July 31, 1956 H. E. SCHLEICHER 2,756,612

INTERCHANGEABLE INTERLOCKING MECHANISMS FOR ELECTRIC SWITCHES

Filed Sept. 30, 1952

2 Sheets-Sheet 1

Fig. 1.

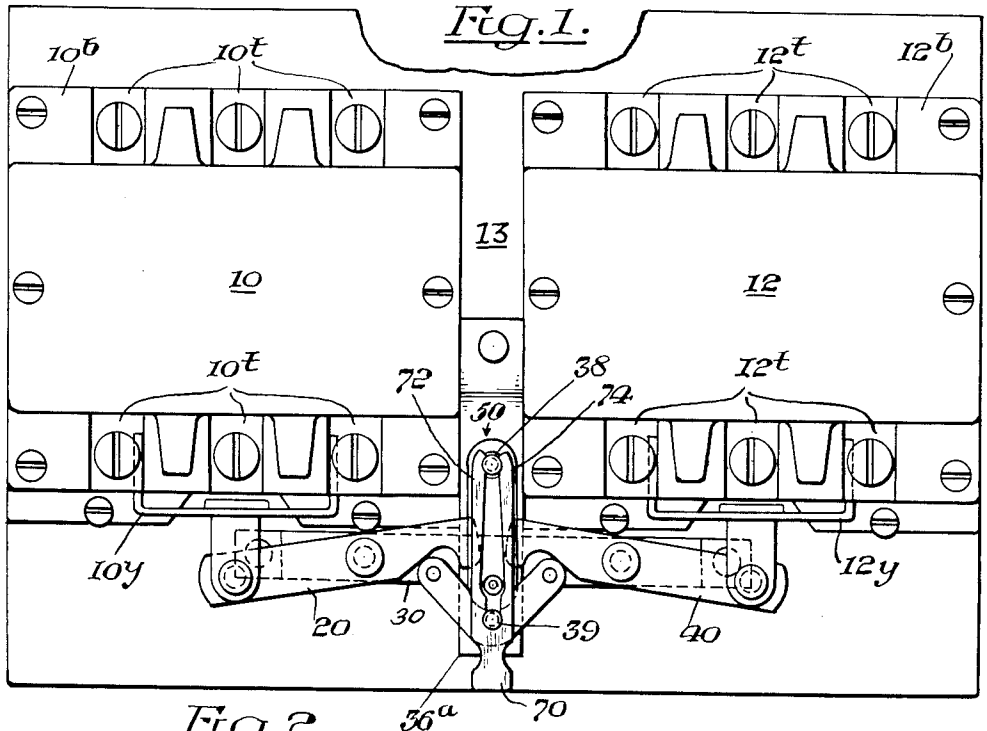
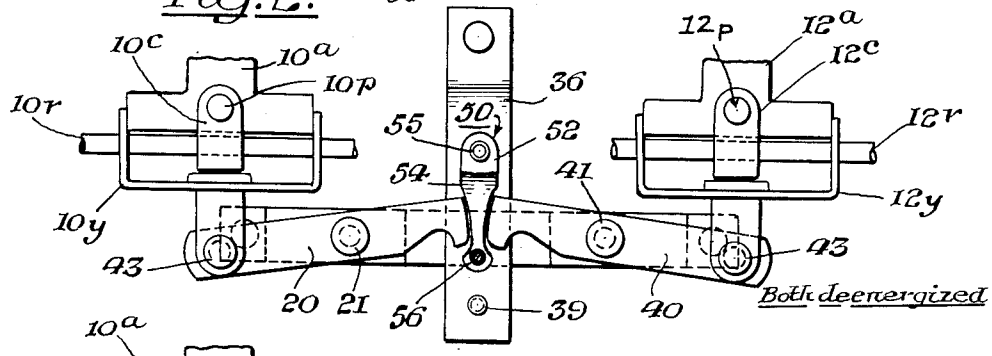


Fig. 2.



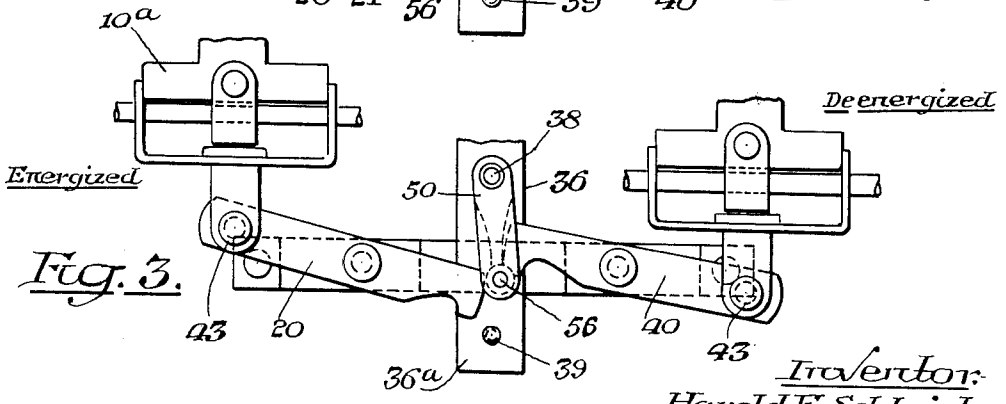


Fig. 3.

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Fig. 4.

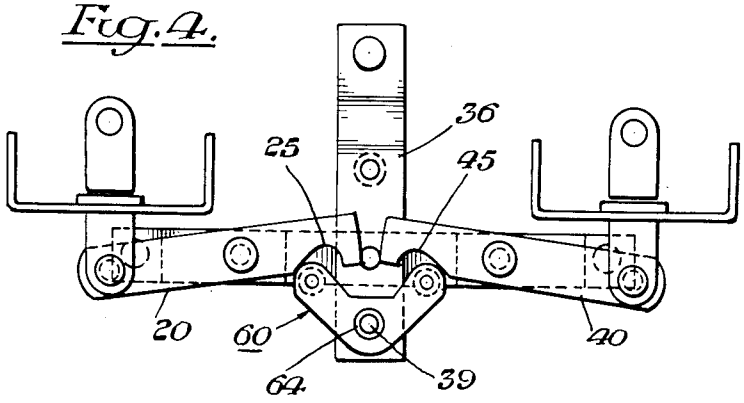


Fig. 5.

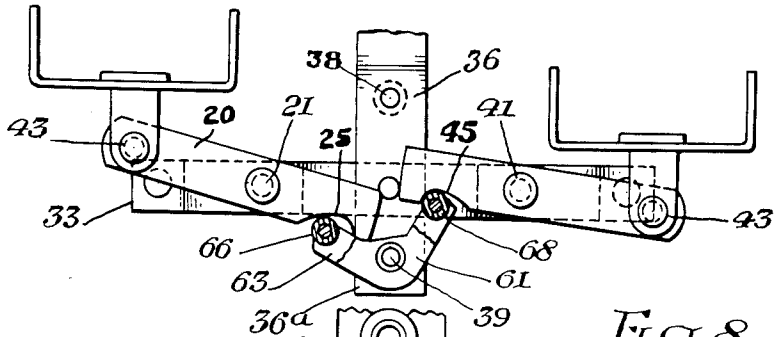


Fig. 6.

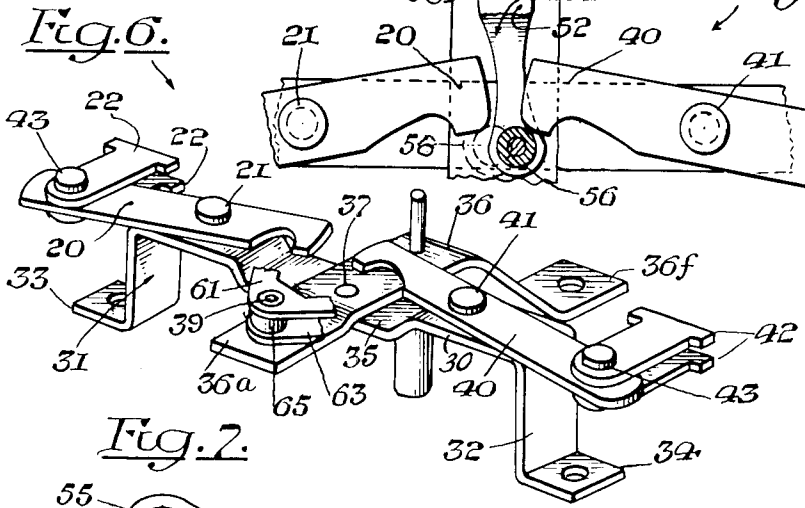
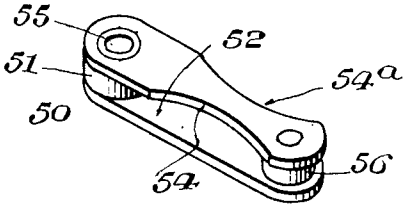


Fig. 8.

Fig. 7.



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INTERCHANGEABLE INTERLOCKING MECHANISMS FOR ELECTRIC SWITCHES

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Application September 30, 1952, Serial No. 312,233

7 Claims. (Cl. 74—483)

This invention relates to interlocking mechanisms for electric switches and more particularly for electromagnetically operated electric switches which are used side by side and which must not be operated simultaneously.

Electric switch manufacturers are called upon to supply electromagnetic switches mounted side by side upon a panel or base and provided with interlocking mechanism which will prevent the two switches from being simultaneously operated. However, the different circuits in which the switches may be connected require that the interlocking mechanism function in different ways. Sometimes the switches must function in circuits wherein it would be fatal to have one switch closed before another opens. Then it is necessary that the interlocking mechanism absolutely prevent the movement of one switch into closed position until the other has completely opened. Under other conditions the requirements are not so rigid but it is nevertheless necessary that one switch not close while another is closed. Under these less rigid conditions it is sufficient that the two switches not be permitted to close at the same time, and it is helpful to have the closing movement of one facilitate and assist the opening movement of the other.

In order to provide interlocking mechanism at low cost which will satisfy both requirements, it is desirable that the same basic parts be used in both types of operation. It is therefore desirable that simple interchange of interlocking elements be made possible to convert the interlocking mechanism of one type to the interlocking mechanism of the other either at the manufacturer's plant or at the customer's or user's convenience after he has the apparatus installed.

Therefore it is an object of the invention to provide interlocking mechanisms for electromagnetically operated switch mechanisms and the like which are convertible from one type to another by a simple interchange of a single element.

Another object of the invention is to provide interlocking mechanism which can be used to absolutely prevent the closing movement of one switch when the associated switch is either partially or fully closed or, alternatively, will prevent the closure of one switch while the other is closed and will utilize the closing movement of one switch to facilitate and assist the opening movement of the other.

A related object is to provide interlocking mechanism wherein by interchange of one element the interlocking mechanism may be converted from one type to the other without the need of tools or other equipment.

Another object is to provide interlocking mechanism of the aforesaid type to avoid the need for the manufacturer to provide a stock of parts for different mechanisms to provide the different functions aforesaid.

Another object of the invention is to provide interlocking mechanism adapted to accomplish the foregoing objectives and to perform the aforesaid functions with a minimum number of parts and which may be economically manufactured and assembled without sacrificing durability or accuracy.

Other objects and advantages of the invention will become apparent as it is described in connection with the accompanying drawings.

In the drawings:

Fig. 1 is a plan view illustrating a pair of electromagnetic switches mounted side by side and provided with interlocking mechanism embodying the principles of the invention.

Fig. 2 is a plan view, partly broken away, of the mechanism illustrated in Fig. 1, with both switches open and the interlocking element in place to absolutely prevent closing movement of one switch until the other is open.

Fig. 3 is a view similar to Fig. 2, with one of the switches closed.

Figs. 4 and 5 are views similar to Figs. 2 and 3 but with another interlocking element substituted.

Fig. 6 is a perspective view of the interlocking mechanism according to Figs. 1, 4 and 5 with the switches open.

Fig. 7 is a perspective view of the interlocking element used in Figs. 2, 3 and 8.

Fig. 8 is an enlarged fragmentary view of a portion of the parts as shown in Fig. 2.

Referring to the drawings, and particularly to Fig. 1, a pair of similar electromagnetic electric switches **10** and **12** are shown as mounted upon a flat back plate or panel **13** of any suitable material. For convenience the invention may be considered as applied to electromagnetic switches of the general type illustrated in the Schleicher Patent No. 2,399,575, issued April 30, 1946, in which an insulating block or base, such as **10***b* and **12***b*, is spaced from a back or mounting plate **13** providing a space for the electromagnet and operating mechanism of the switch between the base and back plate. On top of the base, adjacent opposite edges, are mounted conventional wire terminals **10***t* and **12***t* to which line and load wires are connectible. Connected with each terminal is a fixed contact, not visible, being obscured by cover members of switches **10** and **12**. The fixed contacts are engaged and disengaged by bridging contacts (not shown) which are operated by the movement of an electromagnet armature **10***a* or **12***a* when the electromagnet is energized and deenergized, thereby to cause switch closing and opening. Preferably the electromagnet armature is of T-shape as shown but it need not necessarily be of such shape.

The motion of the electromagnet armatures **10***a* and **12***a* is transmitted to the operating mechanism and switch contact by means of transverse rods **10***r* and **12***r* which may be connected with the operating mechanism in any suitable fashion. These rods are connected to the armatures by connecting links **10***c* and **12***c* which may be stamped from sheet metal into substantially U-shape and assembled with their legs lying upon the top and bottom surfaces, respectively, of the portion of the armatures **10***a* and **12***a* and pivotally connected thereto by pivot pins **10***p* and **12***p*. Such connection leaves the armature free to adjust its face to the faces of the electromagnet field piece, while yet causing the transverse rod to move with the armature.

In the present invention the to and fro movement of the transverse rods **10***r* and **12***r* is transmitted to yoke members **10***y* and **12***y* stamped from sheet metal into U-shape and having the rods passing thru their parallel leg portions. The motion of the yoke member, transverse rod and electromagnet armature is transmitted to pivoted levers **20** and **40** of interlocking mechanisms by means of T-shaped connecting bars or links **22** and **42**, the link **22** being pivotally connected upon the end of the lever **20** by a flat-headed pivot pin **23** and the connecting bar link **42** being connected to the end of the lever **40** by a similar pivot pin **43**. Pairs of links may be used, if desired, as

shown. The interlocking levers **20** and **40** are pivotally mounted by flat-headed pivot pins **21** and **41** in their mid portions upon a frame member designated generally by the numeral **30**. The frame member may be conveniently stamped from a strip of sheet metal into substantially U-shape with its parallel legs **31** and **32** supported from feet **33** and **34**, respectively, outturned from the ends thereof. They, in turn, may be secured to the back plate **13**. The central or transverse portion of the frame is offset downwardly in the direction of the legs and feet of the frame. Riveted to the offset portion of the frame **30** is the upper portion or arm **36***a* of a supporting member **36** stamped from sheet metal into substantially *Z*-shape. Its lower portion or foot **36***f* is riveted to the back plate **13**. Near the end of its upper part or arm **36***a* is mounted a pivot pin **39** upon which may be mounted one of the interlocking members hereinafter more fully described. Also mounted upon the arm portion **36***a* at a point spaced from the pin **39** and near the portion connecting arm **36***a* and foot **36***f* is another pivot pin **38** upon which may be mounted the other of the interlocking members hereinafter described.

From the foregoing it may be observed that when one or another of the armatures of the switches **10** and **12** is energized, the interlocking lever **20** or **40**, as the case may be, will be caused to pivot about its mounting pin **21** or **41**, causing the inner end of the interlocking lever to move downwardly, as the invention is viewed in the drawings. When the armatures are released by deenergization of the electromagnet, their normal weight will cause them to move downwardly by gravity (which may, if desirable, be assisted by a spring as in my prior patent). Such downward movement will cause the inner ends of the interlocking levers to move upwardly, as viewed in the drawings.

I

Assuming that it is desired to provide interlocking means to absolutely prevent any movement of the electromagnet armature toward switch closing position, i. e., upwardly in the drawing, until the armature of the other electromagnet switch has fully dropped out, I provide for this purpose an interlocking member designated generally by the numeral **50**. As may best be seen in Figs. 2, 3, 7 and 8 this member comprises two thin stamped sheet metal strips constituting top and bottom plates **54**, **52** with rounded ends. They are spaced apart at one end by a collar **51** thru which passes a hollow rivet **55** whose ends are peened over upon the outer surfaces of the upper and lower plates. Between the opposite ends of the plates is a cylindrical roller or locking member **56** whose reduced ends extend thru small apertures in the top and bottom plates **54**, **52**. The interlocking member **50** is mounted by slipping the hollow rivet upon the mounting pin **38**. The interlocking member **50** is thus pivotally supported between the ends of the interlocking levers **20** and **40**.

The swinging interlocking lever is of such length and its pivot pin **38** is so located that the roller **56** will lie in the path of the inner end of one interlocking lever (the right lever **40**, for example, in Fig. 8), if the left or other lever **20** has been caused to pivot (as in Fig. 3) by the energization of the armature **10***a*. Such movement of the left lever **20** will have forced the roller **56** toward the right in the drawings, so that any effort by right lever **40** to move, if the armature **12***a* should become attracted, will be prevented entirely by the enegagement of the bottom inner corner of the right lever **40** with the roller **56**, the roller being unable to move out of the path of lever **40** because of engagement with the end of left lever **20**.

Preferably the ends of the interlocking levers are made arcuate about the axes of their respective pivot pins **21** and **41**, so that the armature of the energized magnet will be free to drop out as soon as it is deenergized, carrying the end of the associated interlocking lever upward. But during such drop-out motion the roller **56** remains immovable by reason of the curvature of the end of the interlocking lever causing that lever to remain in engagement with the roller until the armature has fully dropped out.

The pivotal motion of the levers **20** and **40** is normally limited by the motion which the switch mechanism permits the armatures and transverse rods **10***r* and **12***r* to have. Hence, the ends of those levers never pass out of the path or arc of movement of the locking roller **56**. However, at the end of the drop-out movement of one armature the locking roller **56** should be able to move enough to permit the other interlocking lever to move in case its armature it attracted. To enable such movement of the roller **56** the lower corners of the inner ends of the interlocking levers **20**, **40** are slightly curved, permitting the roller to be pushed just enough by one of the levers **20**, **40** toward the other to enable said one lever to clear the roller or at least to slide on its surface.

From the foregoing it will be clear that it is impossible for one switch to close while the other is closed, and furthermore one can not start its closing movement until the other has fully opened or dropped out.

To enable the member **50** carrying the locking roller **56** to be assembled and removed after the remainder of the structure has been completely fabricated and remains assembled, the bottom plate **54** is cut away on each side, as at **54***a*, so that the portion between the cuts can drop between the ends of the interlocking levers as the member **50** is mounted on the pivot pin **38**.

II

When it is desired to provide an interlock which not only will prevent both switches from being actuated at once but also will utilize the energization of one to aid and hasten the drop-out action of the other, an interlocking member of bell-crank shape, as illustrated in Figs. 4 and 5, is used instead of the member **55**. This member **60** may be fabricated from two plates of bell-crank shape stamped from thin sheet metal and secured together in spaced relation by a hollow rivet **64** passing thru a collar **65**. The hollow rivet **64** also serves as a bearing for pivotally mounting the bell-crank member on the pivot pin **39** which it will be recalled is mounted upon the member **36** near the end thereof. Mounted in the ends of the bell-crank member are rollers **66** and **68** having reduced ends forming bearings extending thrus the upper and lower plates **61** and **63** of the bell-crank member. These rollers are adapted to engage in notches **25** and **45** formed, respectively, in the interlocking levers **20** and **40** by cutting away a portion of the lower edge of the inner ends of the interlocking levers.

The notches **25** and **45** are preferably formed so that when one armature, for example the armature **10***a* in the left switch, is attracted and the left interlocking lever **20** is caused to pivot, the surface of the notch **25** will engage the left roller **66** and cause the bell-crank member to pivot in counterclockwise direction. Such pivoting of the bell-crank lever will cause the right roller **68** to move up fully into the notch **45** of the right interlocking lever **40**, as may be observed by reference to Fig. 5. In this position of the parts the interlocking lever **20** and the arm carrying the roller **66** are nearly parallel so that the lever action of the interlocking lever **20** is exerted to maximum extent against the roller **66** and the bell crank lever, tending to maintain it in the position of Fig. 5. If now the switch at the right should have its armature **12***a* attracted, it would attempt to move the interlocking lever **40** in counterclockwise direction as the switch **12** tried to operate. However, such action is prevented by the engagement of the roller **68** within the notch **45** and against the surface of the interlocking lever **40**. Due to the position of the arm carrying the roller **68** which approaches a 90° angle with the interlocking lever **40**, the component of the force exerted by lever **40** tending to move the bell-crank member in clockwise direction is less than that which attempts to move it in counterclockwise

direction as exerted by the switch **10**. Hence, energization of the switch **10** and movement of the parts in the position of Fig. 5 prevent actuation of the switch **12** in case its electromagnet should be energized. If the electromagnet of switch **10** should now be deenergized, the parts would fall into the position of Fig. 4.

However, if the parts were in the position of Fig. 5 and the switch **10** should be deenergized and the switch **12** should become energized at about the same time, the upward movement of the armature **12***a* and concomitant counterclockwise rotation of the interlocking lever **40** would cause the bell-crank member **60** to move in clockwise direction and the force exerted by the roller **66** against the interlocking lever **20** would assist the drop-out action of the armature **10***a*, by causing the interlocking lever **20** to move counterclockwise about its pivot **21**.

Obviously, the reverse of the above described actions would occur if the switch **12***a* had had its electromagnet energized and was actuated first.

From the foregoing it will be obvious that I have provided an interlocking mechanism for use in connection with electromagnetic switches mounted side by side which can be used either to prevent absolutely the operation of one switch until the other has completely been deenergized and dropped out, or it can be used merely to prevent operation of the two switches simultaneously while facilitating the dropping-out action of one switch when the other has become energized. Moreover, the adaptability of this mechanism to use, under the different conditions above described, is accomplished very simply and with minimum expense and trouble by merely substituting one interlocking element for another, to wit, the element **50** for the element **60**, and vice versa. It will be clear that this substitution can take place after the switches have been installed and wired or it can be done at the factory or by the seller or user at any time when it is convenient or desirable.

Another advantage of the invention is that it can be applied to conventional electromagnetic switches, and the conversion from one type of interlocking to the other can be accomplished utilizing all of the parts of the interlocking mechanism except one.

Although the interlocking element **60** can be in place, as illustrated in Fig. 1, when the interlocking element **50** is used, element **60** would not be effective and its functions could not be performed while the element **50** remained in place, since the latter will prevent absolutely operation of one switch prior to the other dropping out completely.

In order to prevent the interlocking elements **50** and **60** from falling off their pivotal mounting when one or the other is used, and at the same time in order to facilitate replacement or removal of the one element or the other when it is necessary to replace one by the other, a manually removable bifurcated securing member **70** may be provided. Such a member may conveniently be stamped from sheet metal in the shape illustrated in Fig. 2. Its bifurcations **72** and **74** may be seated or fitted within necks, such as **38***n*, formed in the top of the pivot pins **38** and **39** by cutting circumferential grooves therein just above the members **50** and **60**. By making the bifurcations slightly springy it is easily possible to fit the securing member **70** onto the device with the bifurcations embracing both of the necks on the pivot pins **38** and **39** simultaneously.

Many modifications within the scope of the invention will occur to those skilled in the art. Therefore I do not limit it to the specific form of parts as illustrated and described.

What I claim is:

1. Interlocking mechanism for electromagnetic switches comprising a pair of pivoted levers adapted to be moved by electromagnet armatures between unattracted and attracted positions, an interlocking element, means on said levers engageable by said element to prevent movement of one lever into attracted position while the other lever is in attracted position, and furthermore to prevent movement of one lever toward attracted position until the other lever has moved fully into unattracted position, a second interlocking element, other means on said levers engageable by said second element to prevent movement of one lever into attracted position while the other lever is in attracted position, said second element transmitting the motion in switch-actuating direction of one lever to assist movement of the other lever in the opposite direction, means enabling said interlocking elements to be jointly mountable in their usual operating positions.

2. Interlocking mechanism for electromagnetic switches comprising a pair of pivoted levers adapted to be moved by electromagnet armatures between unattracted and attracted positions, an interlocking element, means on said levers engageable by said element to prevent movement of one lever into attracted position while the other lever is in attracted position, and furthermore to prevent movement of one lever toward attracted position until the other lever has moved fully into unattraced position, a second interlocking element, other means on said levers engageable by said second element to prevent movement of one lever into atiracted position while the other lever is in attracted position, said second element transmitting the motion in switch-actuating direction of one lever to assist movement of the other lever in the opposite direction, frame means on which said levers are mounted, means on said frame means for pivotally mounting said interlocking elements, individually, said pivotal mounting means being located to enable mounting of both said interlocking elements at once, and said interlocking elements being formed to permit functioning of said first element while second element is in place.

3. Interlocking mechanism for electromagnetic switches comprising a pair of pivoted levers adapted to be moved by electromagnet armatures between unattracted and attracted positions, an interlocking element, means on said element engageable by said levers to prevent movement of one lever into attracted position while the other lever is in attracted position, and furthermore to prevent movement of one lever toward attracted position until the other lever has moved fully into unattracted position, said levers having their adjacent ends each curved on a radius concentric with its pivotal axis, said curved ends having sliding engagement with said means on said interlocking element during movement of one lever or the other between attracted and unattracted positions, and said means on said interlocking element preventing any movement of the other lever while movement of one lever between attracted and unattracted positions is occurring.

4. The mechanism as claimed in claim 3, wherein the means on the interlocking element abuts the one lever while sliding over the other between attracted and unattracted positions preventing any movement of the one lever while the other is in any position but fully unattracted, and means on said levers permitting limited movement of said interlocking element when both levers are in unattracted position, so that either one can start toward attracted position.

5. Interlocking mechanism for electromagnetic switches comprising a pair of pivoted levers adapted to be moved by electromagnet armatures between unattracted and attracted positions, an interlocking element, means on said element engageable by said levers to prevent movement of one lever into attracted position while the other lever is in attracted position, and furthermore to prevent movement of one lever toward attracted position until the other lever has moved fully into unattracted position, said levers having their adjacent ends each curved and in sliding engagement with said means on said interlocking element during movement of one lever or the other between attracted and unattracted positions, and said levers each exercising a camming action on said element concomitant with initiation of movement toward attracted

position preventing any movement of the other lever toward attracted position.

6. Interlocking mechanism for electromagnetic switches comprising a pair of pivoted levers adapted to be moved by electromagnet armatures between unattracted and attracted positions, an interlocking element, means on said element engageable by said levers to prevent movement of one lever into attracted position while the other lever is in attracted position, and furthermore to prevent movement of one lever toward attracted position until the other lever has moved fully into unattracted position, said levers having their adjacent ends each curved and in sliding engagement with said means on said interlocking element during movement of one lever or the other between attracted and unattracted positions, means pivotally mounting said interlocking element, and said levers each exercising a camming action on said element concomitant with initiation of movement toward attracted position preventing any movement of the other lever toward attracted position.

7. Interlocking mechanism for electromagnetic switches comprising a pair of pivoted levers adapted to be moved by electromagnet armatures between unattracted and attracted positions, an interlocking element, means on said levers engageable by said element to prevent movement of one lever into attracted position while the other lever is in attracted position, and furthermore to prevent movement of one lever toward attracted position until the other lever has moved fully into unattracted position, said means on the levers comprising adjacent curved ends in sliding engagement with said interlocking element during movement of one lever or the other between attracted and unattracted positions, and said levers each exercising a camming action on said element concomitant with initiation of movement toward attracted position preventing any movement of the other lever toward attracted position, frame means on which said levers are pivotally mounted, means pivotally mounting said interlocking element on said frame means, and means for mounting a second interlocking element on said frame means while said first element remains mounted in operative position, other means on said levers engageable by said second element to prevent movement of one lever into attracted position while the other lever is in attracted position, said second element transmitting the motion in switch-actuating direction of one lever to assist movement of the other lever in the opposite direction, said second element being formed and located not to interfere with operation of said first element but said second element being ineffective while said first element is in place.

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