July 29, 1952 G. J. FREESE 2,604,796

INTERLOCK

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Fig. 1.

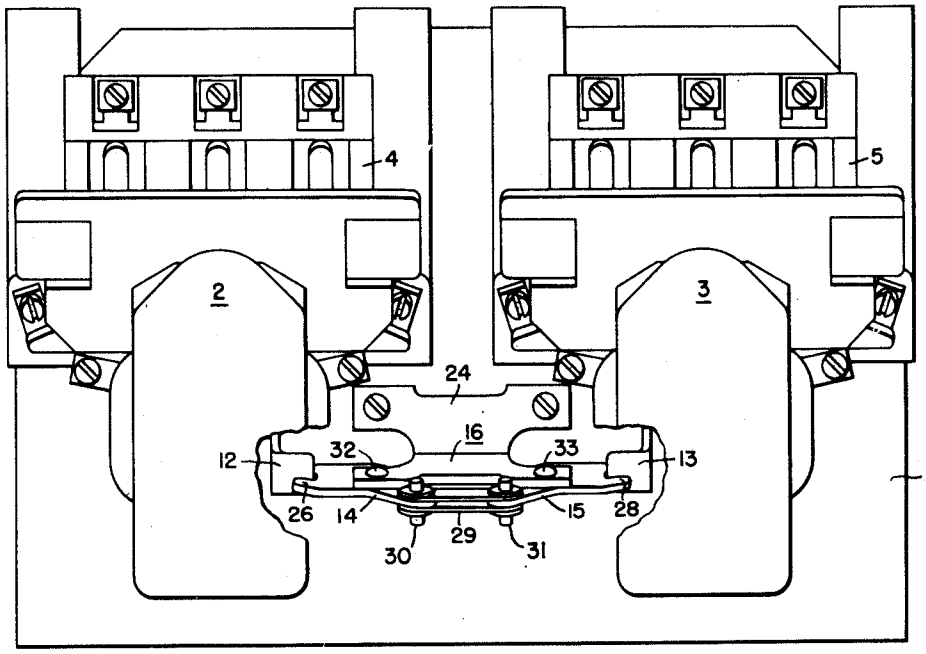


Fig. 2.

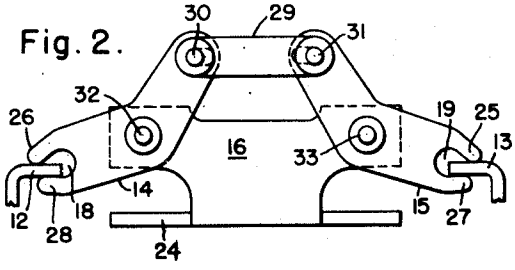


Fig. 3.

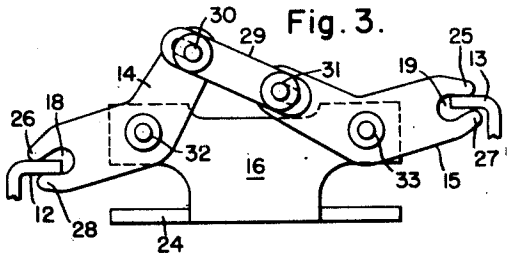


Fig. 4.

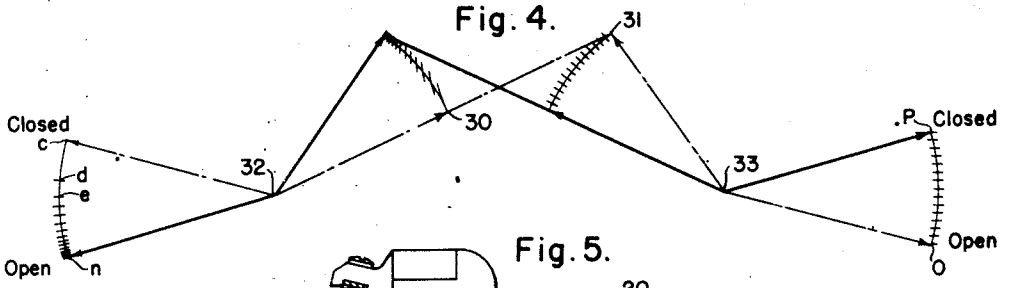
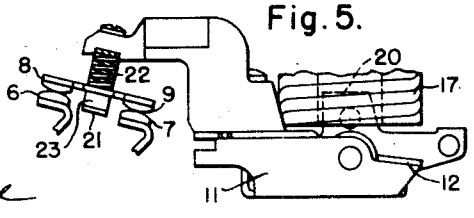


Fig. 5.



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INTERLOCK

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8 Claims. (Cl. 74—483)

1

My invention relates to a mechanical interlock, and more particularly to an improved arrangement of interlocking mechanism for a pair of electromagnetic contactors.

Electromagnetic contactors on reversing control as well as multiple speed control of electric motors must be interlocked in order to prevent the completion of a circuit through more than one switch or contactor at the same time. This requires that an operating circuit through the contacts on one of the contactors must be on open circuit before a second operating circuit can be established through the contacts of the other contactor. The interlock must not only be capable of preventing simultaneous physical contact engagement in more than one switch, but in addition must be effective to prevent contact engagement by a second switch prior to extinguishment of the arc drawn by the contacts of the switch being opened. Premature contact engagement of the contacts moving to closing position would result in a short circuit. The problem is rendered more difficult by the modern relay and contactor design. The modern designs call for small moving parts having low inertia, the use of high-speed magnets with small magnet travel, and a smaller open gap distance between the stationary and movable contacts.

A broad object of my invention is to provide interlocking mechanisms for a pair of electromagnetically operated contactors which are effective to maintain the contacts of one contactor in the open position for a sufficient length of time until the contacts of the other contactor move to the open position.

Another broad object of my invention is to provide interlocking means between a pair of relatively movable members such that one member, having a first directional position, is moved at a high rate of speed into a second directional position while the other member is moved at a relatively slow rate of speed from its second directional position to its first directional position.

A somewhat more specific object of my invention is to provide interlocking means for a pair of electromagnetically operated contactors to effect high speed movements of the contacts of one contactor from a closed position to an open position while the contacts of the second contactor move relatively slowly from an open position to a closed position, and also provide that either contactor may be freely operated from open position to closed position and back while the other contactor is in the open position.

Another broad object of my invention is to

2

provide interlocking means between a pair of relatively movable members such that one member, having a first directional position, is moved at a high speed to a second directional position while the other member is moved at a slow speed from its second directional position to its first directional position, and to provide for independent operation of either member as long as the other member is in its second directional position.

Other objects and advantages will become more apparent from a study of the following specification and the accompanying drawing, in which:

Figure 1 is a front view of a pair of contactors provided with my invention;

Fig. 2 shows a view, from below, of the interlock in cooperation with contactor elements, and wherein the contactor elements are shown in the non-actuated, or second directional, position;

Fig. 3 is a view, similar to the showing in Fig. 2, with the contactor element of the right-hand contactor in the actuated, or first directional, position;

Fig. 4 is a diagrammatic showing of the law of operation of my interlock; and

Fig. 5 is a side view somewhat schematic of one of the contactor elements for actuating the interlock.

Referring to Fig. 1, the numeral 1 designates a base upon which a pair of electromagnetic contactors 2 and 3 are mounted. The base, in use, is mounted on a vertical panelboard. The showing in Fig. 1 is thus a front view with the plane of the paper in the position of the panelboard.

Each of the switches is provided with air insulated housing and arc chambers 4 and 5 containing a set of stationary contacts 6 and 7 and a set of movable contacts 8 and 9. See Fig. 5. The movable contacts of each contactor are provided with the pivoted contactor elements 11 pivoted, as shown in Fig. 5, and being provided with the ears, or projections, 12 and 13 for coaction with the pivoted levers 14 and 15 of the interlock 16. The engagement at 18 and 19 is rather loose so that the effect of the pivotal movement of the elements 11 is as if the ears 12 and 13 moved rectilinearly.

The electromagnetic contactors are of well known design. Each contactor is provided with an actuating coil, as the coil 17 indicated schematically in Fig. 5, a magnetic circuit, and an operating core, or armature, 20.

The control for energizing the coils of the contactors is such that the two coils cannot be energized at the same time. But when the armature actuating coil, as coil 17 in Fig. 5, is energized the

pivoted element 11 moves counterclockwise to cause the movable contacts 8 and 9, usually three pairs in each arc box, to be moved to bridge the stationary contacts 6 and 7, also usually three pairs in each arc box.

Each pair of movable contacts is mounted for guided movement in a stirrup 21 and an overtravel spring 22 is disposed back of each pair of movable contacts. When the coil 17 is energized, the armature actuates the element 11 to such a position that the movable contacts bridge the stationary contacts and each of the overtravel springs 22 is compressed by the movement of the movable contacts away from the bottom 23 of the stirrup 21.

When the actuating coil 17 of the contactor is deenergized, the overtravel springs actuate the element 11 clockwise and the force of gravity of the armature completes the opening of the circuit closed at the movable and stationary contacts.

The interlock comprises a bracket 24 rigidly secured to the support 1. Upon this bracket I mount two obtuse angled levers 14 and 15. The lever 14 has the curved fingers 26 and 28 loosely engaging the ear 12 and the obtuse angled lever 15 has the curved fingers 25 and 27 loosely engaging the ear 13.

The levers 14 and 15 are so pivoted on the bracket that their pivotal movement substantially includes the line of movement of the ears 12 and 13 respectively. A link 29 having bearing slots at its ends loosely engaging the pivot pins 30 and 31 operatively connects the levers 14 and 15.

When, for example, the right-hand contactor 3 is energized, the ear 13 wil be in the position shown in Fig. 3 and the link 29 will be on dead center with the bearing pins 30, 31 and 33. However, if the right-hand contactor is deenergized, the overtravel springs 22 of the right-hand contactor forcibly operate ear 13 downwardly to break the dead-center position.

If the left-hand contactor 2 is energized and the right-hand contactor 3 is deenergized, the pins 31, 30 and 32 will be on dead center, but again when the left-hand contactor is deenergized, the overtravel springs 22 of the left-hand contactor forcibly break the overcenter position.

Since the actuating coils are never energized at the same time, it is apparent that the interlock cannot jam the operation of the contactors. Furthermore, the right-hand contactor 3 can be operated back and forth from open-circuit position to closed-circuit position, as long as the left-hand contactor is in the open circuit position. Similarly the left-hand contactor can be operated back and forth from open circuit position to closed circuit position, as long as the right-hand contactor 3 remains in the open circuit position. For the stated conditions the operation of the contactors is independent.

While the independent functioning of the contactors, if but one is to be operated at a time, is important, for reversing control, or speed control of a motor when the contactors must be operated in succession, or operated alternately, it is extremely important that the contacts at no time are in closed circuit position at the same time. My control accomplishes this and more. When one contactor is in closed circuit position and the other is to be closed, the one to be closed is delayed in its closing operation while the contactor to open is assisted and accelerated by the closing force of the contactor that is being closed.

The theory of this operation is shown in Fig. 4.

Assuming the left-hand contactor is in closed circuit position, namely, the lever 14 is in such position that points 31, 30 and 32 are on dead center, and that the control for the contactors effects the deenergization of the left-hand contactor 2 and a moment later the energization of the right-hand contactor 3. The first thing that happens is that the overtravel springs of the left-hand contactor break the overcenter position of the bearing pins 31, 30 and 32. The second thing that happens is that the actuating coil of the right-hand contactor 3 attempts to move the right-hand contactor 3 to closed circuit position. However, contrary to the conditions for independent operation of the contactors, the right-hand contactor coil is not only burdened with the duty of closing the right-hand contactor but now must assist and accelerate the left-hand contactor from the closed circuit position to the open circuit position.

Assuming that the delay on the closing operation is such that lever 15 moves through equal angles for equal time periods. That is, after successive equal time intervals the point O moves through successive equal angles, as indicated by the graduations at the right in Fig. 4, to point P. In view of the special linked interconnection I provide, the ear 12 moves from point *c* to *d* during the first time interval, from point *d* to *c* during the second equal time interval, and so on to point *n*.

The opening contacts on the left-hand contactor are thus moved initially at a high rate of speed into substantially full open position while the closing contacts of the right-hand contactor move at a relatively low rate of speed. Arc interruption is thus greatly facilitated and all the other advantages expected of an interlock are obtained by apparatus that is extremely simple, reliable, and above all inexpensive.

Since certain changes may be made in the above-described construction and different embodiments of my invention may be made without departing from the spirit and scope thereof, it is intended that all the matter contained in the foregoing description and the subject matter shown in the accompanying drawing shall be considered as illustrative and not in a limiting sense.

I claim as my invention:

1. A mechanical interlock for two spaced movable elements, each of which is movable in a straight line and in the same direction from an initial position to a final postion, said interlock comprising two obtuse angled levers, a lever pivot for each lever pivotally mounting each lever in the region of the vertex of the obtuse angle, said levers being pivotally mounted between the elements and having their outer arms operatively engaging the elements so that movement of one of the elements from its initial position to its final position rotates one of said levers counterclockwise and so that movement of the other element from its initial position to its final position rotates the other of said levers clockwise, a link having a lost-motion pivotal connection with each of the ends of the adjacent arms of the pivoted levers, the lost-motion of said link permitting angular movement of one lever or the other by the respective elements to respective angular positions in which the lever pivot of the lever which has been angularly moved and said pivotal connections occupy positions substantially in a straight line, to lock the

lever which has not been moved against movement by the element connected thereto.

2. An interlock for a pair of relatively movable members operable to lock one of said members against movement when the other of said members is in a given position, in combination, a mounting bracket between the members, a pair of obtuse angled levers, a lever pivot for each lever pivotally mounting each lever on the bracket so that the levers swing substantially in the same plane on spaced parallel pivots, the outer arms of the levers, when the levers are in their initial positions, being substantially horizontal and each horizontal arm operatively engaging respectively one of said members and the other, or adjacent, arms being directed upwardly in horizontally spaced relation to each other, a link pivotally engaging the upwardly directed adjacent arms, the pivotal engagement of the link and the said upwardly directed adjacent arms comprising a lost-motion type engagement, the lost-motion being just sufficient that the movable members may be selectively moved freely from said initial position to a final position in which the adjacent arm of the lever which has been moved and said link occupy positions substantially in a straight line to lock the lever which has not been moved against movement by the member connected thereto.

3. A mechanical interlock for two spaced movable elements, each of which is movable in a straight line and in the same direction from an initial position to a final position, said interlock comprising two obtuse angled pivoted levers, one for each of said elements, said levers being pivotally mounted between the elements and having their outer arms operatively engaging the elements so that movement of one of the elements from its initial position to its final position rotates one of said levers counterclockwise and so that movement of the other element from its initial position to its final position rotates the other of said levers clockwise, first electromagnetic means, when energized, adapted to move a first of said elements from its initial position to its final position, second electromagnetic means, when energized, adapted to move the second of said elements from its initial position to its final position, biasing means for biasing each element away from its final position, a link having a lost-motion pivotal connection with each of the ends of the adjacent arms of the pivoted levers, the length of the link and the lost-motion permitting selective angular movement of each lever to a position in which the adjacent arm of the lever which has been moved occupies a position substantially in a straight line with said link such that one element connected with the lever which has not been moved cannot be moved from its initial position to its final position at the time that the electromagnetic means of the other element is energized, but upon deenergization of the electromagnetic means for the other element the energization of the electromagnetic means for said one element causes said one element to move at a given speed from its initial position to its final position and causes the other element to move at a higher speed from its final position to its initial position.

4. A mechanical interlock for two spaced movable elements, each of which is movable in a straight line and in the same direction from an initial position to a final position, said interlock comprising two obtuse angled pivoted levers, one for each of said elements, said levers being pivotally mounted between the elements and having their outer arms operatively engaging the elements so that movement of one of the elements from its initial position to its final position rotates one of said levers counterclockwise and so that movement of the other element from its initial position to its final position rotates the other of said levers clockwise, first electromagnetic means, when energized, adapted to move a first of said elements from its initial position to its final position, second electromagnetic means, when energized, adapted to move the second of said elements from its initial position to its final position, overtravel springs operatively coupled with the first element adapted to move the said first element from its final position upon deenergization of the electromagnetic means for actuating the first element, overtravel springs operatively coupled with the second element adapted to move the said second element from its final position upon deenergization of the electromagnetic means for actuating the second element, a link having a lost-motion pivotal connection with each of the ends of the adjacent arms of the pivoted levers, the length of the link and the lost-motion permitting selective angular movement of each lever to a position in which the adjacent arm of the lever which has been moved occupies a position substantially in a straight line with said link such that one element connected with the lever which has not been moved cannot be moved from its initial position to its final position when the electromagnetic means of the other element is energized, but upon deenergization of the electromagnetic means for the other element the energization of the electromagnetic means for said one element causes said one element to move at a given speed from its initial position to its final position and causes the other element to move at a higher speed from its final position to its initial position.

5. An interlock for a pair of elements having substantially rectilinear movement, in combination, a first machine element having in normal operation a substantially rectilinear movement from an initial position to a final position, a second machine element having structure and function similar to the first disposed in spaced relation to the first and the line of movement of the two elements being substantially in the same plane, a pair of pivoted bell crank levers, pivoted to swing in the plane of movement of the machine elements and disposed between the machine elements, said bell crank levers having arms that are disposed at an obtuse angle with respect to each other and corresponding arms of the levers respectively operatively engaging the machine elements, the disposition of the parts being such that the outer arms of the levers are substantially horizontal when the elements are in their respective initial positions, a link having at its ends loose pivotal engagement with the adjacent upwardly directed arms of the levers, the pivotal connection of the link being just sufficiently loose that free operation of each machine element may be had as long as the other machine element is in its initial position, movement of a selected one of said machine elements rotating the lever connected thereto to a position in which the adjacent arm of the rotated lever occupies a position substantially in a straight line with said link to lock the other lever against angular movement by the machine element connected thereto.

6. An interlock for a pair of elements having

substantially rectilinear movement, in combination, a first machine element having in normal operation a substantially rectilinear movement from an initial position to a final position, a second machine element having structure and function similar to the first disposed in spaced relation to the first and the line of movement of the two elements being substantially in the same plane, a pair of pivoted bell crank levers, pivoted to swing in the plane of movement of the machine elements and disposed between the machine elements, said bell crank levers having arms that are disposed at an obtuse angle with respect to each other and corresponding arms of the levers respectively operatively engaging the machine elements, the disposition of the parts being such that the outer arms of the levers are substantially horizontal when the elements are in their respective initial positions, a link having at its ends loose pivotal engagement with the adjacent upwardly directed arms of the levers, the pivotal connection of the link being just sufficiently loose that free operation of each machine element may be had as long as the other machine element is in its initial position, movement of a selected one of said machine elements rotating the lever connected thereto to a position in which the adjacent arm of the rotated lever occupies a position substantially in a straight line with said link to lock the other lever against angular movement by the machine element connected thereto, and biasing means for each machine element to bias it away, for a short distance, from its final position.

7. An interlock for a pair of elements having substantially rectilinear movement, in combination, a first machine element having in normal operation a substantially rectilinear movement from an initial position to a final position, a second machine element having structure and function similar to the first disposed in spaced relation to the first and the line of movement of the two elements being substantially in the same plane, a pair of pivoted bell crank levers, pivoted to swing substantially in the plane of movement of the machine elements and disposed between the machine elements, said bell crank levers having arms that are disposed at an obtuse angle with respect to each other and corresponding arms of the levers respectively operatively engaging the machine elements, the disposition of the parts being such that the outer arms of the levers are substantially horizontal when the elements are in their respective initial positions, a link having at its ends loose pivotal engagement with the adjacent upwardly directed arms of the levers, the pivotal connection of the link being just sufficiently loose that free operation of each machine element may be had as long as the other machine element is in its initial position, movement of a selected one of said machine elements rotating the lever connected thereto to a position in which the adjacent arm of the rotated lever occupies a position substantially in a straight line with said link to lock the other lever against angular movement by the machine element connected thereto, and means for each machine element for actuating the machine element from its initial position to its final position.

8. An interlock for a pair of elements having substantially rectilinear movement, in combination, a first machine element having in normal operation a substantially rectilinear movement from an initial position to a final position, a second machine element having structure and function similar to the first disposed in spaced relation to the first and the line of movement of the two elements being substantially in the same plane, a pair of pivoted bell crank levers, pivoted to swing in the plane of movement of the machine elements and disposed between the machine elements, said bell crank levers having arms that are disposed at an obtuse angle with respect to each other and corresponding arms of the levers respectively operatively engaging the machine elements, the disposition of the parts being such that the outer arms of the levers are substantially horizontal when the elements are in their respective initial positions, a link having at its ends loose pivotal engagement with the adjacent upwardly directed arms of the levers, the pivotal connection of the link being just sufficiently loose that free operation of each machine element may be had as long as the other machine element is in its initial position, movement of a selected one of said machine elements rotating the lever connected thereto to a position in which the adjacent arm of the rotated lever occupies a position substantially in a straight line with said link to lock the other lever against angular movement by the machine element connected thereto, means for each machine element for actuating the machine element from its initial position to its final position, and biasing means for each machine element to bias it away, for a short distance, from its final position.

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