hereinafter described. The restraining linkage comprises a centrally pivoted lever 20 connected at one end through the link 21 to the toggle 13—14, and at its other end by a link 22 to a pivoted member 23. The member 23 is provided with a roller 24 adapted to engage and be restrained by a pivoted tripping member, or prop 25, having a portion adapted to be engaged by the movable plunger of a tripping relay 26 for moving the prop 25 clockwise and out of engagement with the roller 24. The link 22 of the interconnecting linkage is connected to the member 23 at a point intermediate the roller 24 and the fixed pivot 23′, thereby permitting not only a small tripping force for moving the prop 25 out of engagement with the roller 24, but also permitting rapid collapse of the restraining structure as will be hereinafter described.

For the purpose of holding the actuating means in the closed circuit position thereof when the toggle structure 10 is restrained in its thrust-transmitting position, there is provided a pivoted latch 27 comprising a forked portion 28, the lower arm of which is adapted to ride over and engage a pin 29 on the lever 4 when the same has moved to the closed circuit position, as illustrated in Fig. 2. The latch 27 is limited as to clockwise movement by the stop member 30 which is so positioned that the thrust of pin 29 against the lower arm of the latch holds the same in firm engagement with the stop member. The upper arm of the fork is in the path of a projecting pin 31 comprising the central pivot of the toggle 13—14, and upon collapse of the toggle in response to actuation of the tripping mechanism the link 13 of the toggle, together with the pin 31, moves counter-clockwise whereupon the upper arm of the fork is engaged by the pin and rotated in a counter-clockwise direction to disengage the pin 29 of the actuating means. The actuating means, assuming of course, that the motors 2 and 3 are deenergized, may be reset or returned to the initial position as shown in Fig. 1, by suitable means as the spring 32 having a fixed bearing 33 at one end and a movable bearing 34 at its free end connected to the resetting rod 35. For the purpose of reducing shock when the powerful spring 7 is released to project the rod 9′ upwardly, there is provided buffer means, as the spring 40, adapted to seat between the fixed support 8 and a movable bar 41 supported by the guide rods 42. The rod 9′ extends loosely through the bar 41 and is provided with stop means as the nuts 43. Opening movement of the rod 9′ causes the stop means to engage the bar 41 to compress the spring 40 which absorbs the impact.

The operation of the mechanism is as follows:

The switch closing operation, assuming the mechanism to be in the open circuit position illustrated in Fig. 1, is effected by energizing simultaneously the circuits of the motors 2 and 3, or equivalent motive means. In the initial position of the actuating means illustrated in Fig. 1, the toggle 13—14 is stretched and the member 23 moved clockwise so as to permit the prop 25 to ride under and engage the roller 24. In this position the thrust-transmitting structure acts as a comparatively rigid member for the purpose of transmitting movement from the actuating means to the switch operating rod. As the motors come up to speed the centrifugal mechanism acts as illustrated in Fig. 2 to cause clockwise rotation of the levers 4 and 5 with resultant movement of the thrust-transmitting structure towards the right, or in the direction tending to produce clockwise rotation of the cranks 11 and 12. During this movement the resistance arm of the spring charging crank 12 moves but a short distance as compared with the operating rod 1 connected to the crank 11. The cranks are so arranged that the roller 36 at the lower end of the rod 1 abuts the portion 37 of member 9 when the rod is in its fully closed position as illustrated in Fig. 2. Accordingly the powerful opening spring 7 may be easily charged by the actuating means by reason of the great mechanical advantage of the crank 12, whereas the switch closing movement may be effected concurrently by the same actuating means although requiring a longer stroke involving, however, less resistance.

When the mechanism is in the closed circuit position illustrated in Fig. 2, the powerful opening spring 7 is maintained in compressed position by the thrust-transmitting structure 10, the tripping mechanism and the latch 27. Upon collapse of the thrust-transmitting structure, the spring is effective to exert a powerful upward thrust on the rod 1 during the initial part of its opening stroke, thereby imparting high speed separating movement to the switch contacts. Once this high speed initial movement is acquired, it is unnecessary to apply the large opening force throughout the entire stroke of the switch rod since the circuit is generally interrupted during the first part of the opening stroke, and moreover, since the kinetic energy

of the moving parts at the end of the stroke should be as small as possible in order to prevent excessive stresses being set up in the apparatus.

When the circuit breaker is to be tripped open for any reason, the actuation of the tripping magnet causes the pivoted prop 25 to be moved clockwise out of restraining engagement with the roller 24 so that the thrust transmitted along the toggle 13—14 causes the toggle to buckle at its central pivot, as indicated in Fig. 3, since it is no longer locked by the tripping mechanism. This buckling at the central pivot may take place practically simultaneously with the release of roller 24 since the inertia of member 23 is inappreciable. Collapse of the toggle structure permits the cranks 11 and 12 which are now no longer restrained by the roller 16, to rotate counter-clockwise to the open circuit position illustration in Fig. 1. During the collapse of the toggle 13—14, the pin 31 of the toggle engages the forked latch as illustrated in Fig. 3, to move it out of restraining engagement with the pin 29 of the actuating means. Fig. 3 illustrates the mechanism in an intermediate position during the tripping operation, prior to return of the actuating means to the initial resetting position.

It will be noted that the switch operating rod 1 is trip-free with respect to the actuating mechanism during any part of the switch closing operation, that is, the thrust-transmitting structure 10 may collapse in response to actuation of the tripping mechanism to permit opening movement of the switch rod regardless of the position of the actuating means. In this event, suitable means, (not shown), may be provided for deenergizing the circuits of the motors for returning the actuating means to the initial position. The means above described may likewise be readily adapted to deenergize the motors when the mechanism is in the closed circuit position illustrated in Fig. 2. The shock absorbing spring 40 not only dissipates the excess energy remaining in the opening spring 7 during normal operation of the mechanism, thereby avoiding damage to mechanical parts, but also allows the mechanism to be tripped without damage when the breaker rod is not directly connected with the opening spring.

It shall, of course, be understood that the motors 2 and 3 may be replaced by a single motor or equivalent actuating device, although the present arrangement comprising two centrifugal operating mechanisms in tandem is preferred for the purposes of economy in construction, and speed and efficiency in operation.

It shall also be understood that my invention is not limited to the specific details of construction and arrangement thereof herein illustrated, and that changes and modifications may occur to one skilled in the art without departing from the spirit of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. Switch operating mechanism comprising a switch operating member, electromotive actuating means for effecting switch closing movement of said member, an energy storing device for causing initial switch opening movement of said member at high speed, and means interconnecting said device and actuating means whereby the mechanical advantage in effecting an energy storing operation is greater than the mechanical advantage in effecting the switch closing operation.

2. Switch operating mechanism comprising a switch operating rod, electromotive actuating means for effecting switch closing movement of said rod, a spring causing initial switch opening movement of said rod at high speed, and means operatively interconnecting said spring and actuating means whereby the spring charging operation is effected substantially concurrently with the closing operation within less travel than that of the switch operating rod.

3. Switch operating mechanism comprising a switch operating rod, motive means for effecting switch closing movement of said rod, an energy storing device for applying an accelerating force to said rod during the initial switch opening movement thereof, and means interconnecting said device and motive means and cooperating with said operating rod whereby the energy storing operation on said device is effected concurrently with the switch closing operation and within less travel than that of the operating rod.

4. Circuit breaker operating mechanism comprising a switch operating rod, motive means for causing switch closing movement of said rod, spring means adapted to engage said rod in its closed circuit position for causing initial switch opening movement of the rod at high speed, and means operatively connected to said spring means for permitting charging of the same by said motive means so arranged that the switch operating rod is moved by the motive means throughout its complete closing stroke while the spring charging operation is being effected concurrently therewith and within less travel.

5. The combination with switch operating mechanism comprising a switch operating member and motive means for imparting circuit closing movement thereto, of an energy storing device operatively connected with said member in the closed circuit position thereof for causing initial high speed opening movement, and lever mechanism interconnecting said motive means individually with said switch operating member and energy storing device whereby the energy

storing and switch closing operations are effected concurrently, said lever mechanism being arranged so that the mechanical advantage of the connection between the motive means and energy device is greater than that between the motive means and switch operating member.

6. In switch operating mechanism comprising a switch operating rod and electromotive means for imparting circuit closing movement thereto, the combination comprising spring means adapted to be charged for causing initial switch opening movement of said rod at high speed, a crank connected to said spring means, a second crank connected to said switch operating rod, toggle structure interconnecting said electromotive means and said cranks for effecting switch closing and spring charging operations concurrently, said spring charging crank having a greater mechanical advantage than the switch closing crank whereby the spring charging stroke comprises but a part of the switch closing stroke, and tripping means operatively associated with said toggle structure for causing collapse thereof, said spring means being immediately effective to exert a powerful thrust on the switch operating rod throughout its initial opening movement.

7. In switch operating mechanism the combination comprising a switch operating rod, actuating means for imparting circuit closing movement to said rod, collapsible thrust-transmitting structure interconnecting said actuating means and operating rod for effecting the circuit closing operation thereof and for holding the rod in closed position, a trip member for causing collapse of said structure and consequent switch opening movement of said rod, a lever having a fixed pivot and a roller adapted to engage and be restrained by said trip member, and a linkage for holding said structure in thrust-transmitting position interconnecting the structure and the lever at a point intermediate its fixed pivot and roller whereby actuation of the trip member to release said roller permits immediate collapse of the thrust-transmitting structure and opening movement of the swtich rod.

8. In switch operating mechanism, the combination comprising a switch operating rod, electromotive actuating means for imparting switch closing movement to said rod, toggle structure interconnecting said actuating means and rod adapted to transmit closing thrust thereto, a latch for holding said actuating means in closed circuit position, tripping mechanism adapted to restrain the toggle structure in its thrust-transmitting position, said tripping mechanism being effective when actuated to permit collapse of the toggle structure independently of the actuating means and thereby to permit opening movement of the switch rod, and means operatively relating said toggle structure and latch whereby the latch is moved out of its restraining position in response to collapse of the toggle structure to permit resetting of the actuating means.

9. Switch operating mechanism comprising a switch operating rod, an accelerating spring arranged to cause opening movement of said rod, a crank operatively connected to said operating rod, a second crank operatively connected to said accelerating spring, and means operatively related to said cranks effecting an energy storing operation on said spring and a switch closing operation through said rod, one of said cranks having a greater mechanical advantage than the other in effecting its corresponding operation.

10. Switch operating mechanism comprising an operating rod, an accelerating spring arranged to cause opening movement of said rod, a crank operatively connected to said rod, a second crank operatively connected to said spring, said second crank having the greater mechanical advantage, and means operatively related to said cranks effecting compression of said spring and switch closing movement of said rod.

11. Switch operating mechanism comprising an operating rod, an accelerating spring arranged to cause opening movement of said rod, a crank pivotally connected to said rod, said crank having a cam surface, a second crank connected to said spring for effecting compression thereof, means including a roller coacting with said cranks at different leverages, said roller engaging the cam surface of said first crank and a portion of said second crank to cause simultaneous rotation of said cranks at different rates and compression of said spring and switch closing movement of said rod respectively.

In witness whereof, I have hereunto set my had this 15th day of April, 1930.

CARL THUMIM.