Nov. 17, 1953

H. J. FRAMHEIN

COMPOUND PRESSURE PUMP

2,659,307

Filed Nov. 4, 1947

3 Sheets-Sheet 1

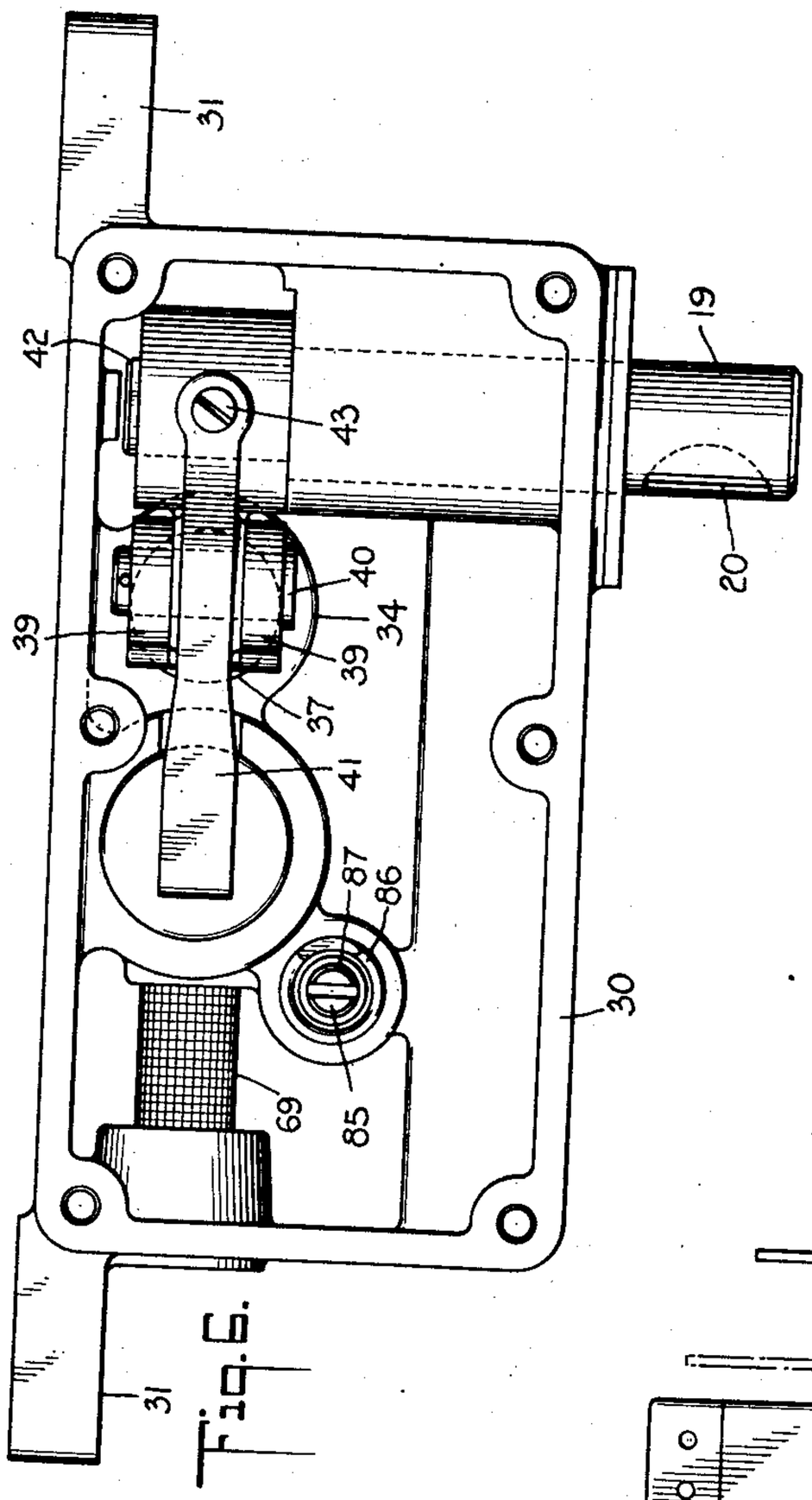

Fig. 6.

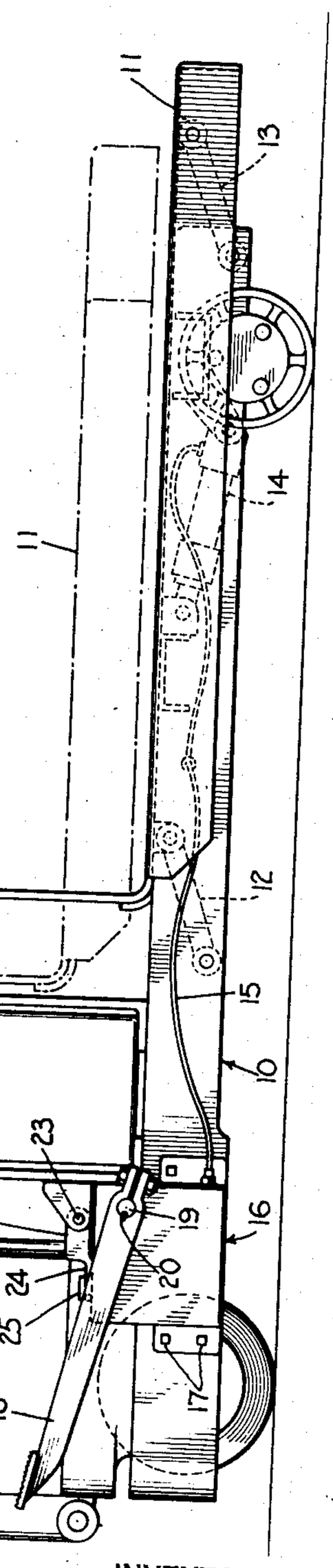

Fig. 1.

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3 Sheets-Sheet 2

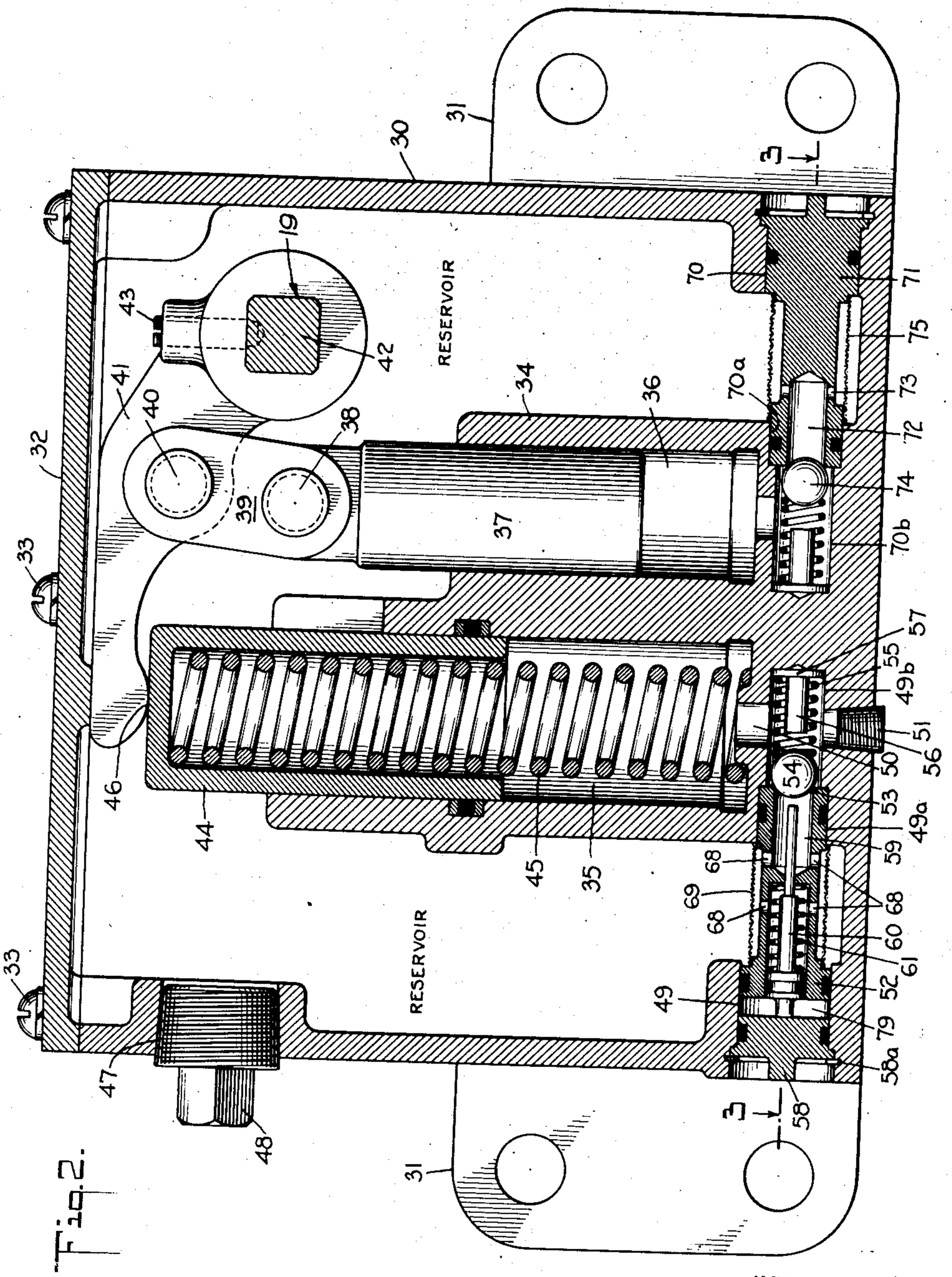

Fig. 2.

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3 Sheets-Sheet 3

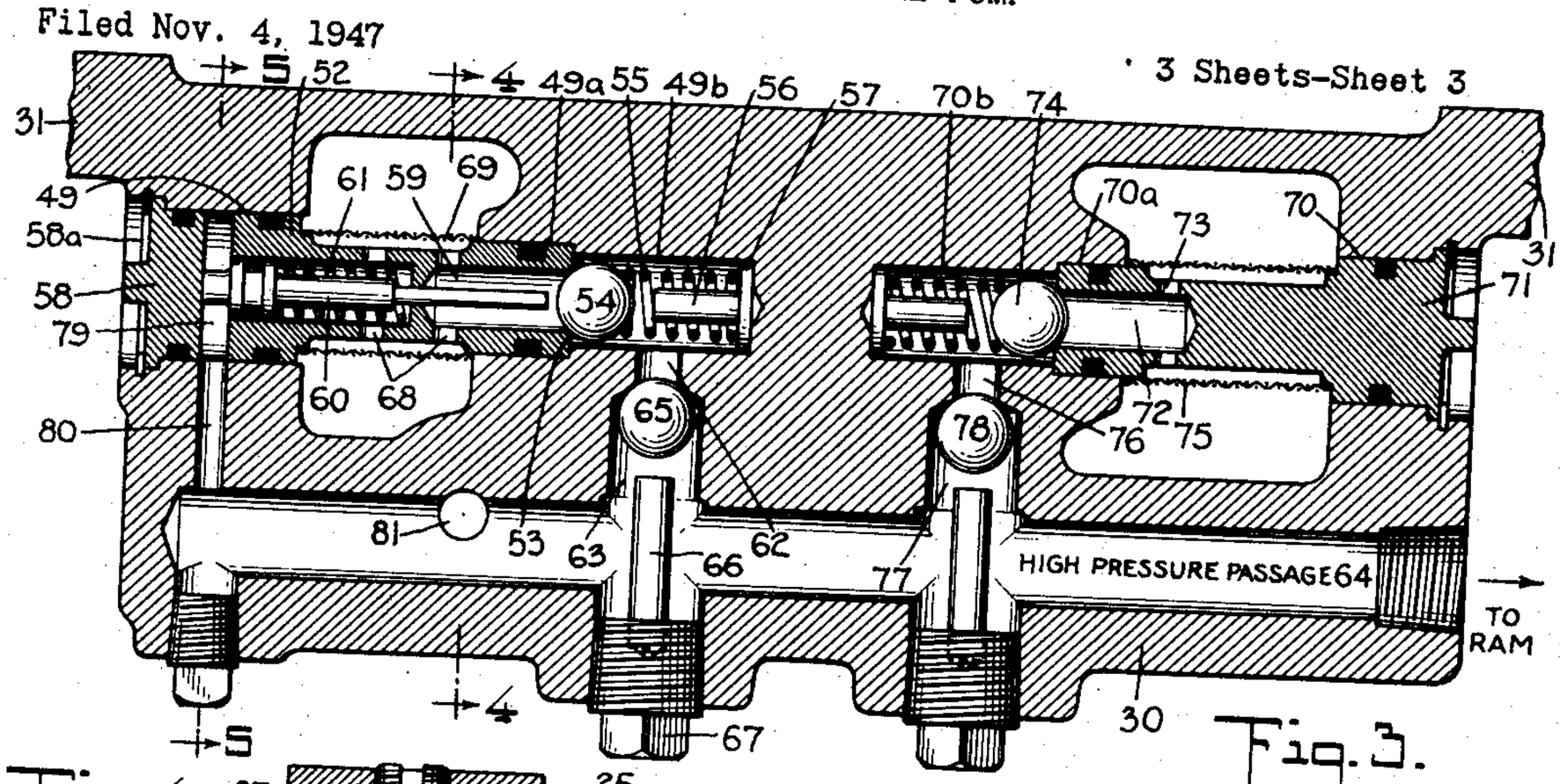


Fig. 3.

Fig. 4.

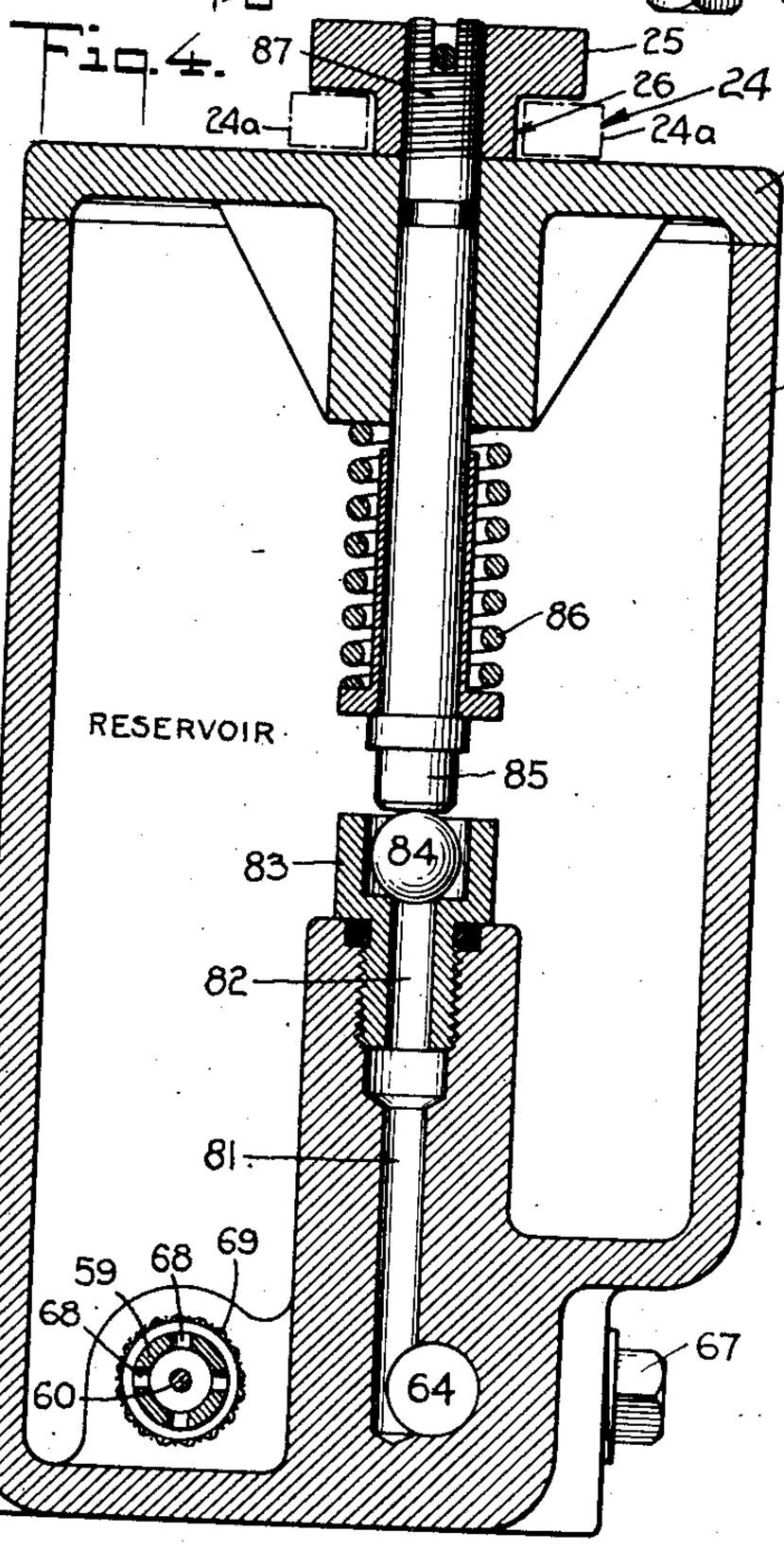
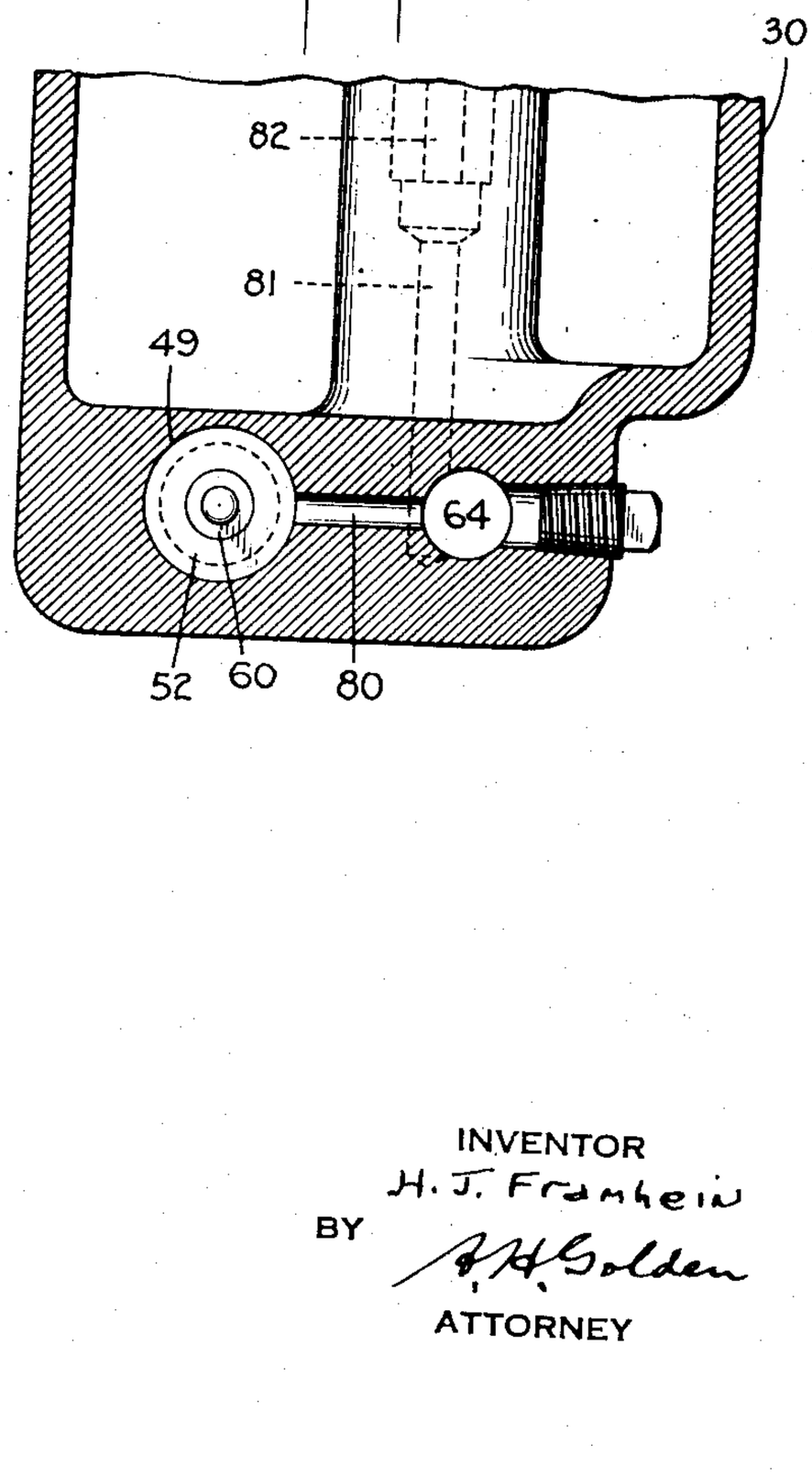


Fig. 5.



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UNITED STATES PATENT OFFICE

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COMPOUND PRESSURE PUMP

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1 Claim. (Cl. 103—4)

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This invention relates to a pump, and more particularly to a ram actuating pump of the type that may be used in an industrial truck, jack, or the like, for elevating a load lifting member or platform relatively to a main frame or lifting head. In this application I shall describe my invention as applied to an industrial platform lift truck.

In trucks of the particular class, it is desirable to elevate the load platform at a relatively high speed until it strikes the load that is to be raised. Thereafter, the platform is elevated at a lower speed to a desired height.

Pumps capable of coacting with a ram for lifting a load platform as I have outlined, are old and well-known in the art. As a general rule, such pumps comprise a pair of pumping cylinders equipped with operating pistons, one of the cylinders being larger than the other, and forming what I term a high speed lifting cylinder. The smaller cylinder is, of course, the low speed lifting cylinder. The pistons of the two cylinders are arranged in telescopic relation and are operated simultaneously, with the fluid flowing toward the platform lifting ram. As soon as the elevating platform strikes the load, the larger or high speed lifting cylinder is rendered ineffective, and the low speed or smaller cylinder operates alone to effect the lifting of the load.

It is the object of my invention to contribute a pump of the general class described in which the operation I have just outlined is inherent, the construction of my pump being extremely simple and with the flow of fluid so arranged as to minimize to the extreme, the effort required to move the piston of the larger or high speed cylinder once the low speed cylinder becomes effective. It is a further object of the invention to minimize the stresses in the mechanical parts of the pump and thereby to increase the possible life of the pump.

The nature of my contribution to the art will best be appreciated after a reading the specification that follows taken in conjunction with the drawings presented herewith. Thus, those skilled in the art will see at once the extremely simple means that I have provided for obtaining the results I have outlined, while the important nature of my contribution will be evident upon comparison of my structure herein set forth with the relatively complicated and less effective mechanisms of the prior art. Those skilled in the art will appreciate that the conception on which my disclosure is based may readily be utilized as a basis for the designing of other structures for

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carrying out the several purposes of my invention.

Referring now to the drawings, Fig. 1 is an elevation of an industrial truck showing my invention applied thereto. Fig. 2 is a vertical sectional view of the pump used in the truck. Fig. 3 is a section taken along lines 3—3 of Fig. 2. Figs. 4 and 5 are respectively sections taken along lines 4—4 and 5—5 of Fig. 3. Fig. 6 is a top view of the pump and casing with the cover of the casing removed.

Referring now more particularly to the drawings, and especially Figs. 1, 2, and 6, the truck to which my invention is applied comprises a main frame 10 and an elevating platform 11. The elevating platform 11 is pivoted to the main frame 10 through means of parallel links 12 and 13 as is standard in the art, and moves upwardly from its full line position to the dotted line position illustrated in Fig. 1 upon actuation of a lifting ram 14. Lifting ram 14 is connected by a suitable liquid carrying pipe 15 to a pump 16 secured through bolts 17 to the main frame 10.

Pump 16 is operated by foot treadle 18 that serves to rotate a pumping shaft 19 to which it is keyed at 20. Obviously, the fluid will be forced through the pipe 15 to the ram 14 upon movement of the treadle 18, and the elevating platform will be raised. The load is lowered through operation of a suitable handle 21 carried by a lever 22 pivoted at 23 to the main frame. Lever 22 has a forked portion 24 lying under the head 25 of a nut 26 best seen in Fig. 4, the functioning of which will be described shortly.

Pump 16 is formed of a casing 30 equipped with brackets 31 relatively to which function the securing bolts 17 already referred to. Casing 30 is preferably formed from a single casting having a cover plate 32 secured by suitable screws 33. Formed is an integral part of the casing casting is an upstanding portion 34 bored for a high speed cylinder 35 and a low speed cylinder 36. Mounted within the low speed cylinder is a piston 37 to which is pivoted at 38 a link 39 pivoted at 40 to a lever 41. Lever 41 is formed with a square bore whereby it may be fitted on the square reduced portion 42 of the operating shaft 19 to which foot treadle 18 is keyed. A holding screw 43 may be used to hold the lever 41 against lateral movement. Obviously, movement of the treadle 18 will, through the link 39, actuate the piston 37.

Mounted within the high speed cylinder 35 is a high speed piston 44, and positioned between the said piston 44 and the lower end of the cylinder

35 is a spring 45. Spring 45 serves to maintain the upper end of the piston 44 against the surface 46 of lever 41. Obviously, the lever 41 will, when it moves counter-clockwise in Fig. 2, operate piston 44 against the pressure of spring 45. It is evident, also, that when pressure is relieved on the treadle 18, spring 45 will operate against the surface 46 to bring lever 41 back to its position of Fig. 2. Because of the particular arrangement, a single spring 45 suffices to return both pistons to the upward position of Fig. 2.

Surrounding the portion 34 of the casting 30 is a chamber forming the liquid reservoir of my pump, this chamber being adapted to be filled through an opening 47 normally closed by a plug 48. A compound bore 49, 49*a*, 49*b*, best seen in Figs. 2 and 3, is formed in the casting leading from the outside of the casing into the reservoir, and into communication with a bore 50 leading to high speed cylinder 35. A plug 51 is adapted to close the outer end of the bore 50, it being obvious that the bore 50 is fabricated by a drill inserted from the outside of the casing, and thus making necessary the use of plug 51. Plug 51 is therefore termed a manufacturing plug, since it has no function except to make possible certain manufacturing procedure. I use other such plugs also to be here termed manufacturing plugs.

In the compound bore 49, 49*a*, 49*b*, I utilize a valve plug designated generally by reference numeral 52, and itself formed with a series of bores, and terminating at 53 in a seat for a ball valve 54. Ball valve 54 is held against surface 53 by a relatively light spring 55, in turn held in position by a pin 56 carried by a disc 57 at the end of the portion 49*b* of the compound bore. Suitable O rings prevent leakage past the plug 52 as is standard in the art. A manufacturing plug 58 is used to close the outer end of compound bore 49, 49*a*, 49*b*, and is held secured to the casing by a snap ring 58*a* that may be readily removed, allowing the plug 58 itself to be removed from its bore closing position. Formed centrally of the valve plug 52 is a bore 59 in which is housed a control piston 60 maintained in the position illustrated in Fig. 2 by a spring 61 and functioning as will presently be set forth. It is well to note that manufacturing plug 58 limits the outward movement of the piston 60 by spring 61.

Referring now to Fig. 3, it will be seen that the bore portion 49*b* of the composite bore 49, 49*a*, 49*b* is in communication through bores 62, 63 with what I term a high pressure passage 64. A ball valve 65 is positioned between bores 62, 63 and is held against movement beyond a predetermined position by a pin 66 held in place by a manufacturing plug 67. High pressure passage 64 is of course connected to the pipe 15 leading to the ram 14.

Valve plug 52 is formed with openings 68 to allow the flow of fluid into its central passage 59 toward the high speed pump cylinder 35. It will be noted that a screen 69 surrounds a portion of the valve plug 52 so as to filter the fluid moving toward the pump cylinder 35, as is naturally required in devices of this class.

From the structure thus far described, it will be obvious that upward movement of the piston 44 under the influence of spring 45 to the position of Fig. 2, will effect the flow of fluid from the reservoir through the openings 68, past the ball valve 54, into the bore 50, and into the cylinder 35. Downward movement of the treadle 18 will, through the lever 41, effect a downward

movement of the piston 44 against the force of spring 45. Since ball valve 54 is seated initially by its spring 55, it is naturally held even more firmly against its seat through the pressure exerted by the downward movement of the piston 44. Therefore, fluid will be forced through bores 62, 63, past the ball valve 65 which will be moved from its seat, although limited in its movement by the pin 66. The fluid thus moving under pressure will naturally go into the high pressure passage 64 and through the pipe 15 to the ram 14 to elevate platform 11. This is the action of the high speed low pressure pump 35. We come now to a discussion of the low speed high pressure pump cylinder 36 and its piston 37.

Referring now to Figs. 2 and 3, it will be seen that the casing casting 30 is formed with a composite bore 70, 70*a*, and 70*b*, similar in practically every respect to the composite bore 49, 49*a*, 49*b*. However, the valve plug that is used for filling this bore, and designated by reference numeral 71, is different from valve plug 52 in that it does not contain a control piston 60, but has merely a central passage 72 in communication through openings 73 with the reservoir. A ball valve 74, similar in every respect to the ball valve 54, coacts with valve plug 71 and is similarly controlled. A screen 75 is positioned to function as does the screen 69. As seen in Fig. 3, the cylinder 36 is in communication through passages 76, 77 with the high pressure passage 64, under the control of a ball valve 78 functioning in exactly the same way as does the ball valve 65. Thus, during the up stroke of the piston 37 to its position of Fig. 2, the ball valve 74 will be unseated and fluid will flow from the reservoir into the cylinder 36. On the downward stroke of the piston 37, the ball valve 74 will be seated and the ball valve 78 unseated, so that fluid will flow into the high pressure passage 64 and toward the ram 14.

It can therefore be said that during the first strokes of the foot treadle 18, and until the platform 11 encounters the load it is to lift, the two pistons 44 and 37 will be actuated simultaneously to pump fluid at relatively high speed into the ram 14. I shall now describe just what happens when the platform 11 encounters a load and requires the development of very high pressure in the high pressure passage 64 for the actuation of ram 14.

It will be noted from Figs. 2 and 3, that there is a space 79 between the manufacturing plug 58 and the end of valve plug 52 in which is mounted the control piston 60. This space 79 is in alignment with a bore 80, shown in Figs. 3 and 5, extending into the high pressure passage 64. As a result of this arrangement, when the pressure in the passage 64 exceeds a predetermined amount, it is effective to operate against the end of the control piston 60 and to depress that piston against the force of the spring 61. The effect of this action is to unseat the ball valve 54 and to hold it unseated so long as the pressure remains higher than that for which spring 61 is calibrated. Once this ball valve 54 is unseated, the movement of the piston 44 upwardly and downwardly in Fig. 2 effects a flow of fluid from the reservoir to the cylinder 35 and then back to the reservoir again. This flow is accomplished with but little effort, so that the pressure between surface 46 of the lever 41 and the piston 44 is very little. In other words, immediately upon the development of sufficiently high pressure within the passage 64 to lift the platform 11

and a load, the high speed cylinder **35** and its piston **44** are rendered ineffective. Thereafter, all of the lifting takes place through actuation of the piston **37** within the low speed cylinder **36**.

In order to change the amount of pressure required to unseat valve **54** to render the high speed pump inoperative, it is merely necessary to remove plug **58**, take out piston **60** and spring **61**, substitute a different spring, and replace the parts.

The fluid in the high pressure passage **64** remains under pressure at all times during the maintenance of the elevating platform **11** in an elevated position. By relieving the pressure within the said passage **64**, it is possible to lower the elevating platform. This relieving of the pressure within the high pressure passage **64** is accomplished by means well illustrated in Figs. 4 and 5. In those figures, it will be seen that the high pressure passage **64** is in communication with a vertical relief passage **81** in turn in communication with a passage **82** in a valve support **83** threaded into a portion of the casting of the casing **30**. Valve support **83** maintains in position a ball valve **84** normally closing passage **82**. Ball valve **84** is held against its seat by a control rod **85** spring pressed downwardly in Fig. 4 by a spring **86**. Rod **85** has threaded to its upper end at **87** a nut **26** formed with a head **25**, as already referred to earlier in this application. Lying under the head **25** of the nut **26** are the tines **24***a* of the forked portion **24** of the lever **22**. It is now readily seen that when the handle **21** shown in Fig. 1 is moved with the lever **22** on the pivot **23**, the control rod **85** is raised against the pressure of the spring **86** so that the ball valve **84** may be unseated. Fluid will then flow from the ram **14**, through the pipe **15** into the high pressure passage, and thence into the reservoir. Obviously, this allows a lowering movement of the elevating platform. It should be noted that ball valve **84** is also capable of functioning as a relief valve set in accordance with the strength of spring **86**.

I think the operation of my invention and the contribution made thereby to the art will now be fully appreciated by those skilled in the art.

I now claim:

In a combination of the class described, a base casting formed with a reservoir, a low pressure intake bore extending into said casting from the outside thereof and leading to said reservoir, a low pressure pump in communication with said bore, a plug for said bore having openings through which fluid may flow from said reservoir toward said pump, a control valve coacting with said plug and bore, a high pressure intake bore extending into said casting from the outside thereof and leading to said reservoir, a high pressure pump in communication with said bore, a plug for said bore having openings through which fluid may flow from said reservoir toward said pump, a control valve coacting with said plug and bore, a spring pressing each of said control valves toward its seat and with said control valves adapted to be unseated on the suction stroke in each pump cylinder to allow flow of fluid to said cylinders, the pressure strokes seating said valves, a pressure outlet passage in said casting parallel to said low pressure and high pressure bores and leading to the exterior thereof and in communication with both pump cylinders, a control piston in the plug of said low pressure intake bore, passage means between said low pressure intake bore and said pressure outlet passage whereby the control piston moves upon the development of predetermined pressure in said pressure outlet passage to hold said control valve unseated during the pressure stroke of said low pressure pump, and a valve between said pressure outlet passage and each of said pump cylinders.

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