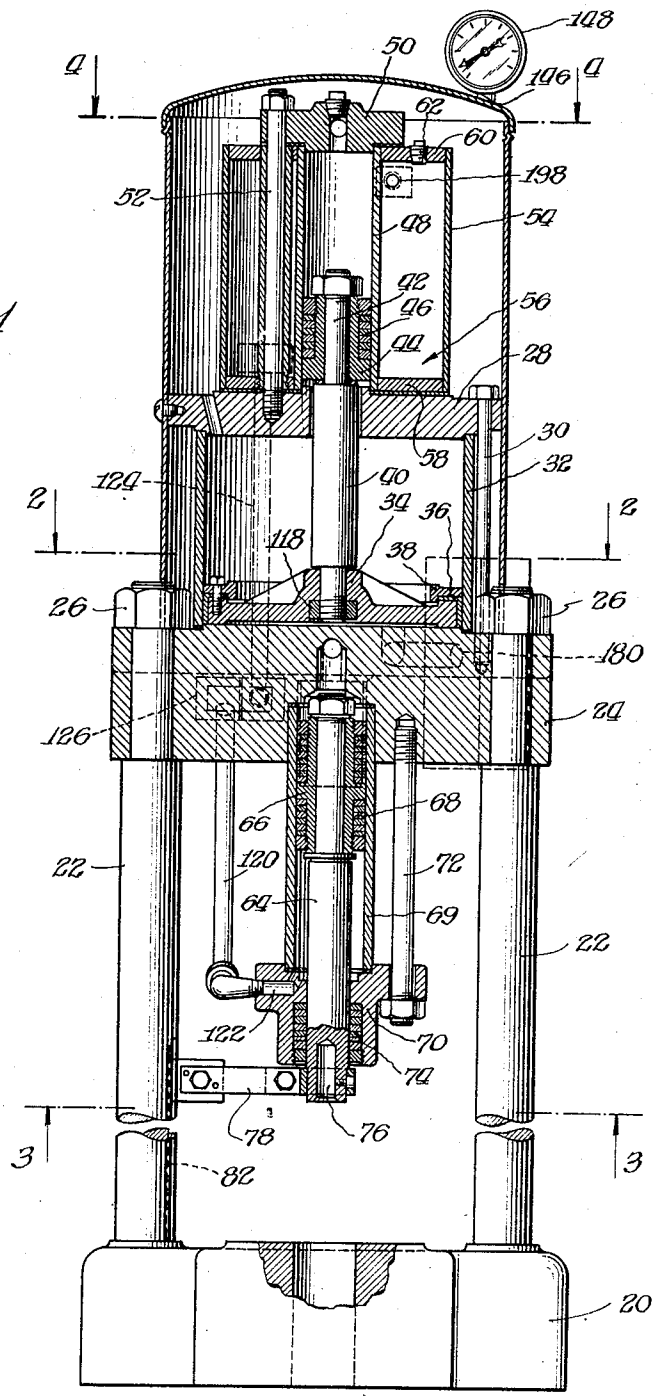
April 10, 1951 W. S. HANSEN 2,548,784

PNEUMATICALLY OPERATED HYDRAULIC PRESS

Filed March 22, 1946 5 Sheets-Sheet 1

Fig. 1



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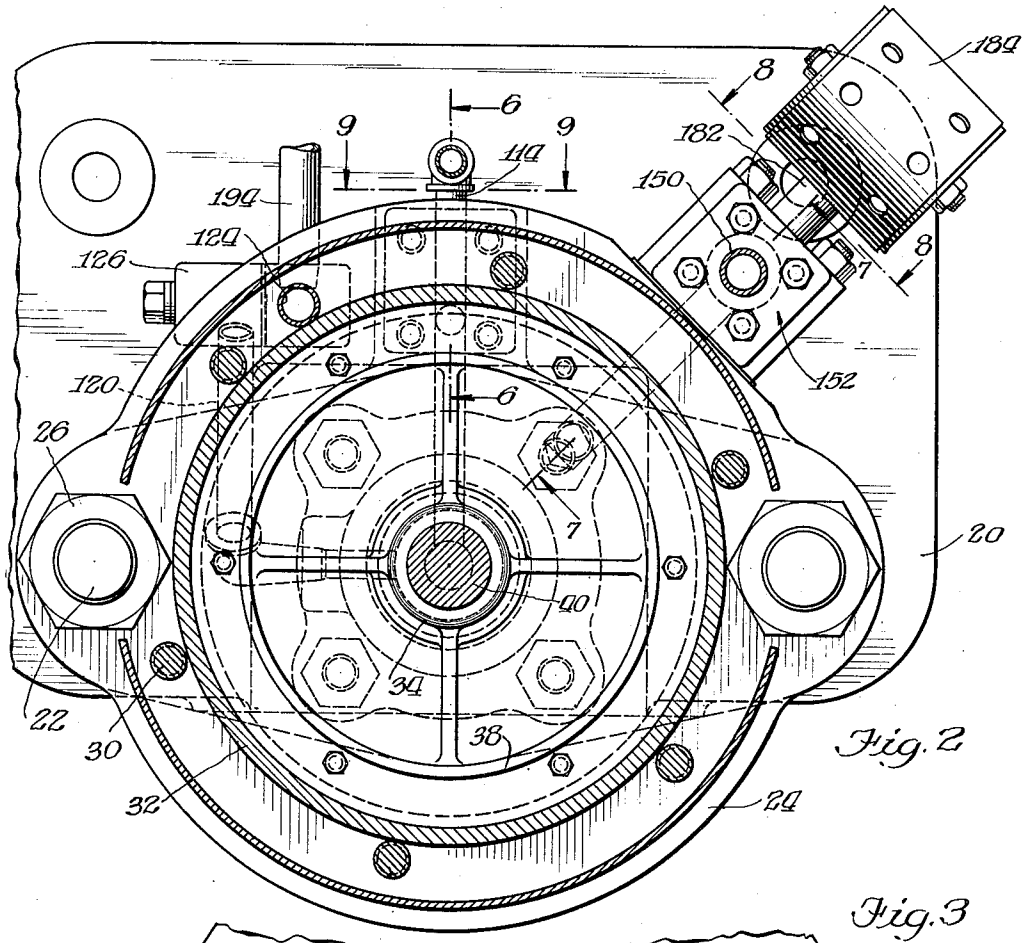

Fig. 2

Fig. 3

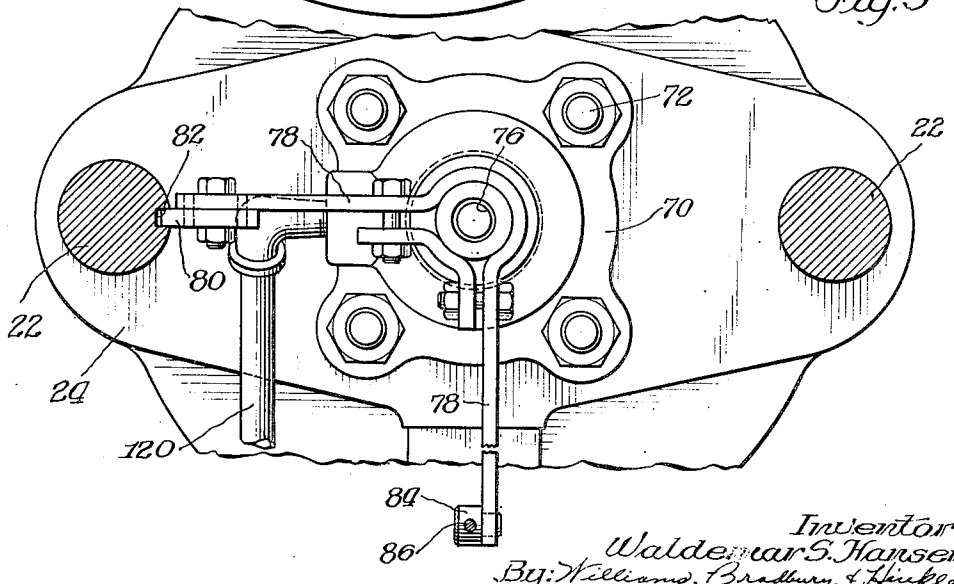

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Fig. 5

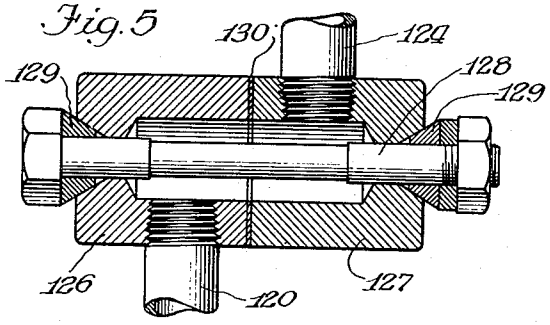

Fig. 4

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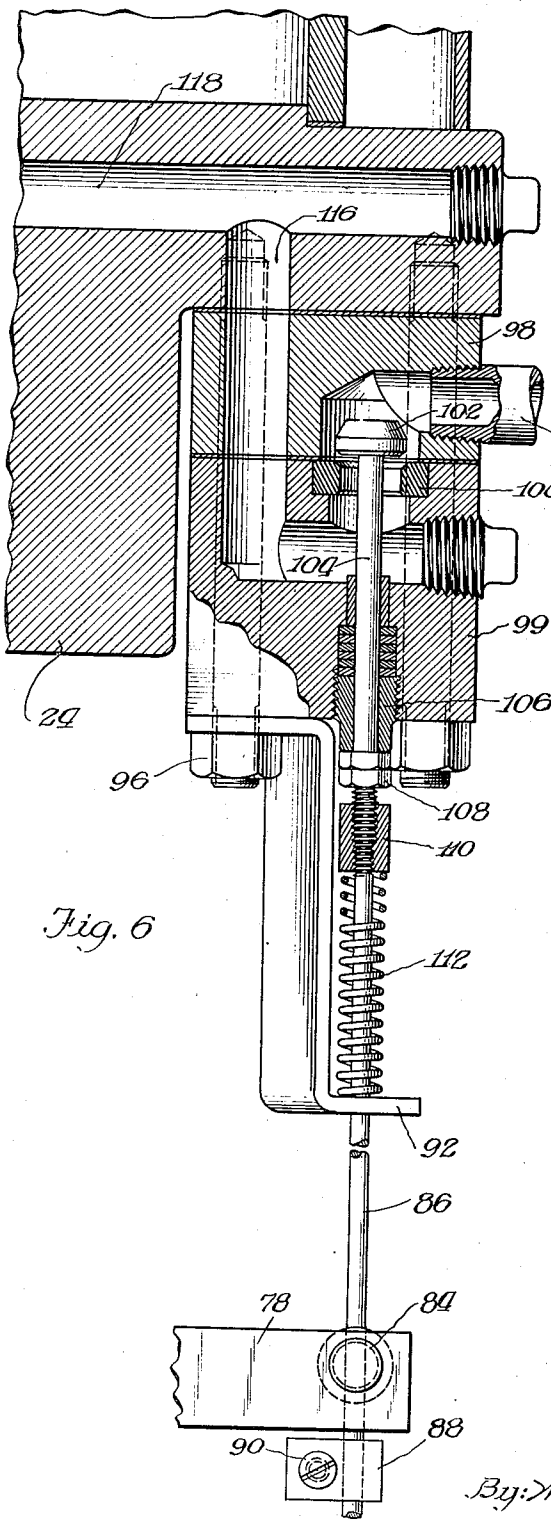

Fig. 6

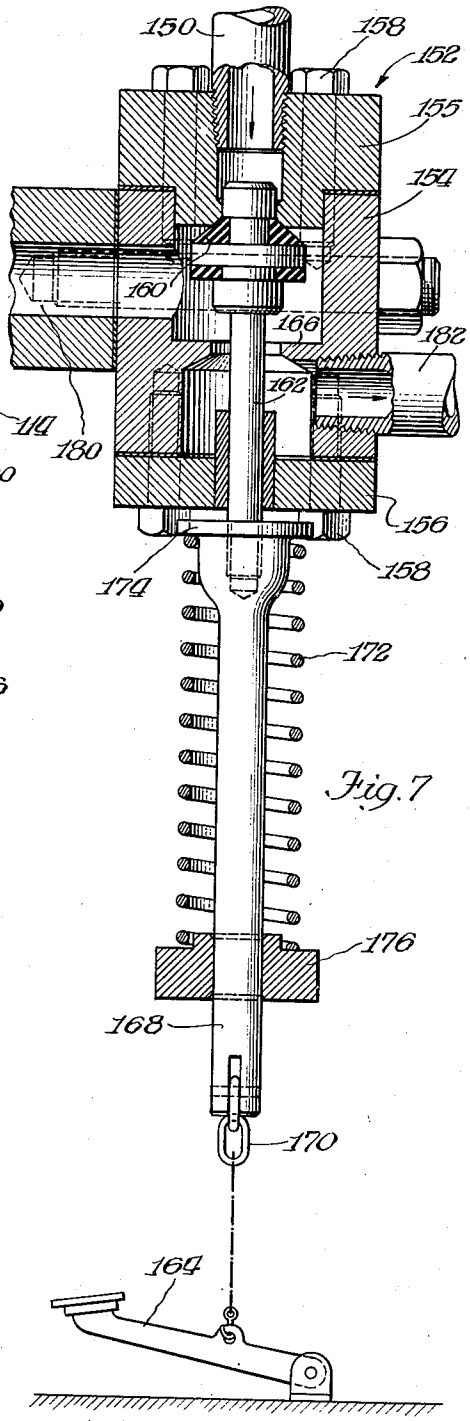

Fig. 7

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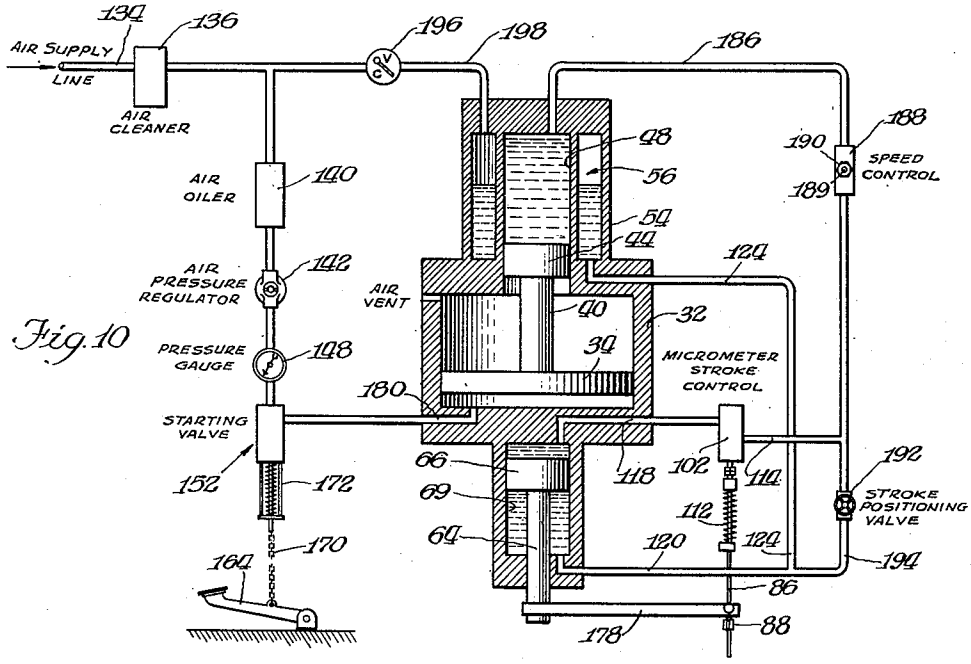

Fig. 10

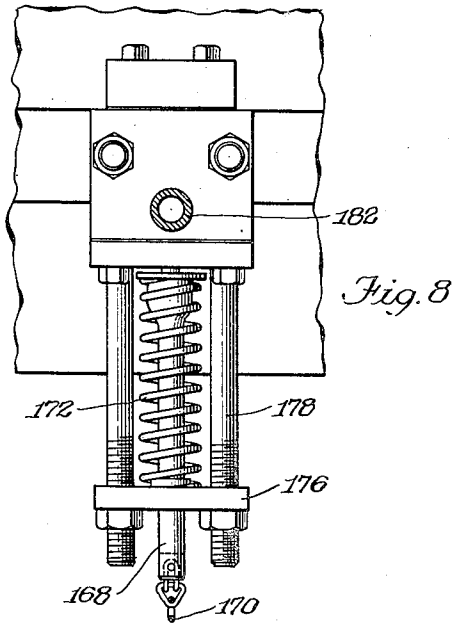

Fig. 8

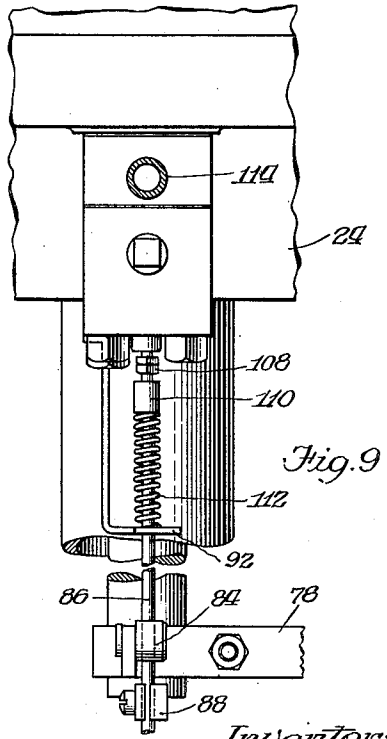

Fig. 9

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UNITED STATES PATENT OFFICE

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PNEUMATICALLY OPERATED HYDRAULIC PRESS

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Application March 22, 1946, Serial No. 656,498

3 Claims. (Cl. 60—54.5)

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My invention relates generally to hydraulic presses, and more particularly to compressed air operated hydraulic presses.

Unless a convenient source of hydraulic pressure is available, hydraulic presses are generally inefficient because it is usually necessary to maintain the hydraulic pressure during the intervals between operations of the press. Thus, the hydraulic pump must, for practical reasons, run continuously, and consumes power while the press is not in actual operation. Furthermore, in many forms of hydraulic presses the length of the stroke and the position of the operating stroke relative to the bed of the machine are not conveniently adjustable, and, as a result, these presses are frequently operated with a stroke greater than required for the particular operation being performed.

In pneumatically operated presses, this condition usually prevails so that it is found that the consumption of compressed air is much greater than that required to perform the particular operation. This is due, of course, to the fact that in pneumatically operated motors of the reciprocating type the same amount of compressed air is utilized in effecting the full stroke of the piston whether the piston is operating against a load or not. Thus, if the required stroke of the plunger is less than the full stroke of the piston of the air motor, and the air motor operates only through its full stroke, it is apparent that the apparatus is inefficient in its consumption of compressed air.

It is therefore an object of my invention to provide an improved hydraulic press using compressed air as the motive power, in which the extent and location of the stroke relative to the bed of the press may be readily controlled.

A further object is to provide an improved hydraulic press in which the speed of the operating stroke may readily be adjusted.

A further object is to provide an improved hydraulic press having a pneumatic actuator in which the stroke is manually initiated by opening an air valve, and in which the stroke of a hydraulically operated plunger is arrested by closing a valve in the hydraulic system.

Other objects will appear from the following description, reference being had to the accompanying drawings, in which:

Fig. 1 is a front elevational view of the press, showing the major components in central vertical section;

Figs. 2, 3, and 4, are horizontal sectional views,

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taken on the lines 2—2, 3—3, and 4—4, respectively, of Fig. 1;

Fig. 5 is a fragmentary sectional view, showing an adjustable oil type swivel connection;

Fig. 6 is a sectional view of the hydraulic fluid control valve, taken on the line 6—6 of Fig. 2;

Fig. 7 is a fragmentary sectional view of the compressed air control valve, taken on the line 7—7 of Fig. 2;

Fig. 8 is a sectional view, taken on the line 8—8 of Fig. 2;

Fig. 9 is a fragmentary sectional view, taken on the line 9—9 of Fig. 2; and

Fig. 10 is a diagrammatic view illustrating the hydraulic and pneumatic circuits.

As shown in Fig. 1, the press comprises a base 20 having a pair of supporting columns 22 secured thereto, these columns supporting a head plate 24 which is rigidly secured thereto by nuts 26 threaded over the ends of the tie rods or columns 22. An air cylinder head 28 is rigidly secured to the head plate 24 by tie rods 30, which are threaded in the plate 24 and also clamp an air cylinder 32 between the head 28 and plate 24.

An air piston 34 having a sealing member 36 clamped thereto by a ring 38, is reciprocable in the cylinder 32 and has a piston rod 40 extending freely through the head 28. The piston rod 40 has a reduced upper end portion 42 around which is clamped a power piston 44 having a plurality of sealing rings 46. The piston 44 is reciprocable in a power cylinder 48, the upper end of which is closed by a head 50, the head 50 being secured to the head 28 by a plurality of tie bolts 52, the tie bolts clamping the cylinder 48 in place. Surrounding the cylinder 48 is a cylindrical sheet 54 which, together with the outer wall of the cylinder 48, forms a reservoir 56 for the hydraulic actuating fluid, the lower part of the reservoir being formed by an annular plate 58 while the upper end is closed by a similar plate 60. The reservoir 56 may be partially filled with oil or other hydraulic actuating liquid through a filler opening normally closed by a plug 62.

The tool carrying plunger comprises a piston rod 64 having a motor piston assembly 66 secured thereto, the assembly comprising a plurality of sealing rings 68 suitably clamped to the rod 64 and reciprocable in a motor cylinder 69. The rod 64 extends downwardly through a head 70 which is secured to the plate 28 by a plurality of tie bolts 72, and is provided with a packing gland 74. The lower end of the plunger rod 64 is provided with a socket 76 for the reception of the tool or fixture. Clamped to the lower end

of the plunger rod 64 is a valve actuator comprising an elbow 78 (Fig. 3), one arm of the elbow 78 having a guide element 80 fitting in a suitable groove 82 formed in one of the columns 22, thus preventing rotation of the plunger rod 64. The other arm of the elbow 78 has a bushing 84 secured thereto, this bushing having a vertical hole for the reception of a rod 86.

Upon the limit of the downward stroke of the plunger rod 64, the bushing 84 engages an adjustably positioned stop 88 which is clamped in adjusted position on the rod 86 by a screw 90. The rod 86 is guided in a bracket 92 suitably secured to the head plate 24 by one of several studs 96 which also serve to clamp to the head plate 24 hydraulic valve sections 98 and 99, suitable gaskets being provided to seal the joints between these parts. The valve section 99 is provided with a valve seat insert 100 which is adapted to be closed by a valve 102, this valve having a stem 104 extending through a suitable packing gland 106 and having stroke adjusting nuts 108 threaded thereon. The rod 104 is secured to the rod 86 by a rigid coupling 110 and the latter also serves as an abutment for a compressed coil spring 112, the lower end of which presses against the bracket 92. The valve 102 is thus spring impelled to open position, the degree of opening permitted being limited by the adjustment of nuts 108 to vary the space between the upper one of these nuts and the packing gland 106. The valve 102 is adapted to control the flow of oil from a pipe 114 connected to the section 98, and an L-shaped passageway 116 formed in part in the sections 98 and 99 and in the head plate 24. The passageway 116 communicates with a duct 118 formed in the plate 24. The passageway 118 communicates with the upper end of the cylinder 66 (Fig. 1).

A pipe 120 is connected to the lower end of the cylinder 66 (Fig. 1) by its connection to a passageway 122 formed in the head 70. The pipe 120 has an adjustable swivel connection with a pipe 124, these pipes being threaded in swivel sections 126 and 127, respectively (Fig. 5). The swivel sections are clamped together in adjusted position by a bolt 128 having conical sealing washers 129 engaging in complementary recesses formed in the ends of the swivel sections 126, 127. A sealing gasket 130 is provided to seal the joint between the two swivel sections. By tightening the nut of the bolt 128 the three seals provided respectively by the conical sealing washers 129 and the gasket 130 are made tight at the same time.

The pipe 124 has its upper end threaded in a connector 132 (Fig. 4) which is welded to the cylinder 54, and the pipe thus communicates with the reservoir 56.

Compressed air is supplied from a suitable source through a pipe 134 (Fig. 4), and after passing through an air filter or cleaner 136, flows through a T 138 to an adjustable pressure regulator 140. An air line lubricator 142 receives the air from the pressure regulator and is connected to a T 144. One branch of the T has a pipe 146 connected thereto for an air pressure gauge 148 (Fig. 1), while the other branch of the T 144 is suitably connected as by a pipe 150 with an air control valve 152, shown in detail in Fig. 7. This air control valve comprises a body 154 having end caps 155 and 156 secured thereto by studs 158. The cap 155 has a seat therein for a double acting valve 160 carried by a stem 162. The valve 160 is normally held in the position shown in Fig. 7, but upon operation of the suitably controlled treadle 164, is adapted to move away from the seat formed in the head 155 and engage a seat 166 formed in the valve body 154. The treadle 164 is connected to an operating rod 168 by any suitable means such as a chain 170, and is suitably secured to the stem 162, the valve being urged to its upper position by a spring 172 compressed between a flange 174 formed on the rod 168 and a cross bar 176 carried by a pair of studs 178 (Fig. 8). When the treadle is depressed to move the valve 160 to its lower position, air under pressure supplied through the pipe 150 flows into the cavity formed in the valve body 154 and outwardly through a passageway 180 formed in the head plate 24. As indicated in Fig. 1, the passageway 180 communicates with the lower end of the air cylinder 32. When the valve 160 is returned to its normal position by the spring 172, the passageway 180 is connected to a pipe 182, the pipe 182 having exhaust muffler or silencer 184 connected thereto.

The upper end of the hydraulic pump cylinder 48 has a pipe 186 suitably connected thereto, this pipe leading to a speed controlling adjustable needle valve 188, having a valve stem 189 locked in adjusted position by a lock nut 190.

The speed control valve 188 is connected to the pipe 114 and also to a stroke positioning shutoff valve 192, the latter being connected by piping 194 (Fig. 4) with the pipe 124. Air under pressure supplied to the T 138 passes a check valve 196 and flows through a pipe 198 to the upper end of the reservoir chamber 56.

In operation, the cylinder 69 is completely filled with oil or other hydraulic operating fluid, while the reservoir 56 is partially filled with oil. Assuming that the oil conduit system has been purged of air, the operation of the press is as follows.

As previously noted, the point at which the operative down-stroke of the plunger 64 commences, may be adjusted. Referring to Fig. 10, this is accomplished by opening the stroke positioning shutoff valve 192 and depressing the treadle 164 to open the valve 152. When the valve 192 is open, it will be clear that oil in the reservoir 56 under the pressure of the compressed air supply to which it is continuously connected, will flow through the pipes 124 and 194, stroke positioning shutoff valve 192, conduit 114, stroke control valve 102, and passageway 118, into the upper end of cylinder 69. Due to the greater effective cross sectional area of the upper face of the piston 66, this piston is moved downwardly until it attains the position in which it is desired to start the normal downward operative stroke, and at this position the valve 192 is closed.

To adjust for the lower limit of the downward stroke of the plunger 64, the stop 88 is clamped to the rod 86 in such position that it is engaged by the bushing 84 and forces the valve 102 to closed position at the time that the plunger 64 reaches the desired lower limit of its stroke.

The press is now in condition to be operated, assuming that the proper tool or fixture has been secured to the plunger 64, and this is accomplished merely by pressing upon the treadle 164 to open the air supply valve 152. Air under pressure thus is permitted to flow through the passageway 180 into the lower end of cylinder 32, thereby forcing the connected pistons 34 and 44 upwardly and increasing the pressure of the oil in cylinder 48. The oil is thus forced to flow, at a rate controlled by the speed control valve 188,

through conduit 114 and control valve 102 into the upper end of the cylinder 69. The piston 66 and its connected plunger 64 are therefore moved downwardly, the oil beneath the piston 66 being discharged into the reservoir 56 through the pipes 120 and 124. The downward stroke continues until the bushing 84 on the elbow arm 78 engages the clamp stop 88 and moves the rod 86 downwardly a sufficient distance to close the check valve 102. The closure of valve 102 is initiated by the contact of the bushing 84 of the valve actuator 78 with the stop 88 secured to the valve rod 86. As the valve 102 moves close to its seat 100, the pressure of hydraulic fluid on its top surface overcomes the force of the spring 112 and completes the closing movement, further compressing the spring 112 and moving the stop 88 a short distance below the actuator 78.

When the downward stroke of the plunger 64 has been completed, the operator releases the treadle 164 to permit the return of the air controlled valve 160 to its normal position, as shown in Fig. 7, thereby disconnecting the lower end of cylinder 32 from the compressed air supply and connecting it to the exhaust pipe 182, which permits the air to escape to the atmosphere through the silencer 184. Upon thus releasing the air valve, the oil in the reservoir 56, under the pressure of the compressed air supply, is forced through pipes 124 and 120 into the lower end of the cylinder 69, thereby forcing the piston 66 upwardly. The oil in the cylinder 69 above the piston is forced past the valve 102, and through the pipe 114 and speed control valve 188 and conduit 186 to the upper end of cylinder 48, forcing the pistons 44 and 34 downwardly. The valve 102 may be opened by spring 112 because of the slight spacing between the stop 88 and the bushing 84 on the arm 78, which occurs when this valve is moved to its fully closed position. When the pressure is applied to the lower surface of this valve a considerable force is available to open the valve because at this time the pressure in cylinder 48 is negligible. When the piston 34 reaches the bottom of its stroke by contacting the head plate 24, the piston 66 has its upward movement arrested at the position for which the initial adjustment was made.

It will be noted that the air piston 34 is moved only a sufficient distance to supply the necessary oil under pressure to the upper end of cylinder 69 so that if the stroke of the latter is relatively short, the stroke of the air piston 34 will be correspondingly short. It will thus be seen that the minimum amount of compressed air required for a particular stroke of the plunger 64 is used, and this is accomplished even though the upper and lower limits of the stroke of the plunger 64 are readily adjustable to adapt the press for any particular operation it may be required to perform.

The press may be used for broaching, forming, and various pressing operations. In many instances the press will be provided with a suitably indexed table and the valve 152 arranged to be automatically operated, so as to make the press automatic in operation except for the requirement that the workman load unfinished workpieces on the rotating index table and remove the finished parts therefrom.

While I have shown and described a preferred embodiment of my invention, it will be apparent that numerous variations and modifications thereof may be made without departing from the underlying principles of the invention. I therefore desire, by the following claims, to include within the scope of the invention, all such variations and modifications by which substantially the results of my invention may be obtained through the use of substantially the same or equivalent means. It will be understood that the words denoting direction or position, used in the following claims, are not intended to be interpreted in their absolute sense but rather in their relative sense.

I claim:

1. In a hydraulic press, the combination of a reciprocable hydraulic motor comprising, a motor cylinder, a motor piston, and a piston rod secured to the piston and extending from the cylinder to apply pressure to workpieces, a hydraulic power cylinder having a piston reciprocable therein, an air cylinder, a piston reciprocable in the air cylinder and rigidly connected to the power piston, manually operable valve means for admitting compressed air under pressure to one end of the air cylinder, an oil reservoir, means for maintaining the oil in the reservoir under relatively constant pressure, a conduit connecting the oil reservoir with the lower end of the motor cylinder, a stroke control valve, a conduit connecting the stroke control valve in series between the head end of the power cylinder and the head end of the motor cylinder, means operated by the plunger upon traversing a predetermined stroke to close the control valve, a conduit connecting the head end of the power cylinder with the rod end of the motor cylinder, and a manually operable flow cutoff valve in said last named conduit.

2. A pneumatically operated hydraulic press comprising, a frame, a hydraulic motor cylinder secured to the frame, a motor piston in said cylinder having a piston rod extending downwardly therefrom, an air cylinder and a hydraulic power cylinder secured to the frame in substantially axial alignment, a source of air under pressure, means operable at will for alternately connecting the air cylinder to the source of air under pressure and to the atmosphere, operatively connected pistons in said power cylinder and said air cylinder respectively, a conduit connecting the upper end of the power cylinder and the upper end of the motor cylinder, means in said conduit for controlling the rate of flow of hydraulic fluid therethrough, means for predetermining the aggregate volume of hydraulic fluid contained in the upper ends of the hydraulic power and motor cylinders, thereby to predetermine the extent of upward movement of the motor piston and rod, valve means in said conduit, and means to move the valve means to closed position by the motor piston rod when the latter has moved downwardly through a predetermined distance.

3. In a hydraulic press, the combination of a reciprocable hydraulic motor comprising, a motor cylinder, a motor piston, and a piston rod secured to the piston and extending downwardly from the cylinder to apply pressure to workpieces, a hydraulic power cylinder having a piston reciprocable therein, an air cylinder beneath and in alignment with the power cylinder, a piston reciprocable in the air cylinder and rigidly connected to the power piston, manually operable valve means for admitting compressed air under pressure to one end of the air cylinder, an oil reservoir, means for maintaining the oil in the reservoir under relatively constant pressure, a conduit connecting the oil reservoir with the lower end of the motor cylinder, a stroke con-

trol valve, a conduit connecting the stroke control valve in series between the upper end of the power cylinder and the head end of the motor cylinder, means operated by the plunger upon traversing a predetermined stroke to close the control valve, and a manually operated valve and conduits connected between the head end of the power cylinder and the rod end of the motor cylinder, said last named valve being operative to control the aggregate volume of oil in the head end of the motor cylinder and the upper end of the power cylinder.

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