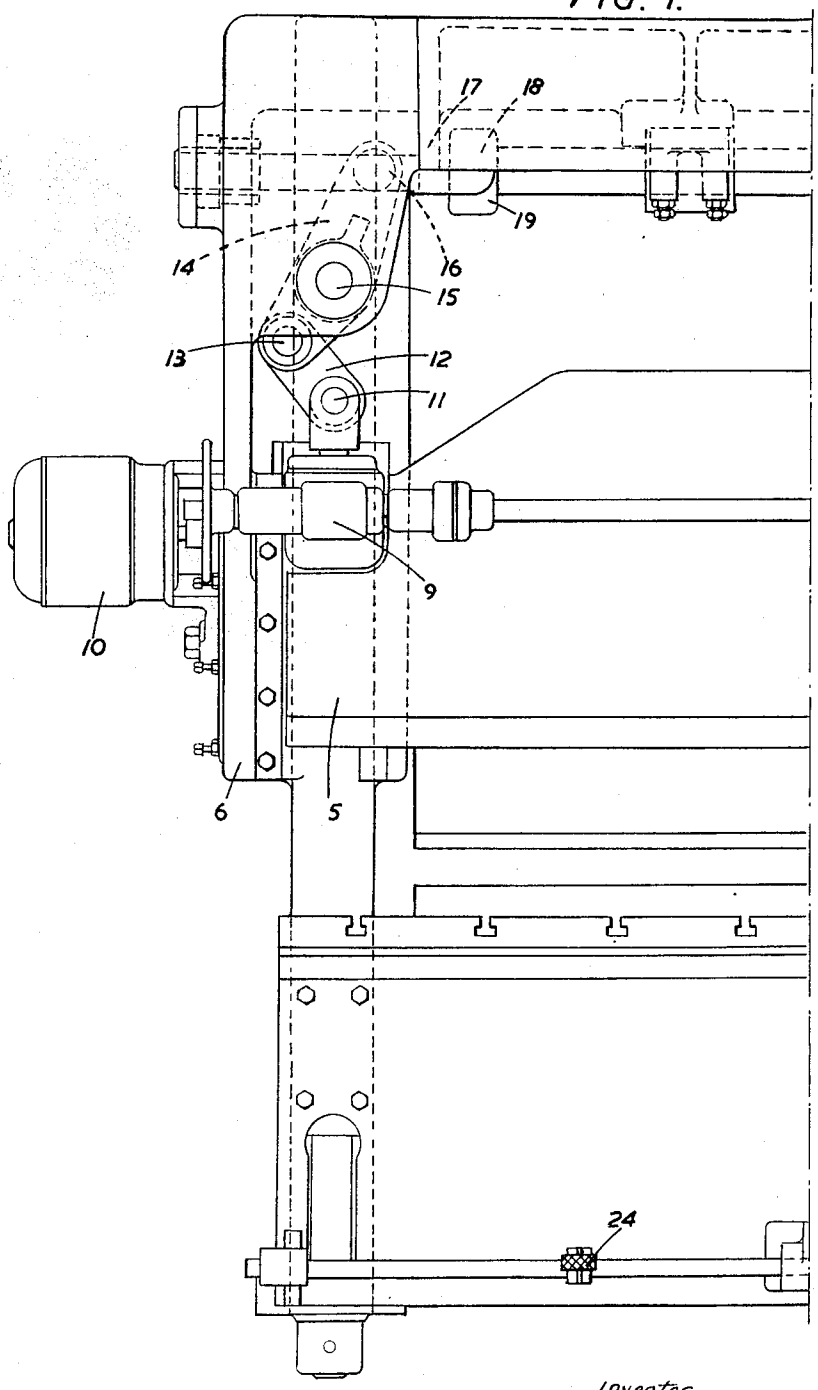
June 10, 1952 C. J. RHODES 2,599,781

HYDRAULIC SYSTEM FOR ACTUATING THE TOOL-CARRYING BEAM OF SHEET BENDING MACHINES

Filed May 25, 1949 5 Sheets-Sheet 1

FIG. 1.



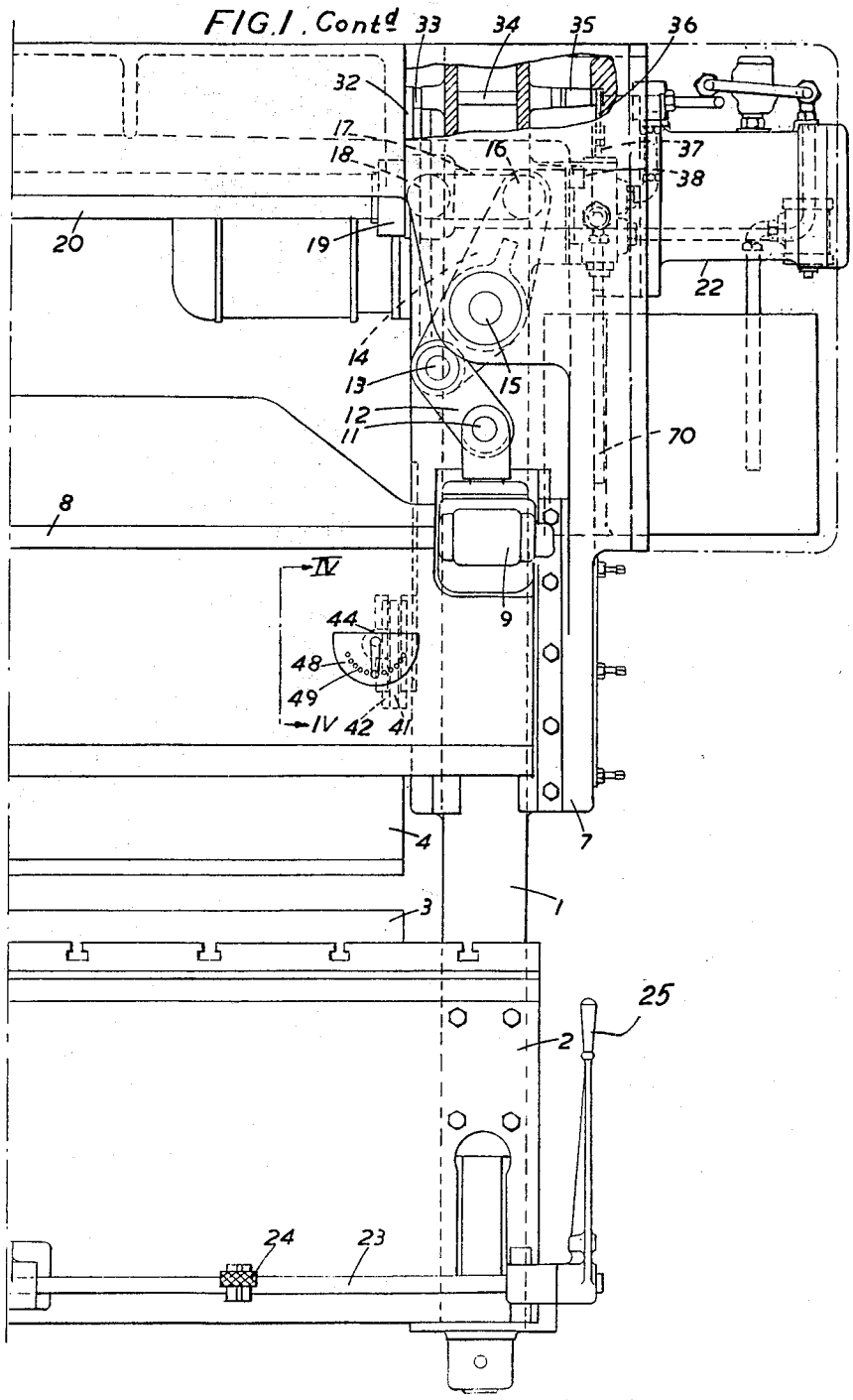
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HYDRAULIC SYSTEM FOR ACTUATING THE TOOL-CARRYING BEAM OF SHEET BENDING MACHINES

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FIG. 1. Cont'd



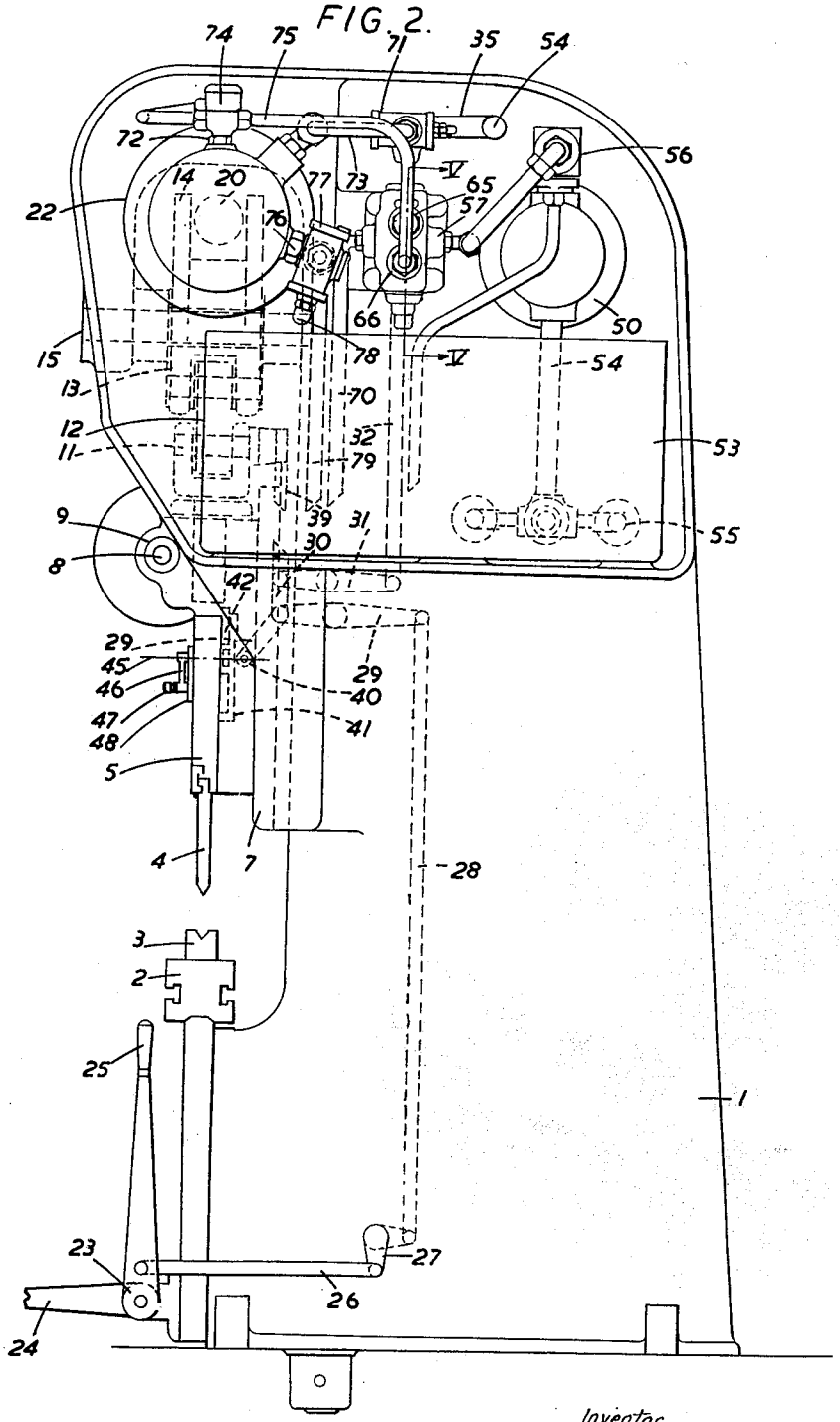
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HYDRAULIC SYSTEM FOR ACTUATING THE TOOL-CARRYING BEAM OF SHEET BENDING MACHINES

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FIG. 2.



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HYDRAULIC SYSTEM FOR ACTUATING THE TOOL-CARRYING BEAM OF SHEET BENDING MACHINES

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FIG. 3.

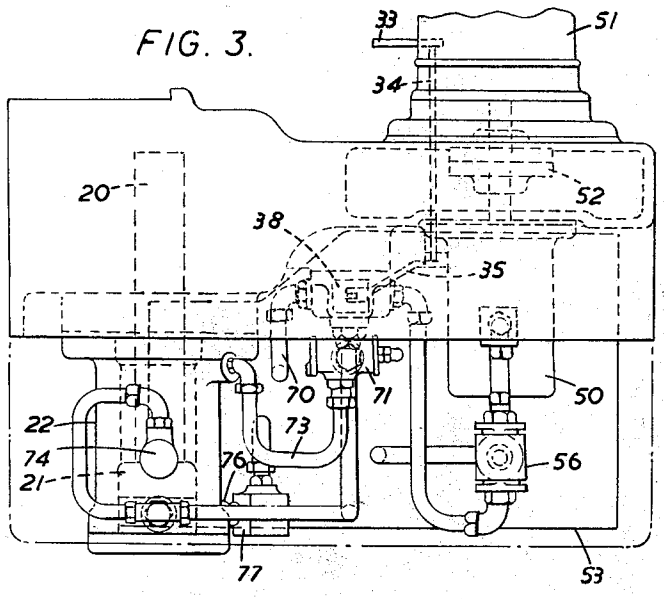
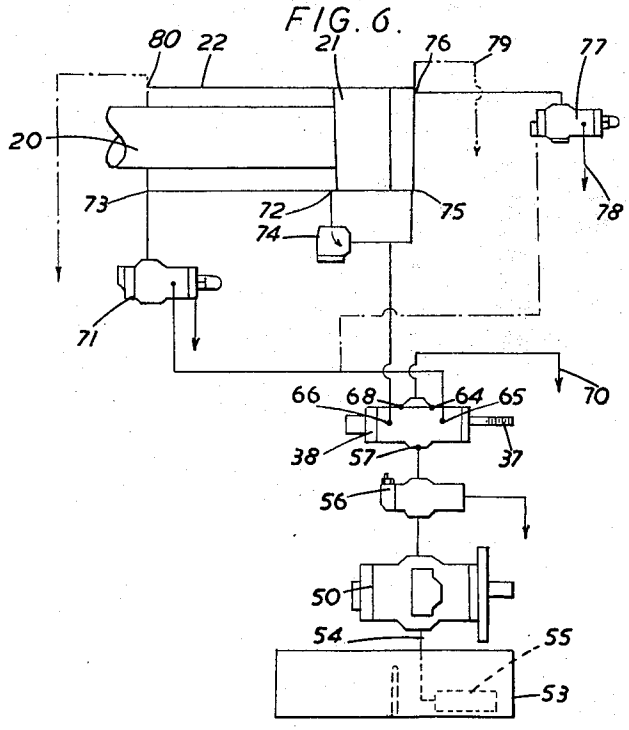


FIG. 6.



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HYDRAULIC SYSTEM FOR ACTUATING THE TOOL-CARRYING BEAM OF SHEET BENDING MACHINES

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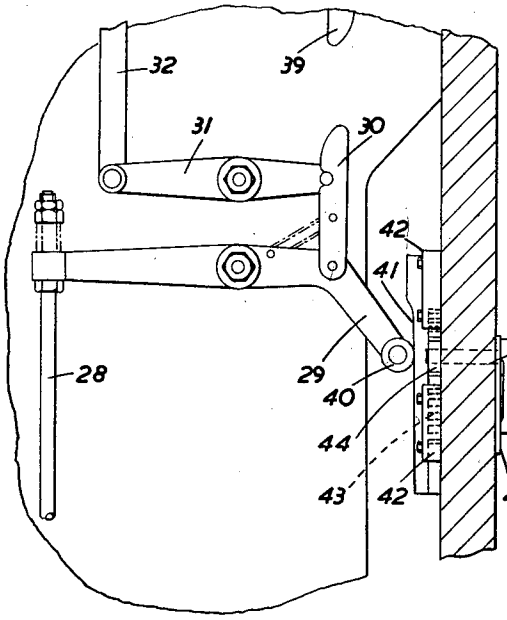


FIG. 4.

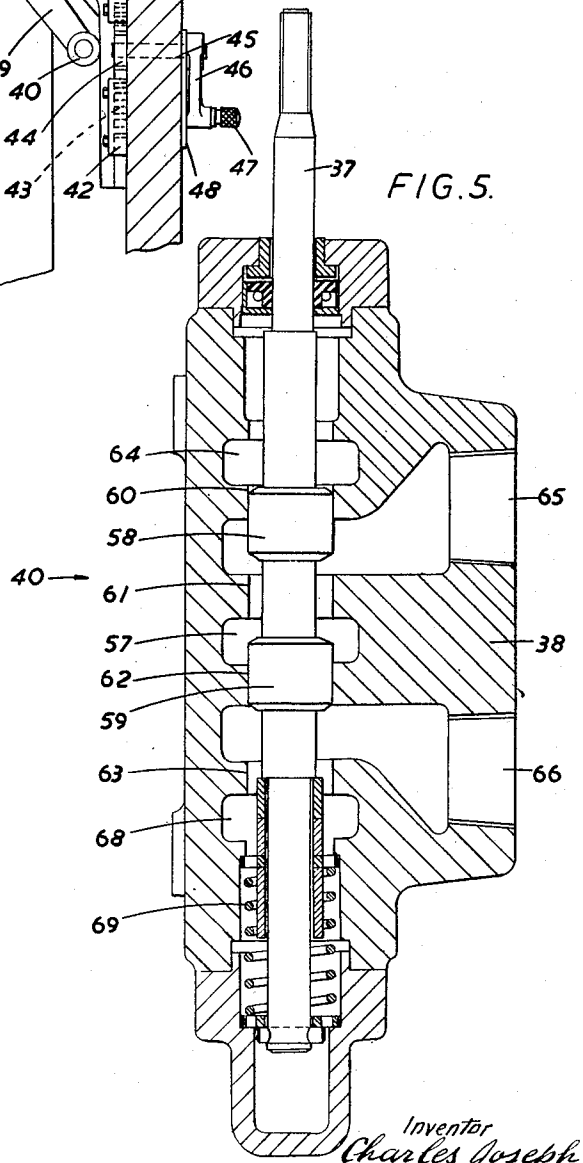


FIG. 5.

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UNITED STATES PATENT OFFICE

2,599,781

HYDRAULIC SYSTEM FOR ACTUATING THE TOOL-CARRYING BEAM OF SHEET BENDING MACHINES

Charles Joseph Rhodes, Wakefield, England

Application May 25, 1949, Serial No. 95,292
In Great Britain April 4, 1949

1 Claim. (Cl. 121—38)

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This invention relates to improvements in and relating to machines for bending sheets and plates of metal.

Machines are known for bending sheets and plates of metal in which the beam, which is raised and lowered by a hydraulic system, carries an upper moving bending tool co-operating with a lower, fixed bending tool on which the plate or sheet to be bent is positioned. If the beam moves with a rapid downward stroke, as is desirable for speed of operation, the moving bending tool comes forcibly into contact with the plate or sheet and may buckle or otherwise damage the latter.

According to the present invention, in a machine for bending sheets and plates of metal, the beam is raised and lowered by a hydraulic system which is controlled in accordance with the position of the beam so as to slow down the downward movement of the beam when the latter reaches a selected distance from the bottom of its stroke.

By suitably selecting the distance from the bottom of the stroke at which the beam is slowed down, according to the character of the bending tools and the nature and thickness of the plate or sheet to be bent, the upper bending tool may be brought relatively gently into contact with the plate or sheet whilst maintaining a relatively high speed of operation.

The hydraulic system may be controlled by a flow-regulating valve actuated by a control member which is adjustable with respect to the beam to vary the distance from the bottom of the stroke at which the beam is slowed down. The control member may be a cam member, adjustably mounted on the beam, co-operating with a cam follower member operatively connected to the flow-regulating valve.

Preferably the machine has a beam arranged to be raised and lowered by hydraulic means including a piston operating in a double-ended cylinder, a control valve adapted to be set to direct pressure fluid to either end of the cylinder at will and to vary the rate of flow of pressure fluid to the cylinder, said valve normally being set to direct pressure fluid into one end of the cylinder for raising the beam, means for setting the control valve to direct pressure fluid at a normal rate of flow to the other end of the cylinder for lowering the beam, a first cam member adjustably mounted on the beam and adapted, when the beam reaches a selected distance from the bottom of its stroke, to move the control valve to a setting which reduces the

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rate of flow of pressure fluid to said last-mentioned end of the cylinder, so that the downward movement of the beam is then slowed down, and a second cam member carried by the beam and adapted to restore the control valve to its normal setting when the beam reaches the bottom of its predetermined stroke, so that movement of the beam is then reversed.

An embodiment of the invention will now be described by way of example with reference to the accompanying drawings, in which:

Fig. 1 is a front view of the machine,

Fig. 2 is an end view of Fig. 1,

Fig. 3 is a fragmentary plan view,

Fig. 4 is a detail section on an enlarged scale taken on the line IV—IV of Fig. 1,

Fig. 5 is a detail section on an enlarged scale taken on the line V—V of Fig. 2, and

Fig. 6 is an explanatory diagram.

The main frame 1 of the machine carries the bed plate 2 on which the fixed bending tool 3 is mounted. The moving bending tool 4 is mounted on the beam 5 which is guided on slides 6, 7 on the main frame 1 so as to be movable towards and away from the bed plate 2. The bending tool 4 is adjustable relatively to the beam 5 in known manner by a worm gear 9 and an associated shaft 8 driven by an auxiliary motor 10.

Movement of the beam 5 is derived from identical toggle mechanisms associated with the two ends of the beam and actuated simultaneously. The lower link 12 of each toggle is pivotally attached to the associated end of the beam 5 by a pivot pin 11, the other end of the link 12 being pivoted to the upper toggle link 14 at the knee 13 of the toggle. The upper toggle link 14 is pivoted intermediate its ends on a stationary pivot 15 provided on the main frame 1 of the machine. The other end of the link 14 is connected by a pivot pin 16 to a connecting link 17 which at its other end is pivoted at 18 to a collar 19. The collar 19 is secured on a rod 20 parallel to the beam and slidable in its axial direction in guides in the main frame 1. One end of the rod 20 carries a piston 21 operating in a cylinder 22 mounted on the main frame 1. By the controlled admission of a pressure fluid, such as oil, into the cylinder 22, the piston 21 is displaced together with the rod 20 and in consequence the beam 5 is raised and lowered. In the drawings, the machine is shown with the beam in the fully raised position, which is the normal position.

To enable the operator to control the machine

by foot or hand as convenient, a control shaft 23 extending across the front of the machine carries foot pedals 24 and a hand lever 25. By means of link-work comprising a horizontal link 26, a bell crank 27 and a vertical link 28, the shaft 23 is connected to a rocking lever 29. The rocking lever 29 is connected by means of a latch member 30 to a trip lever 31 which is connected in turn through a link 32 to a lever 33 mounted on a common shaft 34 with a lever 35. The lever 35 is connected through a link 36 to the spindle 37 of a four-way valve 38.

The latch member 30 co-operates with a cam 39 carried by the beam, so that when the beam reaches the bottom of its stroke the cam 39 actuates the latch member 30 to release the connection between the rocking lever 29 and the trip lever 31.

The end of the rocking lever 29 nearest the beam is cranked downwardly and carries a follower roller 40 which co-operates with a cam 41 mounted in slides 42 on the beam 5. (See Fig. 4.) The cam 41 is formed on one side with a rack 43 which is engaged by a pinion 44 mounted on a shaft 45 journalled in the beam 5. A lever 46 mounted on the outer end of the shaft 45 moves over a calibrated dial 48 and may be set in any desired position by a spring-loaded detent 47 which may engage in any one of a number of depressions 49 (see Fig. 1) in the calibrated dial 48. By operating the lever 46 the cam 41 may be adjusted vertically with respect to the beam. The cam 41 is arranged to actuate the rocking lever 29 at a selected distance from the bottom of the stroke of the beam 5, rocking this lever clockwise as viewed in Fig. 4 and transmitting motion through the latch member 30, trip lever 31, link member 32, levers 33 and 35 and link 36 to raise the spindle 37 of the four-way valve 38.

The power for moving the rod 20 is derived from a rotary pump 50 which is connected to its driving electric motor 51 by way of a flexible coupling 52. The pump 50 draws oil from a reservoir 53 through an inlet 54 provided with filters 55 to prevent foreign matter entering the pump with the oil. From the pump 50 the oil is delivered by way of a relief valve 56, serving to limit the maximum oil pressure, to the central inlet port 57 of the four-way valve 38.

Referring more particularly to Fig. 5, the spindle 37 of the valve 38 is formed with valve heads 58 and 59 intermediate its length. As the spindle 37 slides, the valve head 58 moves between valve seats 60 and 61 whilst the valve head 59 moves between valve seats 62 and 63. The valve is provided with five ports in all. The port 65 is separated from the central inlet port 57 by the valve seat 61 and from the port 64 by the valve seat 60. The port 66 is separated from the central inlet port 57 by the valve seat 62 and from the port 68 by the valve seat 63.

In the normal position of the press in which the beam is stationary in the raised position, the valve spindle 37 is held in the upper position shown in Fig. 5 by a spring 69. In this position the port 65 is in communication with the central inlet port 57 and is shut off from the port 64. When the valve spindle 37 is fully depressed against the action of the spring 69, the port 65 is placed in communication with the port 64 and shut-off from the central inlet port 57, whilst the port 66 is placed in communication with the central inlet port 57 and is shut off from the port 68.

The port 65 leads by way of a check valve 71 to

an inlet 73 at the end of the cylinder 22 at which oil is admitted for raising the beam 5. When the piston 21 is in the position corresponding to the fully raised position of the beam 5, i. e. in the raised position as shown in the drawings, it exposes a port 72 which is thereby placed in communication with the inlet 73. A conduit leads from the port 72 by way of a non-return valve 74 to the port 66 of the four-way valve which in this setting is in communication with the port 68 of the four-way valve 38. The port 68 and the port 64 are both connected to a common return pipe 70. At the end of the cylinder 22 remote from the inlet 73 the cylinder is provided with an inlet 75 which is connected to the conduit between the non-return valve 74 and the port 66 of the four-way valve. At the same end as the inlet 75, the cylinder 22 is provided with an outlet 76 from which a conduit leads by way of an escape valve 77 to the reservoir 53 by way of a conduit 78. The escape valve 77 is controlled by the fluid pressure in the conduit between the port 65 of the four-way valve and the check valve 71 so that when the beam is being raised, i. e. during movement of the piston 21 to the right in Fig. 6, the valve 77 is opened to give free escape of the oil in front of the piston. Owing to the constant delivery of the pump 50 and the smaller piston area for this movement of the piston the return stroke of the beam is faster than the working stroke. The connection to the cylinder 22 of a vent 79 serves to allow the escape of any air bubbles which may enter the hydraulic system, being arranged in a well-known manner to check escape of operating fluid. A bleeder valve 80 (see Fig. 6) may be used for draining the cylinder 22 when required.

In the operation of the device the cam member 41 is adjusted vertically with respect to the beam 5 by means of the lever 46 to slow down the beam at a distance from the bottom of its stroke which is selected according to the character of the bending tools and the nature and thickness of the plate or sheet to be bent. The operator then depresses the pedal 24 and the motion is transmitted through the linkage described to depress the spindle 37 of the four-way valve 38. The pump delivery is directed from the central inlet port 57 of the four-way valve through the port 66 to the cylinder 22 at the inlet 75, so that the piston is urged to the left and the beam 5 is driven down by the toggles 11—18. The oil expelled from the left-hand side of the cylinder flows through the port 65 of the four-way valve to the port 64 and thence to the return conduit 70. When the beam 5 reaches the selected distance from the bottom of its stroke, the cam 41 rocks the lever 29 clockwise as viewed in Fig. 4 and the motion of the rocking lever 29 is transmitted to the valve spindle 37 to raise the latter somewhat, thus restricting the communication between the central inlet port 57 and the port 66 of the four-way valve and thus reducing the rate of flow of pressure oil to the inlet 75 of the cylinder 22. The downward motion of the beam is slowed down accordingly.

When the beam 5 reaches the bottom of its stroke, the cam member 39 actuates the latch member 30 to release the trip lever 31 from the rocking lever 29. The spring 69 of the four-way valve can now re-assert itself moving the valve spindle 37 back to the normal position shown in Fig. 5. The oil under pressure is now delivered from the central inlet port 57 to the port 65 of the four-way valve and thence to the inlet 73 of the cylinder 22 so that the piston 21 is driven

to the right to raise the beam. The pressure in the delivery conduit from the port 65 to the inlet 73 causes the valve 77 to open so that the oil in front of the piston can escape through this valve as well as by way of the cylinder inlet 75 and the ports 66 and 68 of the four-way valve to the return conduit 70. When the piston 21 reaches the end of its travel it exposes the port 72 so that the oil supplied from the pump to the inlet 73 is discharged from the port 72 of the cylinder via the ports 66, 68 of the four-way valve to the return conduit 70. This completes the cycle of operations which can be re-initiated by actuating the pedal 24 or hand lever 25.

What I claim is:

A hydraulic system for raising and lowering the tool carrying beam of a machine for bending sheets and plates of metal, comprising a double-ended cylinder, a piston movable in said double-ended cylinder and operatively connected to said beam to raise and lower the same with a predetermined stroke, a source of pressure fluid, a return conduit, a four-way control valve connected to said source of pressure fluid, said cylinder and said return conduit, a movable valve member within said valve, a spring for urging said movable valve member into one extreme position, which is the normal position, to place the end of said cylinder for raising said beam in communication with said source of pressure fluid and to place the other end of said cylinder in communication with said return conduit, said movable valve member being movable into a second extreme position, which is the operative position, the place said first-mentioned end of said cylinder in communication with said return conduit and to place said other end of said cylinder in communication with said source of pressure fluid, initial movement of said movable valve member from said operative position towards said normal position being operative to reduce the flow of liquid to said other side of said cylinder, a control lever, a rocking lever operatively connected to said control lever, a latch member releasably connecting said rocking lever to said movable valve member, said control lever being movable to set said movable valve member in said operative position so as to initiate downward movement of said beam, a first cam member adjustably mounted on said beam and adapted, when said beam reaches a selected distance from the bottom of its stroke, to actuate said rocking lever to impart to said movable valve member initial movement from said operative position towards said normal position, so that the downward movement of said beam is slowed down, and a second cam member carried by said beam and adapted, when said beam reaches the bottom of its predetermined stroke, to release said movable valve member from said rocking lever and thus permit said movable valve member to be restored by spring action to said normal position, whereby movement of said beam is then reversed.

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