

C. H. BAYER

INTERLOCKING MECHANISM

Fig. 1.

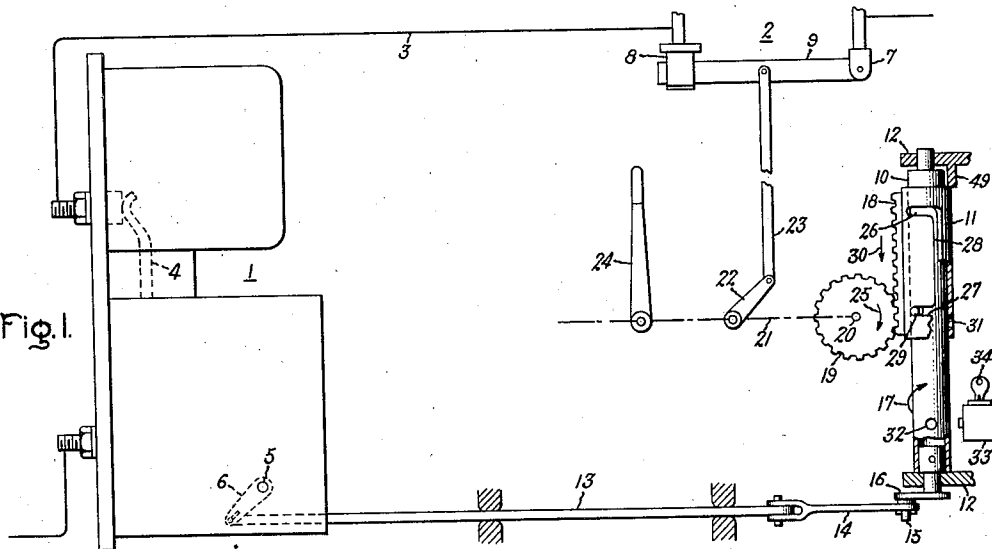


Fig. 2.

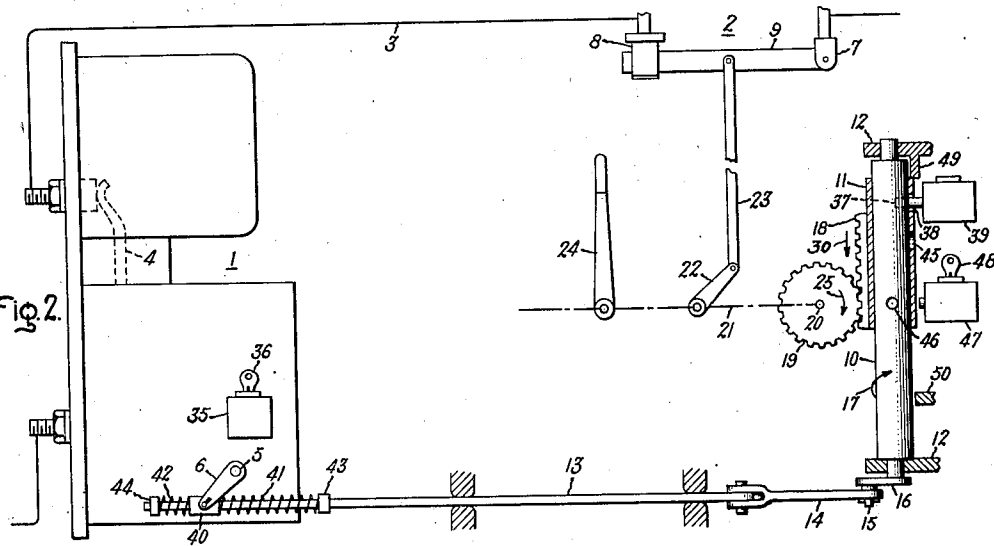
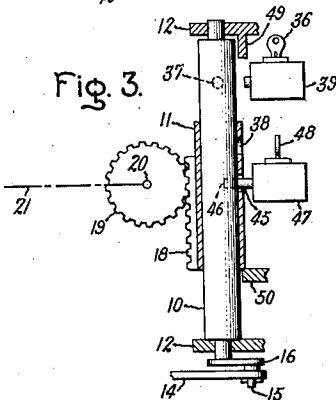


Fig. 3.



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My invention relates to improvements in interlocking mechanisms and more particularly to improvements in mechanisms for so mechanically interlocking electric switches that they can be operated only in a predetermined sequence and also locked against operation.

For the safety of operating and maintenance personnel, and also to avoid damage to system apparatus, electric switches are frequently so mechanically interlocked that they can be operated only in a predetermined sequence. For inspection and maintenance purposes, electric switches are often so arranged that they can be locked against unsupervised operation. Thus, for example, in the case of a circuit breaker and a disconnecting switch in series in the same circuit, the desired operating sequence is usually close disconnecting switch, close circuit breaker, open circuit breaker, open disconnecting switch. Further, when both switches are open, it is often desirable to lock both against unsupervised operation.

An object of my invention is to provide for a plurality of devices which have to be operated in a predetermined sequence an improved interlocking mechanism which embodies a minimum number of movable parts and is structurally simple and foolproof. Another object of my invention is to provide an improved interlocking mechanism wherein a desired sequence of operations is obtained by the relative positioning of two movable members, each arranged for a different type of movement. A further object of my invention is to provide an improved interlocking mechanism whereby two devices may be normally interlocked against joint operation or positively locked against separate operation. These and other objects of my invention will appear in more detail hereinafter.

In accordance with my invention, I provide for operating a plurality of devices only in a predetermined sequence an improved interlocking mechanism wherein two movable members are so mounted one within the other that not more than one member can be actuated at a time. Further in accordance with my invention, one of the members is mounted for rotary movement and the other is mounted for translatable movement. Also in accordance with my invention, I provide means for preventing movement of both of the members.

My invention will be better understood from the following description when considered in connection with the accompanying sheet of drawings,

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and its scope will be pointed out in the appended claims.

In the accompanying sheet of drawings, Fig. 1 illustrates an interlocking arrangement embodying my invention as applied to a circuit breaker and a disconnecting switch so that the opening and closing operation thereof can be effected only in a predetermined sequence and so that both switches may be locked in the open position; Fig. 2 illustrates a modification of my invention showing both the circuit breaker and disconnecting switch locked in the closed position; Fig. 3 is a partial view similar to Fig. 2 showing the interlocking feature in the locked open position of both the circuit breaker and the disconnecting switch.

For the purpose of illustrating my invention, I have shown in Fig. 1 two switches such as a circuit breaker 1 and a disconnecting switch 2 arranged in series in a circuit 3 for operation in a predetermined sequence. As far as my invention is concerned, the type of circuit breaker or disconnecting switch is immaterial. But, as shown, the circuit breaker comprises a movable contact 4 and an operating mechanism therefor comprising, in part, a rotatable member such as a shaft 5 which is provided with a crank 6. Also as shown, the disconnecting switch is of the blade type embodying a hinge jaw 7, a contact jaw 8 and a pivoted blade contact 9.

For interlocking the circuit breaker 1 and the disconnecting switch 2 so that they can be operated only in a predetermined sequence, viz. close disconnecting switch, close circuit breaker, open circuit breaker, open disconnecting switch, as shown in Fig. 1, I provide in accordance with my invention two members such as two coaxial cylinders 10 and 11 mounted one within the other, one member, such as the inner cylinder 10, being supported for rotary movement relatively to the other member and this other member, the outer cylinder 11, being supported for translatable movement relatively to the inner cylinder. As shown in Fig. 1, the inner cylinder 10 is suitably rotatably mounted in bearing supports 12, and the outer cylinder 11 is slidably supported on the inner cylinder 10.

For rotating the inner cylinder 10 in response to the opening and closing operations of the circuit breaker 1, I provide suitable interconnecting means between the crank 6 of the circuit breaker mechanism and the inner cylinder 10. As shown, this means comprises a slidably supported link 13 and a tie link 14 between the link 13 and a pin 15 in a crank 16 suitably secured to the cylinder 10. When the circuit breaker 1 opens, counter-

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clockwise rotation of the crank 6 effects movement of the link 13 to the right to turn the inner cylinder 10 in the direction indicated by the arrow 17. During the closing operation of the circuit breaker 1, the crank 6 rotates clockwise to move the link 13 to the left thereby turning the inner cylinder 10 oppositely to the direction indicated by the arrow 17.

For effecting translatory movement of the outer cylinder 11 up and down on the inner cylinder 10 in response to the closing and opening operations of the disconnecting switch 2, the outer cylinder is provided with a toothed rack 18 which is in engagement with a gear 19 mounted on a shaft 20 having its axis of rotation indicated schematically by the dash-dot line 21. Mounted on this shaft 20 is a crank 22 which is interconnected with the disconnecting switch blade 9 by a link 23. Also mounted on the shaft 20 is an operating lever 24, by the rotation of which the disconnecting switch can be opened and closed. Thus, if the operating lever 24 is actuated in a direction to turn gear 19 in the direction indicated by the arrow 25, the disconnecting switch will be opened and the outer cylinder 11 moved downwardly. If the operating lever 24 is actuated in a direction opposite to that indicated by the arrow 25, the disconnecting switch 2 will be closed and the outer cylinder 11 moved upwardly to the position shown in Fig. 1.

In order to interlock the operating mechanisms of the circuit breaker 1 and the disconnecting switch 2 so that these switches can be operated only in the sequence close disconnecting switch, close circuit breaker, open circuit breaker, open disconnecting switch, I provide means for preventing joint movements of the cylinders 10 and 11 and for enforcing separate movements thereof in a predetermined sequence. Thus, as shown in Fig. 1, I provide the outer cylinder 11 with a continuous channel shaped slot having two substantially parallel transverse portions 26, 27 interconnected by a longitudinal portion 28, and on the inner cylinder 10 I provide an element 29 which projects into the slot in the outer cylinder 11.

Assuming now the parts positioned as shown in Fig. 1, then the projection or pin 29 on the inner cylinder 10 is in the extreme left-hand or closed end of the transverse slot portion 27. Under these conditions, it is obvious that the shaft 20 is locked against movement since the outer cylindrical member 11 cannot be operated either up or down. Consequently, the disconnecting switch 2 cannot be opened as long as the circuit breaker 1 is closed. If, however, the circuit breaker 1 opens, then the projecting pin 29 moves to the right in the transverse slot portion 27 in consequence of the rotation of the inner cylinder 10 in the direction indicated by the arrow 17. When the circuit breaker is fully open, the pin 29 is moved to the extreme right-hand end of the transverse slot portion 27. The shaft 20 can now be operated in the direction indicated by the arrow 25 to move the outer cylinder 11 downward, as indicated by the arrow 30, until the pin 29 is at the top of the longitudinal slot portion 28 and in the extreme right-hand end of the upper transverse slot portion 26. When the pin 29 is in this position, an opening 31 in the outer cylinder 11 registers with an opening 32 in the inner cylinder 10. Both cylinders may now be locked against movement by locking means 33 of a type well known to the art wherein the key 34 can be removed only when the lock is in the locking position. Thus, one with supervisory authority

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can lock both switches 1 and 2 in the open position and take the key 34 so that unsupervised operation of the switches is impossible.

If the pin 29 is in the upper end of the longitudinal slot portion 28 and the two cylinders are not interlocked by the lock 33, then either the disconnecting switch or the circuit breaker may be operated independently of the other, but both cannot be operated so as to be closed at the same time. In other words, the circuit breaker can be opened or closed or the disconnecting switch can be opened or closed, but both cannot be closed except in the predetermined sequence close disconnecting switch, close circuit breaker, open circuit breaker, open disconnecting switch.

In the embodiment of my invention shown in Figs. 2 and 3, the interlocking arrangement is essentially the same as shown in Fig. 1 except that the pin and slot feature is omitted and locks are used throughout. Thus, for example, the circuit breaker 1 is provided with a trip lock 35, examples of which are well known to the art. This lock has a key 36 which when turned from the position shown trips the circuit breaker 1 to cause the opening thereof, and before the key can be removed from the lock, the breaker is locked in the open position.

The inner and outer cylinders 10 and 11 are provided with holes 37 and 38, respectively, which register when both the circuit breaker 1 and the disconnecting switch 2 are closed. When in such registry, they are interlocked by a lock 39 which is operated by the same key 36 as the lock 35 so that the key 36 must be withdrawn from the lock 39 in the locked position thereof before it can be inserted in the lock 35 to permit the closing of the circuit breaker 1. Inasmuch as the cylinders 10 and 11 are interlocked by the lock 39 when both the circuit breaker 1 and the disconnecting switch 2 are closed and remain locked until after the circuit breaker is tripped, no rotary movement of the inner cylinder can occur when the circuit breaker is tripped. Consequently, it is necessary to provide a variable length energy absorbing means between the circuit breaker operating crank 6 and the crank 16 on the inner cylinder 10 in order to ensure the opening of the circuit breaker without undue strain on the interlocking mechanism. For this purpose, as shown in Fig. 2, the link 13 may be provided with a slidable crosshead 40, which is connected to the crank 6 and is resiliently restrained on the link 13 by springs 41 and 42 which respectively bear against collars 43 and 44 on the link 13.

When the circuit breaker 1 opens, energy is stored in the spring 41 so that upon release of the lock 39 the inner cylinder 10 is turned in the direction indicated by the arrow 17. When the lock 39 is released, it is possible to open the disconnecting switch 2. This opening movement lowers the outer cylinder 11 until a hole 45 therein registers with a hole 46 in the inner cylinder 10 which was turned in the direction indicated by the arrow 17 when the lock 39 was released. Upon release of this lock, the key 36 cannot be removed. When the holes 45 and 46 are in registry, a lock 47, as shown in Fig. 3, operated by a key 48 is caused to engage the registering holes 45 and 46 so as to prevent any closing action of the disconnecting switch and the circuit breaker. The key 48 may be removed from the lock 47 in the locked position and retained by someone in supervisory authority so as to prevent any unsupervised operation of the switches. In order

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to ensure the desired longitudinal registry of the holes in the inner and outer cylinders 10 and 11, motion limiting means 49 and 50 may be provided to fix the up and down movements of the outer cylinder 11.

While I have shown and described my invention in considerable detail, I do not desire to be limited to the exact arrangements shown, but seek to cover in the appended claims all those modifications that fall within the true spirit and scope of my invention.

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

1. An interlocking mechanism comprising two coaxial cylindrical members mounted one within the other, the inner member being supported for rotary movement relatively to the outer member and the outer member being longitudinally slidable on the inner member, said members having interlocking means preventing joint movement thereof and being provided with openings which register when the members are in a predetermined relative position, and locking means for engaging said openings when they are in registry to prevent separate movement of the members.

2. An interlocking mechanism comprising two coaxial cylindrical members of unequal length having the longer one mounted within the other, the inner member being supported for only rotary movement relatively to the outer member and the outer member having only translatable movement relatively to the inner member and provided with a continuous slot having two parallel transverse portions interconnected by a longitudinal portion, separate means for effecting the respective movements of said members, and means for preventing joint operation of said movement effecting means comprising an element on said inner member extending into the slot in said outer member.

3. An interlocking mechanism comprising two coaxial cylindrical members mounted one within the other, the inner member being supported for rotary movement relatively to the outer member and the outer member being supported for translatable movement relatively to the inner member and provided with a continuous slot having two parallel transverse portions interconnected by a longitudinal portion, said members being provided with openings which register when the members are in a predetermined relative position, means for effecting the respective movements of said members, means for preventing the operation of said movement effecting means except in a predetermined sequence comprising an element on said inner member extending into the slot on said outer member, and locking means for engaging said openings when they are in registry to prevent movement of the members.

4. An interlocking mechanism comprising two coaxial cylindrical members mounted one within the other, the inner member being supported for rotary movement relatively to the outer member and the outer member being supported for translatable movement relatively to the inner member and provided with a continuous slot having two parallel transverse portions interconnected by a

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longitudinal portion, means for effecting the respective movements of said members, means for preventing the operation of said movement effecting means except in a predetermined sequence comprising an element on said inner member extending into the slot in said outer member, said members being provided with openings positioned to register when said element is at one end of said longitudinal slot, and locking means for engaging said openings when they are in registry to prevent movement of the members.

5. An interlocking mechanism comprising two coaxial cylindrical members mounted one within the other, the first member being supported for only rotary movement and the second member being supported for only translatable movement, said members being provided with openings which register when the members are in a predetermined relative position, and stationary locking means for engaging said openings when they are in registry to prevent any effective movement of the members.

6. An interlocking mechanism comprising an inner cylindrical member surrounded by an outer coaxial cylindrical member, one of said members being supported for only rotary movement and the other of said members being supported for only translatable movement, the outer of said members being provided with a continuous slot having two parallel transverse portions interconnected by a longitudinal portion, separate means for effecting the respective movements of said members, and means for preventing the operation of said movement effecting means except in a predetermined sequence comprising an element on said inner member extending into the slot in said outer member.

7. An interlocking mechanism comprising an inner cylindrical member surrounded by an outer coaxial cylindrical member, one of said members being supported for only rotary movement and the other of said members being supported for only translatable movement and provided with a continuous slot having two parallel transverse portions interconnected by a longitudinal portion, separate means for effecting the respective movements of said members, and means for preventing the translatable movement of said other member except when the rotary movable member is in a predetermined position comprising an element on the rotary movable member extending into the slot in said other member.

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