March 23, 1926. 1,578,233.

W. FERRIS

HYDRAULIC PRESS

Filed March 24, 1924 2 Sheets-Sheet 1

Fig. 1.

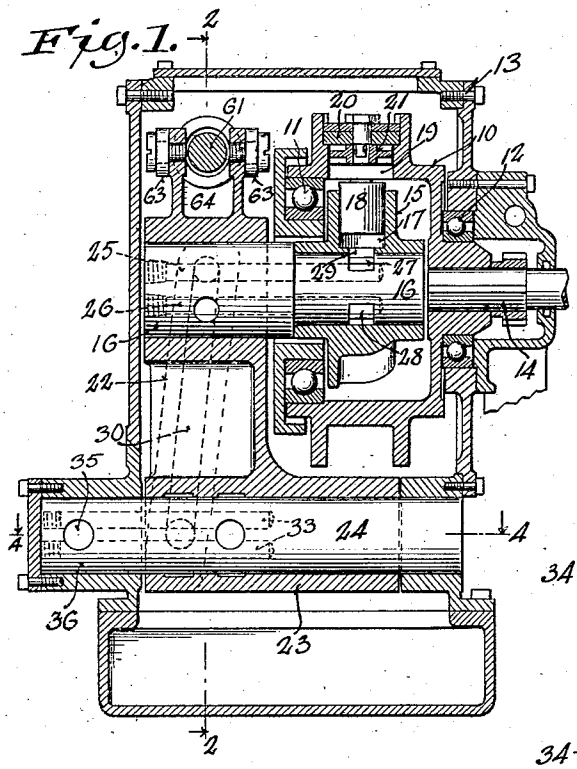


Fig. 3.

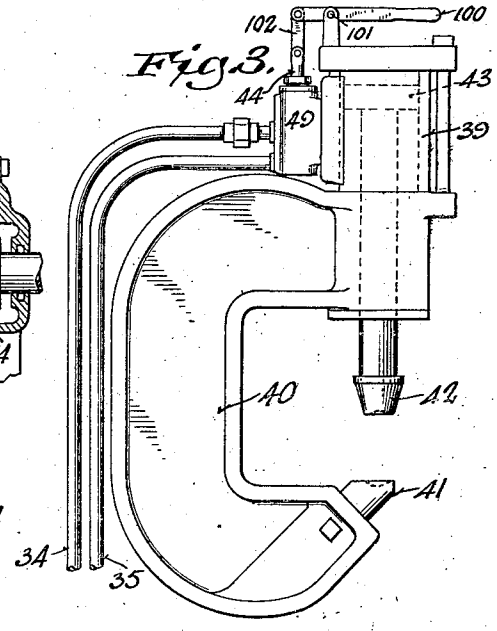
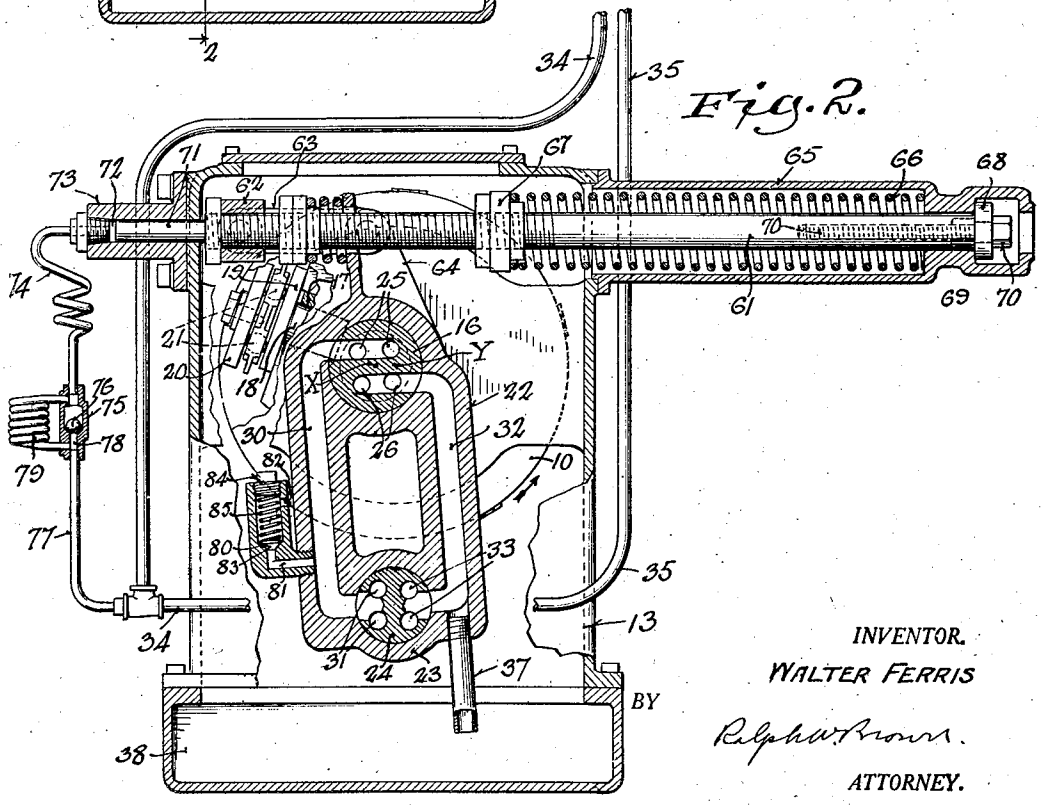


Fig. 2.



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Fig. 4.

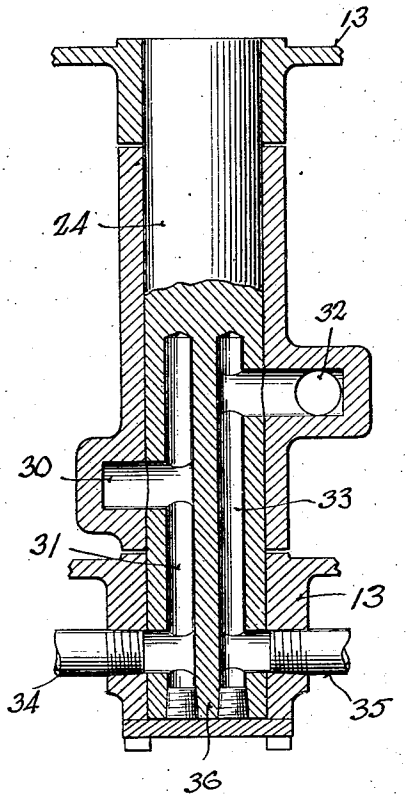
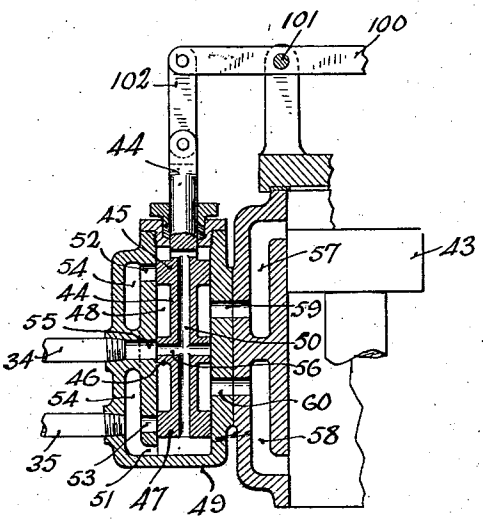


Fig. 5.



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1,578,233

UNITED STATES PATENT OFFICE.

WALTER FERRIS, OF MILWAUKEE, WISCONSIN, ASSIGNOR TO THE OILGEAR COMPANY, OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN.

HYDRAULIC PRESS.

Application filed March 24, 1924. Serial No. 701,356.

To all whom it may concern:

Be it known that I, WALTER FERRIS, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented a certain new and useful Improvement in Hydraulic Presses, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

This invention has to do with hydraulic presses and, more particularly, with hydraulic drives therefor.

In some types of presses it is necessary, or at least highly desirable, that the press be capable not only of applying a given pressure to the work but also of maintaining a high pressure thereon for an appreciable period of time. In a riveter, for instance, it is desirable to maintain the pressure, which may be several tons, upon the rivet until the rivet has set. I have found that a variable speed hydraulic transmission is well adapted for driving presses of this character when due provision is made for maintaining the given pressure against leakage losses in the system.

One object of the present invention is the provision of a novel hydraulic transmission having operating characteristics well suited for the operation of presses of the character referred to.

Another object is the provision of a hydraulic transmission for presses in which the main operating pump is automatically operable to produce a given pressure upon the work and to maintain that pressure against leakage losses.

Another object is the provision of a novel control mechanism for hydraulic transmissions.

Another object is the provision of a riveter having a hydraulic transmission drive so constructed and arranged as to provide portability.

Other objects and advantages will appear from the following description of an illustrative embodiment of this invention.

In the drawings:

Figure 1 is a sectional view of a variable displacement pump constructed in accordance with the present invention.

Figure 2 is a sectional view of the pump taken substantially on the line 2—2 of Figure 1.

Figure 3 is a side elevation of a riveter driven by the pump.

Figure 4 is a horizontal sectional view taken substantially on the line 4—4 of Figure 1.

Figure 5 is a sectional view of the reversing valve shown in Figure 3.

The pump shown is a variable displacement pump of the type shown and fully described in my copending application, Serial No. 682,056, filed December 21, 1923, so that only a brief description thereof will be sufficient for a full understanding of the present invention. This pump comprises a driving cage 10 rotatably mounted in spaced bearings 11 and 12, fixed in a casing 13, and driven by a shaft 14 keyed thereto. A cylinder barrel 15 rotatable upon a pintle 16 is provided with a series of radial cylinder bores 17, each containing a piston 18 reciprocable longitudinally therein. Each piston is provided with a crosshead 19 disposed opposite to and parallel with one of a series of tangential reaction plates 20 removably fixed in the periphery of the driving cage 10. A set of rollers 21 interposed between each crosshead and reaction plate transmits the operating thrust between each piston and reaction plate and permits free longitudinal reciprocation of each crosshead relative to the cooperating plate. The pintle 16 is rigidly mounted in an arm 22 having a sleeve 23 at its lower end journaled upon a shaft 24 fixed in the lower part of the casing 13. Upper and lower pairs of passages 25 and 26 in the pintle terminate in ports 27 and 28, respectively, formed in the upper and lower surfaces of the pintle and arranged to register with cylinder ports 29 during rotation of the cylinder barrel. A passage 30 in arm 22 effects communication between the upper pintle passages 25 and a pair of passages 31 in shaft 24. Similarly,

a passage 32 in arm 22 effects communication between passages 26 and a pair of passages 33 in shaft 24. Passages 31 and 33 communicate with the pump discharge and intake conduits 34 and 35, respectively, associated with that end 36 of the shaft 24 which projects beyond the casing 13. A conduit 37 communicating with the passage 32 leads downwardly into the body of liquid, preferably oil, in the sump 38 constituting the base of the casing 13.

The pump in this instance is shown operably connected through the conduits 34 and 35 with the power cylinder 39 of a hydraulic riveter 40. The riveter shown comprises the usual C frame having a fixed die 41 and cooperating movable die 42 carried and actuated by a piston 43 in the power cylinder.

A reversing valve 44 controls communication between the conduits 34 and 35 and the opposite ends of the power cylinder. This valve may be of any well known construction, but in this instance comprises a piston valve having three connected heads 45, 46 and 47 reciprocable in a bore 48 in the valve block 49. A longitudinal passage 50 in the valve maintains communication between the opposite ends of the bore 48, the lower end of the bore communicating at all times with the conduit 35 through a passage 51. Ports 52 and 53 adjacent the opposite ends of the bore are both covered by the heads 45 and 47, respectively, when the valve is in the intermediate position shown. These ports communicate with the conduit 35 through passage 54. Conduit 34 communicates with an intermediate port 55, covered by the head 46 when the valve is in intermediate position. A passage 56 in the head 46 communicates with the passage 50. When in the position shown, passage 56 also communicates with the port 55 so that liquid delivered by the conduit 34 is free to pass through passages 56, 50 and 51 to the conduit 35 and the operating fluid is thus returned to the pump without entering the power cylinder 39. The upper and lower ends of the power cylinder communicate, respectively, through passages 57 and 58 and ports 59 and 60 with the bore 48 above and below the intermediate head 46. Thus, when the valve is lowered from the position shown, fluid enters from conduit 34 to the bore between the heads 45 and 47 and passes through port 59 and passage 57 to the upper end of the power cylinder to drive the operating piston downwardly, fluid from the lower end of the cylinder escaping through the passage 58, ports 60 and 53 and conduit 35 back to the pump. The reverse occurs when the valve is moved upwardly from the intermediate position shown, fluid from conduit 34 being delivered to the lower end of the cylinder through ports 55 and 60 and passage 58, and exhausting from the upper end of the cylinder through passage 57, ports 59 and 52 and passage 54. The valve 44 is controlled by a hand lever 100 pivoted as at 101 upon the riveter and connected through a link 102 with the valve.

The rate of liquid flow in the conduits 34 and 35 is, in this instance, controlled by regulating pump displacement. It will be understood, of course, that in operation the pump driving cage 10 is driven by the shaft 14 in one direction only, that is, in a counter clockwise direction (Fig. 2), and that the displacement of the pump is proportional to the degree of eccentricity of the axis of rotation X of the cylinder barrel 15 with respect to the axis of rotation Y of the driving cage 10. Thus, when the longitudinal axis of the pintle 16 is coincident with the axis of the shaft 14, pump displacement is zero and when the pintle is shifted to the left from such position by swinging the arm 22 toward the position shown in Figure 2, fluid is discharged by the pump through conduit 34 at a rate proportional to the distance between the axes X and Y.

In the pump shown, the position of the arm 22 is controlled by a rod 61 threaded in a trunnioned nut 62 connected by appropriate linkage 63 with an upstanding projection 64 carried by the upper end of the arm 22. This rod extends longitudinally within a spring housing 65 mounted in and projecting from the casing 13. A heavy compression spring 66 within the housing and bearing upon a thrust collar 67 adjustably threaded on the rod 61 yieldably maintains the rod and consequently the arm 22 in the extreme left position shown in Figure 2. Movement of the rod 61 toward the left is limited by a bearing washer 68 within the extended end 69 of the housing 65 and carried by a long screw 70 threaded in the rod 61.

The rod 61 is, in this instance, placed under the control of the working pressure in the conduit 34. In the mechanism shown this is accomplished by the provision of an extension 71 on the rod 61 constituting a piston closely fitted in the cylinder bore 72 in a block 73 fixed to the outside of the main casing 13. A length of small bore tubing 74 communicates at one end with the cylinder bore 72 and at the other end with a casing 75 of a check valve 76. A pipe 77 maintains communication between the conduit 34 and a port 78 in the casing 75 controlled by the valve 76. The valve permits a free flow of fluid through the port 78 from pipe 77 to tube 74 but automatically closes the port against passage of fluid in the opposite direction. The pipe 77 and tube 74 are always in communication, however, through a choke coil 79 of small bore tubing.

Before beginning a riveting operation, the pump pintle 16 is in the extreme offset posi-

tion shown in Figure 2, and the valve 44 is in the intermediate position shown in Figure 5. Under these conditions, the pump, rotating in a clockwise direction, is working at full capacity and delivering fluid through conduit 34 to the valve 44, the fluid returning from the valve to the pump through conduit 35 without entering the power cylinder 39. To initiate a working stroke the valve 44 is lowered by manipulation of the handle 100 to thereby open communication between conduit 34 and the upper end of the power cylinder and between the lower end of the power cylinder and the conduit 35. This causes a downward travel of the piston and die 42 toward the work until engaged and resisted by the work. The pressure between the die and work is transmitted to the fluid in the upper end of the cylinder and consequently to the bore 72 through the conduit 34, pipe 77, valve casing 75 and tubing 74. This pressure in the bore 72 acting upon the end of piston 71 causes the rod 61 to move toward the right (Fig. 2) against the pressure of the spring 66, to thereby shift the pump pintle 16 toward neutral position to reduce the stroke of the pump. The pump stroke is thus reduced in accordance with the degree of pressure in the conduit 34 and in the upper end of the power cylinder, which in turn is dependent upon the pressure between the die 42 and work. Thus, when a maximum working pressure has been attained and the die can no longer advance, the pump serves merely to maintain this pressure against leakage losses, the stroke of the pump having been reduced to this point by the pressure in the bore 72.

When this set pressure has been maintained for a sufficient period, the operator shifts the valve 44 into its upper extreme position to thereby open communication between the upper end of the power cylinder and the conduit 35 and between the lower end of the cylinder and conduit 34. This instantly relieves the pressure in the conduit 34 and the piston and die begins its upward travel. The check valve 76 then comes into play to prevent a sudden release of pressure in the bore 72, to thereby prevent the consequences of too sudden a readjustment of the rod 61 and pump to the maximum stroke position of Figure 2. This valve closes the port 78 so as to prevent the return flow of fluid from the tubing 74 to the tubing 77, except through the restricted tubing 79. In a very short interval of time, however, the rod 61 and pump pintle 16 are returned to the position shown in Figure 2 and the piston and die 42 continue their upward travel until they reach the upper end of the stroke or until the operator returns the control valve 44 to the neutral position of Figure 5.

The tubing 74 is of sufficiently small diameter and of sufficient length to dampen out the periodic pressure fluctuations that would otherwise occur in the bore 72, as a result of the slight periodic fluctuations in volume of fluid delivery characteristic of pumps of the multiple piston type.

As the die engages the work the pressure in the hydraulic circuit ordinarily increases in an interval of time much shorter than is required to effect the automatic reduction in the pump stroke. To protect the system against destructive peak pressures a high-pressure relief valve 80 is preferably provided. The relief valve shown comprises a casing having a port 81 in communication with the passage 30 and an exhaust port 82. A spring loaded valve 83 controls the flow of fluid through the port 81, and a plug 84 screwed in the end of the valve casing determines the pressure of the spring 85.

Various changes may be made in the embodiment of the invention hereinabove specifically described, without departing from or sacrificing any of the advantages of the invention as defined in the appended claims

I claim:

1. In a hydraulic press the combination of a plunger, and hydraulic means for operating said plunger, comprising a variable displacement pump automatically operable to advance said plunger at a predetermined rate and to maintain a predetermined pressure between said plunger and work against leakage losses.

2. In a hydraulic press the combination of a plunger, hydraulic means including a variable displacement pump for operating said plunger, and pump displacement regulating means automatically operable to maintain a predetermined pressure between said plunger and work against leakage losses.

3. In a hydraulic press the combination of a plunger, hydraulic means including a variable displacement pump for operating said plunger, means normally operable to yieldably maintain pump displacement at a predetermined maximum to advance said plunger toward the work, and means responsive to pressure between said plunger and work for reducing pump displacement to thereby maintain a predetermined pressure between said plunger and work against leakage losses.

4. In a hydraulic press the combination of a plunger, hydraulic means including a variable displacement pump for operating said plunger, means for regulating pump displacement, yieldable means operable thereon to increase pump displacement, and means responsive to fluid pressure in said hydraulic means for reducing pump displacement.

5. In a hydraulic press the combination of a plunger, a piston and cylinder for driving said plunger, a variable displacement pump for supplying driving fluid to said

cylinder, means responsive to the pressure between said plunger and work for reducing pump displacement, and a control valve between said pump and cylinder for controlling the supply of driving fluid thereto.

6. A device of the character described comprising a press having a hydraulic power cylinder, a variable displacement pump, pipe connections between said pump and cylinder, yieldable means for increasing pump displacement, means responsive to the pressure of fluid in said cylinder for decreasing pump displacement, and a valve associated with said connections for controlling the delivery of fluid to said cylinder.

7. A device of the character described comprising a hydraulic power cylinder, a variable displacement pump, pipe connections between said pump and cylinder, means responsive to an increase in pressure in said connections for decreasing pump displacement, and a valve associated with said connections for controlling the delivery of fluid to said cylinder.

8. A device of the character described comprising a hydraulic power cylinder, a variable displacement pump, fluid connections including a control valve between said pump and cylinder, and means for automatically decreasing pump displacement with an increase of pressure in said connections so as to establish and maintain a predetermined pressure in said connections against leakage losses.

9. A device of the character described comprising a hydraulic motor, a variable displacement pump, fluid connections between said pump and motor, a high pressure relief valve associated with said connections, yieldable means for increasing pump dislacement, and means responsive to the pressure in said connections for decreasing pump displacement to thereby establish and maintain a predetermined pressure in said connections against leakage losses.

10. A device of the character described comprising a hydraulic motor, a variable displacement pump for supplying driving fluid to said motor, means for regulating pump displacement, a spring normally operable thereon to increase pump displacement to a predetermined maximum, pressure actuated means operable upon said regulating means to reduce pump displacement and a high pressure relief valve automatically operable to prevent excessive pressures during the operation of said pressure actuated means.

11. A device of the character described comprising a hydraulic motor, a variable displacement pump for supplying fluid to said motor, pressure controlled means for reducing pump displacement, yieldable means for increasing pump displacement, and means for checking the action of said last named means.

12. A device of the character described comprising a hydraulic motor, a variable displacement pump for supplying fluid to said motor, yieldable means for increasing pump displacement, hydraulic means controlled by the pressure of fluid delivered by said pump for reducing pump displacement, and a check valve for checking the action of said yieldable means but permitting unrestricted action of said hydraulic means.

13. A device of the character described comprising a variable displacement pump, yieldable means for increasing pump displacement, means for decreasing pump displacement, and means for checking the action of said yieldable means.

14. A device of the character described comprising a variable displacement pump, means including a spring for varying pump displacement, and check means for retarding the action of said spring.

15. A device of the character described comprising a variable displacement pump, means responsive to the pressure of fluid delivered by said pump for varying pump displacement, and means for dampening the effect of periodic fluctuations in said pressure upon said first named means.

16. A device of the character described comprising a variable displacement pump, and hydraulic means responsive to the pressure of fluid delivered by said pump for varying pump displacement, said means including a length of small bore tubing operable to dampen the effect of periodic fluctuations in said pressure upon said displacement varying means.

17. In a hydraulic press the combination of a plunger, a piston and cylinder for actuating said plunger, a variable displacement pump directly connected with said cylinder for delivering a driving liquid thereto, means for regulating pump displacement, means for yieldably maintaining said regulating means in one position to effect movement of said plunger toward the work at a predetermined rate, and means responsive to the pressure between said plunger and work for operating said regulating means to reduce pump displacement and to thereby maintain a predetermined pressure between the plunger and work against leakage losses.

18. In a hydraulic press the combination of a plunger, a piston and cylinder for actuating said plunger, a variable displacement pump for delivering a driving liquid to said cylinder to operate said plunger, pressure responsive means automatically operable to regulate pump displacement to maintain the pressure substantially constant when said plunger is under load, and high pressure relief mechanism supplementing the action

of said regulating means to avoid sudden excessive pressures.

19. In a hydraulic press the combination of a variable displacement pump, a plunger driven by liquid delivered from said pump at a rate corresponding to pump displacement, said plunger adapted to reciprocate toward and from the piece of work, and means responsive to the pressure between said plunger and work for reducing pump displacement to effect and maintain a predetermined pressure between said plunger and work against leakage losses.

In witness whereof, I hereunto subscribe my name this 1st day of February, 1924.

WALTER FERRIS.