June 9, 1964 F. SUTER 3,136,128

HYDRAULIC JACK ASSEMBLY AND HOUSING

Filed Aug. 1, 1960 3 Sheets-Sheet 1

Fig. 2

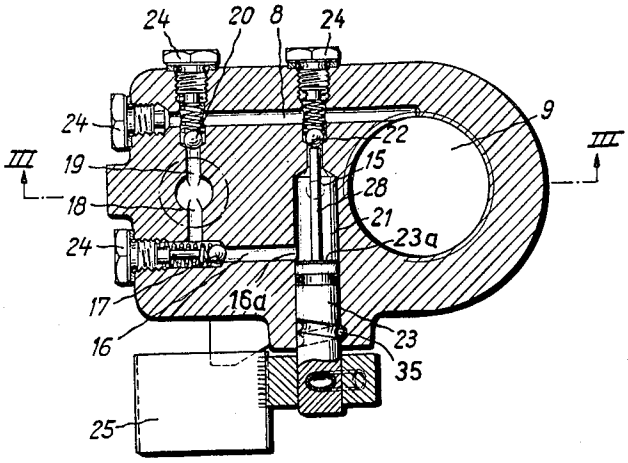

Fig. 1

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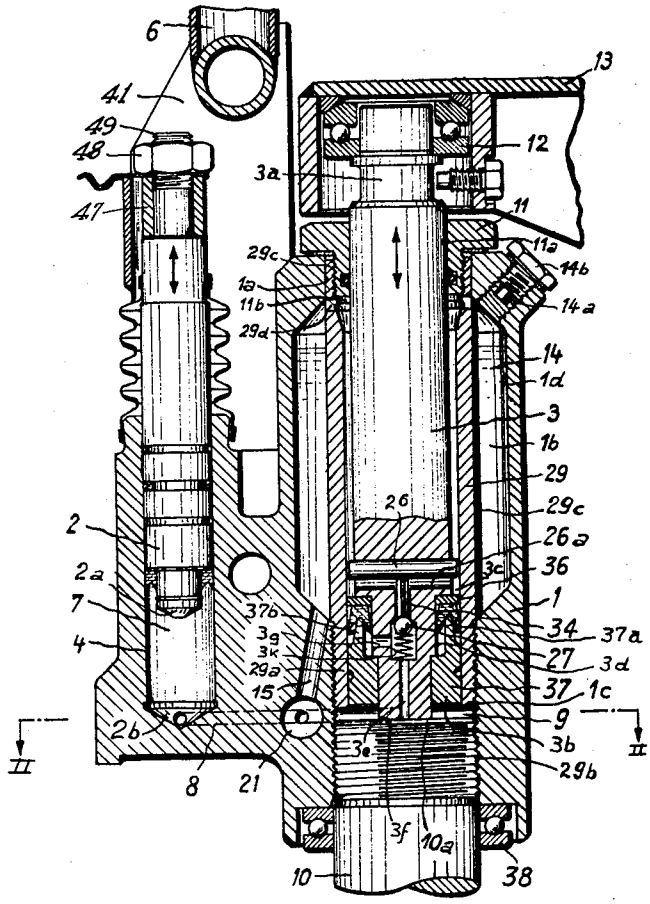
Fig. 3



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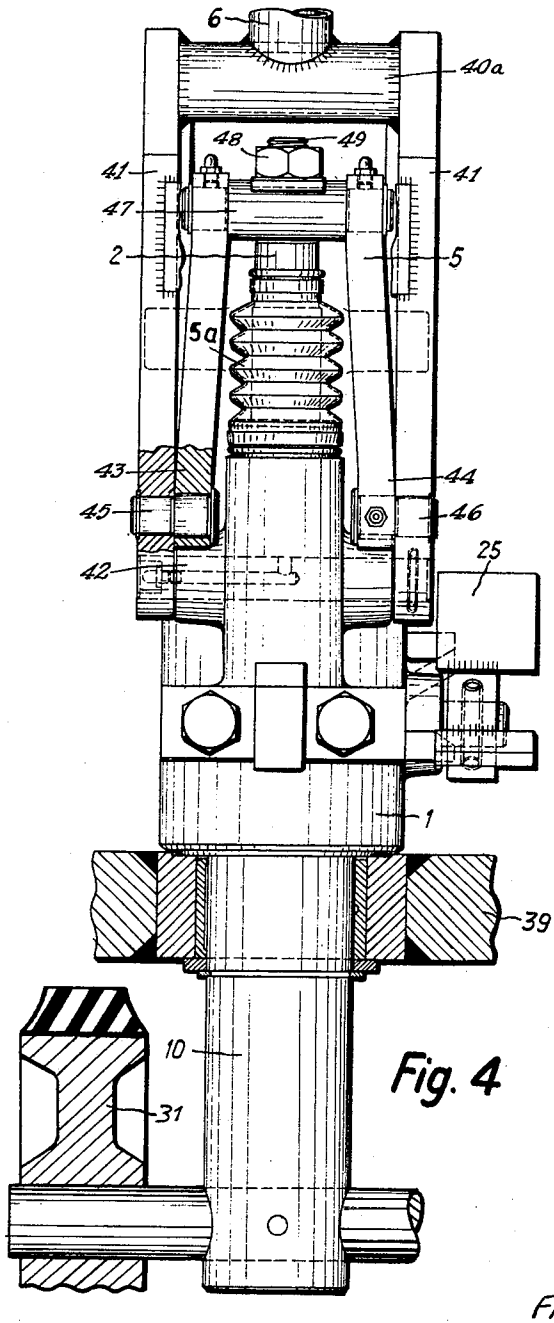

Fig. 4

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HYDRAULIC JACK ASSEMBLY AND HOUSING

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3 Claims. (Cl. 60—52)

The present invention relates to a novel jack assembly and associated housing adapted to be employed in conjunction with hand-operated lifting trucks and the like, of the type where a driving piston which may be displaced by movement of a truck handle causes displacement of a driven piston or tappet for purposes of vertically adjusting the carrying assembly of the lifting truck.

The jack units heretofore known in the art and employed with mobile lifting trucks have the disadvantage of being quite intricate in design employing a large number of channels for the fluid medium, thereby necessitating complicated and expensive methods of manufacture and machining. Moreover, it is impossible to vent such known constructions effectively, with the attendant result that air cushions tend to form in the pump chamber.

The present invention eliminates these drawbacks by providing an arrangement wherein the pressure passageway between pump chamber and tappet chamber and at least a portion of the suction passageway between pump chamber and the fluid reservoir are oriented in a common plane, the latter of which approximately defines the lower limit of the tappet and pump chambers and is substantially horizontally disposed in the housing assembly. In accordance with the present invention there is provided a jack assembly having a housing block including vertically arranged bore means into which are slidably arranged displaceable piston elements. One of the piston elements and its associated cylinder bore has a tapered end portion engageable with one another to prevent the formation of undesirable air pockets or cushions tending to hamper proper functioning of the pump assembly. The housing of the pump is further provided with channel means including a pressure channel and a suction channel which are oriented in a common plane with respect to the tapered end portion of one of the cylinder bores. The channel means are so oriented in the jack housing that the machining thereof is relatively simple thereby keeping manufacturing costs to a minimum. The arrangement of the specific features of the jack assembly also engenders a pumping unit which is quite reliable in operation and well suited for use in conjunction with lifting trucks and the like.

Accordingly, it is an important object of the present invention to provide a novel jack assembly and arrangement of channel means permitting the manufacture thereof to be carried out in a relatively simple and economical manner.

It is another important object of the present invention to provide means tending to prevent formation of undesirable air cushions thereby improving operation of the pump unit.

Another important object of the present invention is the provision of a jack assembly which may be readily manufactured in a relatively simplified manner, is highly

reliable in its operation and, adapted for use in conjunction with lifting trucks and the like.

Still a further object of the invention is to provide a novel jack assembly and housing wherein the pressure passageways and at least a portion of the suction passageways are lying in a common plane with respect to one end of a pumping chamber, thereby permitting the machining operation of the jack housing to be carried out in a simple and economical manner.

These and still further objects and the entire scope of applicability of the present invention will become apparent from the detailed description given hereinafter; it should be understood, however, that the detailed description and specific example, while indicating a preferred embodiment of the invention, is given by way of illustration only, since various changes and modifications within the spirit and scope of the present invention will become apparent to those skilled in the art from this detailed description.

In the drawings:

FIGURE 1 illustrates a perspective view of a hand-operated lifting truck and jack assembly pursuant to the present invention;

FIGURE 2 illustrates a sectional view taken along the line II—II of FIGURE 3;

FIGURE 3 is a sectional view of the jack assembly pursuant to the present invention and taken along the line III—III of FIGURE 2;

FIGURE 4 illustrates a front view of the jack assembly mounting taken in the direction of the arrow C of FIGURE 1.

General Description

Referring now to the drawings and, more particularly, to FIGURE 1, there is disclosed a jack assembly A adapted to be employed with a hand-operated lifting truck or the like B. The lifting truck B is constituted by a frame **33** supporting the vertically displaceable lifting arms or forks **40** adapted to be raised and lowered by the jack assembly A. The frame **33** is supported on the wheels **31** and **31***a*, the wheels **31** being pivotably mounted on the yoke **39** bearing against the lower portion of the jack assembly A. Accordingly, swivelling of the wheels **31** causes the entire jack assembly A to turn therewith, the thrust being taken up by the lower thrust bearing **38** and the upper thrust bearing **12** arranged on opposite sides of the jack assembly A, see FIG. 3. An angularly displaceable truck handle **6** movable in the direction of the arrow D is pivotally mounted on the jack assembly A and is adapted to displace a piston member **2** for reciprocating said piston member due to up and down movement of the truck handle **6** in the direction of the arrow D. The specific details of operation of the lifting truck B is described in my copending United States patent application Ser. No. 38,553, now Patent No. 3,026,089, filed June 24, 1960 and forms no part of the present invention. By briefly referring to FIGURE 4, it will be observed that the handle **6** is connected at its lower end to a crossbar **40***a* rigidly secured to the lateral brackets **41**. The lateral brackets **41** are pivotably connected at their respective lower end to the jack housing **1** by means of a shaft member **42**. Arranged between the lateral brackets **41** are a pair of upwardly extending linkage members **5** pivotably secured to the lateral brackets **41** at their lower

ends 43 and 44 by the pivot bolts 45 and 46, respectively. The upper ends of the linkage members 5 support a hollow crossbar 47 through which the threaded upper end 49 of the piston member 2 extends. The hollow crossbar 47 is held seated on the piston member 2 by a nut 48 engaging the threaded upper end 49 of piston member 2. The piston member 2 is displaceably supported within its associated cylinder and is enclosed by an expansible bellows 5*a*. It will thus be appreciated that movement of the truck handle in the direction of the arrow D of FIGURE 1, causes the crossbar 47 to operatively displace the piston member 2 due to pivotable movement of the linkage members 5.

The jack assembly A comprises a housing consisting of a housing block 1 having a vertical bore including an upper bore portion 1*a*, an intermediate bore portion 1*b* and a lower bore portion 1*c*, the respective walls of which define a chamber adapted to accommodate a displaceable element, as for example a piston or tappet 3. The housing block 1 is further provided with a substantially parallel, laterally disposed, vertically arranged cylinder bore 4, having a conical tapered end portion 2*b*, the walls of which define a chamber or cylinder in which there is slidably arranged a displaceable driving piston 2 having a tapered end portion 2*a* adapted to snugly engage the correspondingly shaped tapered end portion 2*b* of the cylinder bore 4. The longitudinal axis of the respective chambers are substantially parallel to one another. A cylindrical sleeve 29 is supported between the upper bore portion 1*a* and the lower bore portion 1*c* of the tappet receiving bore. The one end 29*a* of said cylindrical sleeve 29 is provided with threads 29*b* engaging a correspondingly threaded portion provided on the inner wall of said lower bore portion 1*c*. Disposed beneath said cylindrical sleeve 29 is a threaded plug member 10 resting on the wheels 31 and fastened into the lower end of said lower bore portion 1*c*. The plug member 10 is spaced a suitable distance from said one end 29*a* of the cylindrical sleeve 29 corresponding approximately to the diameter of a pressure channel 8 provided in the housing block 1. At the opposite end 29*c* of said cylindrical sleeve 29 there is internally mounted a sealing cap 11 having an annular recess 11*a* through which extends the upper portion 3*a* of a displaceable piston or tappet 3 slidably arranged within the cylindrical sleeve 29 and communicating with a shoulder 14 cooperable with the lifting arms 40 of the truck B. The bottom face 11*b* of the sealing cap 11 serves as a limit stop for the stroke of the piston or tappet 3. The opposite end or head 3*b* of said piston or tappet 3 is provided with two radial and inwardly directed shoulder portions 3*c*, 3*d* spaced a predetermined distance from one another. The lower shoulder 3*d* normally bears against a bushing 37, which defines at least a portion of the lower extremity of the piston 3, said bushing 37 being force fitted about the head portion 3*b* of the piston or tappet 3. Arranged within said cylindrical sleeve 29 is a packing or sealing ring 36 which is urged against the other shoulder portion 3*c* of the displaceable piston 3 by means of the upwardly extending protrusions 37*a* of the bushing 37, which in turn are provided with the lateral orifice means 37*b* to permit contact of the fluid medium with the sealing ring 36 for the purpose of keeping the packing 36 seated against the upper shoulder portion 3*c* of the piston or tappet 3 and against the wall of the cylindrical sleeve 29. The piston 3 is provided with a transversely extending slot or opening 26*a* within which is carried a displaceable pin 26 having a diameter smaller than said slot 26*a*. Communicating with said slot is an axial bore 3*e* extending from said slot 26*a* to the bottom face 3*f* of the piston 3, the latter in its lowermost position contacts the upper surface 10*a* of the plug 10. A lateral opening 3*g* communicates with an enlarged portion 3*h* of said axial bore 3*e*, which in turn is provided with a spring biased discharge check valve 27 normally urging a holding pin 34 against the transverse

pin 26 to retain the latter in its uppermost position. The space between the outer wall 29*c* of the cylindrical sleeve 29 and the inner wall 1*d* of the intermediate bore portion 1*b* of the housing block 1 defines a compartment serving as a reservoir for a suitable fluid medium such as oil. Adjacent the upper end of the housing block 1 there is provided a port 14*a* permitting introduction of the fluid medium into the compartment 14 and normally closed by a threaded closure cap 14*b*. The upper end 29*c* of said cylindrical sleeve 29 is provided with a laterally directed port 29*d* communicating the reservoir compartment 14 with the interior of the cylindrical sleeve 29.

Accordingly, when the tappet 3 is in its uppermost position, with the transverse pin 26 bearing against the bottom face 11*b* of the sealing cap 11, the discharge or relief check valve 27 is opened by the holding pin 34 and the fluid medium is able to be by-passed or returned to the reservoir 14 through the flow path defined by axial channel or bore 3*e*, the transverse opening 26*a* and the laterally directed port 29*d*. At the lower end of the reservoir compartment 14 there is provided an inclined channel 15 communicating with a channel 21 having arranged therein an axially displaceable sealing piston 23, carrying at one end 23*a* thereof a push rod 28 capable of being urged against a spring biased check valve 22. The housing 1 is further provided with the substantially parallel pressure channel 8 and suction channel 16 which are disposed at right angles to the sealing piston channel 21. The suction channel 16 as well as the pressure channel 8 communicate with the tapered end portion 2*b* of the piston cylinder 7 by means of the respective oppositely arranged passageways or channels 18 and 19. Each of the channel members 8 and 16 are in registry with a check valve 20 and 17, respectively, permitting fluid flow in only one predetemined direction. The pressure channel 8 communicates with the preferably cylindrical chamber or space 9 between the lower end 29*a* of the cylinder sleeve 29 and the upper face 10*a* of the sealing cap 10 carried by the lower bore 1*c*, and serves as a pressure line for transporting a fluid medium from said driving piston cylinder 7 via pressure passageways 8 and 19, check valve 20 to the bottom portion of the driven piston or tappet 3. The respective channels 8, 16, 18, 19 and 21 lie substantially in a common horizontal plane with respect to the tapered end portion 2*b* of the driving piston cylinder 7 and the cylindrical chamber 9 for the tappet 3. The respective ends of the channels 8, 16 and 21 are closed by the threaded sealing caps 24, one end of channel 21 further being closed by the sealing piston 23. The channels 18, 16, 21 and 15 define suction passageways for transporting fluid medium contained in reservoir 14 to the piston cylinder 7, whereas channels 8 and 19 define pressure passageways for delivery of fluid medium from said piston cylinder 7 to the cylindrical chamber 9 for driving the tappet or piston 3. The apex of the tapered conical portion 2*b* corresponds approximately to the lowest portion of the channels 18 and 19.

A control member 25 which may be manually actuated is carried at one end of the sealing piston 23 to cause axial displacement of the latter by means of the spiral groove 35 in the direction of the pressure channel 8 to open the check valve 22, while at the same time closing at least a portion of the mouth 16*a* of the suction channel 16, in order to release the oil under pressure acting against the tappet 3 during lowering of the carrying arms 40 of the lifting truck B. The sealing piston 23 upon closing of the mouth 16*a* of the suction channel 16 prevents return flow of fluid medium from the motor cylinder 9 through pressure channel 8 and suction channel 16 into pump cylinder 7. If such were not the case, there would exist the possibility that fluid medium would enter pump cylinder 7 and the thereby displaced piston 2 could undesirably and rapidly move the operating handle 6, and thus might cause injury to one standing near the jack assembly. Consequently, the provision of a sealing pis-

ton **23** not only serves as a safety measure, but also ensures return of the fluid medium only back into the reservoir **14**.

Operation

The action of the jack assembly A is as follows: Upon downward movement of the truck handle **6** in the direction of the wheels **31**, the driving piston **2** forces the oil or other suitable fluid medium now contained in the piston cylinder **7** through the channel **19** to unseat the check valve **20**, and then through the pressure channel **8** into the tappet chamber **9** to lift the tappet **3** thereby raising the carrying arms **40** of the lifting truck B. Subsequent upward movement of the truck handle **6** initiates the suction stroke of the pump, whereby the upwardly displaced piston **2** draws oil into the piston cylinder **7** from the reservoir **14** via the inclined channel **15**, channel **21**, the suction channel **16** and the suction channel **18**, said channels defining a suction passageway or network for the fluid medium. During the suction stroke of the piston **2**, the check valve **17** is opened by the fluid medium in response to the negative or suction pressure appearing in the piston cylinder **7**. During the pressure or pumping stroke of the piston **2**, the control lever or member **25** is in the position shown in FIGURE 2 with the check release valve **22** in closed condition. If the operator desires to lower the lifted tappet **3** for purposes of unloading the transported goods, actuation of the control lever **25** causes axial displacement of the sealing piston **23** to open the check release valve **22** while simultaneously closing the mouth **16***a* of the suction channel **16**. Consequently, the fluid medium contained in the cylinder sleeve **29** is returned back into the reservoir **14** via the channels **8**, **21** and **15**.

It will thus be readily appreciated that the aforementioned pumping assembly and housing arrangement is readily conducive to efficient and relatively simplified manufacture. All the pressure and suction passageways may be formed in a relatively simple and economical manner by means of drilling suitable borings from externally of the pump housing. Moreover, the pumping arrangement ensures effective venting of the pump cylinder since the pumping piston in its lowermost position prevents formation of undesirable air cushions due to tapering of one end of the piston and its associated cylinder.

Having thus described the invention what is desired to be secured by United States Letters Patent is:

1. In a jack assembly, the combination of a housing including a housing block provided with a pair of vertically extending, spaced and substantially parallel bore means defining respective compartments, a fluid pressurizing member and a fluid actuated member mounted for reciprocatory movement in said respective compartments, sleeve means arranged within said compartment of said fluid actuated member to define an annular reservoir compartment for a fluid medium, said housing block having channel means communicating each of said compartments with one another, said channel means including a pressure and a suction channel lying in a common substantially horizontal plane with respect to at least the lower end of said compartment of said fluid pressurizing member, valve means disposed in said channel means, said valve means comprising a first valve cooperating with said suction channel and opening in the direction of said fluid pressurizing member, a second valve cooperating with said pressure channel and opening away from said fluid pressurizing member, and a release valve cooperating with said pressure channel and adapted to be opened by sealing piston means, said channel means further including a transversely extending channel, said transversely extending channel being provided with displaceable sealing piston means movable in the direction of said pressure channel for obturating one end of said suction channel and opening said release valve to communicate said pressure channel with said annular reservoir, said sealing piston means during lifting operation of said jack assembly being free of said one end of said suction channel, and means operatively connected with said sealing piston means to displace the latter.

2. In a jack assembly, the combination of, a housing including a housing block provided with a pair of vertically extending spaced and substantially parallel bore means defining respective first and second compartments, respective first and second displaceable members mounted for reciprocatory movement in said respective first and second compartments to provide a pump unit and a fluid actuated unit respectively, one end of one of said compartments and one end of its associated displaceable member being provided with a tapered conical portion engageable with one another to prevent formation of an air cushion, said housing block having channel means communicating said respective compartments with one another, said channel means including a first channel and a second channel lying in a common substantially horizontal plane with respect to said tapered conical portion of said one compartment, valve means disposed in said first channel opening away from said pump unit and valve means in said second channel opening toward said pump unit, said channel means further including additional channel means communicating with a low pressure area and one end of said second channel, said additional channel means being provided with displaceable sealing piston means movable in the direction of said first channel for obturating one end of said second channel and opening a releasable valve means to communicate said first channel with said low pressure area, said sealing piston means during lifting operation of said jack assembly being free of said one end of said second channel, and means operatively connected with said sealing piston means to displace the latter.

3. In a jack assembly adapted to be employed in conjunction with a lifting truck; the combination of a housing block provided with first compartment means including upper, intermediate and lower portions and second compartment means including a tapered bottom portion spaced a predetermined distance from said first compartment means with the longitudinal axis of said respective compartment means substantially parallel to one another, a cylinder sleeve carried by said upper and lower portions of said first compartment of said housing block and spaced from the inner walls of said first compartment to define an annular reservoir compartment, a respective displaceable piston element mounted in said cylinder sleeve and said second compartment means for reciprocable movement therein, said piston element in said second compartment means being a fluid pressurizing member and said piston element in said cylinder sleeve being a fluid actuated member, said displaceable piston mounted in said second compartment means and being provided with a tapered end portion which in its lower position snugly seats in said tapered bottom portion of said second compartment means to prevent an air cushion from forming therein, a plug member carried by said lower portion and spaced from one end of said cylinder sleeve to define a cylindrical chamber, said housing being provided with channel means communicating said second compartment means with said annular reservoir compartment and said cylindrical chamber of said first compartment means, said channel means including a pressure channel in registry with said annular second compartment means and said cylindrical chamber disposed adjacent said one end of said cylinder sleeve, said channel means further including a suction channel communicating said reservoir compartment with said second compartment means and substantially parallel to said pressure channel, valve means including inlet and outlet valves in said channel means cooperating with said first and second compartments permitting pressurization of a fluid medium by said fluid pressurizing member and transfer thereof to drive said fluid actuated member, said suction chan-

nel and said pressure channel together with said cylindrical chamber and said tapered bottom portion of said second compartment means lying in a common horizontal plane, said channel means further including additional channel means communicating with said reservoir compartment, and one end of said pressure channel, said additional channel means being provided with a displaceable sealing piston means movable in the direction of said pressure channel for obturating one end of said suction channel and opening a releasable valve means to communicate said pressure channel with said reservoir compartment, said sealing piston means during lifting operation of said jack assembly being free of said one end of said suction channel, and means operatively connected with said sealing piston means to displace the latter.

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