

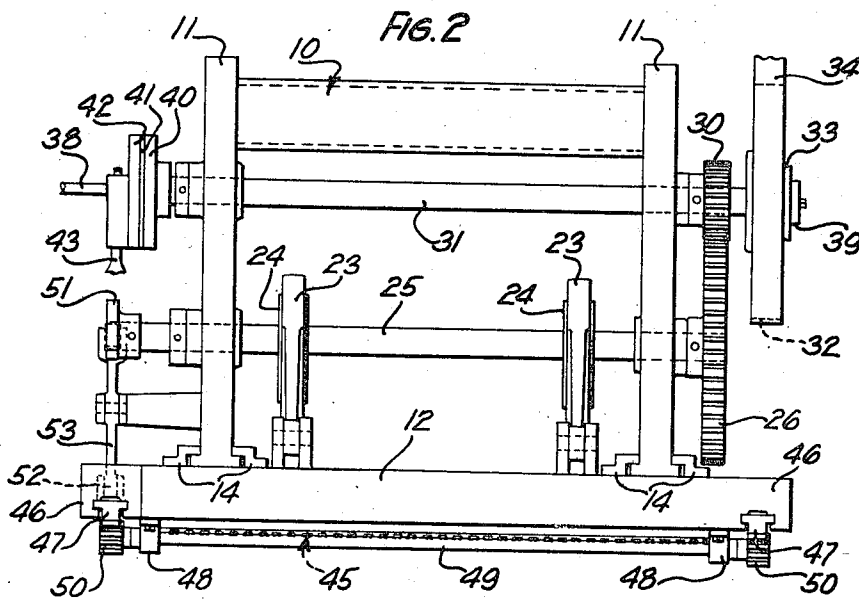
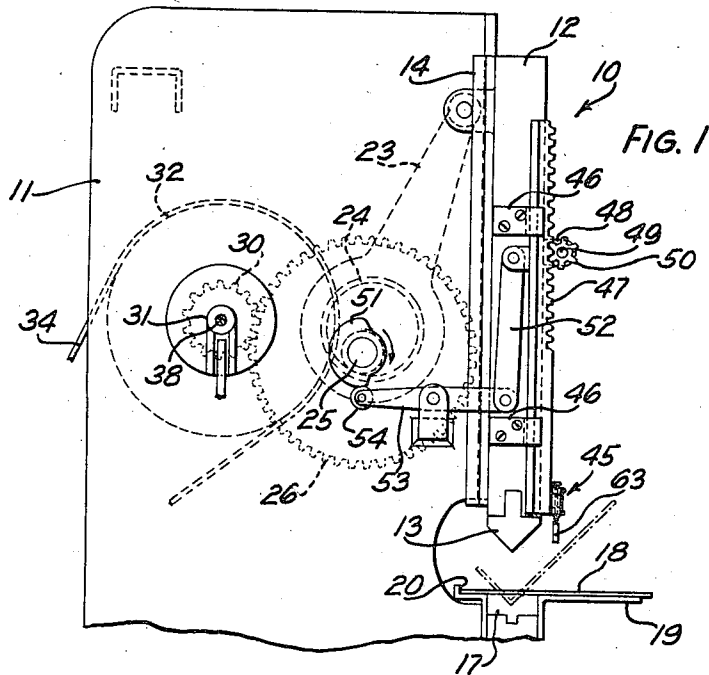
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Filed March 16, 1933

2 Sheets-Sheet 1



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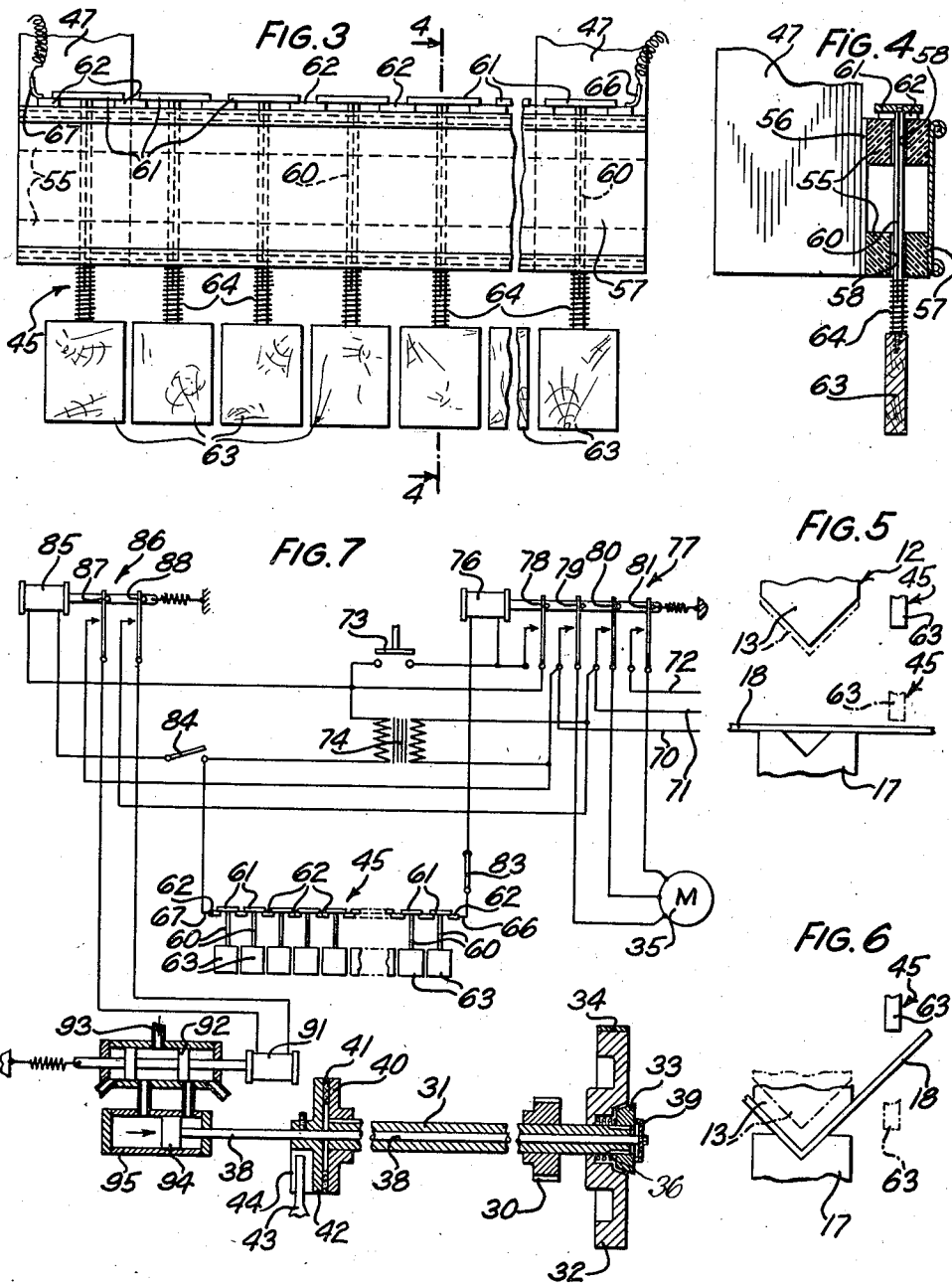
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SAFETY GUARD AND CONTROL SYSTEM

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This invention relates to safety guards and control systems for power operated machines, and more particularly to safety guards and control systems for forming presses and the like.

An object of this invention is to provide an improved inexpensive and reliable safety guard and control system for power operated machines.

In accordance with one embodiment of the invention as applied to a forming press, a safety guard and automatic stop is provided comprising a guard panel composed of a plurality of individually movable sections depending from a horizontal bar extending across the danger zone of the press and which is automatically moved downwardly in timed relation to the downward travel of the forming ram so that the danger zone is covered by the guard panel during the entire downward travel of the ram, excepting during the final small portion of its downward travel, during which time the guard panel is moved upwardly so as not to interfere with the forming operation. The individual sections of the guard panel control an electrical circuit, including means for stopping the ram upon one or more of the guard sections encountering an obstruction, such as an operator's hand, during the downward travel of the ram.

Other features and advantages of this invention will more fully appear from the following detailed description taken in connection with the accompanying drawings, in which

Fig. 1 is a fragmentary side view of a press brake provided with a safety guard and control system embodying the invention;

Fig. 2 is a plan view thereof;

Fig. 3 is a fragmentary front view of the safety guard;

Fig. 4 is a vertical section taken on the line 4—4 of Fig. 3;

Fig. 5 is an enlarged fragmentary view showing the relative positions of the safety guard and the ram after the latter has moved downwardly a slight distance;

Fig. 6 is a view similar to Fig. 5, showing the position of the safety guard just previous to and during the forming operation, and

Fig. 7 is a fragmentary view in diagrammatic form of the safety guard showing the electrical circuit and means associated therewith for stopping the ram upon the safety guard encountering an obstruction during the downward travel of the safety guard.

Referring now to the drawings, and particularly to Figs. 1 and 2, the features of this invention have been shown embodied in a press brake,

indicated generally by the numeral 10, and which is fragmentarily illustrated. The press brake is of a well known type and only such details thereof have been shown in this application which are essential to a complete understanding of the present invention. A frame of the press includes a pair of spaced standards 11 upon the forward flanged ends of which a vertically reciprocating ram 12 carrying a punch 13 at its lower end is slidable, the ram being guided on the standards by means of gib plates 14 fixed to the rear face of the rams and cooperating with the flanges on the standards. Supported upon the bed of the press below the punch 13 is a stationary die 17, the punch and the die, as shown in the drawings, cooperating in the operation of the press to form a right angle bend, as shown in broken lines (Fig. 1), in sheet material 18 positioned on a support 19, the forward edge of the material engaging a stop 20 before being formed.

The ram is reciprocated by means of a pair of crank arms 23 pivotally connected at their upper ends to the ram with their lower ends operatively connected to eccentrics 24 fixed to a driving or crank shaft 25. Fixed to the right end of the shaft 25 (Fig. 2) is a gear 26 meshing with a pinion 30 fixed to a clutch shaft 31. Loosely journaled on the shaft 31 at its right end is a fly wheel 32 which also forms a clutch element, the outer end face of the wheel being recessed to form a clutch surface which is adapted to have cooperative relationship with a clutch element 33 splined upon the shaft 31. The fly wheel 32 is connected by means of a belt 34 to a pulley (not shown) driven from a motor 35 indicated diagrammatically in Fig. 7. A coiled compression spring 36 surrounding the shaft 31 between opposed surfaces of the clutch elements 32 and 33 normally maintains the clutch elements disengaged, as shown in Fig. 7. Extending loosely through the shaft 31 is a clutch and brake actuating rod 38 carrying at its right end a cup-shaped head 39 having its inner annular edge engaging the outer end face of the clutch element 33. A movement of the rod 38 towards the left, in a manner to be hereinafter described, operatively engages the driven clutch element 32 with the driving clutch element 33, and by means of the pinion 30, gear 26, eccentrics 24 and the crank arms 23, the ram 12 is given a reciprocatory motion to carry the punch 13 to and from the die 16, assuming that the fly wheel forming the driving clutch member 32 is being rotated.

Secured to the left end of the shaft 31 is a brake disk 40 carrying an annular friction pad 55

41. Cooperating with the disk 40 is a disk 42 fixed to the rod 38, the disk 42 being moved into braking engagement with the pad 41 of the disk 40 upon movement of the rod 38 toward the right to permit the disengagement of the clutch elements 32 and 33. Thus, upon the disengagement of the clutch elements 32 and 33, the shaft 31 is immediately subjected to a very effective braking action which causes the shaft 31 and connected parts to stop very quickly. To prevent the rod 38 and attached brake disk 42 from rotating either during the engagement of the clutch elements 32 and 33 or while the brake is being applied to the shaft 31 a stationary stop member 43 is provided which extends between a pair of lugs 44 integral with the brake disk 42, the arrangement being such that the rod 38 and the attached disk may be moved longitudinally, but rotary motion thereof is prevented.

20 In accordance with a feature of the present invention, a safety guard, indicated generally by the numeral 45, is operatively associated with the ram 12 and actuated in timed relation therewith for protecting an operator against possible injury in case his hands or fingers or other obstructions are in the danger zone of the ram 12 during the downward movement thereof. The guard 45 upon encountering any such obstruction during its downward movement renders effective automatically mechanism for quickly stopping the downward movement of the ram, thus preventing injury to the operator.

Vertically slidable in a pair of spaced channeled guide blocks 46 fixed to each end face of the ram 12 are rack bars 47 (Figs. 1 and 2) to the lower ends of which is secured the safety guard 45 extending completely across the front or operator's side of the machine. Journaled upon the forward face of the ram 12 by means of bearings 48 is a shaft 49 having fixed to each end a pinion 50 meshing with the teeth of the associated rack bar 47. This cross-connection of the slidable rack bars 47, it will be obvious, insures that they will move in unison when motion is imparted to one of them, thus effecting a corresponding movement to each end of the safety guard 45 to maintain it in a desired horizontal position at all points in its downward and upward movements.

As shown in Figs. 1 and 2 the left rack bar 47 receives motion from a rotary cam 51 secured to the shaft 25, the rack bar being pivotally connected to one end of a link 52, the opposite end of which is similarly connected to one end of a pivotal lever 53 carrying at its opposite end a roller 54 engaging the cam face of the cam 51. It will be obvious that the weight of the safety guard 45 fixed to the lower ends of the cross connected rack bars 47 and the link and lever mechanism connected thereto will at all times maintain the roller 54 in engagement with the cam 51 and thereby insure an accurate and positive movement of the safety guard in accordance with the contour of the cam.

The safety guard 45, referring particularly to Fig. 2, extends across the entire width of the ram 12 and the punch 13, which is secured to its lower end. The guard 45 comprises a comparatively long rectangular frame or panel constructed from a pair of vertically spaced horizontal bars 55 of insulating material (Figs. 3 and 4), for instance, hard rubber or bakelite, interconnected in spaced relation by means of metal plates 56 and 57 secured to the rear and front faces, respectively, of the bars. Opposite ends of the plate 56 are rigidly secured to the rack bars 47 to move therewith,

and the upper and lower ends of the plate 57 are turned over to provide reinforcing ribs for the guard panel.

The two bars 55 are provided with a plurality of similarly spaced vertically aligned square apertures 58. Reciprocally carried in each pair of aligned apertures 58 is a rod 60 which is square in cross-section throughout the greater part of its length and of slightly smaller diameter than the apertures 58 so that the rods 60 are restrained from rotary movement in the apertures of the rods 55 but are free to move upwardly and downwardly in a manner to be presently described. Fixed to the upper end of each rod 60 is a rectangular shaped metal plate 61 which normally engages or contacts on its under surface at each end with metal plates 62 secured to the upper surface of the top horizontal bar 55, the plates 62 being equally spaced along the bar at each side of the rods 60 and intermediate the latter. To the lower end of each of the rods 60 is secured a block 63 of wood or other light insulating material. The blocks 63 attached to the several rods 60 are of similar size with their upper and lower edges normally in horizontal alinement and their vertical edges slightly spaced and aligned. Surrounding the rods 60 are coiled compression springs 64 having their opposite ends bearing against the under surface of the lower bar 55 and the upper surfaces of the blocks 63 for normally maintaining the contact plates 61 carried by the rods 60 in engagement with the contact plates 62 secured to the upper bar 55. The blocks 63, arranged as described, provide a sectional curtain for the safety guard 45, the individual blocks being yieldable in a vertical direction upon encountering an obstruction while the guard is moving downwardly. The contact plates 62 at each end of the bar 55 have secured thereto electrical conducting terminals 66 and 67. It will be obvious that the series of contact plates 61 and 62 when in their normal position as shown in Figs. 3 and 7 form a closed electrical conducting path which is part of an electrical control mechanism (Fig. 7), to be presently described, and upon one or more of the blocks 63 being raised that the electrical conducting path through the plates will be opened.

In Fig. 7 there is shown diagrammatically a mechanism responsive to the opening of the normally closed electrical conducting path through the contact plates 61 and 62 of the safety guard 45, while the latter is moving downwardly, for immediately opening the electrical circuit to the motor 35, moving the clutch and brake actuating rod 38 to disengage the clutch elements 32 and 33 and simultaneously therewith operatively engaging the brake disks 42 and 40 to stop the ram 12.

As shown in Fig. 7, the driving motor 35 is of the three phase alternating current type arranged to be connected with line wires 70, 71 and 72 which are connected to a suitable source of supply (not shown). In order to start the press brake in operation a starting push button switch 73 is depressed which completes a circuit from the secondary of a step down transformer 74 through the contact plates 62 and 61 of the guard 45 and a solenoid 76 closing a switch 77 which is provided with contactors 78, 79, 80 and 81. The closing of the switch 77 establishes a holding circuit for the solenoid 76 through the contactor 78, thereby shunting out the starting push button switch 73, after which the circuit there-through may be opened. The primary of the transformer 74 it will be noted is at all times con-

connected to the line wires 70 and 71. The circuit to the motor 35 is thus closed from the line wires 70, 71 and 72 through the contactors 79, 80 and 81, respectively, and maintained closed by the holding circuit described until either a normally closed stopping switch 83 is opened or one or more of the guard blocks 63 are raised. At this time with the motor 35 operating, the fly wheel 32 is being rotated but the drive therefrom to the ram 12 is not connected since the clutch element 33 is not in engagement with the clutch surface of the fly wheel. When it is desired to operate the ram 12 of the press brake a switch 84 is closed which completes a circuit from the previously completed circuit which includes the contact plates 62 and 61 of the guard 45 and a solenoid 85, which closes a switch 86 having contactors 87 and 88.

The closing of the switch 86 establishes a circuit through the contactors 87 and 88 from the line wires 70 and 71, respectively, to actuate a solenoid 91 adapted upon energization to actuate a valve 92 which directs air under pressure from a supply line 93 against the right end of a piston 94 of a pneumatic cylinder 95, the piston being attached to the clutch and brake actuating rod 38. This, it will be apparent, draws the rod 38 towards the left from the position shown in Fig. 7, releases the braking action of the disks 42 and 40 and engages the clutch elements 32 and 33, whereupon the crank shaft 25 is set in motion. By means of the previously described operative connections between the shaft 25 and the ram 12 the latter begins its downward movement to form the material 18. Since the cam 51 is also fixed to the shaft 25 which is rotated in the direction of the arrow (Fig. 1) the cam is likewise rotated in the same direction and by means of the previously described operative connections between the cam and the rack bars 47 which carry the guard 45, the latter also moves downwardly by the action of gravity. The face of the cam 51 is so shaped that the guard 45 is caused to move downwardly in predetermined timed relation to the downward movement of the ram 12 in the following manner. During the first half inch travel, for example, of the ram 12, as shown in broken lines in Fig. 5, the guard 45 rapidly travels in advance of the ram so that the danger zone of the press brake is covered by the guard during substantially the entire downward travel of the ram, excepting, for example, its last half inch of travel. It will be obvious that the cam 51 and the operative connections from the crank shaft 25 to the guard 45, previously described, may be designed and arranged to complete the movement of the guard to its operative position during a predetermined initial portion of the downward movement of the ram 12 and complete a return movement of the guard during a predetermined final portion of the downward movement of the ram. Also, the cam 51 may be designed to effect a downward movement of the guard 45 to any desired position relative to the material.

In the embodiment of the invention herein disclosed, the forming punch 13 is in contact with the material 18 being formed during the last half inch of travel of the ram 12 and, therefore, the danger zone need not be covered by the guard during this final portion of the downward travel of the ram. The lowermost position of the guard 45 is indicated in broken lines in Figs. 5 and 6 and the uppermost position of the guard is indicated in full lines in these figures. In the in-

stant embodiment of the invention, the guard 45 is moved from its uppermost position to its lowermost position during the downward travel of the ram 12 from its uppermost position to the position indicated in broken lines in Fig. 5. The guard 45 remains at its lowermost position during the downward movement of the ram 12 from the broken line position shown in Fig. 5 to the remaining downward movement of the ram 12, the guard 45 is moved upwardly to its uppermost position, the rate of this upward movement of the guard being such that it does not interfere with the portion of the material which moves upwardly as a right angle bend is formed therein, as shown in Fig. 6.

Assuming now that the operator's hand, fingers or other obstruction has inadvertently been placed in the danger zone or line of travel of the ram 12 or the guard 45, either before the ram starts to move downwardly or by chance during its travel. In this case it will be noted that since the guard 45 will have advanced to its lower position before the ram 12 has traveled an appreciable distance one or more of the vertically yieldable guard blocks 63 forming the sectional curtain of the guard will encounter the operator's hand, fingers or other obstruction. The blocks 63 will consequently be held stationary while the guard as a whole is moving downwardly and thereby open the circuit through the contact plates 61 and 62, thereby deenergizing the solenoid 76 which results in the operation of the switch 77 to open the circuit through the contactors 78, 79, 80 and 81, and consequently the supply circuit to the motor 35 from the line wires 70, 71 and 72 is broken. Simultaneously with the deenergization of the solenoid 76 it will be apparent that the energizing circuits through the solenoids 85 and 91 are also broken with the result that the valve 92 is returned to the position shown in Fig. 7 which causes the air under pressure to be directed against the left end of the piston 94, thereby moving the rod 38 towards the right, disengaging the clutch elements 32 and 33 and engaging the brake disk 42 with the brake disk 40. Thus the downward movement of the ram 12 is very quickly arrested when the guard encounters an obstruction, thereby preventing injury to the operator, or, in the case of an obstruction other than the operator's hands or fingers being in the danger zone, protecting the press brake from damage.

From the foregoing description it is believed to be apparent that this safety guard and control system is an efficient and sensitive means for protecting an operator against injury by moving parts of a machine and for preventing damage to the machine. Although one specific embodiment thereof has been illustrated and described in detail, it will of course be understood that the invention is not to be limited thereto, except as defined by the appended claims.

What is claimed is:

1. In a forming press having a reciprocable forming member and operating means therefor, a movable guard, and means for moving the guard in timed relation with the movement of said forming member for covering the danger zone of the press during a movement of the forming member in one direction, said means operating to effect a return movement of the guard during a predetermined final portion of said movement of the forming member.

2. In a forming press having a reciprocable forming member and operating means therefor, a

movable guard, and means effective during a predetermined initial portion of the downward movement of the forming member for moving the guard to a position wherein it covers the danger zone of the press, said means operating to effect a return movement of the guard during a predetermined final portion of the downward movement of the forming member.

3. In a safety guard for a machine having a movable member and operating means therefor, a guard, and means for operating said guard in timed relation with the movement of said member for covering the danger zone of the machine during a movement of said member in one direction, said means operating to effect a return movement of the guard during a predetermined final portion of said movement of the member.

4. In a safety guard for a machine having a movable member, means for actuating the member, a guard carried on the member, and means operatively connected to said actuating means for moving said guard on the member in timed relation to the movement thereof for covering the danger zone of the member in advance of and during a movement of the member, said guard moving means operating to effect a reverse movement of said guard during a predetermined final portion of said movement of the member.

5. In a safety guard and control system, a guard member comprising a plurality of independently movable sections and a series of contacts respectively controlled by said sections and being closed when said sections are in their normal relative positions to complete a control circuit, said guard sections being effective collectively and individually to open said circuit upon movement of one or more sections out of said normal relative positions.

6. In a safety guard and control system for a machine having a movable forming member and operating means therefor including an electric motor and an operating circuit for said motor, a guard member comprising a slidable element extending across the operator's side of the machine, contacts controlled by said guard element and closed when said element is in its normal position to complete said motor circuit, and means for operating said guard in timed relation to the movement of the forming member, said guard element being effective to open the motor circuit upon movement of said element out of its normal position.

7. In a safety guard and control system for a machine having a vertically movable forming member and operating means therefor including an electric motor and an operating circuit for said motor, a guard member comprising a plurality of independently movable suspended sections extending across the operator's side of the machine, a series of contacts respectively controlled by said guard sections and being closed when said sections are in their normal relative positions to complete said motor circuit, and means for operating said guard in timed relation to the movement of the forming member, said guard sections being effective collectively and individually to open said motor circuit upon movement of one or more sections out of said normal relative positions.

8. In a safety guard for a machine having a vertically reciprocable member, means for reciprocating the member, rack bars vertically reciprocable on the member, a guard carried by the rack bars, interconnected pinions journaled on the member meshing with said rack bars for causing the latter to move in unison, and means

operatively connecting one of said rack bars to said means for reciprocating the member for moving the rack bars and said guard on the member in timed relation to the movement of the member for covering the danger zone of the machine.

9. In a safety guard and control system for a forming press having a movable forming member and means for actuating said member including an electric motor and an operating circuit for said motor, a guard comprising a plurality of independently movable sections including contacts normally closing said motor circuit, and means for operating said guard in timed relation to the movement of said forming member for covering the danger zone thereof in advance of and during a forming movement of said member, said guard sections being effective collectively and individually to open said circuit upon one or more of said guard sections encountering an obstruction during said forming movement of the member.

10. In a safety guard and control system for a forming press having a reciprocatory forming member and means for reciprocating said member toward and from work to be formed including an electric motor and an operating circuit for said motor, a guard comprising a plurality of independently movable sections including contacts normally closing said motor circuit, and means for operating said guard in timed relation to the movement of said forming member toward the work for covering the danger zone of said member in advance of and during substantially the entire advance movement thereof, said guard operating means operable to effect a reverse movement of said guard during a predetermined final portion of the advance movement of said member, said guard sections being effective collectively and individually to open said circuit upon one or more of said guard sections encountering an obstruction during the advance movement of said forming member.

11. In a safety guard and control system for a forming press having a reciprocatory ram carrying a forming member and means for reciprocating said ram toward and from work to be formed including an electric motor and an operating circuit for said motor, a guard carried on said ram comprising a plurality of independently movable sections including contacts normally closing said motor circuit, and means for relatively moving said guard on said ram in timed relation to the movement of said ram toward the work for covering the danger zone of said forming member in advance of and during substantially the entire advance movement thereof, said guard operating means operable to effect a reverse movement of said guard during a predetermined final portion of the advance movement of said ram, said guard sections being effective collectively and individually to open said motor circuit upon one or more of said guard sections encountering an obstruction during said advance movement of said ram.

12. In a motor driven forming press having a reciprocable forming member and operating means therefor, a movable guard, means for automatically moving the guard in timed relation with the movement of said forming member for covering the danger zone of the press during movement of the forming member in one direction, a circuit including said motor, and circuit controlling members mounted for relative movement on said movable guard for breaking a cir-

cuft to the motor when moved relative to said movable guard as by striking an object.

13. In a forming press having a reciprocable forming member and operating means therefor, means for automatically moving the guard in timed relation with the movement of said forming member for covering the danger zone of the press during movement of the forming member in one direction, a movable guard, an electrical circuit including said operating means, and means associated with said guard for controlling said circuit.

14. In a motor driven forming press having a reciprocable forming member and operating means therefor, a movable guard comprising a

plurality of members mounted for relative movement thereon and extending across the operator's side of the press, means for moving the guard in timed relation with the movement of said forming member for covering the danger zone of the press during movement of the forming member in one direction, a circuit including said motor, and a circuit controlling member carried by each of said relatively movable guard members, said circuit controlling members being effective individually and collectively to break a circuit to the motor when moved relative to said movable guard by striking an object.

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