Jan. 5, 1971 K. J. HANDLER 3,552,182

PRESS BRAKE WITH HYDRAULIC RAM ADJUSTMENT

Filed Nov. 20, 1968 2 Sheets-Sheet 1

FIG. 1.

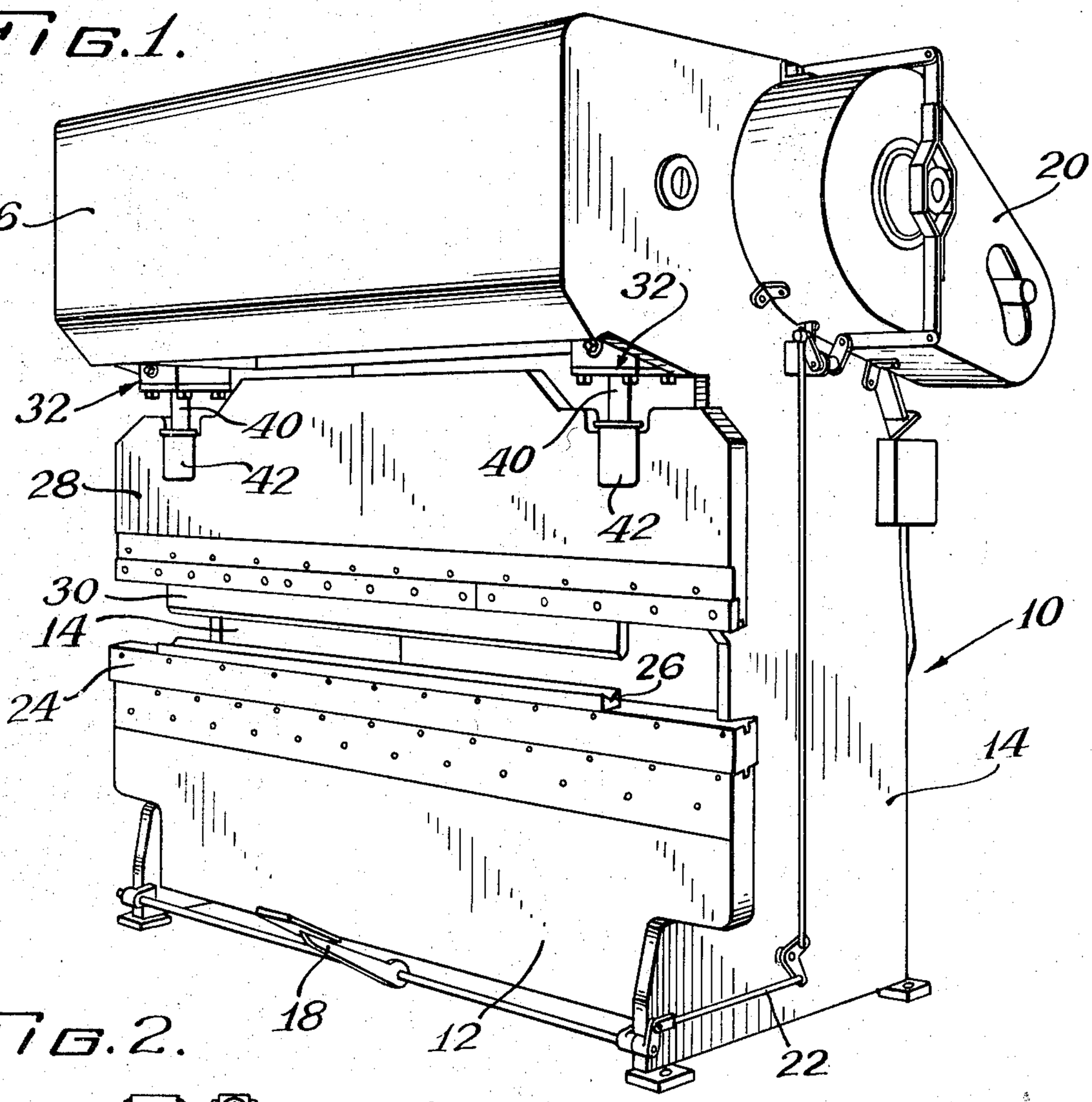
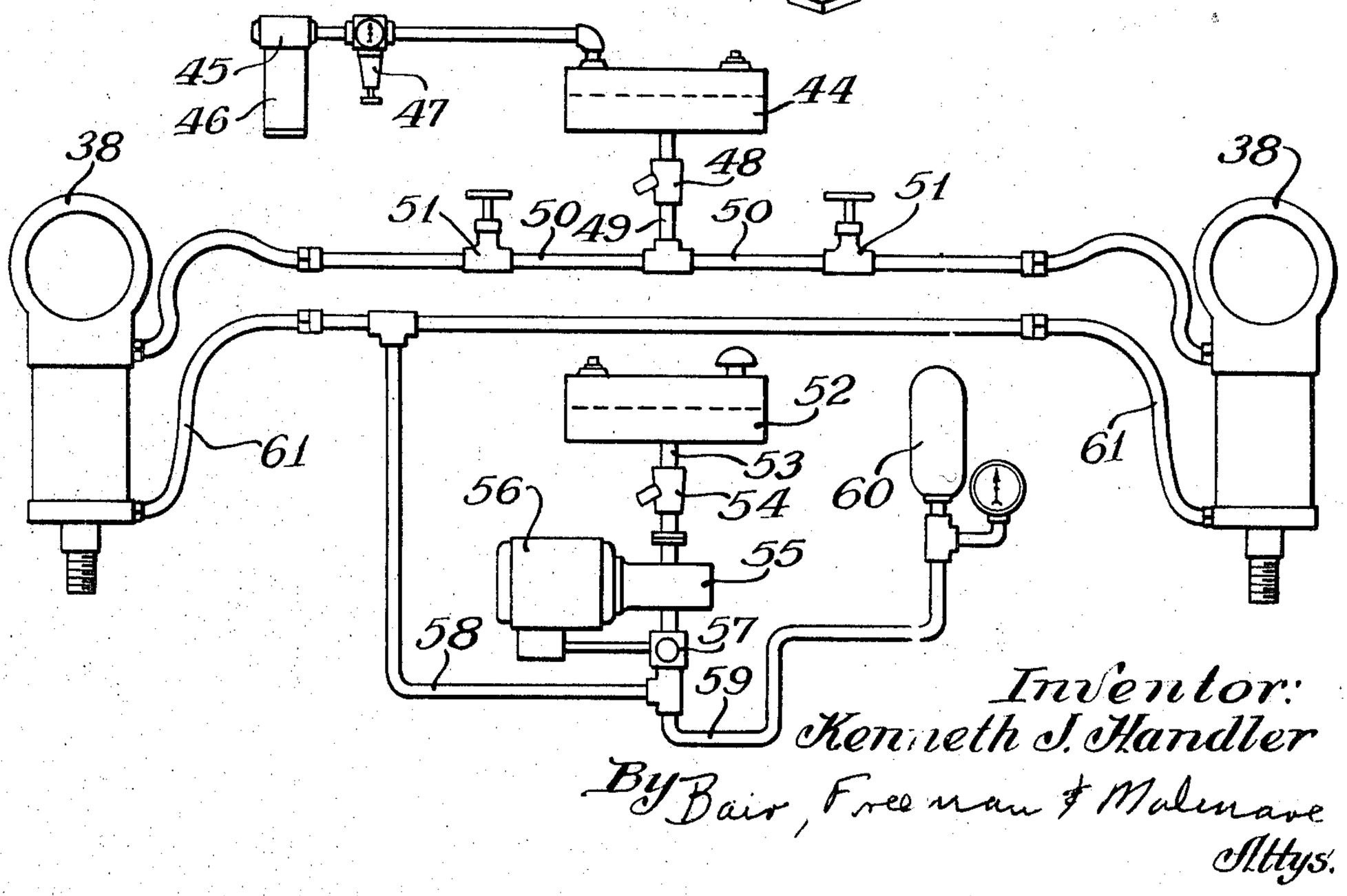



FIG. 2.




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FIG. 4.

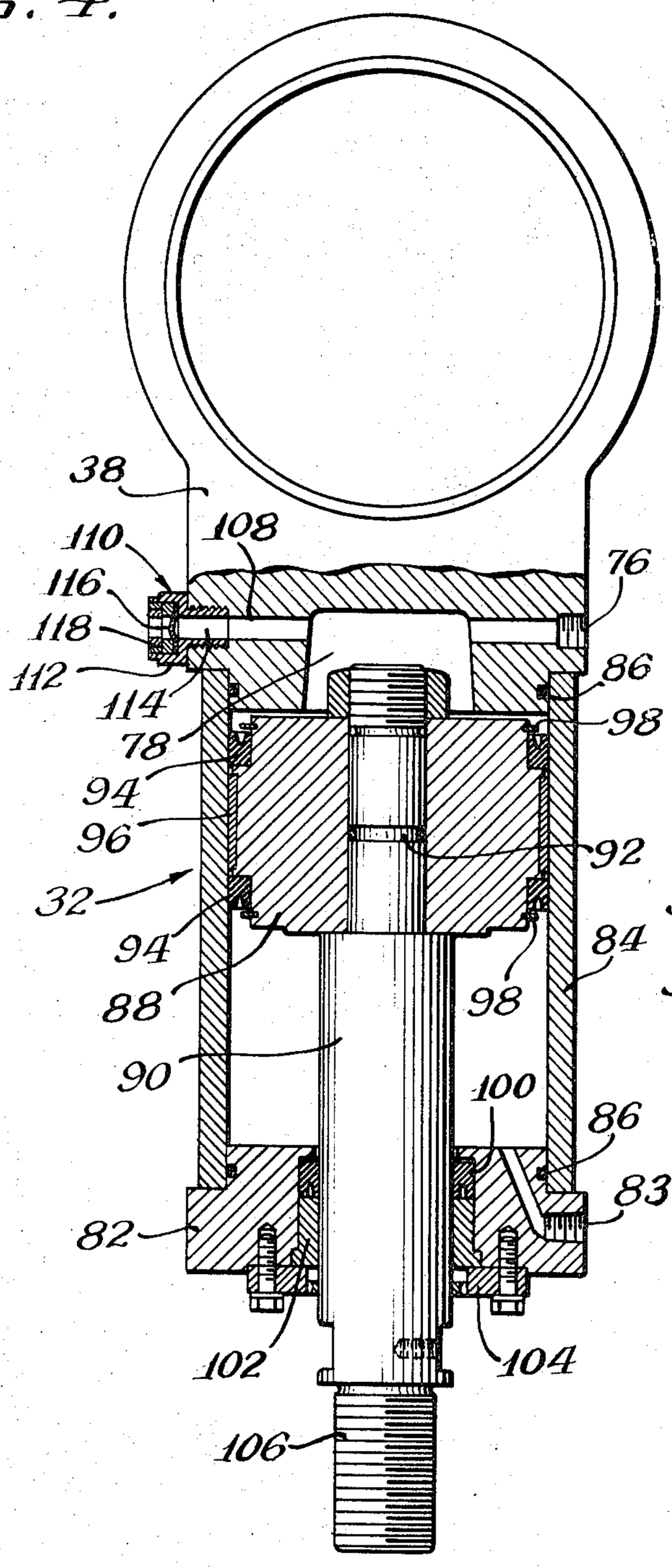
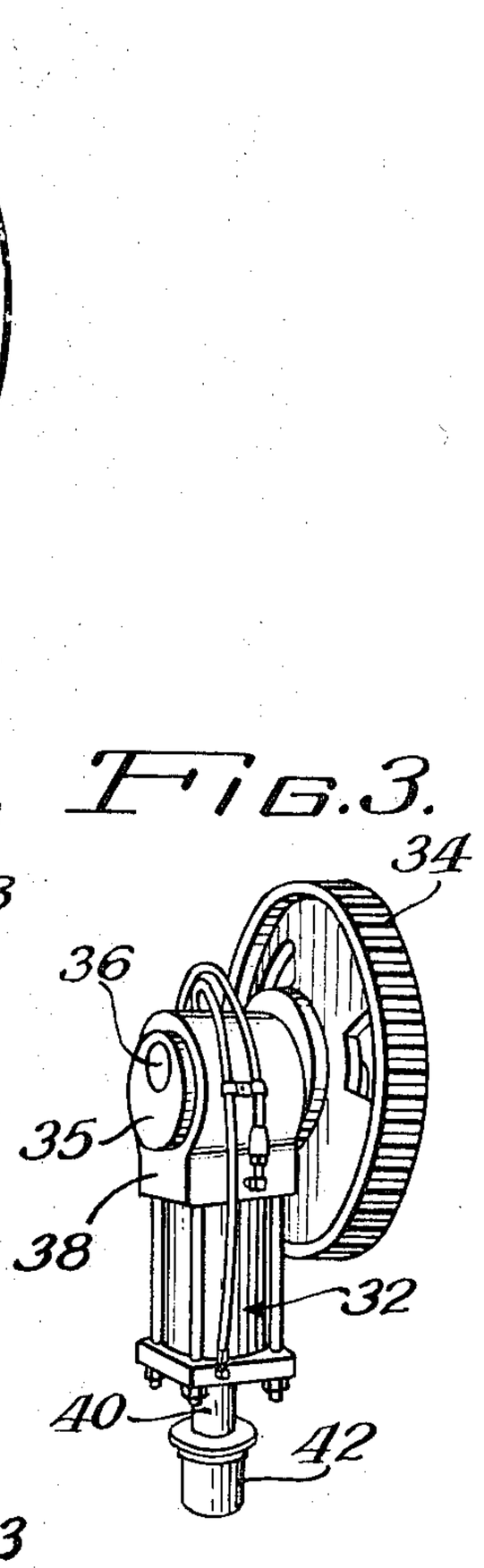



FIG. 3.




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United States Patent Office

3,552,182

Patented Jan. 5, 1971



3,552,182

# PRESS BRAKE WITH HYDRAULIC RAM ADJUSTMENT

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Filed Nov. 20, 1968, Ser. No. 777,346

Int. Cl. B21d *55/00*

U.S. Cl. 72—432

3 Claims

## ABSTRACT OF THE DISCLOSURE

A press brake for bending metal. A hydraulic cylinder and piston arrangement is fixed at its upper end to the drive means and is fixed at its moving end to the ram. A hydraulic pump is connected to the hydraulic drive cylinder to adjust the spacing between the upper and moving ends of the cylinder and piston arrangement so that the spacing between the ram and the bed is adjusted to the desired amount. Means are provided to lock the hydraulic fluid in place on each side of the piston in the hydraulic cylinder so that the ram remains locked at the fixed spacing. Relief means are interconnected to the hydraulic fluid on the high pressure side of the piston for relieving the fluid pressure at a preselected level to avoid damage to the press brake.

## BACKGROUND OF THE INVENTION

Field of the invention and description of the prior art

This invention relates to a press brake and it particularly relates to a press brake having hydraulic drive means for adjusting the relative spacing between the bed and the ram of the machine.

Press brakes used for bending sheet metal, bars, or the like generally comprise a bed on which the material to be bent is placed and a movable ram which is aligned above the bed and moves down with force against the metal part to effect the desired bending. These press brakes are capable of bending material having varying thicknesses. It has been the general practice in the art to adjust the spacing between the ram and the bed by mechanical means, such as a screw or jack arrangement. An operator manually adjusts the jack or screw setting so as to change the relative distance between the bed and the ram, the jack moving the ram up or down relative to the bed. These manual adjustments are time consuming and relatively inaccurate. A further difficulty is encountered with these jack arrangements when the press brake becomes jammed because of an overlooked. These jack arrangements are difficult to release. Also, a jam may result in serious damage to the drive mechanism as well as to the jack arrangement.

Significant improvements have been made over apparatus which use mechanical jacks in the provision of hydraulic cylinder and piston arrangements for adjusting the spacing between the bed and the ram. These arrangements, wherein hydraulic cylinders are used, provide significant improvements because the ram height adjustments may be made considerably faster and there is greater accuracy in making the setting. Also, the hydraulic system enables a jam to be released rapidly because the operator merely needs to open manual shut off valves to release the hydraulic fluid locked in the pressure system. The ram retreats automatically, and the machine is returned to service within a matter of minutes.

Another advantage in the use of hydraulic cylinders for adjusting the ram height would appear to be that the hydraulic fittings and hoses should rupture before any serious and expensive damage could occur to the press brake, such as to the frame or the drive of the machine. It has



been found, however, that hoses and fittings of hydraulic pressure systems rupture at highly varying pressures. Hydraulic fittings and hoses are guaranteed to rupture above a certain value, but the actual rupture pressure may extend over a wide range above the guaranteed value. As a result, the machine would ultimately be damaged by an overload when the hydraulic fittings or hoses rupture at a pressure higher than desired, so that rather than simply losing oil through a hose rupture, serious mechanical damage can result to the press brake.

It is therefore an object of this invention to provide an improved press brake using a hydraulic ram height adjustment arrangement wherein the hydraulic fluid is relieved before there can be any damage done to the operating parts of the machine.

It is also an object of this invention to provide an im-

## SUMMARY OF THE INVENTION

proved press brake wherein the apparatus includes a hydraulic system for adjusting the ram height, which hydraulic system includes a rupture disc which relieves the over pressure of the hydraulic system at a predetermined value and before any damage can be done to the machine.

Further purposes and objects of this invention will appear as the specification proceeds.

All of the foregoing objects are accomplished by providing a press brake which comprises a frame, a stationary bed on the frame for receiving material to be bent thereon, a ram on the frame which is aligned above the bed, means for driving the ram toward the bed to bend the material interposed between the bed and the ram, hydraulic cylinder and piston means having first and second end portions, the first end portion being connected to the drive means, the second end portion being connected to the ram, means connected to the hydraulic cylinder and piston means to adjust the spacing between the end portions by the use of hydraulic fluid so that the spacing between the ram and the bed is adjusted to a desired spacing, means to normally lock the hydraulic fluid within the cylinder and piston means during use so that the ram remains locked at a fixed spacing from the bed, and means interconnected to the hydraulic fluid in the cylinder and piston means to relieve the pressure of the fluid when it reaches a preselected level so as to avoid damage to the press brake.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a press brake using my improved hydraulic system for adjusting the ram height;

FIG. 2 is a schematic drawing of the hydraulic ram height adjustment circuitry used in the press brake of FIG. 1.

FIG. 3 is a perspective view of a height adjustment cylinder mounted on a drive gear and eccentric ararngement which drives the cylinder and the ram downwardly; and

FIG. 4 is an enlarged cross-sectional view of the hydraulic cylinder and piston arrangement having a burst plug therein for relieving the pressure of the pressurized hydraulic fluid at a predetermined level.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a press brake, generally **10**, includes a base **12**, upright sides **14**, and an overhead assembly **16**. An operating foot pedal **18** is operatively connected to the brake **10** at its lower end. The pedal **18** operates a clutch (not shown) contained within a housing **20** through an operating linkage, generally **22**. The linkage **22** includes several members which are secured to one of the upright sides **14**. The overhead assembly **16**, contains a drive mechanism (not shown) which operates the press brake **10**.

The press brake **10** includes a die holder **24** upon which a female die **26** is mounted. The elongated die holder **24** has a ram **28** movably aligned thereabove. The ram **28** generally constitutes a heavy metal plate having a male die **30** fixedy secured at its lower end and in alignment directly above the female die **26**. The sheet material or bar stock which is to be bent is inserted between the fixed die **26** and the moving die **30**. The ram **28** is then driven downwardly to cause the desired bending of the material.

Since the operating performance of the press brake **10** is dependent upon material thickness, the die configuration, the amount of bending desired, and the force applied during the bending operation, to accomplish the desired results, it is necessary to adjust the spacing between the dies **26** and **30**. In order to adjust the spacing between the dies **26** and **30**, a pair of laterally spaced hydraulic cylinder members **32** are secured, at their lower ends, to the upper end of the ram **28**, as best shown in FIG. 1.

In FIG. 3, one of the hydraulic cylinders **32** is shown connected at its upper end to a drive gear **34**. The drive gear **34** is operatively connected to drive means (not shown) for operating the ram **28**. The gear **34** has an integral shaft portion **35** which is eccentrically and rotatably mounted on a fixed pivot **36**. The cylinder upper housing **38** is rotatably mounted on the shaft **35**. As the gear **34** and shaft **35** are rotated about the fixed pivot **36**, the entire hydraulic cylinder is moved downwardly by the cranking action of the eccentrically movable shaft **35**.

A piston rod **40** extending outwardly from the hydraulic cylinder **32** is fixedly connected to mounting member **42**. The mounting member **42** includes a ball and socket joint for pivotally connecting the piston rod **40** to the ram **28**. The ram **28** moves in a vertical plane. The ball and socket pivot connection between the mounting member **42** and the ram **28** permits the vertically moving ram **28** to be driven downward by the eccentrically moving cylinder **32**.

Referring to FIGS. 2 and 3 the hydraulic system for the hydraulic cylinder **32** is shown. The hydraulic system constitutes two completely separate systems on each side of piston **88** contained within each hydraulic cylinder **32**. The system on the upper side of the piston **88** is the side which undergoes the high pressure during the operation of the ram **28**. The system of the lower side of the piston is ordinarily subjected to relatively low pressures which are required to raise and support the weight of the ram **28**.

The upper system includes a reservoir or tank **44**. The oil in the tank is under constant air pressure which passes through an inlet **45**, a filter **46**, a regulator **47**, and then into the tank **44**. The air pressure assures a non-turbulent flow of oil from the tank to assure against ingestion of air into the hydraulic fluid, which would create an objectionable condition because of the compressibility of air.

The hydraulic fluid passes through a strainer **48** in an outlet line **49**. The line **49** branches into two lines **50** which are each connected into the upper side of the piston **88** in the housing **38**. A high pressure shut off valve **51** is interconnected in each of the branch lines **50**.

The lower system includes a hydraulic fluid storage tank **52**, normally maintained under atmospheric pressure. The oil is withdrawn from the tank **52** through an outlet line **53** and through a strainer **54** by a pump **55**. A reversible electric motor **56** drives the pump **55**. A solenoid valve **57** is on the pressure side of the pump and is open when the motor is running and is closed when the motor is off. The outlet line **53** branches to a pressure line **58** and a line **59** which leads to a hydraulic accumulator **60**. The pressure line **58**, in turn, branches into two cylinder inlet lines **61** which pass to the lower side of the piston **88**.

Referring to FIG. 4, the cylinder **32** includes the



housing **38** which is secured to the drive shaft **36**. An inlet **76** for the pressurized hydraulic fluid from the line **50** is provided in the pressure end of the cylinder **32**. The hydraulic cylinder **32** also has an end closure member **82** and a cylindrical outer wall **84** which is positioned between the housing **38** and the closure member **82**. An inlet **83** from the line **61** is provided in the closure member **82** for communication of the fluid with the cylinder **32**. Tie rods, shown in FIG. 3, are provided for firmly securing the closure member **82** and the cylinder wall **84** to the housing **38**. Pressure seals **86** are provided between the inner surface of the cylinder wall **84** and the recessed outer wall of the end member **82** and between the cylinder wall and the recessed outer wall of the housing **38**. The seals **86** are high pressure seals and prevent undesired leakage of the pressurized hydraulic fluid.

The piston **88** is slidably positioned within the cylinder walls **84** and reciprocates between the end member **82** and the housing **38**. The piston **88** is secured to a piston rod **90**. A central aperture in the piston **88** receives the restricted end of the piston rod **90**. A hydraulic seal **92** is carried between the piston rod **90** and the walls defining the aperture of the piston **88**, in order to prevent passage of hydraulic fluid from one side of the piston to the other side. A nut threadably engages the end of the piston rod **90** and secures the piston **88** in place against the enlarged portion of the piston rod **90**.

The outer cylindrical periphery of the piston **88** includes a pair of U-cup packings **94** in its opposite ends and a packing **96** is interposed therebetween. The U-cups **94** are held in place by means of retaining rings **98** received in the outer periphery of the piston **88**. The U-cups **94** and the packing **96** are in sliding contact with the face of the cylindrical walls **84** of the cylinder **32** and prevent the passage of the pressurized hydraulic fluid from the high pressure side of the piston to the low pressure side of the piston. These packings are important in the structure because any passage of pressurized hydraulic fluid from one side of the piston to the other will adversely affect the vertical adjustment of the ram **28**. The hydraulic fluid is therefore locked in place after the setting of the vertical adjustment of the ram has been accomplished. The lock valves **72**, the accumulator **60**, and the packings between the high pressure side and the low pressure side of the piston all cooperate to assure that there will be no loss of pressurized hydraulic fluid to adversely affect the stability of the ram adjustment.

The piston rod **90** passes through an aperture provided in the closure member **82**. A U-cup **100** and rod bearing **102**, permit sliding engagement between the piston rod **90** and the closure member **82** while at the same time the leakage of the hydraulic fluid from between the end plate and the piston rod is prevented. The packing **100** and rod bearing **102** are secured in place by an annular plate **104** which is held to the end plate **82** by bolts. The outer moving end **106** of the piston rod **90** is threaded and receives the ram mounting **42** which includes the ball and socket joint for pivotal connection to the ram.

In the described invention, it is important that the apparatus **10** is to be protected from damage which might be caused from overloading the apparatus. For this purpose, a relief channel **108** extends into the pressure chamber **78** through the cylinder housing **38**. The relief opening **108** is closed at its outer end by a burst plug **110**. The burst plug is threadably and sealably received by the relief port **108** and acts to prevent the leakage of any liquid therethrough. The plug **110** includes a housing portion **112** having a central aperture **114** therein. The central aperture is enclosed by a metallic rupture disc **116**. The rupture disc **116** is secured in place by a securing member **118** which is received in the outer end of the housing **112**. The securing member **118** firmly holds the disc **116** in place. The disc **116** is designed to relieve

the pressure in the chamber **78** at a preselected pressure, such as 3200 pounds per square inch, so as to prevent damage to the apparatus by an overload.

If an overload occurs, the disc **116** will burst and the hydraulic fluid pressure will be relieved and the machine will be temporarily disabled. This will prevent any damage to the apparatus. By the use of the burst plug **110**, there is assurance that there will be no damage to the apparatus in case of a jam or an overload. The only expense involves replacing the used rupture plug **110**. The provision of this burst plug **110** is a simple and inexpensive way to avoid serious damage, and thus provides a very important addition to the overall performance of the apparatus.

In the operation of the press brake **10**, when the operator desires to adjust the spacing between the fixed and moving dies **26** and **30**, he presses a "down" button (not shown) which opens the valve **57**, operates motor **56**, and the weight of the ram forces the pistons **88** in each cylinder **32** downwardly. The fluid, in effect, is pushed out of the cylinder **32**, and passes through the pump **55** and up into the hydraulic fluid storage tank **52**. The fluid on the upper side of the piston fills the space on the upper side of the piston **88**. Air pressure on the oil in the tank **44** assures non-turbulent flow to avoid air entering the fluid. The ram moves to the dead center down position where the dies **26** and **30** are in intimate contact. The valves **51** are then closed to confine the incompressible fluid in a defined space above the piston **88**. The operator then charges the lower side of the piston **88** by operating the motor **56** to drive the pump **55**, while the valve **57** is also opened. This charges the accumulator **60** to a pressure of for example, 425 p.s.i., as limited by a relief valve in the pump. Since the valves **51** are closed during operation of the pump **55**, the ram does not move upwardly. The valve **57** closes and the motor is stopped. The valves **51** are cracked and the pressure developed on the lower side of the pistons **88** raises the pistons **88**, and thereby the ram, the desired amount. The valves **51** are then closed. The ram is thus locked at the desired height because each piston is locked between the two independent hydraulic systems.

The workpiece is then placed between the dies **26** and **30** and the operator steps on the pedal to activate the drive means. The drive means rotate drive gears **34** which, through the eccentric mounting, drives the ram **88** downwardly. If a jam should occur, at a pressure which does not burst the disc **116**, the operator simply opens the valves **51** to permit the pressure to be relieved on the high pressure side of the piston **88**. The pistons **88** are driven in a reverse or upward direction by the pressurized hydraulic fluid stored in the accumulator on the lower side of the piston. This automatically drives the ram upwardly and away from the bed **24**. It is then simple to relieve the jam such as by removing the workpiece.

If an overload occurs which could damage the machine, the increased pressure in the pressure system and within the pressure chamber **78** of the hydraulic cylinder **32** will



cause the rupture disc **116** of the plug **110** to burst. This relieves the pressure of the fluid on the pressure side of the cylinder. When the problem which caused the overload has been alleviated, the operator merely places a new rupture plug **110** into the relief aperture **108** and the apparatus is ready for further use.

While in the foregoing there has been provided a detailed description of a particular embodiment of the present invention, it is to be understood that all equivalents obvious to those having skill in the art are to be included within the scope of the invention as claimed.

What I claim and desire to secure by Letters Patent is:

**1.** A press brake for bending material, said press brake comprising, in combination, a frame, a stationary bed on said frame for receiving said material thereon, a ram on said frame in alignment with and above said bed, means for driving said ram towards said bed to bend the material interposed between said bed and said ram, hydraulic cylinder and piston means having first and second end portions, said piston means having a high pressure side and a low pressure side, said first end portion being connected to said drive means, said second end portion being connected to said ram, hydraulic means connected to said hydraulic cylinder means for adjusting the spacing between said end portions and thereby the spacing between said ram and said bed, means to confine pressurized hydraulic fluid in the high pressure and low pressure sides of said piston means so that said ram is locked at a fixed spacing from said bed, and means interconnected into said high pressure side for relieving the pressure of said fluid when the fluid pressure exceeds a preselected level.

**2.** The apparatus of claim **1** wherein said first end portion of said hydraulic cylinder means is fixed and comprises the upper end of said cylinder and said second end portion of said hydraulic cylinder and piston means is movable and comprises a lower end of said piston means.

**3.** The apparatus of claim **1** wherein said relieving means comprises a plug member having a rupture disc which bursts at the said preselected pressure level.


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U.S. Cl. X.R.

72—453; 100—53