Aug. 24, 1943. J. G. MOOHL 2,327,920

METAL SAWING MACHINE

Filed July 25, 1941 7 Sheets-Sheet 1

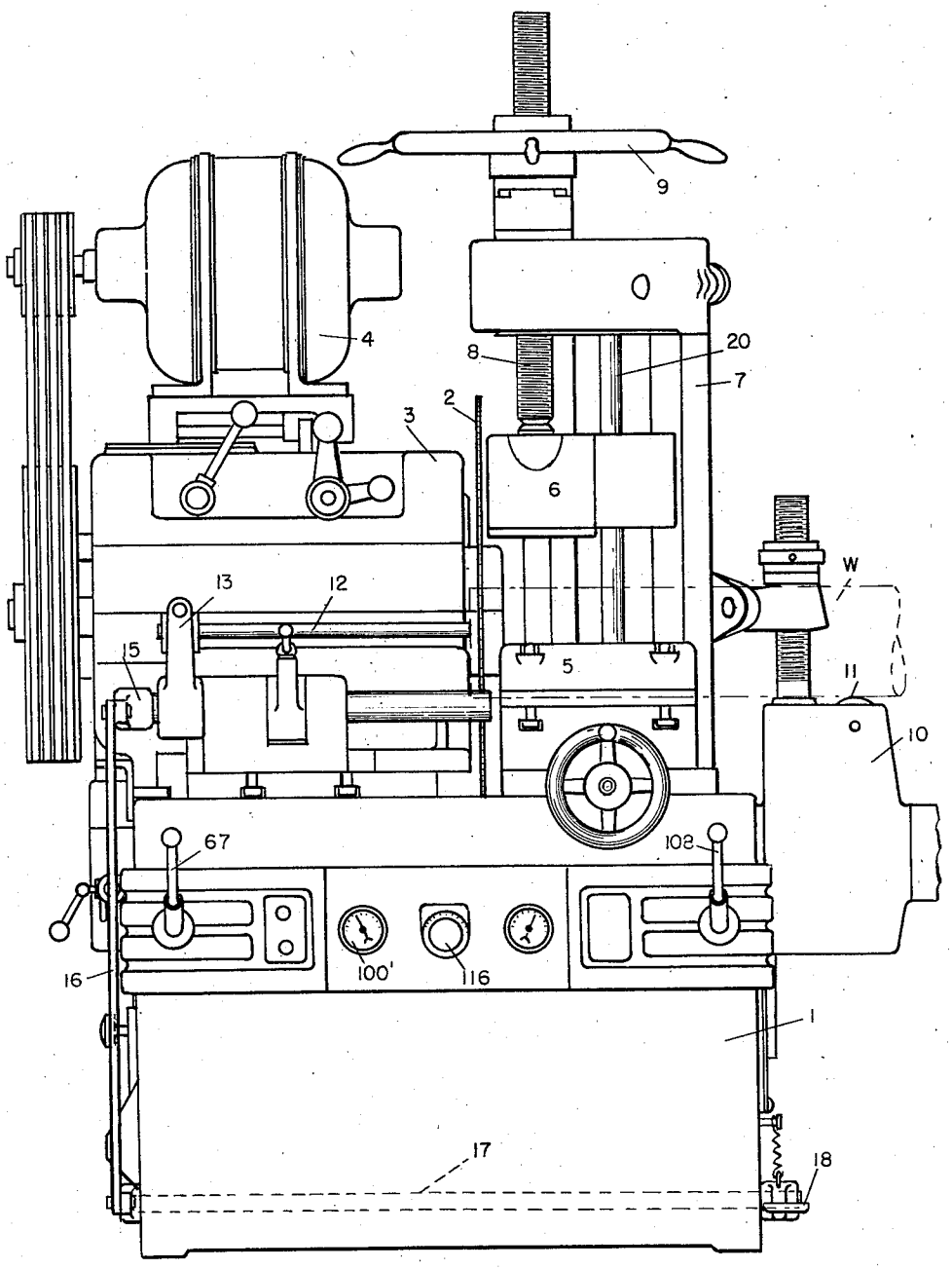

FIG. 1

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METAL SAWING MACHINE

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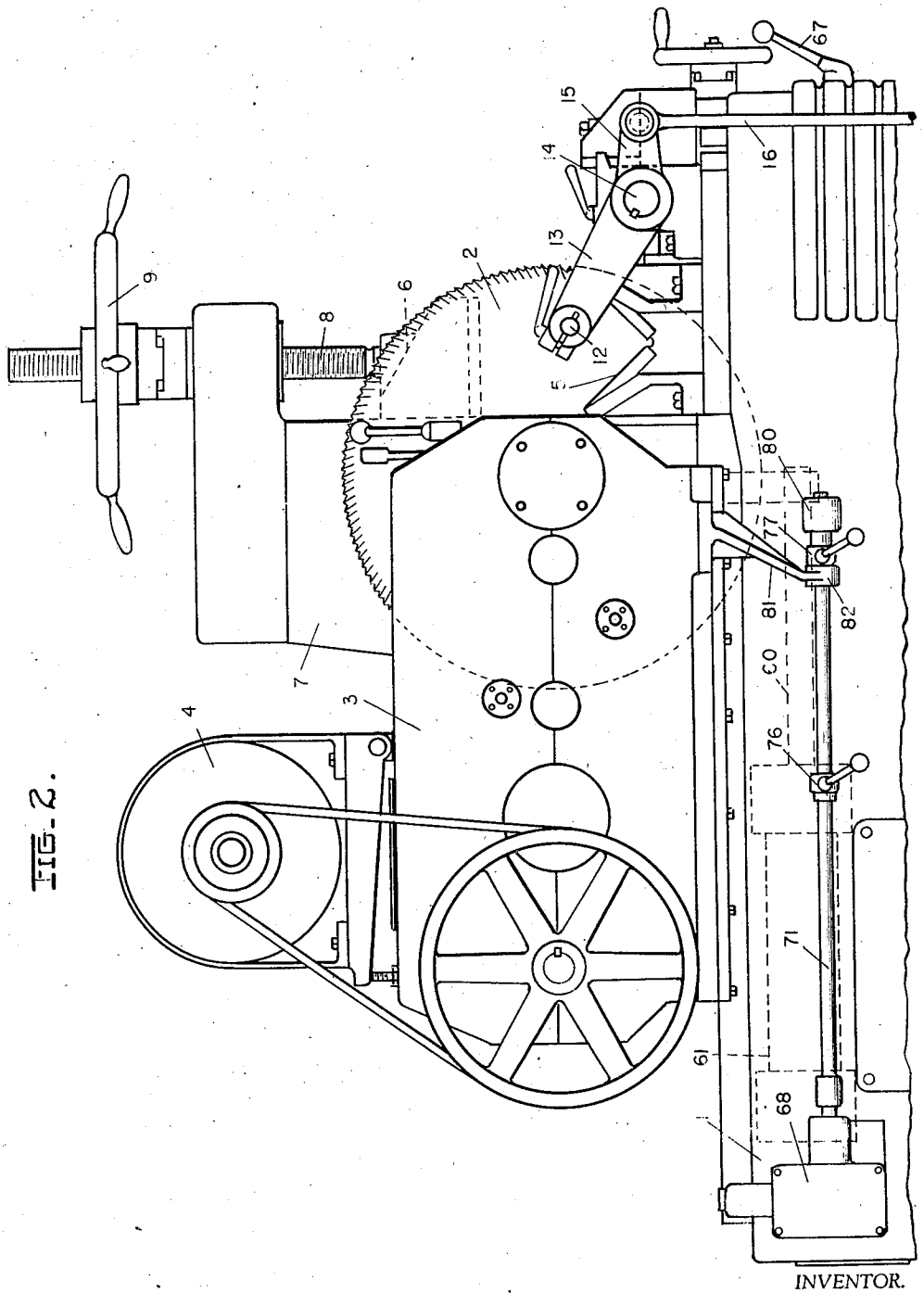

FIG. 2.

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METAL SAWING MACHINE

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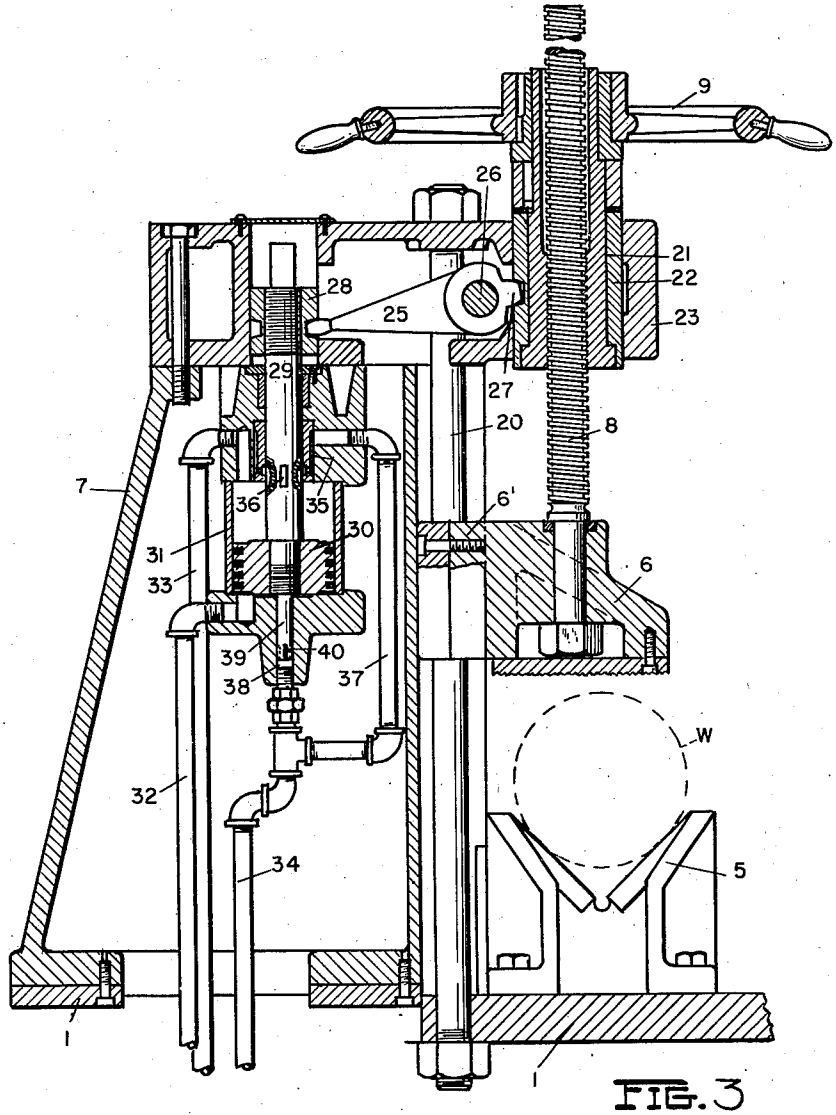

FIG. 3

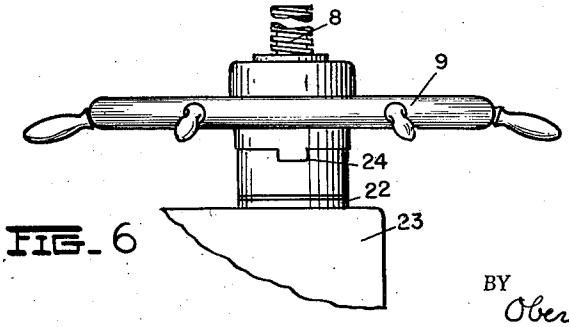

FIG. 6

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METAL SAWING MACHINE

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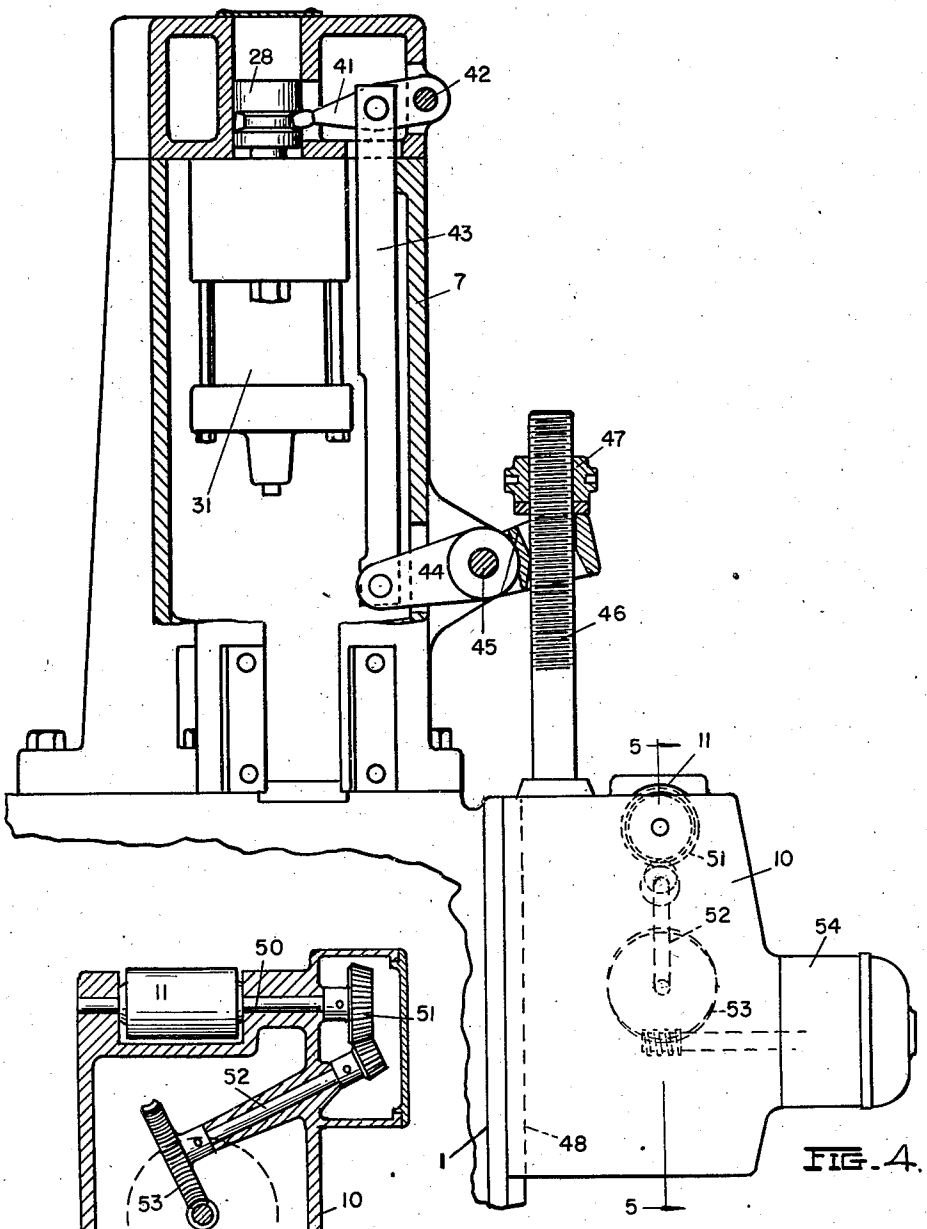

FIG. 4.

FIG. 5

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METAL SAWING MACHINE

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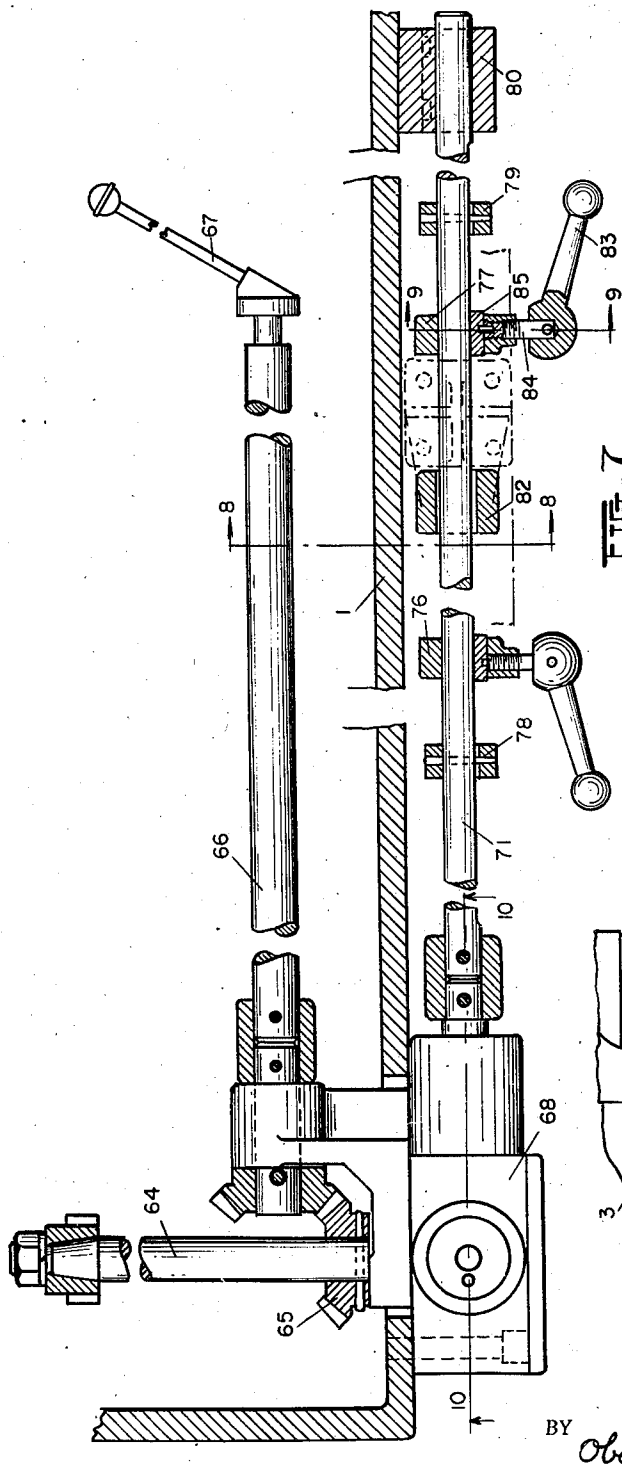

FIG. 7

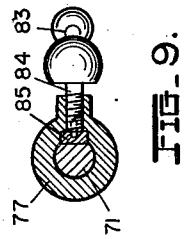

FIG. 9.

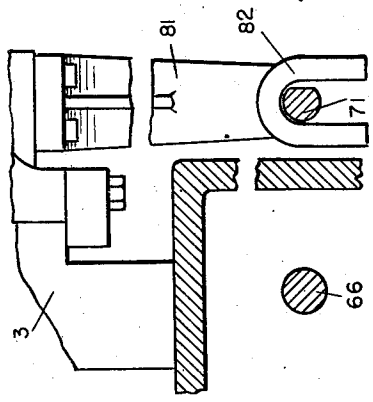

FIG. 8

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METAL SAWING MACHINE

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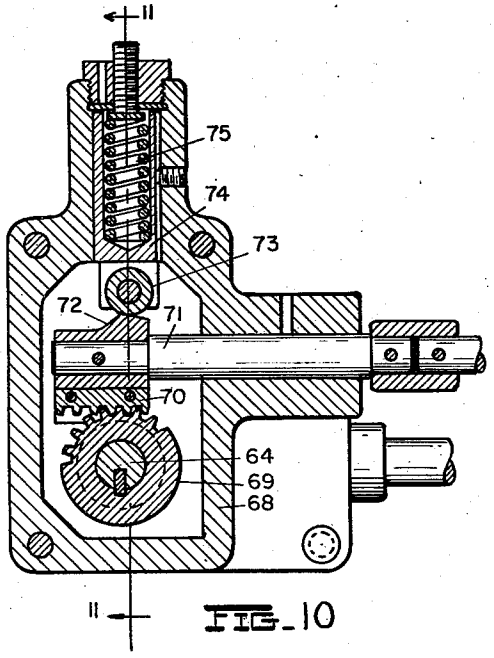

FIG. 10

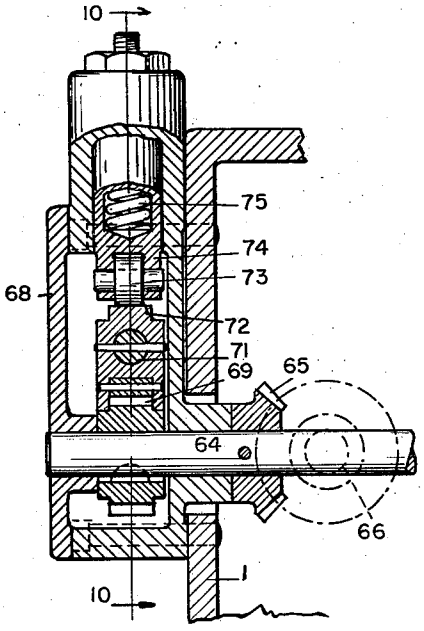

FIG. 11

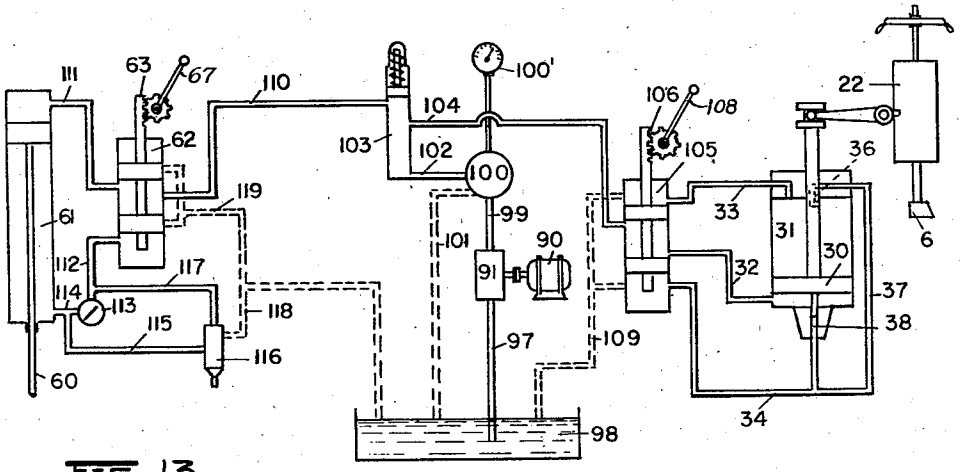

FIG. 13

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METAL SAWING MACHINE

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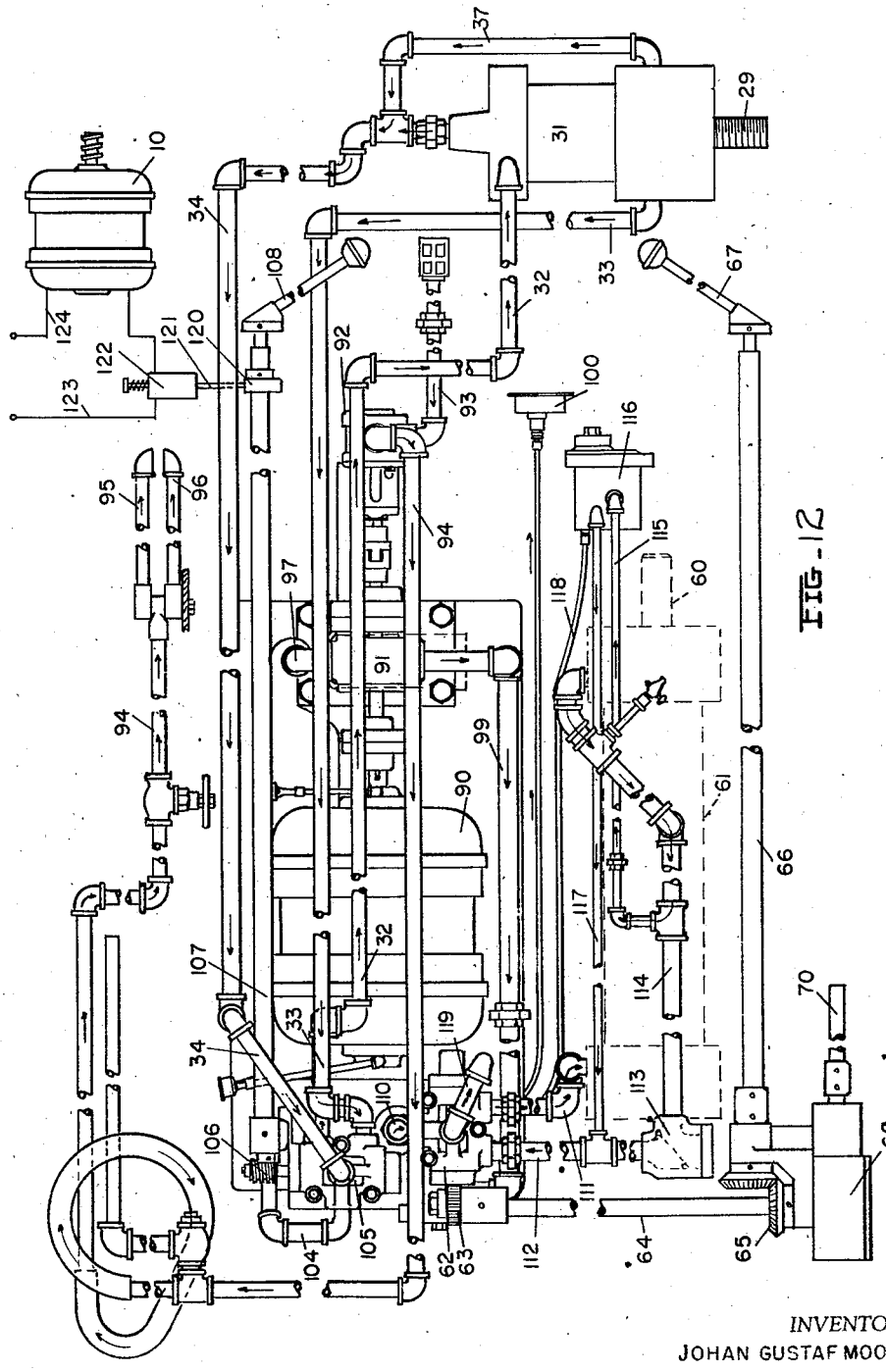

FIG. 12

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Patented Aug. 24, 1943

2,327,920

UNITED STATES PATENT OFFICE

2,327,920

METAL SAWING MACHINE

Johan Gustaf Moohl, Cleveland Heights, Ohio, assignor to The Motch & Merryweather Machinery Company, Cleveland, Ohio, a corporation of Ohio

Application July 25, 1941, Serial No. 404,020

8 Claims. (Cl. 29—69)

The present invention relates to a machine for cutting off or sawing metal wherein a circular disc saw, mounted upon a movable carriage, is traversed through the work-piece or metal to be cut, which, in turn, is held stationary in a work-holding clamp or vise. The general object and nature of my invention is to provide such machine having improved operating efficiency, increased productive capacity and greater work-handling facility.

A further objective of my invention is to incorporate certain safety features in the machine for the purpose of substantially reducing the likelihood of injury or accident to the machine operator.

The foregoing, as well as additional objectives and advantages of my invention, shall be described in detail as the following description proceeds.

To the accomplishment of the foregoing and related ends said invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims, the annexed drawings and the following description setting forth in detail certain mechanism embodying the invention, such disclosed means constituting, however, but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawings:

Fig. 1 is a front end elevational view of a metal sawing machine embodying the improvement of my present invention; Fig. 2 is a side elevational view of the machine shown in Fig. 1; Fig. 3 is a detailed sectional view of the work-holding vise and associated operating mechanism; Fig. 4 is a detailed view, partially in section, of the mechanism for supporting the work as it is conveyed to the work-holding vise; Fig. 5 is a sectional view taken along the line 5—5 of Fig. 4; Fig. 6 is a detailed elevational view of the vise hand-adjusting wheel; Fig. 7 is a detailed, sectional view of the hand control lever and of the machine-actuated mechanism for controlling the saw carriage feed; Fig. 8 is a detailed, sectional view taken substantially along the line 8—8 of Fig. 7; Fig. 9 is a detailed, sectional view taken substantially along line 9—9 of Fig. 7; Fig. 10 is a vertical, sectional view taken along line 10—10 of Figs. 7 and 11; Fig. 11 is a sectional view taken upon a plane normal to that of Fig. 10 and substantially along line 11—11 thereof; Fig. 12 is a lay-out of the hydraulic pressure system control mechanism of the machine; and Fig. 13 is a diagram illustrating the principle of operation of the hydraulic control and operating system.

Now referring more particularly to Figs. 1 and 2 of the drawings, the machine therein comprises a base frame 1 upon which the metal saw 2 is carried by means of the movable saw carriage 3. Driving power is transmitted from the electric drive motor 4 to the saw 2 by means of driving connections and a gear train which need not here be further described in detail. The work-holding clamp or vise comprises the lower, vertically fixed jaw 5 and the upper, vertically movable jaw 6. The housing 7 supports the screw shaft 8 carrying the movable jaw 6. A hand wheel 9 is provided for adjustably regulating the vertical position of the shaft 8 and jaw 6. A vertically movable housing 10 is mounted on the side of the frame 1 and carries a roller 11 for supporting and conveying the work-piece W as the latter is moved into position between the vise jaws 5 and 6.

A stock limit stop gauge or bar 12 is adjustably clamped in the end of the arm 13 which is keyed to the upper rock shaft 14. A lever arm 15 connects the shaft 14 to the connecting rod 16, leading to the bottom rock shaft 17, which, in turn, is oscillated by means of the foot treadle 18.

As the work-piece W is moved between the jaws 5 and 6, the limit stop gauge 12 is in position as shown in Fig. 2, where it abuts against the end of the work-piece, thus determining the length of stock to be severed. After the work-piece is clamped between the jaws 5 and 6, and the piece of stock cut off by the saw 2, the foot treadle 18 is depressed, thus rocking the stock gauge 12 in a clockwise direction (with respect to Fig. 2), thus clearing the way for the removal of the severed stock from the lefthand side of the machine. When the foot treadle 18 is again released, the stock gauge 12 moves back into its original position to measure and to determine the length for the next piece to be cut.

Work-holding vise

The construction of the work-holding clamp or vise and its associated operating mechanism is best illustrated in Fig. 3. The vertical standard or supporting housing 7 rests upon the machine frame 1. A vertical tie bar 20 extends from the top of the housing 7 to the frame 1 and acts as a tension member adapted to receive the full thrust of the vise jaws 5 and 6 when the latter are in closed or work-holding position, thus relieving the major tension stresses which might

be exerted upon the housing 7. The upper jaw 6 has a laterally extending boss 6' which surrounds and slides upon the tie bar 20 and acts as a guide for the jaw 6 in its vertical movement.

The screw shaft 8 threadably engages in a quill 21 which is rotatably mounted, but longitudinally fixed in the sleeve 22. The sleeve 22 is vertically slidable in the laterally projecting portion 23 of the housing or standard 7. The hand wheel 9 engages the quill 21 through the medium of a dog clutch connection shown at 24. Rotation of the hand wheel 9, in turn, rotates the quill 21 and thus determines the vertical position of the vise jaw 6 with respect to the vertically movable sleeve 22. In normal operation, this adjustment will be made so that the jaw 6 clears the work-piece W by an inch or so when the sleeve 22 is in its uppermost position, substantially as shown in Fig. 3.

A rocker arm 25 mounted upon the fixed shaft 26 has a toothlike projection 27 which engages in a complementary recess in the sleeve 22. The other end of the rocker arm 25 is engaged in an annular receiving groove in the cylindrical block carried on the upper end of the piston rod 29. The piston rod 29 is carried by the piston 30 which is adapted to reciprocate in the fluid pressure cylinder 31. Pressure supply lines or conduits 32 and 33 are connected to each end of the cylinder 31. A pressure exhaust or relief line 34 is also connected to either end of the cylinder 31. The relief passage 35 is adapted to be connected with the upper end of the cylinder 31 by means of the by-pass ports 36 in the piston rod 29. The line 37 connects the relief passage 35 to the relief line 34. The relief line 34 is connected to the port 38 in the bottom end of the cylinder 31. A projecting rod or plunger 39 is carried on the bottom side of the piston 30 and is adapted to fit within the port 38. Small by-pass ports 40 are provided in the end of the plunger 39 whereby the port 38 is placed in communication with the interior of the cylinder 31 when the piston approaches its uppermost position. The operation of the work-holding vise as just described, is as follows:

The parts are initially in the position as shown in Fig. 3, with the work-piece resting on the lower, fixed jaw 5. Fluid under pressure, which may be either pneumatic or hydraulic, is introduced through the pressure supply line 32 to the lower end of the cylinder 31. The piston 30 is thereby forced in an upward direction, rocking the rocker arm 25 in a clockwise direction and moving the sleeve 22, the screw shaft 8 and the movable jaw 6 in a downward direction until it firmly engages and clamps the work-piece W in the vise. At the same time, fluid in the upper end of the cylinder 31 is evacuated out through the line 33. In the event that the vertical position of the movable jaw 6 is not first properly adjusted in order to secure a firm and positive clamping of the work-piece W, fluid pressure is exhausted through the ports 40 and 38 to the line 34 so that it will be impossible to build up a back pressure in the line 32, and thus, to prevent traverse or feeding operation of the saw carriage, as will be subsequently described. In this manner, any possibility of light or insecure clamping of the work-piece whereby the latter might be forced or displaced from the work-holding vise to the injury of the machine or the operator, is positively guarded against.

After the work-piece has been cut off by operation of the saw 2, fluid pressure is introduced through the line 33, to the upper end of the cylinder 31, moving the piston 30 in a downward direction and the movable vise 6 correspondingly in an upward direction. As the piston 30 approaches the end of its downward or return stroke, the ports 36 place the relief passage 35 in communication with the upper end of the cylinder 31, thus relieving pressure out through the lines 37 and 34. In this manner, back pressure is not stored up in the line 33, after the necessary work of opening the work-holding vise has been performed. Such relief of back pressure accomplishes the dual function of eliminating waste of excess power applied to the pressure source, such as the hydraulic pump, and also cooperates with the safety control of the operation of the saw carriage 3, as will be further subsequently described. In other words, it is not possible to start the saw carriage 3 upon its operating feed or traverse as long as the vise jaw 6 is in open or uppermost position. This feature contributes greatly to the safety of the operation of the machine in that it is not possible, inadvertently, to cause movement of the saw carriage while the operator, when the vise is open, might be performing certain preliminary adjustments thereon in the vicinity of the path of travel of the saw.

Work feed and supporting mechanism

The above mechanism is best shown in Figs. 4 and 5. A lever 41 has one end engaging the groove in the cylindrical block 28 and its other end pivotally mounted upon the fixed shaft 42. Movement of the lever 41 is connected through the bar 43 to the rocker arm 44 pivotally mounted to the fixed shaft 45. The righthand or outer end of the rocker arm 44 surrounds the threaded connecting rod 46 which is attached at its lower end to the vertically movable housing 10. An adjustable thrust collar 47 is mounted on the upper end of the connecting rod 46 and is adapted to be contacted by the rocker arm 44.

The housing 10 is mounted by means of a dovetailed slide-way to the side of the machine frame 1. A work-supporting roller 11 projects above the top side of the housing 10 and is mounted upon the drive shaft 50 journalled therein. The shaft 50 is connected by means of the taper gears 51 through the shaft 52 and the worm and gear set 53 to the electric drive motor 54.

The operation of the last described mechanism is as follows:

As the piston rod 29 and block 28 is moved in a downward direction, raising the movable jaw 6 to release the work-piece W, the lever arm 41 is likewise moved in a downward direction and its movement is transmitted through the rod 43 and rocker arm 44 to move the housing 10 and work supporting roller in an upward direction. As the roller 11 is moved upwardly, it contacts with the underside of the work-piece W, raising the latter out of contact with the fixed vise jaw 5. The drive motor 54 is then actuated, rotating the roller 11 in a counter-clockwise direction (with respect to Fig. 4), conveying the work-piece W in a lefthand direction until its end contacts with the stock gauge 12, at which point the vise jaw 6 is caused to move downwardly to clamp the work-piece and concurrently moving the roller 11 and housing 10 to its lowered position out of contact with the underside of the work-piece.

Saw carriage feed mechanism

A connecting rod 60 connects the saw carriage 3 to a piston reciprocable in the fluid pressure

cylinder 61 mounted in the base frame 1 of the machine. Reciprocation of the rod 60 thus effects movement of the carriage 3 towards and away from the work-holding vise. A four-way control valve 62 of the "dumb-bell" or "spool" type, as is well-known to those skilled in the art, has its valve stem connected by rack and gear 63 to the rock shaft 64, which is, in turn, connected through the bevel gear set 65 to the transverse rock shaft 66 leading to the front end of the machine. A hand lever 67 is mounted on the front end of the shaft 66. Manipulation of the hand lever 67 is thus effective to shift the "spool" of the valve 62 to introduce fluid pressure alternately to either end of the cylinder 61 to cause feed and return movement of the saw carriage 33.

The outer end of the rock shaft 64 enters the gear housing 68. The gear 69 is keyed to the outer end of the shaft 64 and engages with the rack 70 on the end of the connecting rod 71. A cam track 72, also carried by the end of the rod 71 is engaged by the cam following roller 73 mounted in the lower end of the plunger 74 which is loaded by the coil compression spring 75. The pressure of the spring 75 is thus transmitted through the plunger 74 to the roller 73, to the cam track 72, to aid in the longitudinal movement of the connecting rod 71. The connecting rod 71 (see Fig. 7) carries the adjustable limit stop collars 76 and 77 and the fixed limit stop collars 78 and 79, respectively. The right-hand end of the rod 71 is slidably supported in a boss 80 on the side of the machine frame 1. A downwardly depending bracket 81 from the saw carriage 3 has a U-shaped yoke 82 fitting over the rod 71 and adapted to engage with the limit collars 76 and 77. The position of the collars 76 and 77 on the rod 71 is adjusted by means of a mechanism comprising a hand lever 83 on the threaded screw 84, which bears against a contact shoe 85, engaging with a "flat" on the side of the rod 71.

The operation of the last-described mechanism is as follows:

The limit stop collars 76 and 77 are preliminarily set at positions corresponding to the desired length of travel of the saw carriage 3. The fixed limit stops 78 and 79, of course, determine the maximum range of this adjustment setting. The lever 67 is then manipulated to introduce pressure to the head end of the cylinder 61 causing the saw carriage to move in a righthand direction with respect to Fig. 2 or towards the work-piece. When the saw carriage 3 approaches the end of its working stroke, the yoke 82 contacts with the limit stop collar 77, moving the rod 71 in a right-hand direction. This causes the roller 73 to move or ride up upon the rise in the cam track 72, compressing the spring 75. As soon as the roller 73 reaches the top of this rise in the cam track 72, it will, of course, tend to ride down upon the other side of it, urging the rod 71 in a righthand direction with a very rapid movement or "snap action," thus rotating the gear 69 and the rock shaft 64 to shift the spool of the control valve 62 to introduce fluid pressure to the rod end of the cylinder 61, thus starting the saw carriage 3 on its return or retracting stroke (in a lefthand direction with respect to Fig. 2).

As the saw carriage 3 reaches the end of its return stroke, the yoke 82 contacts with the limit stop collar 76, again moving the connecting rod 71 in a lefthand direction, rotating the shaft 64 through such an arc as to move the spool of the control valve 62 to a neutral position in which no pressure is introduced to either end of the cylinder 61. The mechanism is thus set for a repeat cycle of operation.

Control system

As it should now be quite apparent, the operation of those component parts of the machine comprising the work-holding vise, the saw carriage and the work-supporting and conveying roller, are interdependent and made to function, one with respect to the other. This is accomplished by means of a control system which is particularly illustrated in Figs. 12 and 13.

Within the base frame 1 of the machine there are located an electric drive motor, a pressure pump and an oil supply reservoir which, in effect, comprise the source of the fluid or hydraulic pressure for the system. Thus, the drive motor 90 is connected to the hydraulic pump 91. The coolant supply pump 92 is also coupled to the motor drive and adapted to deliver the usual coolant medium from the intake line 93 to the outlet line 94, to the delivery branches 95 and 96, suitably positioned on either side of the circular saw 2.

An intake line 97 leads from the oil supply reservoir 98 to the pump 91. The outlet, or pressure delivery side of the pump 91 is connected by the line 99 to the pressure regulating valve 100. A pressure gauge 100' is connected to the regulating valve 100 and mounted on the front panel on machine frame 1. A return line 101 leads from the regulating valve 100 to the reservoir 98.

The line 102 leads from the pressure regulating valve 100 (i. e., a pressure control valve adapted to regulate the amount of pressure delivered from the pump 90 to the line 102) to the differential pressure-actuated valve 103. The valve 103 is of standard construction and adapted to deliver fluid to its outlet lines 104 and 110 at different, predetermined pressures. Thus, at the lower, predetermined pressure at which the valve 103 is set, the line 102 is placed in communication with the delivery line 104 leading to the distributing valve 105 which is also of the standard "dumb-bell" or "spool" type and whose shiftable spool is actuated by means of a rack and gear connection 106 to the rock shaft 107 leading to the front end of the machine where the hand lever 108 is connected to it. The pressure delivery lines 32 and 33 lead from the distributing valve 105 to the cylinder 31. The pressure relief or return line 34 leads from the cylinder 31 back to the valve 105. A return line 109 leads from the valve 105 to the reservoir 98.

At the higher, predetermined pressure of the differential valve 103, the pressure delivery line 102 is placed in communication with the delivery line 110 leading to the distributing or control valve 62. The pressure delivery line 111 leads from the valve 62 to the head end of the saw carriage feed cylinder 61. The pressure delivery line 112 leads from the valve 62 to the check valve 113 and thence, through the line 114 to the rod end of the cylinder 61. The check valve 113 is adapted to permit flow only in a direction from the line 112 to the line 114, and not in a reverse direction.

The line 115 connects the line 114 to the flow control valve 116, which, in turn, is connected by the line 117 to the delivery line 112.

Thus, as pressure is introduced from the control valves 62, through the delivery line 111 to the head end of the cylinder 61, the speed or rate

of movement of the piston and piston rod 60 in a direction corresponding to the saw carriage feed, is controlled by the action of the flow control valve 116 which determines the rate at which the fluid is evacuated from the rod end of the cylinder 61. If the flow control valve 116 is set at a relatively high rate, the rate of traverse of the saw feed carriage 3 will be correspondingly greater. Conversely, a relatively lower flow rate setting of the flow control valve 116 will function to decrease the speed of the saw carriage feed.

This last described feed rate control particularly contributes to the safety and efficiency of operation of the machine in that it permits the proper regulation of the rate of saw feed for metals of varying hardness and cross-sectional size.

An exhaust line 118 from the flow control valve 116 connects to the exhaust line 119 from the valve 62, leading to the supply reservoir 98. A cam 120 is mounted upon the rock shaft 107 and is adapted to actuate the push rod 121 of the electric switch 122 connected in the electric circuit comprising the supply lines 123 and 124 leading to the drive motor 10 for the work-supporting roller 11. Thus, as the hand lever 108 is manipulated to open the movable jaw 6 of the work-holding vise, the motor 10 is correspondingly actuated to rotate the roller 11, and as the jaw 6 is closed, the motor 10 and the roller 11 are correspondingly stopped.

Directing attention particularly to Fig. 13, it will be seen that pressure cannot be delivered to the delivery line 110 leading to the saw carriage feed control valve 62 unless and until sufficient pressure is developed in the differential control valve 103. Such pressure is developed only if the piston 30 is at rest in a position short of the end of its upward or working stroke, where the vise jaw 6 is firmly and positively clamped against the work; otherwise pressure is relieved out through the by-pass port 38 to the relief line 34. On the other hand, sufficient back pressure cannot be developed in the line 104 to actuate the valve 103 to connect the line 110 for operation of the saw feed carriage when the piston 30 is, at any point, on its downward or return stroke, which is effected by introduction of pressure through the delivery line 33. Thus, as the piston 30 reaches the end of its downward stroke, pressure is relieved through the by-pass ports 36 to the return lines 37 and 34.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

I, therefore, particularly point out and distinctly claim as my invention:

1. In a metal sawing machine, a work-holding vise comprising a fixed jaw and a movable jaw, a fluid pressure cylinder having a piston connected to said movable jaw, a pressure supply source, valve means for introducing fluid under pressure alternately to each end of said cylinder, and means carried by and movable with said piston for relieving fluid pressure in each end of said cylinder when said piston reaches a predetermined point in its travel adjacent the opposite end of said cylinder.

2. In a metal sawing machine, a work-holding vise comprising a fixed jaw and a movable jaw, a fluid pressure cylinder having a piston connected to said movable jaw, a pressure supply source, valve means for introducing fluid under pressure alternately to each end of said cylinder, a by-pass port in one end of said cylinder leading therefrom to pressure discharge, and means carried by said piston for opening said port at a point adjacent the end of its stroke in a direction away from said one end of said cylinder.

3. In a metal sawing machine, a work-holding vise comprising a fixed jaw and a movable jaw, a fluid pressure cylinder having a piston connected to said movable jaw, a pressure supply source, valve means for introducing fluid under pressure alternately to each end of said cylinder, a by-pass port in one end of said cylinders leading therefrom to pressure discharge, and a projecting plunger on the end of said piston adapted to enter into and to close said port during the majority of the working stroke of said piston and to open said port at a point adjacent the end of such working stroke.

4. In a metal sawing machine, a work-holding vise comprising a fixed jaw and a movable jaw, a fluid pressure cylinder, a piston reciprocable in said cylinder, a piston rod connecting said piston to said movable jaw, a pressure supply source, valve means for introducing fluid under pressure alternately to each end of said cylinder, by-pass ports in each end of said cylinder, one of said ports being adapted to be opened and closed by registering ports in said piston rod, and a projecting plunger on the head end of said piston adapted to enter into and to open and close the other of said ports.

5. A metal sawing machine comprising a work-holding vise, a saw carriage movable with respect to said vise, a fluid pressure-actuated means for operating said vise and a second fluid pressure-actuated means for moving said carriage, a single pressure supply source, pressure control means for introducing fluid under pressure from said source to said first-named pressure-actuated means prior to introduction to said second pressure-actuated means and valve means mechanically connected to and actuated by movement of said first named pressure-actuated means for relieving presure therein, when said vise is in fully opened position.

6. A metal sawing machine comprising a work-holding vise, a saw carriage movable with respect to said vise, a pressure cylinder and piston therein connected to said vise for opening and closing the latter, a second cylinder and piston therein connected to said carriage for moving the latter, a pressure supply source, control valves connected to each of said cylinders, a valve actuated by a pressure differential connecting said pressure supply source to both of said control valves whereby pressure is introduced to one of said control valves prior to introduction to the other and a pressure relief valve formed by ports in said first-named piston and adapted to be opened automatically by movement of said piston in said first named cylinder to a position corresponding to fully opened position of said vise.

7. A metal sawing machine comprising a work-holding vise, a saw carriage movable with respect to said vise, a presure cylinder and piston therein connected to said vise for opening and closing the latter, a second cylinder and piston therein connected to said carriage for moving the latter, a pressure supply source, control valves connected to each of said cylinders, a valve actuated by a pressure differential connecting said pressure supply source to both of said control

valves whereby pressure is introduced to one of said control valves prior to introduction to the other, manually actuated means for operating each of said control valves, a work supporting roller mounted adjacent said vise, an electric motor for rotatably driving said roller, an electric control switch for actuating said motor, and means connecting said switch to that one of said manually actuated means which operates said control valve for said first-named cylinder.

8. In a metal sawing machine, a work-holding vise comprising a fixed jaw and a movable jaw, a vertically movable work support mounted adjacent said fixed jaw, a work-contacting roller carried by said work support, an electric motor for rotatably driving said roller, an electric control switch for actuating said motor, a fluid pressure cylinder having a piston connected to said movable jaw and to said movable work support to move said movable jaw and said work support in unison and in the same direction, valve means for introducing fluid pressure alternately to each end of said cylinder, and means connecting said switch to said valve means for operating said switch in unison therewith.

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