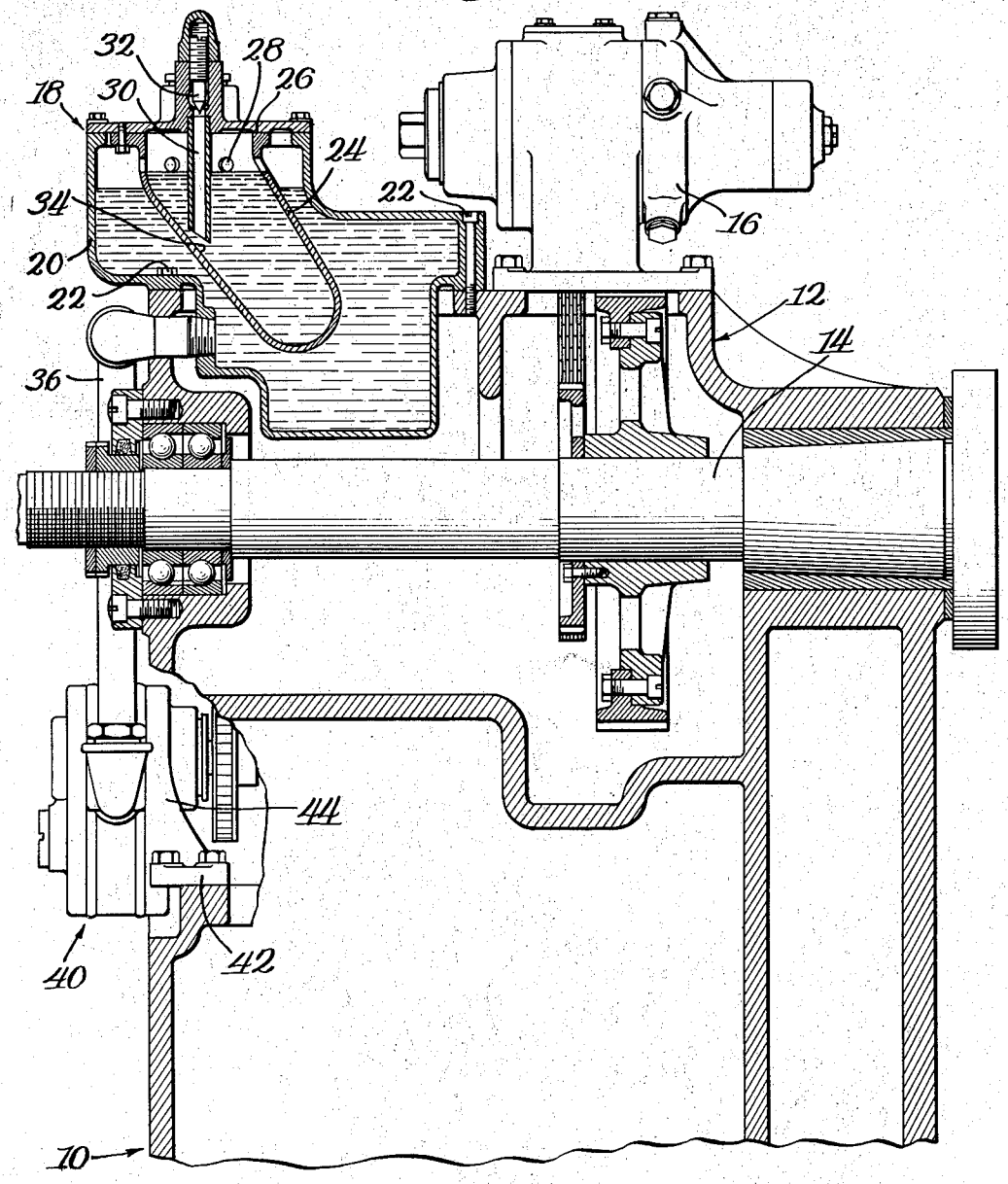
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HYDRAULIC SYSTEM

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Fig. 1



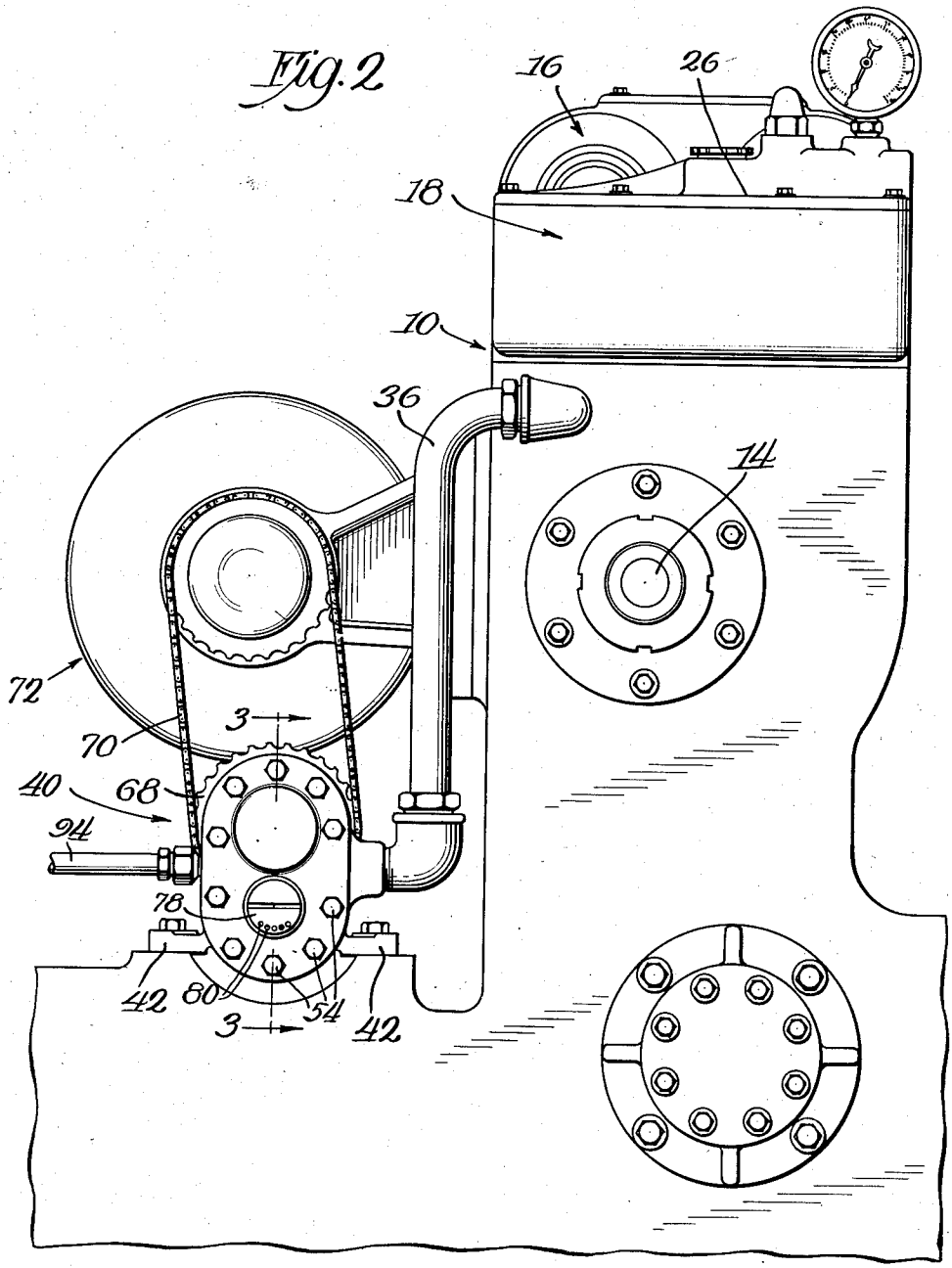
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HYDRAULIC SYSTEM

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Fig. 2

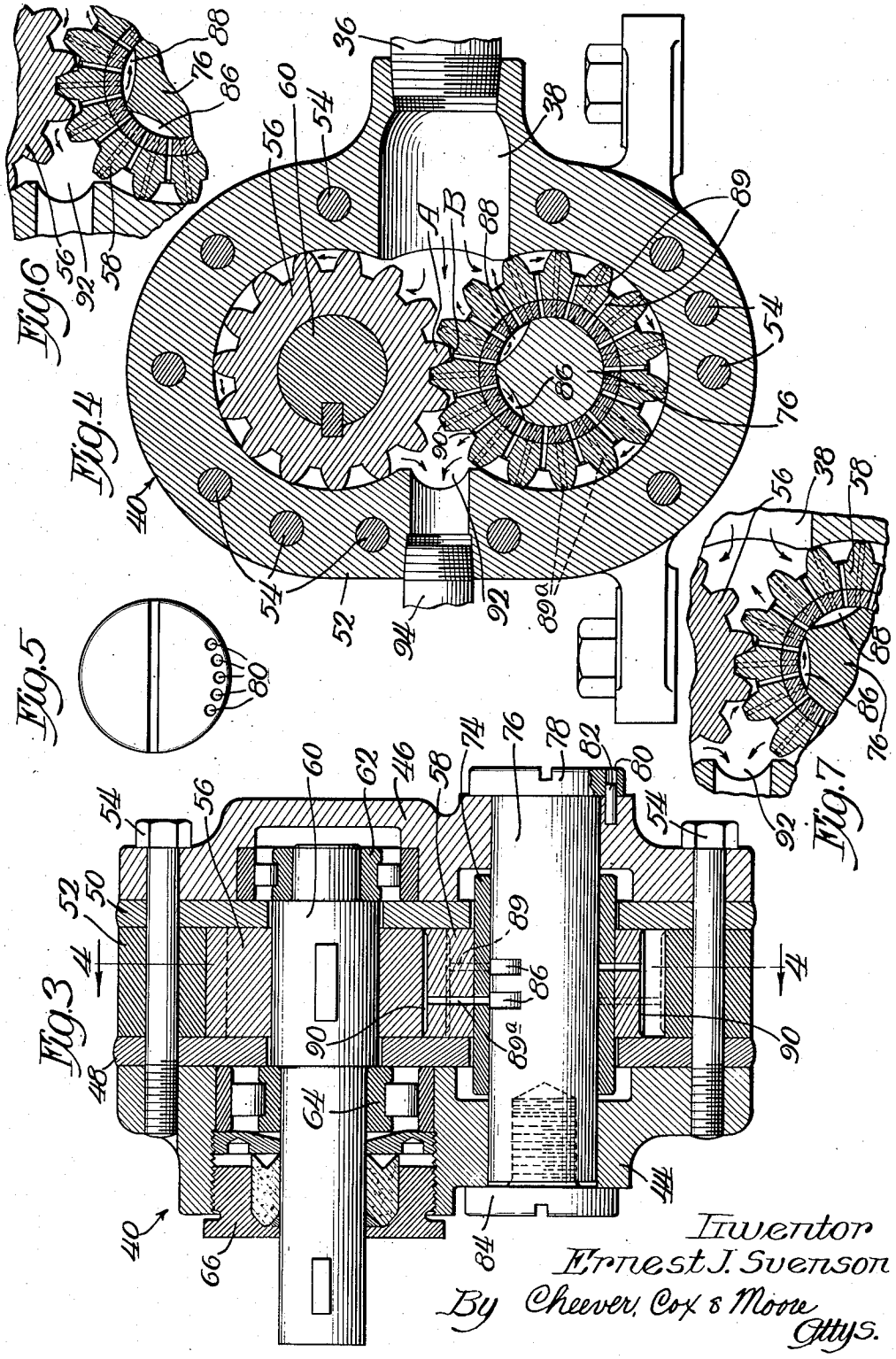


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HYDRAULIC SYSTEM

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UNITED STATES PATENT OFFICE

1,985,748

HYDRAULIC SYSTEM

Ernest J. Svenson, Rockford, Ill.

Application May 28, 1930, Serial No. 456,571

12 Claims. (Cl. 137—78)

My invention relates generally to hydraulic systems of control, and particularly to means for preventing the introduction of air within said hydraulic systems.

One of the serious problems which has been encountered in connection with the control of fluids used as propelling mediums, is the problem of eliminating air from said fluids. The introduction of air within a fluid circuit serves to materially reduce the propelling efficiency thereof. Means have been used heretofore for allowing air to escape from the system, but such means do not in any sense prevent air from entering the system. If air can be initially prevented from entering the system, and the system is sealed against leakage, perfect operating conditions will result. Experience has shown that the whirling action which results when fluid is returned to a reservoir, causes air to be introduced within the fluid body, and this air is carried off by the fluid withdrawn from the reservoir. Experience has also shown that in hydraulic systems equipped with pumping devices, such as gear pumps and the like, the suction produced by such pumping devices is in some instances sufficient to cause air to be sucked into the system, and the air tends to increase fluid leakage in the system.

It is one of the primary objects of my present invention to eliminate the difficulties and inconveniences which have been experienced heretofore as a result of the presence of air within a fluid circuit, and to this end I propose to provide means for positively preventing the introduction of air within a system.

A further object of my invention is to provide a system of fluid control, in which fluid may be returned to a reservoir without subjecting the main body of the fluid to any agitation, and thereby prevent air from being taken into said fluid body.

Another object is to so arrange a fluid reservoir, as above set forth, that fluid which is returned thereto will first be directed into an auxiliary or secondary reservoir, and from this reservoir the fluid will overflow into a main reservoir, thereby preventing the fluid in the main reservoir from being subjected to any agitation.

In addition to the above mentioned objects, my invention contemplates the provision of a hydraulic system equipped with a gear pump which is adapted to receive fluid from a reservoir, such as the type set forth above, said gear pump being so arranged as to positively prevent the development of suction between the teeth thereof.

These and numerous other objects and advantages will be apparent from the following detailed description when considered in connection with the accompanying drawings, wherein—

Figure 1 is a vertical sectional view of a fragmentary portion of a lathe head stock equipped with a hydraulic system of control embodying features of my invention, a portion of said system, including the gear pump, being shown in elevation;

Figure 2 is an elevational view of the mechanism as viewed from the left of Figure 1;

Figure 3 is a vertical central sectional view of the gear pump taken substantially along the line 3—3 of Figure 2;

Figure 4 is a vertical sectional view of the gear pump taken substantially along the line 4—4 of Figure 3;

Figure 5 is an end elevational view of the member which serves as a valve and also as a journal for the gear having the radial passages, said view being taken from the right of Figure 3;

Figure 6 is a fragmentary sectional view similar to Figure 4 disclosing a shifted position of the valve; and

Figure 7 is a fragmentary sectional view similar to Figure 6, disclosing another shifted position of said valve.

Referring now to the drawings more in detail, wherein like numerals have been employed to designate similar parts throughout the various figures, it will be seen that for the purpose of illustrating one practical embodiment of the invention I have shown the same in operative association with a fragmentary portion of a material working apparatus or lathe, which I have designated generally by the numeral 10, Figures 1 and 2. The lathe 10 includes a head stock designated generally by the numeral 12, Figure 1, which supports a suitable work spindle 14. Positioned on the upper portion of the head stock 12 is a high pressure plunger pump 16. A detailed description of the head stock 12 and the plunger pump 16 is not required for a clear understanding of the present invention, and if a more detailed description is desired, reference is made to my copending application Serial No. 439,306, filed March 27, 1930.

Mounted on the upper portion of the head stock 12 adjacent the pump 16 is a fluid reservoir which I have designated generally by the numeral 18. This reservoir includes a main reservoir 20, which is secured to the head stock by means of suitable bolts 22 and a secondary or auxiliary reservoir 24, which extends downwardly into the main reservoir 20. This auxiliary reservoir is secured

in any suitable manner to a cover plate 26 which is bolted to the top of the main reservoir.

The auxiliary reservoir 24 is provided with a series of overflow apertures 28, which are arranged in horizontal alinement, and it will be noted that said auxiliary reservoir is inclined downwardly and to the right as shown in Figure 1. Fluid is directed into the auxiliary reservoir through a pipe 30 which connects at its upper extremity with a screw valve 32. This valve serves to govern the fluid pressure which is desired in the hydraulic system, of which it forms a part. In other words, fluid is returned to the auxiliary reservoir 24 through the valve 32 and the pipe 30. Attention is called to the fact that the fluid from the pipe 30 is directed against an inclined surface 34 of the auxiliary reservoir 24, Figure 1. The fluid in striking the inclined surface 34, is gently directed into association with the main fluid body without subjecting the same to any undue whirling or agitation. In this manner I am able to eliminate the introduction of air which normally takes place when fluid returned to a reservoir is permitted to set up a churning or whirling action in the fluid body. Experience has shown that when a fluid body, such as oil, is churned as the result of a sudden incoming stream of fluid, air becomes trapped within said body, and it is with the idea of reducing these difficulties as far as possible that I have arranged the inclined surface 34 adjacent the lower extremity of the pipe 30.

When the level of the fluid in the auxiliary reservoir or chamber 24 reaches the openings 28, it gently flows through said openings into the main reservoir 20. Thus, it will be apparent that the fluid body in the main reservoir is never subjected to any agitation. Fluid from the main reservoir 20 is directed by gravity through a pipe line 36, which communicates with the intake chamber 38 of a gear pump, which I have designated generally by the numeral 40, Figure 4.

This gear pump 40 is mounted on the frame of the machine or lathe 10, as clearly shown in Figures 1 and 2, by means of brackets 42 formed integral with and extending laterally of a side casing 44 of the gear pump. The gear pump also includes a second side or end casing 46, and interposed between the casings 44 and 46 are a pair of spacer plates 48 and 50, and interposed between these spacer plates is a central casing section 52. These casing sections and spacer plates are secured in position by means of suitable bolts 54, and these spacer plates 48 and 50 serve to insure the proper spacing of the parts for receiving a pair of meshing gears 56 and 58.

The gear 56 is mounted upon a shaft 60, said shaft being mounted on one side of the gear in a roller bearing 62 and, on the opposite side of said gear in a roller bearing 64. An extension of the shaft 60 passes through a suitable stuffing box 66 and projects therebeyond to receive a roller chain sprocket 68, Figure 2. This sprocket 68 is connected by means of a chain 70 to a suitable driving mechanism, which I have designated generally by the numeral 72, Figure 2. This driving mechanism might include the main power shaft of the lathe 10 or any other driven element thereof.

The gear 58 is secured to a sleeve 74, which is rotatable upon a valve member or journal 76. One extremity of the valve member 76 is supported by the end casing 44 and the opposite extremity thereof by the end casing 46. One extremity of the valve member 76 is provided with a flange or head 78 which is provided with a series of apertures 80. These apertures are adapted to be brought into successive registration with a pin 82 mounted within the end casing 46. The opposite extremity of the valve member 76 is threaded to receive a tightening screw 84. When this screw 84 is tightened against the adjacent surface of the end casing 44, the head or flange 78 is also tightened against the end casing 46, thereby preventing the leakage of fluid from within the pump casing. The valve member 76 is provided with a pair of peripheral ports 86 and a pair of peripheral ports 88 which are adapted to successively register with complementary radial ports or passages 89 and 89*a* provided in the gear 58. The outer extremities of these ports terminate in grooves 90 which extend over a greater portion of the width of the gear 58, Figure 4.

Fluid from the pipe line 36 enters the chamber 38, Figure 4, and is carried along the periphery of the gears 56 and 58 to an outlet chamber 92, which is connected with an outlet pipe 94. This outlet pipe 94 may be connected with any mechanism, such as actuator piston or the like (not shown).

Attention is now directed to the position of the ports 88, as shown in Figure 4. Consider that the gears are rotating in the direction indicated by the arrows, and that one of the teeth of the gear 56, which I have indicated by the letter A is at the position shown in Figure 4. As the tooth A sweeps through its orbit, there is a tendency for suction to be established in the area B shown in Figure 4, due to the fact that no fluid can pass through the intake chamber 38 between the gear teeth and into the outlet chamber 92. To counteract this tendency, I employ the peripheral port 88, which at that particular instant permits fluid from the intake or low pressure chamber 38 to pass into the area B through the radial port 89. Obviously, by this arrangement I am able to positively eliminate suction at that point, and thereby materially increase the propelling efficiency of the device. It positively eliminates the development of heat in the fluid, which would take place if the area was subjected to evacuation.

It will be noted that the valve member 76 may be secured in various positions of adjustment, such as shown in Figures 6 and 7. To shift the valve member 76, it is only necessary to loosen the screw 84 so as to enable the disengagement of the head 76 from the pin 72. When the proper aperture 80 has been selected and received by the pin 82, the screw 84 may again be tightened. This provides a very simple and convenient means for controlling the positioning of the valve member. Figure 6 discloses the valve member swung to its extreme left position, and Figure 7 discloses said member swung to its extreme right position.

The peripheral valve port 86 may be employed to serve as an additional means for relieving against fluid pressure between the gear teeth. Thus, as the gears 56 and 58 rotate, any fluid from the compression side of the pump which may be trapped between the gear teeth, will be directed through the radial ports into the high pressure chamber. If it is desirable to reduce the displacement of the pump, the valve member may be shifted so as to permit fluid to be returned from the high pressure to the low pressure chamber, as shown in the drawings. Thus, it will be apparent that by providing the peripheral ports 86 and 88 in association with the radial ports 89 and 89*a* of the gear 58, a very practical control arrangement is presented.

From the foregoing it will be apparent that my invention contemplates the provision of a hydraulic system of control, in which air is positively eliminated from the fluid medium. The simple, described arrangement for preventing the agitation of the fluid body in the reservoir presents a very practical construction. The main and auxiliary reservoirs may be mounted in any suitable manner upon a machine, and fluid withdrawn therefrom is completely freed from air. In addition to this air eliminating arrangement, my improved low pressure fluid propelling device or gear pump is so constructed as to further prevent the introduction of air by eliminating the development of suction between the meshing gear teeth. The development of suction between the gear teeth of pumps of this general nature, in many instances has been the cause of air being sucked into the system, and the resulting fluid leakage has caused the development of heat in the system. By providing means for eliminating suction, as above set forth, I have been able to materially increase the displacement of the pump, and by constructing the reservoir as described I have also been able to substantially increase the efficiency of the entire system. By employing the above described arrangement, I obtain very smooth running conditions, in addition to increased displacement, and this is particularly noticeable when the gear pump is coupled with a high pressure generating pump. In such instances the high pressure pump operates with unusual smoothness due to the even flow of fluid, and a decided decrease in the development of heat in the fluid has been obtained. In other words, with my improved arrangement the entire hydraulic system operates more quietly, smoothly, and efficiently.

The term "inclined", as used in the present application to describe the nature of the surface against which the fluid is directed from the outlet of the conduit 30, should be given its broadest interpretation, as setting forth a surface which deviates from the direction of fluid flow at the outlet of said fluid conducting means or conduit 30 for the purpose set forth herein.

Attention is directed to the fact that in my co-pending application, Serial No. 439,306, filed March 27, 1930, I have disclosed, in combination with a hydraulic system and machine parts controlled thereby, mechanism for preventing the introduction of air within the fluid of the system. The claims in the present application are directed to the combination with hydraulic systems generally of means for preventing the inclusion of air, whereas claims in my co-pending application are directed broadly to the combination of such means with particular circuit arrangements and with machine tool and actuator parts.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a hydraulic system, a fluid reservoir, a fluid body therein, a conduit for directing fluid into said reservoir, the cross section of the conduit as compared with the reservoir being relatively small, said reservoir having a wall surface positioned close to and extending transversely of the discharge end of said conduit for receiving fluid from said conduit, a portion at least of said surface being positioned within said fluid body, said wall being inclined with respect to the direction of fluid flow at the outlet of said conduit and extending from the discharge end of said conduit into the fluid body in a manner to effect a non-turbulent entry of fluid from the conduit into said fluid body, whereby to counteract any tendency to agitate the main fluid body within the reservoir resulting from the flow of fluid received thereby, and means for directing fluid away from said reservoir.

2. In a hydraulic system, a fluid reservoir, a fluid body therein, and a conduit extending into said reservoir, the cross section of the conduit as compared with the reservoir being relatively small, said reservoir having a wall surface inclined downwardly from the horizontal into the fluid body and extending transversely of in close proximity to the lower discharge extremity of said conduit to receive fluid therefrom, whereby to effect the calm entrance of the fluid from the conduit into the main fluid body within the reservoir.

3. In a hydraulic system, a fluid reservoir, a fluid body therein, a conduit extending within said reservoir, the cross section of the conduit as compared with the reservoir being relatively small, said reservoir having a wall surface contacting with said fluid body and extending transversely of in close proximity to the discharge extremity of said conduit for receiving fluid from said conduit, said wall being inclined with respect to the direction of fluid flow at the outlet of said conduit and extending from the discharge end of said conduit into the fluid body in a manner to effect a non-turbulent entry of fluid from the conduit into said fluid body, whereby to counteract any tendency to agitate the main fluid body within the reservoir, and another reservoir for receiving overflow fluid from the first reservoir.

4. In a hydraulic system, a fluid reservoir, a fluid body therein, a second reservoir for receiving overflow fluid from the first reservoir, means comprising a conduit having a cross section which is relatively small as compared with the cross section of the first reservoir for conducting fluid into said first reservoir, means for retarding the speed at which the conducted fluid enters the fluid body within said first reservoir, said retarding means including a wall surface inclined with respect to the direction of fluid flow at the outlet of said fluid conducting means and extending from the discharge portion thereof into the fluid body in a manner to effect a non-turbulent entry of fluid from the fluid conducting means into said fluid body, and means for withdrawing the fluid from said second reservoir, the overflowing of fluid into said second reservoir serving to effect the calm entrance of said fluid within the second reservoir, thereby preventing the introduction of air within the fluid body.

5. In a hydraulic system, a fluid reservoir, a conduit having a cross section which is relatively small as compared with the cross section of said reservoir for delivering fluid thereto, said conduit extending into said reservoir, means for retarding the speed of the stream of fluid which emerges from said conduit, a fluid body within said reservoir, said retarding means including a surface inclined with respect to the direction of fluid flow at the outlet of said conduit and extending from the discharge end of said conduit into the fluid body in a manner to effect a non-turbulent entry of the stream of fluid which emerges from said conduit, a second reservoir for receiving the overflow of fluid from the first reservoir, whereby to counteract any tendency to agitate the fluid body in said second res-

ervoir, and a conduit adapted to receive fluid by force of gravity from said second reservoir.

6. In a hydraulic system, a fluid reservoir, a conduit for delivering fluid to said reservoir, a second reservoir for receiving the overflow of fluid from said first reservoir, whereby to prevent the agitation of and hence the occlusion of air within the fluid in said second reservoir, a pump, a conduit extending between the pump and said second reservoir for receiving fluid by force of gravity from said second reservoir and delivering same to the intake side of said pump, the air free fluid under gravity serving to increase the operating efficiency of said pump, and means for directing fluid from the discharge of said pump to said first conduit.

7. In a hydraulic system, a fluid reservoir, a fluid pumping mechanism, conduit means connecting said pumping mechanism with said reservoir for directing fluid from said reservoir to said pumping mechanism, means for conducting fluid into said reservoir, means in said reservoir to effect the calm delivery of fluid within the reservoir, whereby to counteract any tendency to agitate the fluid in said reservoir and thereby prevent the inclusion of air in the fluid received by said pumping mechanism, and means for directing fluid discharged by said pumping mechanism to said conduit means, the exclusion of air serving to increase the operating efficiency of said pumping mechanism.

8. In a hydraulic system, a fluid reservoir, a fluid pumping mechanism, conduit means connecting the reservoir with said pumping mechanism to effect the delivery of fluid to said mechanism by the force of gravity, means for delivering fluid to said reservoir, means in said reservoir for effecting the calm delivery of fluid within said reservoir, whereby to counteract the tendency to absorb air in the fluid body, and means for directing fluid discharged by said pumping mechanism to said conduit means, the air free fluid under gravity serving to increase the operating efficiency of said pumping mechanism.

9. In a hydraulic system, a fluid reservoir, a fluid pumping mechanism, conduit means connecting said pumping mechanism with said reservoir, means for conducting fluid into said reservoir, fluid controlling means extending within the reservoir for receiving fluid from said fluid conducting means, said fluid controlling means including a fluid receiving surface inclined with respect to the direction of fluid flow from said conducting means and extending from the point where the fluid emerges from said conducting means in a manner to effect the calm delivery of said received fluid to said reservoir, and means for circulating fluid from the pumping mechanism to said conduit means.

10. In a hydraulic system, a fluid reservoir, a fluid body within said reservoir, a conduit having a cross sectional area which is small in comparison with the reservoir cross section for directing fluid in a stream to said reservoir, an intake portion of said conduit communicating with a restricted orifice, and means within said reservoir for decreasing the speed of entrance of the fluid from said conduit, said means including a surface which diverges from the direction of said fluid stream and extends from the point where said stream emerges from the conduit into the fluid body in such a manner as to preclude any turbulent action within the fluid body resulting from the entrance of the fluid from said conduit.

11. In a hydraulic system, a fluid reservoir, a fluid body within said reservoir, pumping mechanism, conduit means connecting the fluid body in said reservoir with the intake of said pumping mechanism, conduit means for returning fluid discharged by said pumping mechanism to said reservoir, a restricted orifice mechanism communicating with said second conduit means for the purpose of building up back pressure, and means cooperating with the discharge extremity of said conduit for effecting the non-turbulent return of fluid from said restricted orifice mechanism to the fluid body within said reservoir to thereby avoid the occlusion of air within said fluid body and thus increase the operating efficiency of said pumping mechanism.

12. In a circulatory hydraulic system, a fluid reservoir, a fluid body in said reservoir, pumping mechanism, conduit means for delivering fluid under gravity to the intake of said pumping mechanism, conduit means communicating with the discharge of said pumping mechanism for completing the circulation of fluid back to said reservoir, restricted orifice means associated with said second conduit means for building up pressure of fluid therein, and means for effecting the calm entrance of fluid from said second conduit means to the fluid body in said reservoir whereby to prevent the occlusion of air and thus increase the operating efficiency of the pumping mechanism and prevent deterioration of the fluid resulting from occluded air.

ERNEST J. SVENSON.