Jan. 27, 1953 C. F. TRITELINE ET AL 2,626,542

ELECTRICALLY OPERATED SAFETY INTERLOCK FOR BROACHING MACHINES

Filed May 19, 1950 2 SHEETS—SHEET 1

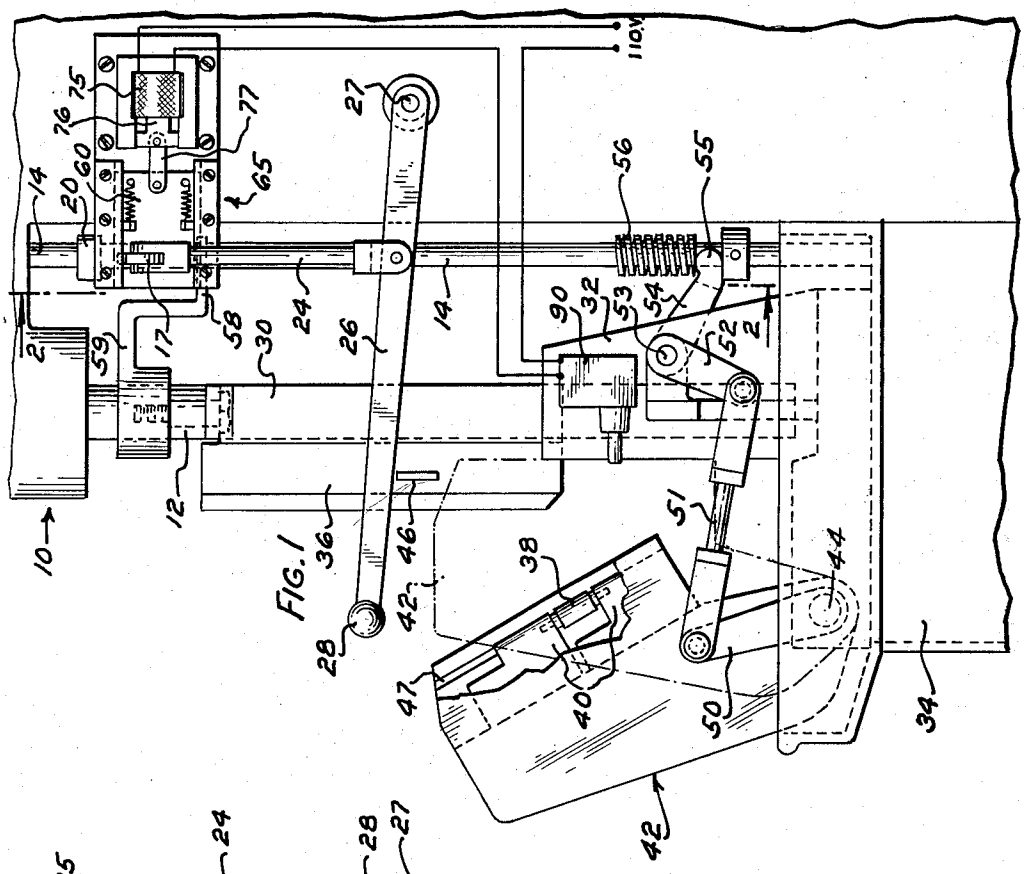

FIG. 1

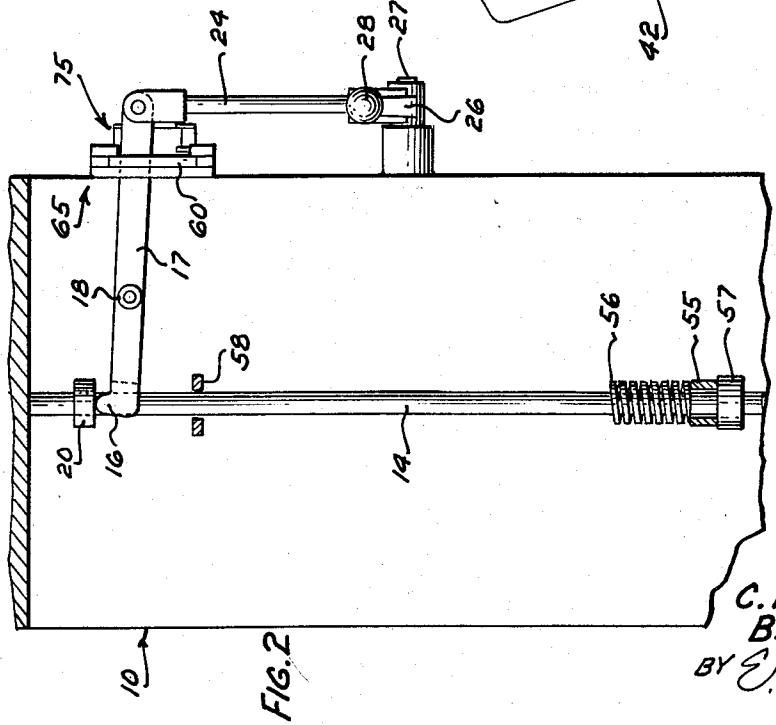

FIG. 2

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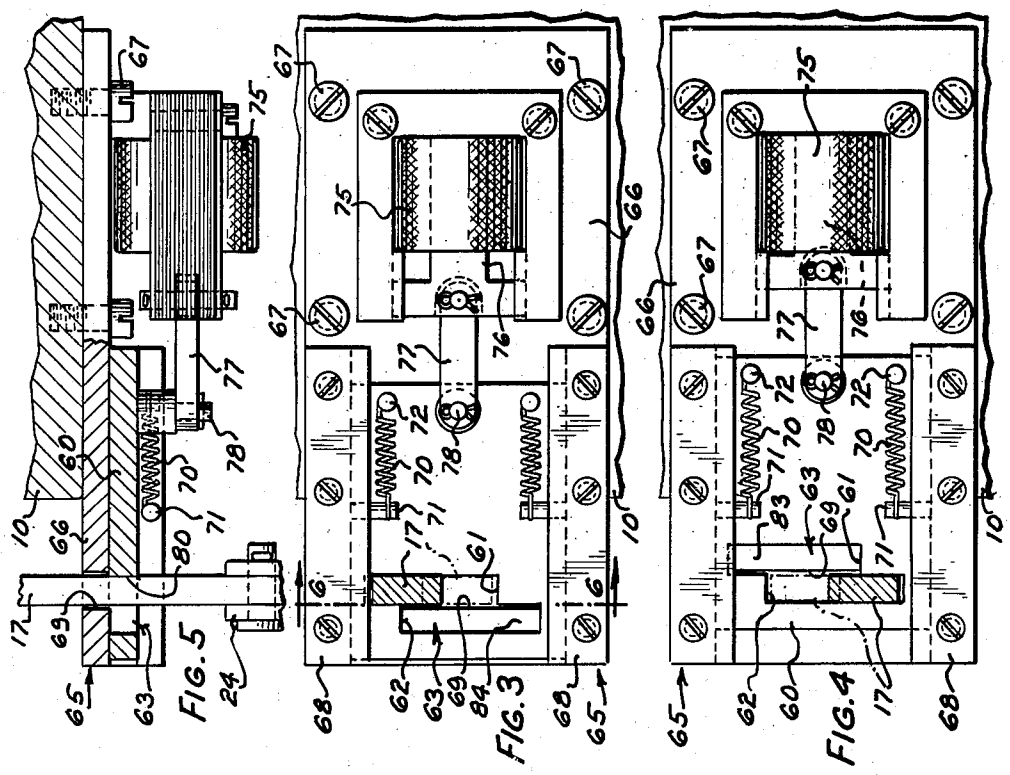

FIG. 5

FIG. 3

FIG. 4

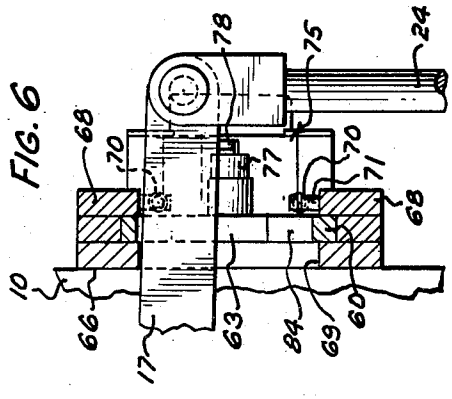

FIG. 6

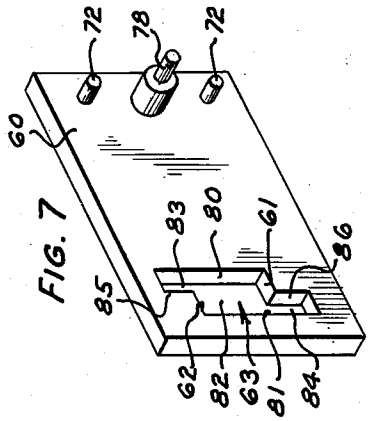

FIG. 7

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ELECTRICALLY OPERATED SAFETY INTERLOCK FOR BROACHING MACHINES

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5 Claims. (Cl. 90—33)

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This invention relates to a safety interlock for the control lever of a material working machine and more particularly to an electrically operated safety interlock for the control lever of a broaching machine for preventing the actuation of the broaching machine before the work holder of the machine is in its operative position.

It is an object of the present invention to provide an efficient and positive safety interlock for preventing improper operation of the control lever of a material working machine.

In accordance with one embodiment of the invention as applied to a hydraulically operated broaching machine having a lever for controlling the forward and return strokes of the broach, a movable control plate is provided having an irregularly shaped aperture therein through which extends an arm connected to and movable with the lever. The control plate is yieldably maintained in one position where the aperture therein limits the movement of the operating lever to and from reverse and neutral positions, and the control plate is movable to a second position by a solenoid when energized in response to the movement of a work holding fixture of the broaching machine to its closed position. The control plate in its second position serves to limit the movement of the lever to and from forward and neutral positions so that only when the work holding fixture is in its closed position may the lever be moved to its forward position to effect the forward stroke of the broach and then only after the work holding fixture has been moved to its open position may the operating lever be moved to its reverse position to effect the return of the broach.

Other objects and advantages of the invention will be apparent by reference to the following detailed description thereof and the accompanying drawings illustrating an embodiment of the invention in which

Fig. 1 is a side elevation view of a portion of a hydraulically actuated broaching machine with the invention applied thereto;

Fig. 2 is a vertical sectional view taken on the line of Fig. 1;

Fig. 3 is an enlarged fragmentary elevational view of the safety interlocking mechanism shown in Fig. 1 with the control plate in its normal position;

Fig. 4 is a view similar to Fig. 3 showing the control plate in a changed position;

Fig. 5 is a horizontal sectional view taken on the line 2—2 of Fig. 3;

Fig. 6 is a vertical sectional view taken on the line 6—6 of Fig. 3; and

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Fig. 7 is a perspective view of the locking plate.

Referring to the drawings, the invention is shown applied to a broaching machine 10 having a vertically movable ram 12 actuated by a hydraulic actuator (not shown) in response to the movements of a rod 14 which actuates the hydraulic control valves and is spring stressed downwardly to a normal or reverse position to cause the ram to return to its upper or starting position. The ram 12 is adapted to advance or move downwardly in response to an upward movement of the rod 14 and is adapted to return or move upwardly in response to a downward movement of the rod 14. Control means are provided to reciprocate the rod 14 to effect the actuation of the ram 12. The end 16 of a lever 17 pivotally mounted at 18 on the broaching machine 10 is engageable with a collar 20 on the rod 14 for moving the rod upwardly in response to actuation of the lever 17 in one direction. At its other end the lever 17 is connected to one end of a link 24, the other end of which is connected to a control lever 26 pivotally mounted on the broaching machine at 27 and having a handle 28 by means of which the lever 26 may be moved downwardly to impart upward movement to the rod 14 to effect the forward movement of the ram 12. When the operator removes his hand from the control handle in its lower position, the spring stressed rod 14 is returned to its reverse position and causes the upward movement of handle 28 as well as the ram 12.

Attached to the lower end of the ram 12 is a broach holding fixture 30 the lower end of which engages in a guideway in a guide member 32 mounted on a table portion or apron 34 of the broaching machine 10. A broach 36 secured in the broach holding fixture 30 is adapted to broach a plurality of longitudinal grooves in a portion of the periphery of a cylindrical work piece 38 held in position between a pair of relatively movable clamping jaws 40 in a work holding fixture 42. The work holding fixture 42 is pivotally mounted on a shaft 44 for movement to and from an open position indicated in full lines in Fig. 1 where the work piece 38 may be applied to and removed from the fixture, and a closed position indicated in dotted lines in Fig. 1 for positioning the work piece 38 in axial alignment with the broach 36. A key 46 on the broach holding fixture 30 is slidable in a key way 47 in the work holding fixture in its closed position during forward movement of the ram and prevents movement of the work holder 42 to open position

until the ram 12 has completed its broaching stroke.

Mechanism is provided for automatically moving the work holder 42 from its closed position to its open position on completion of the forward or broaching stroke of the ram 12 and comprises an arm 50 secured at one end to the shaft 44 and connected at its outer end to one end of link 51. The link 51 at its other end is connected to one end of an arm 52 which is secured at its other end to a shaft 53 mounted in suitable bearings in the guide member 32. A lever 54 also secured to shaft 43 has a forked end 55 which straddles the rod 14 and engages a relatively heavy helical compression spring 56 encircling the rod. The end portion 58 of an arm 59 secured to the ram 12 for movement therewith is adapted to engage the spring 56 near the end of advance movement of the ram 12 to move the spring 56 and the lever 54, and through the linkage associated therewith to cause the work holder 42 to be moved from its closed to its open position. A collar 57 fixed to the control rod 14 and engageable by the lever 54 serves to actuate the rod 14 automatically to its reverse position in response to the movement of the work holder 42 to its open position, to cause the ram 12 to return to its upper position. In machines where it is desirable to eliminate the automatic reversing of the ram and have the ram 12 reversed under manual control the collar 57 may be removed from its position as shown in Fig. 1 and be secured in a position on the rod 14 below the end 16 of the lever 17 to be actuated thereby in response to the actuation of the lever 26.

The safety mechanism limits the movement of the control means and the lever 26 to prevent the full movement thereof to and from its forward and reverse positions to cause the forward and reverse strokes of the ram 12 except under proper conditions. The safety control mechanism comprises a control member in the form of a plate 60 provided with stop shoulders 61 and 62 for limiting the movement of the lever in opposite directions and formed by an irregular recess 63 in the plate through which a portion of the lever 17 extends. The plate 60 is slidably mounted in a guide 65 secured to the side of the broaching machine 10, for movement at right angles to the plane of movement of the lever 17. The guide 65 comprises a supporting plate 66 secured to the side wall of the broaching machine 10 by screws 67 and a pair of guideways 68 engaging the upper and lower edges of the plate 60. A vertical slot 69 formed in the plate 66 provides clearance for movement of the lever 17. A pair of tension springs 70 secured at one end to pins 71 on the ways 68 and at their other ends to pins 72 on the plate 60, serve to urge the plate 60 to the left as viewed in Fig. 3. A solenoid 75 is mounted on the plate 66 and has an armature 76 connected to one end of link 77 the other end which is pivotally connected at 78 to the plate 60. The solenoid when energized, serves to stress the plate 60 for movement with sufficient force to overcome the springs 70 and move the plate 60 to the right.

The movement of the plate 60 in opposite directions may be limited by any suitable stop means. In the present construction the movement of the control member 60 to the left is stopped by engagement of the lever 17 with the wall or edge 80 of the aperture 63 and the movement of the member 60 to the right is stopped by the engagement of the lever 17 with wall or edge 81 of the aperture 63. The intermediate horizontal portion 82 of the aperture 63 defined by the wall 80 and 81 and stop surfaces 61 and 62 provides clearance for the lever 17 in its neutral position and permits horizontal movement of the member 60 to and from its first and second positions. Vertically extending slots 83 and 84 are formed by the ends of the aperture 63 in the plate in spaced relation to each other, the slot 83 extending upwardly between surfaces or walls 80 and 85, and the slot 84 extending downwardly between the surfaces 81 and 86. The recess 63 in effect, is formed by a pair of parallel vertically disposed slots partly offset vertically relative to each other and positioned side by side with portions of the slots communicating with each other.

With the member 60 in its normal or first position, Fig. 3, the slot 83 provides clearance for the movement of the lever 17 to and from its neutral and reverse positions and the wall 85 prevents movement of the member 60 to the right to its second position when the lever 17 is in its reverse position. With the member 60 in its second position (Fig. 4) the slot 84 provides clearance for the movement of the lever 17 to and from its neutral and forward positions and the wall 86 prevents movement of the member 60 to the left to its first position when the lever 17 is in its forward position. It will thus be seen that plate 60 functions in either of its two positions to prevent the full movement of the control lever 26 from one operative position to the other operative position and serves to limit the movement of the lever to and from either one of the operative positions and the neutral position.

The solenoid 75 is connected to a source of current through a normally open micro-switch 90 (Fig. 1) which is mounted on the guide member 32 in a position to be actuated to a closed position by the movement of the work holding fixture 42 to its closed position. Thus, when the work holding fixture 42 is in its open position the micro-switch 90 is open, the solenoid 75 is de-energized and the plate 60 is stressed for movement to the left as viewed in Fig. 3 to its normal or first position, and when the work holding fixture 42 is in its closed position the solenoid 75 is energized and stresses the plate 60 for movement to the right as viewed in Figure 3 to its second position.

In the operation of broaching a part 38, with the plunger 12 of the broaching machine in its upper position, the work holding fixture 42 in its open position, the operating lever 26 is in its upper or reversing position and plate 60 is in its normal or first position with the lever 17 in the slotted portion 83 of the aperture 63 and freely movable to and from the reversing and neutral positions. A work piece 38 may be clamped in position between the clamping jaws 40 of the work holding fixture 42 and the fixture moved from its open position to its closed position to align the work with the broach 36. In response to the closing of the work holding fixture 42 the micro-switch 90 is actuated to close the circuit to the solenoid 70 and cause its energization which then stresses the plate 60 to the right to its second position. The operating lever 26 may then be moved downwardly from its upper or reversing position into its neutral position in which position of the lever 17 the plate 60 is moved to the right to its second position by the solenoid 75 and the operating lever 26 may be moved downwardly from its neutral position to its lower or forward position. The movement of the

operating lever 26 downwardly from its upper position to its neutral position and from its neutral position to its lower position is effected without any hesitation or stopping of the lever 26 in its neutral position by the plate 60, since the movement of slide plate 62 from its first position to its second position is so rapid so as not to interfere with the continuous movement of lever 17 and the operating lever 26.

In response to the movement of the operating lever 26 downwardly to its forward position the end 16 of the lever 17 as it moves upwardly engages the collar 20 and moves the rod 14 upwardly to cause the ram 12 and the broach to move downwardly through a broaching stroke to broach the work piece 38. While the ram 12 and the broach 36 are being advanced the operating lever 26 cannot be returned to its upper or reversing position to reverse the movement of the broach 36 because of the stop surface 62 of the plate 60 which limits the upward movement of lever 17 and the operating lever 26 to a neutral position and this construction insures that the broach cannot be returned to its original starting position prior to the completion of its forward or broaching stroke and thus prevents any damage which might be caused to the broach by accidental reversal of the broach prior to the completion of its forward stroke. After the work piece 38 has been broached and near the end of the forward stroke of the ram 12 the end 58 of the arm 59 carried by the ram engages the spring 56 and moves it and the lever 54 downwardly and causes the work holding fixture 42 to be moved to its open position.

During the initial portion of the movement of the work holder 42 to its open position the switch 90 is returned to its normally open position and the solenoid 75 is deenergized allowing the plate 60 to be stressed to the left to its normal or first position. As the lever 54 is moved downwardly the bifurcated end 55 thereof engages the collar 57 on the rod 14 and moves it downwardly to cause the ram 12 to be moved upwardly and the collar 20 on the rod 14 imparts movement to the lever 17 and causes the levers 17 and 26 to be moved to their reverse positions. When the levers 17 and 26 reach the neutral positions during their movement from their forward to their reverse positions the plate 60 is immediately moved to the left with a snap action to align the slot 63 with the lever 17 to permit the levers 17 and 26 to complete their movement without any interference from plate 60.

Although in the embodiment of the invention disclosed herein, the plate 60 of the safety interlock is shown as cooperating with the lever 17 to limit the movement of the control means. It will be understood that the plate 60 may be positioned to cooperate with the lever 26 or any element of the movable linkage comprising the control means to limit the movement of the control means in the same manner as disclosed above.

It is to be understood that the above-described arrangements are simply illustrative of the application of the principles of the invention. Numerous other arrangements may be readily devised by those skilled in the art which will embody the principles of the invention and fall within the spirit and scope thereof.

What is claimed is:

1. An interlocking device for a broaching machine having a broach actuating ram reciprocable in response to actuation of a control means including an element movable to and from forward, neutral and reverse positions and a work holding fixture movable to and from a closed position for holding the work in alignment with said broach, said interlocking device comprising a member having portions defining an irregular slot for receiving said element therein to limit the movement of said control means, means mounting said member for movement transversely to the movement of said lever to and from a first position and a second position, said irregular slot having an intermediate portion for receiving said element when said element is in neutral position to permit movement of said member to and from its first and second positions, said irregular slot having a first end portion extending transversely from said intermediate portion in one direction and operable when said plate is in said first position for receiving said element and limiting the movement thereof to and from reverse and neutral positions, said irregular slot having a second end portion extending transversely from said intermediate portion in the opposite direction and operable when said plate is in said second position for receiving said element therein and limiting the movement of said element to and from forward and reverse positions, and means operable in response to movement of said work holding fixture from its closed position to move said member to its first position and operable in response to the movement of said work holding fixture to its closed position to move said member to its second position.

2. An interlocking device for a broaching machine provided with control means including an element movable to and from forward, neutral and reverse positions for controlling the forward and reverse movements of a broaching tool, and a work holding fixture movable to and from an operative position for holding the work in the path of the broaching tool, said interlocking device comprising a plate having an irregularly shaped aperture therein for receiving said element therein, means for mounting said plate for movement to and from a first position and a second position, said aperture having a straight intermediate portion providing clearance for said element to permit movement of said control plate to and from said first and second positions when said element is in neutral position, said aperture having a pair of parallel end portions extending transversely from said intermediate portion in opposite directions and from opposite ends thereof, one of said end portions of said aperture serving to permit and limit movement of said element to and from reverse and neutral positions when said member is in its first position and the other of said end portions of said recess serving to permit and limit movement of said operating lever to and from forward and neutral positions when said plate is in said second position, resilient means urging the plate to said first position, a solenoid operatively connected to said control plate for moving said plate to said second position when energized, and means including a switch actuated by the movement of said work holding fixture to its operative position for energizing said solenoid.

3. An interlocking device for a machine having a broach actuating ram reciprocable in response to actuation of a control means including an element movable in a plane to and from forward, neutral and reverse positions and a work holding fixture movable to and from closed position for holding the work in alignment with said broach, said interlocking device comprising a

plate having portions thereof defining a pair of slots for receiving said element therein, said pair of slots being disposed in a direction parallel to the plane of movement of said element and offset in said direction relative to each other and arranged side by side with portions thereof in communication with each other, one of said slots serving to limit the movement of said element to and from reverse and neutral positions and the other of said slots serving to limit the movement of said element to and from forward and neutral positions, means mounting said plate for movement transversely to the plane of movement of said element to and from a first position and a second position to align alternate ones of said pair of slots with said element, said slots providing clearance for said element when said element is in neutral position to permit movement of said plate to and from said first and second positions, means yieldably urging said plate to its first position, and electrical means operable in response to the movement of said work holding fixture to its closed position to urge said plate to its second position.

4. An interlocking device for a broaching machine having a broach actuating ram reciprocable under control of an operating lever which is movable to and from forward, neutral, and reverse positions, and a work holding fixture movable to and from a closed position for holding the work in alignment with said broach, said interlocking device comprising a plate having an aperture for receiving said control lever, means mounting said plate for movement transversely of the direction of movement of said lever, means for stressing said plate for movement in one direction to a first position in response to movement of said work holding fixture from said closed position, and means for stressing said plate for movement in the opposite direction to a second position in response to movement of said work holding fixture to said closed position, the aperture in said plate having a contour permitting movement of said plate to and from said first and second positions only when said lever is in said neutral position and limiting the movement of said lever to and from neutral and forward positions at said first position of said plate and limiting movement of said lever to and from

neutral and reverse positions at the second position of said plate.

5. An interlock for a machine having a control lever and linkage elements movable to and from forward, neutral, and reverse positions to control the forward and reverse movements of a tool on said machine and having a work holder movable to and from an operative position for holding the work in the path of said tool, said interlock comprising a member having an irregularly shaped slot therein for receiving a movable linkage element therein, means mounting the slotted member for movement transversely of the direction of movement of said element, means limiting the movement of said slotted member to and from a first position and a second position, the slot in said slotted member having a contour permitting movement of said member to and from said first and second positions only when said element is in said neutral position and for limiting the movement of said lever and said element to and from neutral and forward positions when said slotted member is in said first position and for limiting the movement of said lever and said element to and from neutral and reverse positions when said slotted member is in said second position, spring means urging said slotted member for movement to one of said positions, and electrical means including a switch operable in response to the movement of said work holder to said operative position for moving said slotted member to the other of said positions.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
902,560	Coldwell	Nov. 3, 1908
1,070,936	Aalborg	Aug. 19, 1913
1,274,632	Tormoen et al.	Aug. 6, 1918
1,576,724	Dacey et al.	Mar. 16, 1926
2,198,882	Monroe	Apr. 30, 1940
2,333,337	Raehrs et al.	Nov. 2, 1943
2,358,643	Kelley	Sept. 19, 1944