Sept. 25, 1962 T. K. CAULEY ET AL 3,055,243

PROTECTIVE SYSTEM FOR MILL ROLLS

Filed Aug. 2, 1960 3 Sheets-Sheet 1

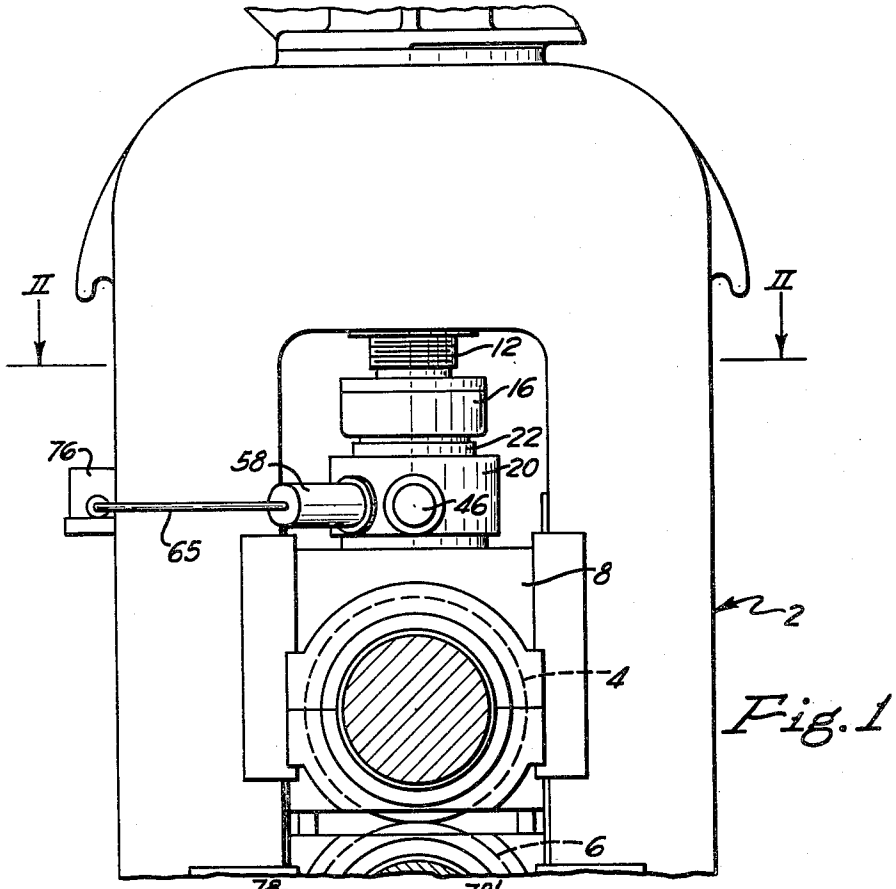



Fig. 1

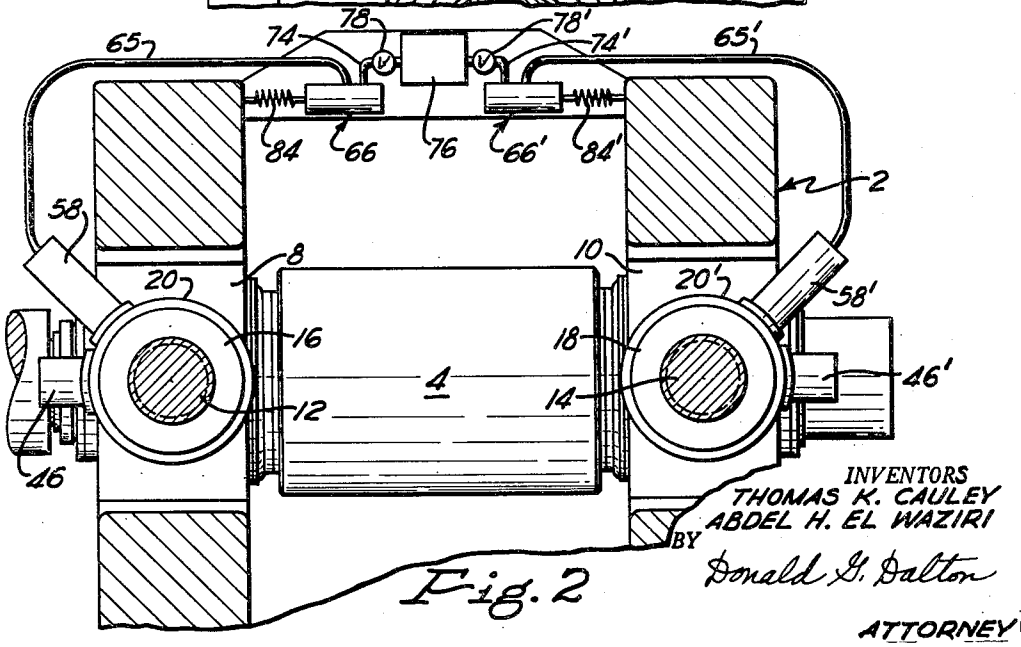



Fig. 2

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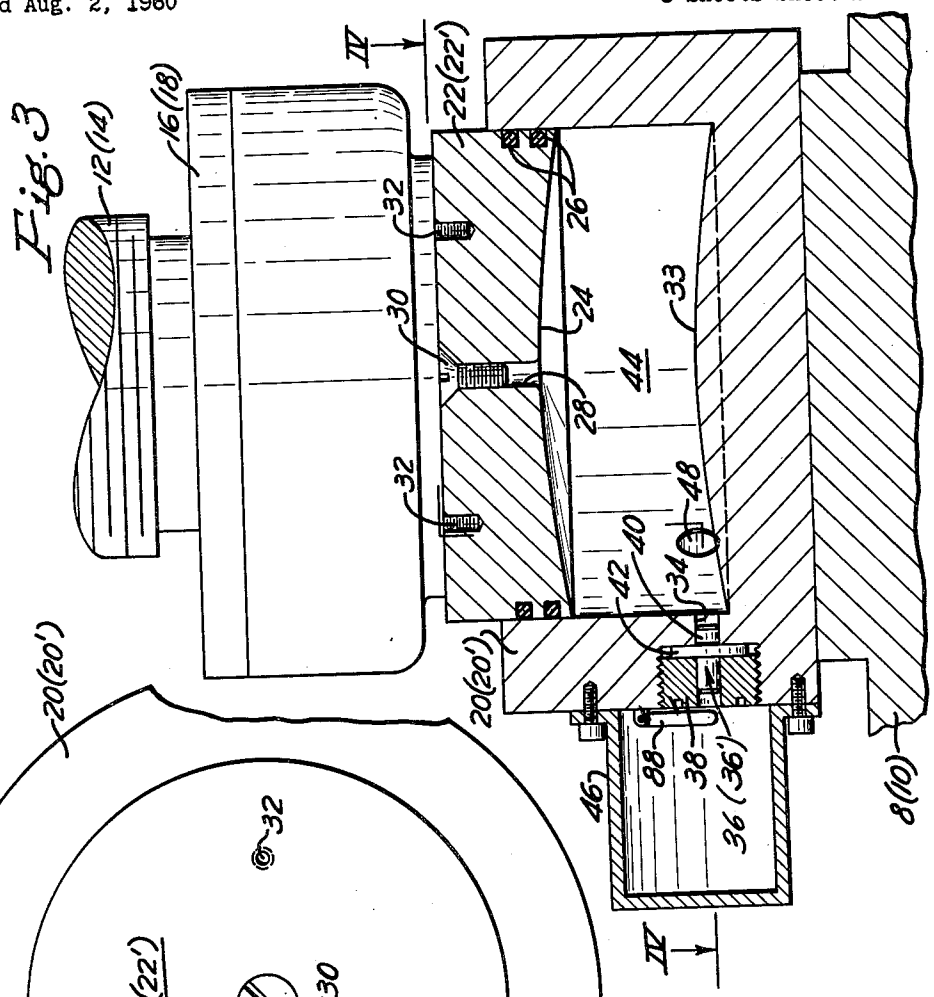



Fig. 3

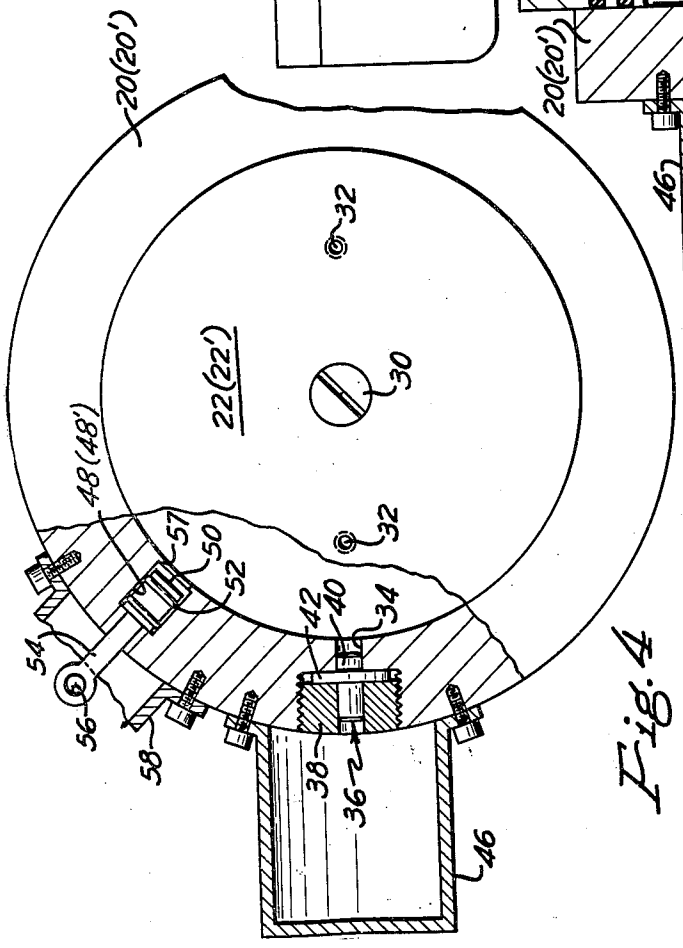



Fig. 4

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Filed Aug. 2, 1960 3 Sheets-Sheet 3

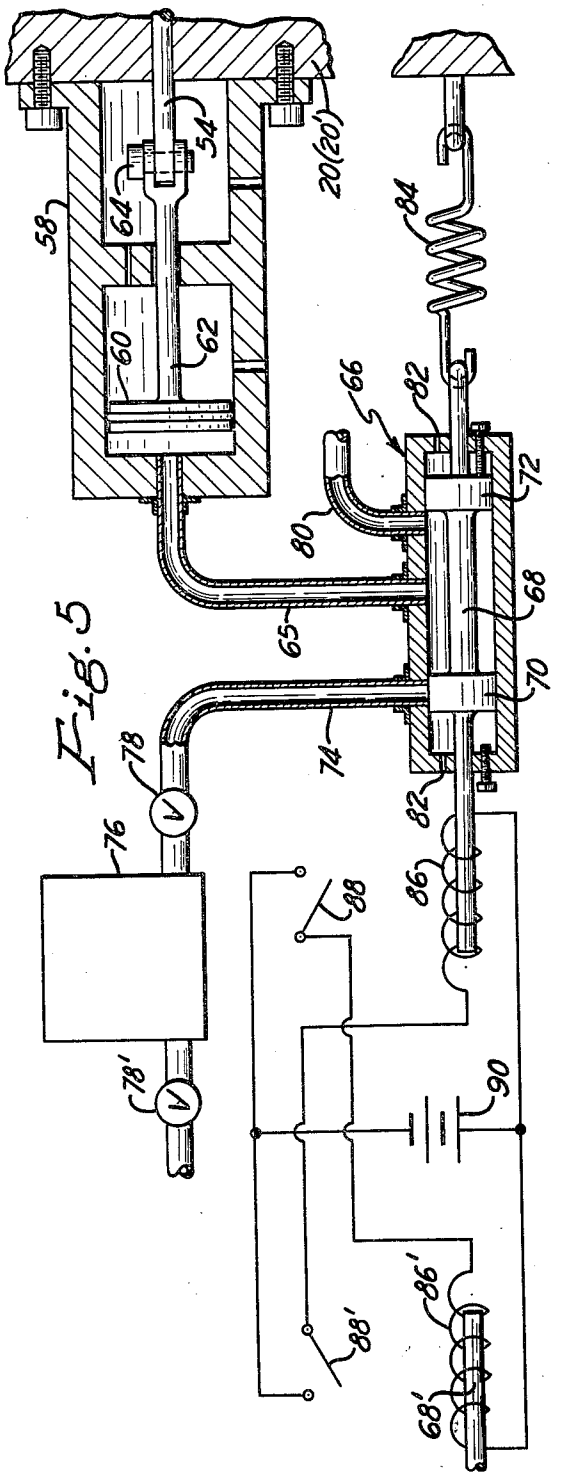



Fig. 5

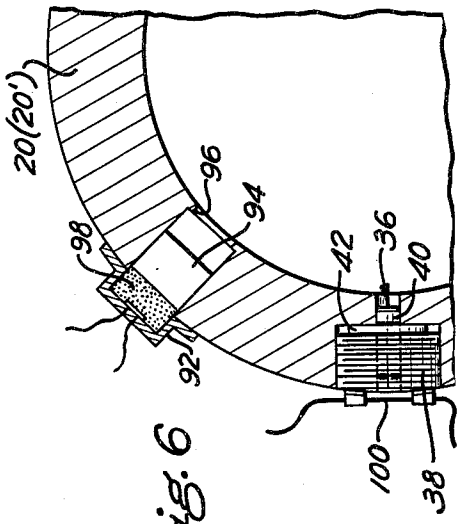



Fig. 6

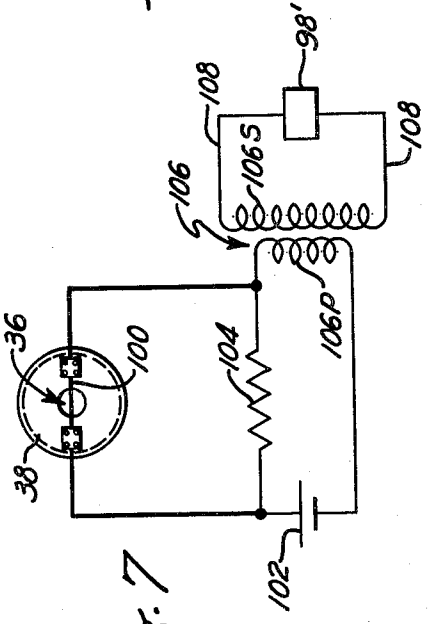



Fig. 7

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3,055,243

# PROTECTIVE SYSTEM FOR MILL ROLLS

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This invention relates to a protective system for mill rolls and more particularly to rolls used in the rolling of steel strip, plate or structural sections. Overloads may arise because of non-uniform heating or cooling of the steel with the steel being at a temperature lower than that designated for rolling temperature or there may be an accidental mis-setting of the gap between the rolls so that too great a reduction is taken in one pass. Regardless of the cause of the overload it is necessary to protect the rolls from the overload in order to avoid fracture of the rolls. Many such protective devices have been provided such as that shown in Erichsen Patent No. 2,108,746 dated February 15, 1938. This and other devices of which we have knowledge are generally satisfactory if the loads on both ends of the roll are the same. However, this is not generally the case since in most instances the load is non-symmetrical and the protective device will release the load on only one side of mill. When this occurs the journal and the roll neck on the side of the mill that is still loaded will be subjected to high bending stresses and subsequent failure, the material passing through the mill will be reduced only on the loaded side so that the material will curve away from the normal roll direction and wreck mill equipment, and the mill bearings will become badly mis-aligned while rotating with resultant damage thereto.

It is therefore an object of our invention to provide an improved protective system for mill rolls.

Another object is to provide such a device which will provide overall stiffness of the rolling mill.

Still another object is to provide such a device which will simultaneously release the load on both bearings of the rolling mill stand when excessive rolling loads occur.

These and other objects will be more apparent after referring to the following specification and attached drawings, in which:

FIGURE 1 is an elevation of our device installed in a rolling mill stand;

FIGURE 2 is a view taken on the line II—II of FIGURE 1;

FIGURE 3 is an enlarged vertical sectional view of one embodiment of our invention;

FIGURE 4 is a view taken on the line IV—IV of FIGURE 3;

FIGURE 5 is a view, partly in section, showing the schematic wiring diagram associated with the device of FIGURES 3 and 4;

FIGURE 6 is a fragmentary view showing a second embodiment of our invention; and

FIGURE 7 is a schematic wiring diagram used with the device of FIGURE 6.

Referring more particularly to the drawings, reference numeral 2 indicates the housing for supporting the usual upper and lower rolls 4 and 6. It will be understood that the rolling mill, instead of being two-high as shown, may be three or four-high as desired. The upper roll 4 is supported in chocks 8 and 10. Adjustment of the roll 4 is provided by mill screw downs 12 and 14 which bear against thrust roller bearings 16 and 18, respectively. A protective device consisting of a cylinder 20 and piston 22 is located between chock 8 and bearing 16. A similar device consisting of cylinder 20' and piston 22' is located between chock 10 and bearing 18. The piston 22 includes a concave dome or surface 24, O-ring seals 26,



a threaded axial hole 28 for receiving a counter sunk screw 30 and tapped holes 32 in the upper surface thereof. The purpose of the holes 32 is to provide means for removing the piston which is done by threading bolts into the holes to provide means for lifting the piston. The cylinder 20 has a convex surface 33 shaped to conform to surface 24. The surfaces 24 and 33 may be either tapered or rounded as desired. An opening 34 is provided through the wall of cylinder 20 adjacent the bottom thereof. A shear plug 36 is provided in the opening 34 and is held in place by means of a nut 38. The plug 36 includes a pin portion 40 and a washer portion 42. The shape of the plug 36 is such that it will fail in pure shear when the pressure of fluid 44 in the cylinder is increased above a predetermined amount. A container 46 is preferably attached to the cylinder 20 around the nut 38 to prevent the fluid 44 from escaping after failure of plug 36. A second opening 48 is provided through the wall of cylinder 20 adjacent the bottom thereof. A plunger 50 provided with O-ring seals 52 is received in the opening 48. A reduced diameter portion 54 extends to the outside of cylinder 20 and has an opening 56 therein for a purpose which will appear later. A shoulder 57 prevents movement of plunger 50 into the cylinder opening. The construction of cylinder 20' and piston 22' is the same as that of cylinder 20 and piston 22 with like parts being indicated by priming the corresponding reference numerals. A cylinder 58 is attached to cylinder 20 in any suitable manner. A piston 60 having its piston rod 62 connected by means of a pin 64 to the plug 52 is received in cylinder 58. A conduit 65 leads from cylinder 58 to a hydraulic valve 66. Hydraulic valve 66 includes a plunger 68 having spaced lands 70 and 72 thereon. A conduit 74 leads from valve 66 to the rolling mill high pressure hydraulic accumulator 76. A metered volume automatic cut-off valve 78 is provided in the conduit 74. A conduit 80 leads from the valve 66 to a drain. A vent 82 is provided at each end of the valve 66. A spring 84 is connected to one end of plunger 68. Solenoid 86 surrounds the other end of plunger 68. A switch 88 is attached to the outside of cylinder 20 and is adapted to be closed by movement of the plug 36 upon failure thereof. Similar equipment is provided for association with cylinder 20' and piston 22' with similar parts being indicated by priming the reference numerals. Power for energizing solenoid coil 86 is provided from a battery 90 through switch 88' and similarly solenoid coil 86' is energized through switch 88.

In operation, fluid is delivered to the cylinders 20 and 20' and the pistons 22 and 22' are placed in position. Any air below the piston is collected in the concave domes 24 and 24' and released through the holes 28 and 28' after which counter sunk screws 30 and 30' are threaded into the holes. If, during operation of the rolling mill, the pressure of fluid 44 exceeds the pre-set rupture level as determined by the strength of shear plug 36 the plug 36 will shear and its pin portion 40 will be ejected through nut 38 to actuate switch 88, thus closing it. Closing of switch 88' will energize solenoid coil 86 to move plunger 68 to the left as shown in FIGURE 5 so that hydraulic accumulator 76 will communicate its pressure through conduits 74 and 65 to move cylinder 60 radially inward, thus forcing plug 48 into cylinder 20 so that the pressure of the fluid therein will increase above the pre-set rupture level and cause shear plug 36 to rupture. Thus, pressure on each end of the top roll 4 will be released almost simultaneously. The operation will be similar when the pressure of the fluid in cylinder 20' exceeds the pre-set rupture level to also release the pressure in cylinder 20.

In the embodiment of our invention shown in FIGURES 6 and 7 a cylinder 92 is attached to cylinder 20 in place of the plunger 50 and the switch 88 is omitted.

The cylinder 92 contains a piston 94 whose inward motion is limited by flange 96 and an explosive charge 98 provided between the outer wall of the cylinder 92 and the piston 94. An insulated wire 100 is provided over the opening in the nut 38. The wire 100 is connected to a battery 102 in parallel with a resistor 104 and to the primary 106P of a transformer 106. Secondary 106S of transformer 106 is connected to leads 108 leading to the explosive charge 98' in the opposite unit. The construction and arrangement of the opposite unit is the same as the unit described above.

In operation, if the pressure of fluid 44 exceeds the pre-set rupture level as determined by the strength of shear plug 36 the plug 36 will shear and its pin portion 40 will be ejected through nut 38 to fracture wire 100. When this occurs a change will occur in primary 106P, thus inducing a current in secondary 106S sufficient to explode the charge 98'. This forces piston 94 inwardly, thus increasing the pressure of fluid 44' above the predetermined high level and causing shear plug 36' to rupture. Thus pressure on each end of the top roll 4 will be released almost simultaneously. In case pressure in cylinder 22' increases above its predetermined high level before the pressure in cylinder 22 the operation will be the same except that the pressure will be increased in cylinder 22 by explosion of the charge 98.

While it has been indicated that pressure in the cylinders will be increased by failure of the plug associated with the opposite cylinder the same result can be obtained by automatically releasing the pressure in the opposite cylinder by means of a valve.

While several embodiments of our invention have been shown and described, it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claims.

We claim:

1. A safety device to be interposed between parts of a rolling mill, press or other like machine liable to be subjected to heavy pressure and adapted to relieve the pressure when a predetermined maximum pressure is reached, which comprises a cylinder having an escape opening, a pressure medium in said cylinder, a piston in said cylinder for compressing said medium under the pressure applied to the said machine parts, the surface of said piston within said cylinder being concave, the surface of said cylinder opposite said piston having a convex contour matching the concave surface of said piston, said piston having a closable opening therethrough from said concave surface, and an element normally closing said escape opening, said element being subject to the action of the pressure medium and adapted to be removed from said escape opening when the predetermined maximum pressure is reached.

2. A protective system for a roll mounted in a machine frame and liable to be subjected to heavy pressures at each end thereof comprising a pair of safety devices one adapted to be interposed between each end of the roll and the associated frame, each safety device including a cylinder having a normally closed escape opening, a pressure medium in said cylinder, a piston in said cylinder for compressing said medium under the pressure applied to the associated end of said roll, said pressure medium automatically passing through said escape opening when the pressure thereof exceeds a predetermined maximum, and means operable by attainment of pressure in either of said cylinders above said predetermined maximum pressure for releasing the pressure medium through both of said escape openings.

3. A protective system for a roll mounted in a machine frame and liable to be subjected to heavy pressure at each end thereof comprising a pair of safety devices one adapted to be interposed between each end of the roll and the associated frame, each safety device including a cylinder having an escape opening, a pressure medium in said cylinder, a piston in said cylinder for compressing said medium under the pressure applied to the associated end



of said roll, a safety element normally closing said escape opening, said safety element being subject to the action of the pressure medium and adapted to be automatically removed from said escape opening when a predetermined maximum pressure is reached, the end surface of said piston within said cylinder being concave, the surface of said cylinder opposite said piston having a convex contour matching the concave surface of said piston, said piston having a closable opening therethrough from said concave surface, and means operable by movement of either of said safety elements to non-closure position to move the other of said safety elements to non-closure position.

4. A protective system for a roll mounted in a machine frame and liable to be subjected to heavy pressures at each end thereof comprising a pair of safety devices one adapted to be interposed between each end of the roll and the associated frame, each safety device including a cylinder having an escape opening, a pressure medium in said cylinder, a piston in said cylinder for compressing said medium under the pressure applied to the associated end of said roll, a safety element normally closing said escape opening, said safety element being subject to the action of the pressure medium and adapted to be removed from said escape opening when a predetermined maximum pressure is reached and means independent of the pressure applied to the said roll for increasing the pressure of said pressure medium to said predetermined maximum pressure, and means operable by movement of either of said safety elements to non-closure position to actuate the last named means of the other of said safety devices.

5. A protective system for a roll mounted in a machine frame and liable to be subjected to heavy pressures at each end thereof comprising a pair of safety devices one adapted to be interposed between each end of the roll and the associated frame, each safety device including a cylinder having an escape opening, a pressure medium in said cylinder, a piston in said cylinder for compressing said medium under the pressure applied to the associated end of said roll, the end surface of said piston within said cylinder being concave, the surface of said cylinder opposite said piston having a convex contour matching the concave surface of said piston, said piston having a closable opening therethrough from said concave surface, a safety element normally closing said escape opening, said safety element being subject to the action of the pressure medium and adapted to be removed from said escape opening when a predetermined maximum pressure is reached and means independent of the pressure applied to the said roll for increasing the pressure of said pressure medium to said predetermined maximum pressure, and means operable by movement of either of said safety elements to non-closure position to actuate the last named means of the other of said safety devices.

6. A protective system for a roll mounted in a machine frame and liable to be subjected to heavy pressures at each end thereof comprising a pair of safety devices one adapted to be interposed between each end of the roll and the associated frame, each safety device including a cylinder having an escape opening, a pressure medium in said cylinder, a piston in said cylinder for compressing said medium under the pressure applied to the associated end of said roll, a safety element normally closing said escape opening, said safety element being subject to the action of the pressure medium and adapted to be removed from said escape opening when a predetermined maximum pressure is reached, said cylinder having a second opening therein, means in said second opening for increasing the pressure of said pressure medium to said predetermined maximum pressure, and means operable by movement of either of said safety elements to non-closure position to actuate the last named means of the other of said safety devices.

7. A protective system for a roll mounted in a machine frame and liable to be subjected to heavy pressures at each

end thereof comprising a pair of safety devices one adapted to be interposed between each end of the roll and the associated frame, each safety device including a cylinder having an escape opening, a pressure medium in said cylinder, a piston in said cylinder for compressing said medium under the pressure applied to the associated end of said roll, the end surface of said piston within said cylinder being concave, the surface of said cylinder opposite said piston having a convex contour matching the concave surface of said piston, said piston having a closable opening therethrough from said concave surface, a safety element normally closing said escape opening, said safety element being subject to the action of the pressure medium and adapted to be removed from said escape opening when a predetermined maximum pressure is reached, said cylinder having a second opening therein, means in said second opening for increasing the pressure



of said pressure medium to said predetermined maximum pressure, and means operable by movement of either of said safety elements to non-closure position to actuate the last named means of the other of said safety devices.

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