

Aug. 15, 1961

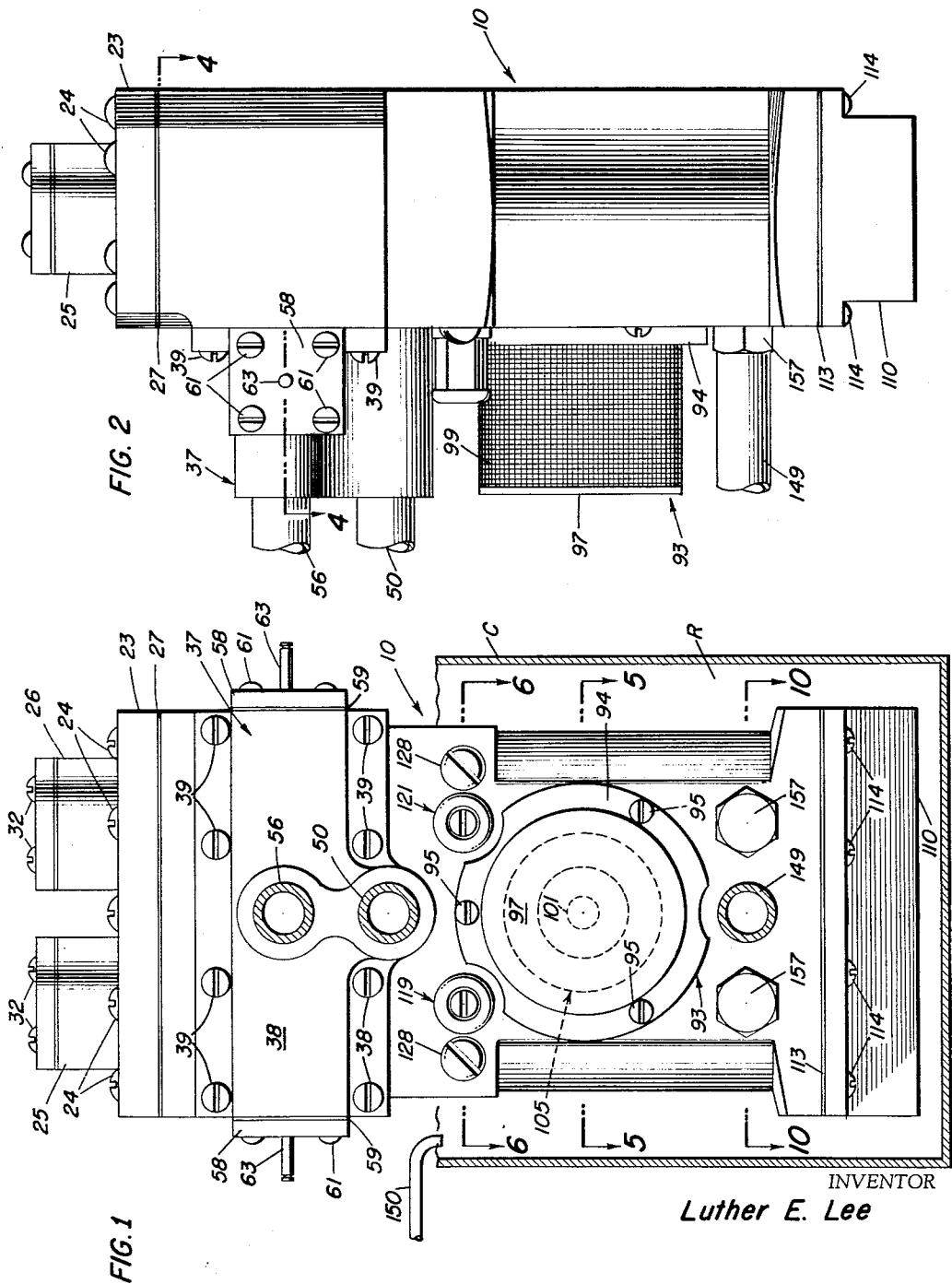
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2,996,014

PUMP

Filed Oct. 30, 1959

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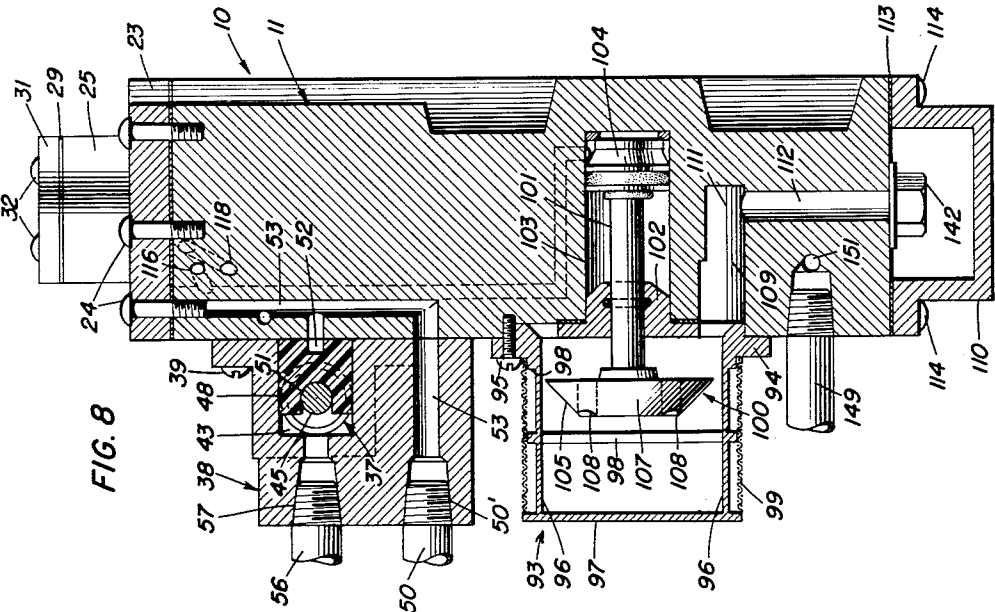


FIG. 8

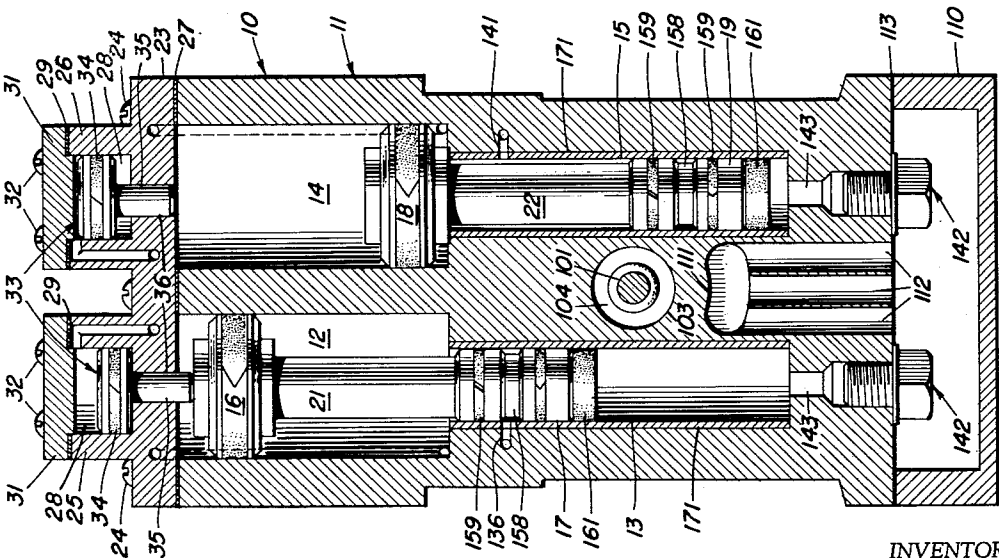


FIG. 7

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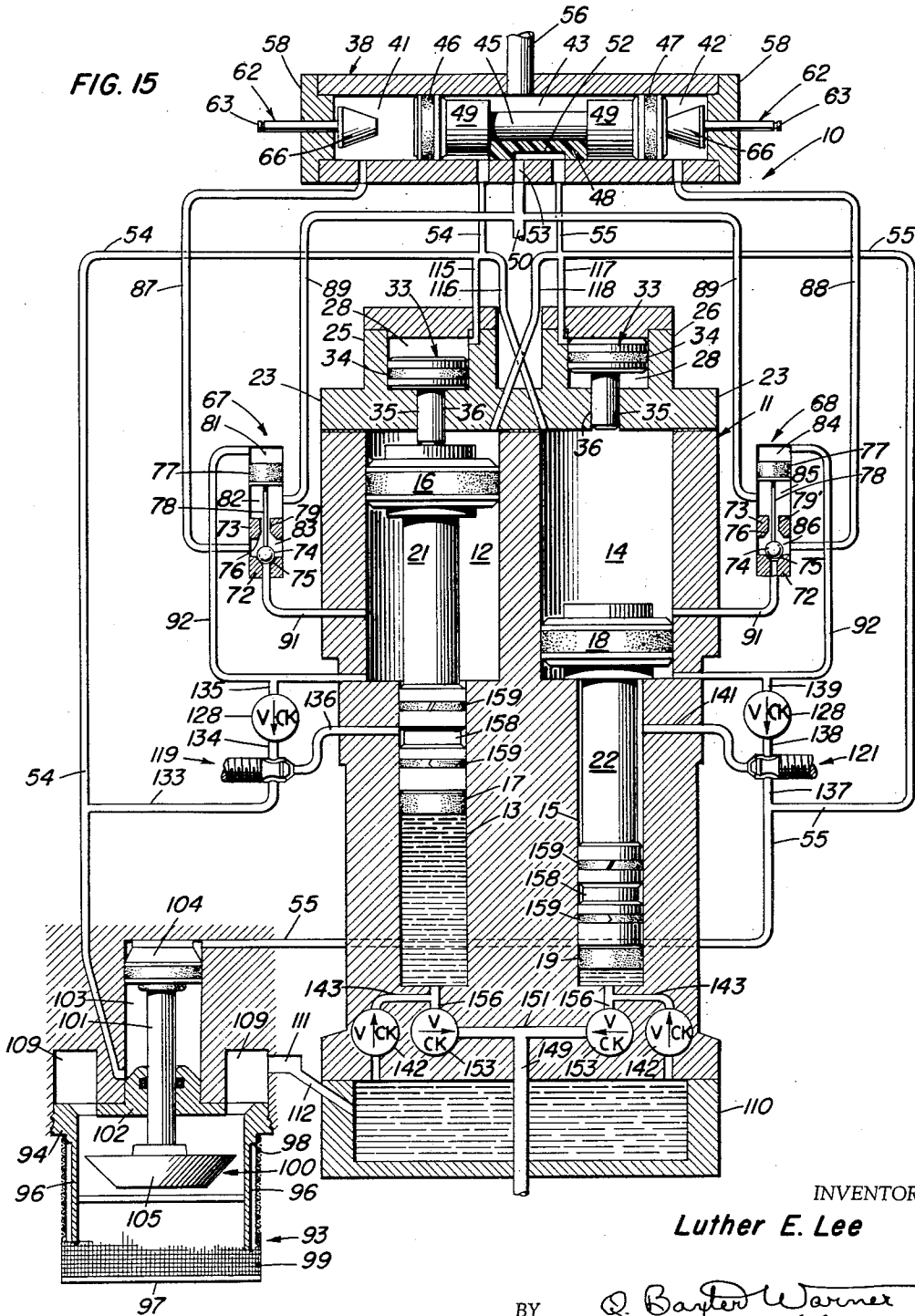
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Filed Oct. 30, 1959

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FIG. 15



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2,996,014
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Filed Oct. 30, 1959, Ser. No. 850,004

11 Claims. (Cl. 103-49)

(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates to a pump and more particularly to a new and improved pump similar to the pump disclosed and claimed in Patent 2,802,424, and is suitable for use with a machine tool such, for example, as a lathe, drill press, milling machine, and deep hole drilling machine for supplying a concentrated directed stream of high velocity pressure fluid onto a cutting tool or within the proximate vicinity thereof during a cutting operation. Moreover the pump is admirably suited for pumping high octane gasoline or other highly inflammable fluids in large quantities under low pressure.

Increased production with superior finish and prolonged tool life have long been objectives sought in the machine tool industry. Thus far, however, each of the above factors have been limited by the other factors involved. For example, prolonged tool life normally requires slower operating speeds, and superior finishes necessitates smaller cuts and therefore reduced production. Thus the attainment of one objective has been achieved only by the loss of another objective. Ordinarily, the actual manual operation time to perform a metal working function is consumed in making a number of adjustments as the work progresses, returning the cutting bit for another cutting stroke, and regrinding and resetting the bit as it wears.

It is contemplated by this invention that by the use of a directed relatively high pressure fluid coolant projected from an appropriately located nozzle to an area immediately proximate the cutting edge of the tool bit and the work, appreciably greater tool life and higher rates of metal working will be realized thus contributing to increased production and greater economy.

An object of the present invention is to provide a new and improved high pressure fuel pump suitable for use with a machine tool or the like.

Another object of the invention is to provide a fluid pressure pump for projecting a coolant fluid under high pressure to the area adjacent the cutting edge of a tool-bit to prolong tool life at increased working rates.

A further object of the invention is to provide a pumping means actuated by low pressure fluid and operative to supply a fluid at the outlet side thereof at relatively high substantially constant pressure.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a view in vertical section of a jacket or container suitable for use with the pump of the present invention, the pump being disposed therein and shown in elevation;

FIG. 2 is a side elevational view of the device of FIG. 1, with the container removed;

FIG. 3 is a plan view of the device of FIG. 2;

FIG. 4 is a transverse sectional view taken on the line 4-4 of FIG. 2;

FIG. 5 is a transverse sectional view taken on the line 5-5 of FIG. 1;

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FIG. 6 is a transverse sectional view taken on the line 6-6 of FIG. 1 with the container removed;

FIG. 7 is a longitudinal sectional view taken on the line 7-7 of FIG. 3;

FIG. 8 is a longitudinal sectional view taken on the line 8-8 of FIG. 3;

FIG. 9 is a longitudinal sectional view taken on the line 9-9 of FIG. 4;

FIG. 10 is a transverse sectional view taken on the line 10-10 of FIG. 1 with the container removed;

FIG. 11 is an enlarged detailed sectional view of the combination pressure operated piston and ball check valve;

FIG. 12 is an enlarged fragmentary detailed sectional view of one end of the differential pistons of the pump construction;

FIG. 13 is an enlarged fragmentary sectional view of one of the adjustable check valves employed in the pump;

FIG. 14 is a view similar to FIG. 11, illustrating an alternate arrangement of the valve of FIG. 11; and

FIG. 15 is a diagrammatic illustration of the pump system of the present invention.

Referring to the drawings, and more particularly to FIG. 1, the numeral 10 generally indicates the pump constructed in accordance with the present invention and adapted to be attached to a conventional engine lathe such, for example, as disclosed in Patent No. 2,854,822, filed January 18, 1955, for Pneumohydraulic-Electric System. Moreover, the pump 10 of the present invention is constructed and arranged to develop a relatively high pressure and to deliver a fluid at high pressure through a system of conduits and control valves to a nozzle assembly mounted on the toolholder of the lathe, the aforesaid nozzle assembly being designed so as to direct the high pressure fluid adjacent the cutting surface of a toolbit at a high velocity and a pressure in excess of 900 p.s.i. to provide and maintain a cooling effect along the vital tool surfaces by removing the generated heat with sufficient promptness to prevent any appreciable heat effects that might injure either the tool or the work.

Furthermore, by providing a reciprocating pump responsive instantaneously to wide fluctuating demands a high pressure machine tool head may be maintained substantially constant throughout the operations so that fluid operated elements on an associated lathe or other apparatus are supplied with sufficient and uniform fluid pressure under varying loads.

The pump 10 comprises a casing or block 11 having axially displaced cylindrical chambers 12, 13, 14 and 15 formed therein, and in which a pair of differential working piston assemblies are slidably retained and reciprocated in response to fluid under pressure. The differential working piston assemblies are provided with low pressure intake pistons 16 and 18 and high pressure discharge pistons 17 and 19 and are arranged so that the pistons will be slidable in a direction parallel to each other when retained in their corresponding cylindrical chambers. A jacket or container C surrounds the pump casing 10, the walls of the container being in spaced relationship with respect to the casing 11 to provide a fluid reservoir R, FIG. 1. Container C, if desired, may be provided with a sight opening whereupon visual inspection of the fluid level within reservoir R may be made. As is more clearly shown on FIGS. 7 and 15 the low pressure pistons are spaced from and connected to the high pressure pistons by elongated piston rods 21 and 22. The piston head surface area of the working pistons 16, 18 and 17, 19 are constructed and arranged so as to transmit as by hydraulic ram action the summation of forces acting upon the relatively large piston head sur-

face areas by a relatively low pressure actuating fluid through the elongated piston rods to the relatively small piston head surface areas to act upon a fluid within the elongated small piston chambers.

A cover or plate member 23 is secured to the upper end of casing 11 as by bolts 24, the cover being provided with a pair of mutually spaced bosses 25 and 26, boss 25 being in alignment with the chamber 12 and boss 26 being in alignment with chamber 14, the chambers being sealed by a gasket 27 disposed between the upper end of the casing 11 and the plate 23. As more clearly shown on FIG. 7, each boss 25 and 26 is provided with a centrally disposed bore or buffer chamber 28, sealed by a gasket 29 and a closure member 31 secured to the bosses as by bolts 32. Disposed within each of the chambers 28 is a buffer or piston element 33 having a piston head 34 slidably disposed within chambers 28 and a stem or shaft 35 slidably disposed within openings 36 formed in plate 23 and extending into chambers 12 and 14, respectively.

As is shown on FIG. 4, a slide valve assembly generally indicated by the reference character 37 and comprising a casing or housing 38 is secured to the block 11, as by bolts 39, the slide valve being constructed and arranged to control low pressure intake and exhaust to the various pressure responsive devices used in the pump construction and which will be hereinafter more fully described. The end of the casing 38 has longitudinally disposed bores or recesses formed therein to provide cylindrical chambers 41 and 42. The central portion of casing 38 is milled out to provide a rectangular fluid inlet plenum chamber 43. Axially movable within the casing 38 is a valve stem 45, the terminal ends thereof carrying pistons 46 and 47, FIGS. 4 and 5. The piston 46 is slidable within chamber 41, and piston 47 is slidable within chamber 42. A throttle or block valve 48 is disposed between a pair of mutually spaced enlarged cylindrical portions 49 formed on the stem 45 and engages the stem by reason of a semicircular groove 51 provided therein, as is best shown on FIG. 8.

The throttle valve 48 is provided with a recess or passageway 52, FIGS. 4 and 15, which straddles the fluid exhaust port or passageway 53 and fluid intake ports or passageways 54 or 55 to exhaust the actuating fluid medium, the fluid medium being supplied to chamber 43 by way of low pressure line 56 in threaded engagement with casing 38, as at 57 and exhausted by way of pipe 50 threaded into casing 38, as at 50'. The throttle valve 48 is movable in first one direction and then in a reverse direction in response to movement of the slide valve 37 during operation of the pump. Therefore, the position of the exhaust port 53 will be disposed in recess 52 of the valve 48, with either the fluid intake port 54 or 55 in communication with the exhaust port 53 during the axial shifting of the valve 48 from one position to the other position. Referring to FIG. 4, the terminal ends of the casing 38 adjacent bores 41 and 42 are sealed by a closure plate 58 and a gasket 59 secured to the casing, as by bolts 61. Each plate 58 carries a buffer or actuating device 62 provided with a stem 63 slidably disposed within centrally disposed bores or guideways 64 formed in plates 58 and sealed by O-rings or the like 65. The stems 63 are provided with heads or buffer elements 66 disposed within bores 41 and 42 respectively, to manually operate the slide valve 37, and to absorb the shock as piston heads 46 and 47 move into engagement therewith during fluid operation of the pump.

As shown in FIGS. 9 and 15, a pair of low pressure fluid control valves generally indicated by the numerals 67 and 68 are disposed within and arranged on each side of casing 11. The valves 67 and 68 are identical in structure and include a pair of mutually spaced inserts or sleeves 72 and 73, a ball check 74 normally being in engagement with a seat 75 formed in sleeve 72 and movable into engagement with seat 76. The valves 67 and 68

further include a piston 77 having a stem 78 adjustably mounted therein and extending through and loosely disposed in a passageway 79 formed in sleeve 73 with the terminal end of the stem in engagement with the ball check 74 to maintain the ball check in engagement with seat 75 and a spring 80 disposed between sleeve 73 and piston 77 to move the piston 77 and stem 78 an amount sufficient to allow the ball check to engage its seat in sleeve 73. Valve 67 operates in a bore formed in casing 11, which bore is provided with chambers 81, 82 and 83, and valve 68 operates in a similar bore formed in the casing 11, this bore being provided with chambers 84, 85 and 86. Chamber 83 in valve 67 is in communication with chamber 82 by way of passageway 79 in sleeve 73, and chamber 86 in valve 68 is in communication with chamber 85 by way of passageway 79' in sleeve 73, as shown in FIG. 15. It will be further noted in FIG. 15 that chamber 83 in valve 67 and chamber 41 in slide valve 37 are connected by a passageway or port 87 and chamber 86 in valve 68 and chamber 42 in slide valve 37 are connected by passageway or port 88. Passageways or vents 89 connect chamber 82 in valve 67 and chamber 85 in valve 68, the aforesaid vents being in communication with the exhaust port 53. Fluid communication between the lowermost end of valve 67 to chamber 12 is established by a passageway 91, and between chamber 81 at the upper end thereof and chamber 12 by a passageway 92, valve 68 being also provided with identical passageways 91-92 to establish fluid communication between the lowermost end of valve 68 and chamber 14 and between chamber 84 at the upper end thereof and chamber 14. As is best illustrated in FIGS. 5 and 8 a filter assembly generally indicated by the reference character 93 is mounted on the casing 11, the filter assembly comprising an annular flange 94 secured to the casing 11, as by bolts 95 and having a plurality of ribs 96 extending outwardly therefrom which support a plate 97 at the terminal end thereof and an annular member 98. Supported by the aforesaid flange 94, annular member 98 and plate 97 and in spaced relation with respect to the ribs 96 is an oil filter device 99, composed of any material suitable for the purpose such, for example, as fine mesh wire screen. The filter assembly 93 further comprises fluid pressure actuated dasher or agitator 100, FIGS. 4 and 8, having a stem 101 slidably arranged in a bearing 102 carried by casing 11 and disposed in alignment with and sealing a bore or chamber 103 formed in the casing. A piston 104 is mounted on one end of the stem 101 and movable within bore 103, the other end of the stem having a fluid agitating member 105 adjustably mounted thereon and disposed within filter 99, the member 105 comprising a bottom wall 106 with an annular inclined wall 107 extending therefrom and provided with a plurality of openings 108. Upon operation of the member 105 the fluid medium within the filter 99 is directed against the filter with sufficient force, by reason of the construction and arrangement of the member 105, to remove and maintain the filter free from all foreign matter.

As shown in FIGS. 8 and 15, the casing 11 is provided with a recess or well 109 which is substantially semicircular, the well bordering on the filter assembly 93 and in communication with reservoir R in container C and with a reservoir 110 by way of passageways 111 and 112 formed in casing 11, the reservoir 110 being sealed and secured to the lower end of casing 11, as by a gasket 113 and bolts 114. It will be understood that during a pumping cycle fluid flows from the reservoir in container C through filter 99 and into reservoir 110.

Turning now to FIG. 15, passageway 54 communicates with the lower end of chamber 103 in casing 11, with one of the buffer chambers 28 provided in cover 23 by way of passageway 115 and with chamber 14 for the working piston 18 by way of passageway 116. Passageway 55 communicates with the upper end of chamber 103 in casing 11, and with the other buffer chamber 28 pro-

vided in cover 23 by way of passageway 117, and with chamber 12 for the working piston 16 by way of passageway 118.

A pair of mutually spaced metering valves 119 and 121 are mounted on casing 11, as best shown on FIG. 6, each valve comprises an adjustable stem 122 in threaded engagement with a nipple or sleeve 123 carried by casing 11 and having an annular groove 124 formed thereon which terminates in a conical valve head 125 disposed in a chamber 126 having a valve seat 127 therein for cooperation with the valve head 125. Spring urged ball check valves 128 are disposed within bores 129 formed in the casing 11 adjacent each of the metering valves 119, the ball checks being normally in engagement with seats 131 and the bores 129 being sealed by plugs or the like 132. Fluid communication is established from passageway 54 to chamber 126 of metering valve 119 by a passageway 133, from chamber 126 to bore 129 by passageway 134, from bore 129 to passageway 92 by a passageway 135, and from chamber 126 to chamber 13 for the working piston 17 by a passageway 136. Fluid communication is established from passageway 55 to chamber 126 of metering valve 121 by a passageway 137, from chamber 126 to bore 129 by a passageway 138, from bore 129 to passageway 91 by a passageway 139, and from chamber 126 of valve 121 to chamber 15 for the working piston 19 by a passageway 141.

Ball checks generally indicated by the numeral 142 are arranged on the lower end of the casing 11, the valves 142 being disposed within the reservoir 110 and in communication with the high pressure working piston cylinders 13 and 15 by fluid intakes or suction passages 143. As more clearly shown on FIG. 13 each of the valves 142 comprises a tubular nipple 144 in threaded engagement with casing 11 and having a ball 145 disposed therein and normally maintained in engagement with a seat 146 by a spring 147, one end of the spring being in engagement with the ball 145 and the other end thereof being in engagement with an apertured plug 148. The desired spring pressure on ball 145 may be obtained by adjusting the plug 148. Furthermore, by the aforesaid intake valve arrangement, it will be understood that the fluid medium, such, for example as oil or the like, is admitted into the high pressure working piston cylinders 13 and 15 during the pumping cycle. It will be understood that the oil may be supplied to the reservoir R in container C in any suitable manner such, for example, as by a pipe 150, FIG. 1.

A fluid outlet pipe 149 is threaded into the casing 11 and communicates with a passageway 151 which in turn communicates with a pair of bores 152. Disposed within each bore 152 is a ball check 153 maintained into engagement with a seat 154 by a spring 155, and adapted to be moved out of engagement with the seat 154 during a pumping cycle to permit oil to be exhausted from cylinders or chambers 13 and 15. The bores 152 communicate with passageways 143 by way of passageways 156 and are sealed by plugs 157, FIG. 10. By the aforesaid outlet valve arrangement, it will be understood that the oil or other suitable fluid medium is discharged from the high pressure working piston cylinders 13 and 14.

It will be noted on FIGS. 7 and 15 that each of the high pressure pistons 17 and 19 is provided with an annular groove 158 and having an O-ring 159 disposed at each side thereof, the O-ring being composed of any material suitable for the purpose such, for example, as Teflon. Each piston is further provided with a cup-shaped member 161, composed of Teflon and having a conical element 162 integrally formed therewith and disposed in a complementary recess 163 formed in the end of the piston, as best shown on FIG. 12. The member 161 is secured to the end of the piston by a bolt 164 in threaded engagement therewith, as at 165 and provided with a head 166 in engagement with a washer 167. Disposed in a conical recess 168 in member 162 is a sealing gasket 169 such, for example, as an O-ring, the O-ring 169 being compressed

by the washer 167 into sealing engagement with the bolt, washer and conical recess as the bolt is threaded into the piston. It will be understood that by the O-ring arrangement 159 and the Teflon cup-shaped member 161 low pressure fluid is prevented from entering low pressure chambers 12 and 14 during a pumping operation.

It will be noted on FIG. 7 that the chambers 13 and 15 are each provided with a sleeve or insert 171 composed of any material suitable for the purpose such, for example, as brass, steel, bronze or the like, the inserts may be removed and larger high pressure pistons may be employed in chambers 13 and 15 in lieu of pistons 17 and 19, if desired.

In the arrangement of FIG. 14 a valve generally indicated by reference character 172 may be employed in lieu of the aforesaid valve 67—68. This valve comprises a piston assembly 173 movable within chambers 170 and having a stem 174 which carries at one end thereof a piston head 175 provided with a ring 176, composed preferably of Teflon, the other end of the stem carries a sealing head 177 provided with an annular penetrating or sealing element 178. Disposed within one end of the aforesaid chambers is a plug or sleeve 179, having a centrally disposed bore 181 extending therethrough in communication with the passageway 91. A sleeve 182 is press-fitted into the bore 181 and carries a seat 183, composed of any material suitable for the purpose such, for example, as Teflon, the annular element 178 on stem 174 being adapted to penetrate the seat 183 an amount sufficiently to provide a sealing connection therebetween in response to a predetermined pressure applied to the piston assembly 173. It will be understood that passageways connecting the valve 172 to the various components of the pump will be similar to passageways 87, 89, 91 and 92, as shown in low pressure control valves 67—68.

Referring now to FIG. 15 for a more complete understanding of the operation of the pump, the reservoir R in container C is provided with a quantity of suitable fluid to be pumped during the pumping cycles. When the slide valve 37 is in the position, as shown on FIG. 15, a suitable low pressure fluid medium, such for example, as compressed air is admitted into the plenum chamber 43 in slide valve 37 by way of inlet line 56. When this occurs pressure from chamber 43 is admitted into chamber 103 in the agitator assembly 100 by way of passageway 54, into the buffer chamber 28 for working piston 16 through passageway 115, into chamber 14 for working piston 18 via passageway 116, into chamber 81 of control valve 67 through passageway 92, and into chamber of working piston 16 by way of passageway 133, metering valve 119 and passageway 136. The pressure to chamber 12 is cut-off when piston 17 reaches the position, as shown in FIG. 15, with the passageway 136 in registration with the groove 158 in piston 17 and sealed-off by rings 159 disposed on each side of the groove 158. When this occurs the aforesaid chambers 103, 28, 14, 81 and that portion of chamber 12 below piston 16 are pressurized. However, that portion of chamber 12 above piston 16 has very little, if any, pressure therein at this time since the pressure previously supplied thereto has been exhausted during upward movement of piston 16 to the position shown in FIG. 15.

During this cycle of operation of the pump, the ball check 74 of control valve 67 is maintained in sealing engagement with seat 75 by the piston and stem arrangement since the pressure in chamber 81 acting on the piston maintains the stem in engagement with the ball check. When the valve 67 is in this position, communication between chamber 41 in the slide valve 37 and chamber 83 in the valve 67 is by way of passageway 87 and communication between chamber 82 in valve 67 and exhaust passageway 53 is by way of passageway or vent 89. It will be further noted that when the working piston 18 is in the position shown on FIG. 15, pressure is exhausted from chamber 12 by way of passageways 118, 55, chamber 52 in the throttle valve 48, port 53 and pipe 50, from

buffer chamber 28 for working piston 18 by way of passageways 117, 55, chamber 52 in throttle valve 48, port 53 and pipe 50, from chambers 14 by way of passageways 92—139, ball check 128, passageways 137—55, chamber 52 in throttle valve 48, port 53, and pipe 50, from chamber 15 by way of passageway 141, metering valve 121, passageways 137—55, chamber 52 in throttle valve 48, port 53 and pipe 50, from chamber 103 of the agitator assembly by way of passageway 55, chamber 52 in throttle valve 52, port 53, and pipe 50, and from chamber 84 in control valve 68 by way of passageways 92—139, ball check 128, passageways 137—55, chamber 52 in throttle valve 48, port 53 and pipe 50.

After the aforesaid exhaust cycle, ball check 74 of control valve 68 is forcibly moved into sealing engagement with seat 76 formed in sleeve 73 by the pressure from chamber 14 as the piston moves beyond passageway 91. When this occurs vent pipe 89 for chamber 85 is sealed-off and thus the pressure is admitted into chamber 42 of slide valve casing 38, forcing the slide valve toward the left. During the movement of the slide valve to the left, the ball check 74 of valve 67 is maintained in sealing engagement with seat 74, whereupon the pressure created by the movement of the slide valve will be exhausted by way of passageway 87, chamber 83, bore 73, chamber 82, passageway 89, chamber 52, port 53 and pipe 50.

When the slide valve has been moved to the left in the aforesaid manner recess 52 in throttle valve 48 bridges exhaust port 53 and passageway 54, and thus a reverse cycle of operation of the pump will occur whereupon piston 16 will be moved in a downward direction and piston 18 will be moved in an upward direction. During this cycle of operation the agitator 101 within chamber 103 of the filter assembly will be moved in a downward direction, ball check 74 in control valve 68 will remain in sealing engagement with seat 75 and ball check 128 will remain closed and thus this cycle of operation is substantially the same as when the slide valve 37 is in the position shown in FIG. 15. During this cycle of operation, however, the passageways formerly used for exhaust lines will now become a low pressure line, and the passageways formerly used for a low pressure line will now become an exhaust line. In other words the pressure and exhaust passageways are alternately shifted from one to the other in response to the movement of slide valve 37 and pistons 16—18 from one position to the other.

During upward movement of piston 17, fluid from reservoir 110 is admitted into chamber 13 by way of check valve 142 and passageway 143 and, concurrently therewith and during downward movement of piston 19, fluid is exhausted from chamber 15 by way of passageway 156, check valve 153, passageway 151 and pipe 149. Upon upward movement of piston 19, fluid from reservoir 110 is admitted into chamber 15 by check valve 142 and passageway 143 and concurrently therewith and during movement of piston 17 fluid is exhausted from chamber 13 by way of passageway 156 and check valve 153.

Fluid is supplied to reservoir 110 by way of recess 109, and passageways 111—112 during the suction strokes of piston 17 and 19, the fluid being thoroughly cleaned as the fluid passes through screw 99. Furthermore, during the pumping operation piston 101 is reciprocated within chamber 103 as pressure is alternately admitted and exhausted therefrom in the aforesaid manner. In response to the movement of piston 101, the agitator disposed within filter screen 99 and having an inclined wall 107 and openings 106 in the bottom wall thereof agitates the fluid sufficiently to prevent foreign matter for collection on the screen thereby to assure a continuous flow of clean fluid into the reservoir 110.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within

the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A fluid operated reciprocating pump comprising: differential working pistons each having selectively proportioned surface areas, said pistons being movable by a low pressure supply fluid to pump a fluid medium to increase the discharge pressure thereof, fluid actuated means operated by said fluid in accordance with the position of said pistons, means including a passageway in communication with said fluid actuated means and each of said working pistons and functioning as an inlet in accordance with the position of said pistons, fluid operated means controlled by said working pistons, said fluid operated means including an additional passageway in communication with each of said working pistons and the fluid actuated means and functioning as an exhaust in accordance with the position of said pistons and fluid operated means, port means in communication with said fluid operated means and said fluid actuated means for venting said fluid operated means in accordance with the position of the pistons and the fluid operated means, filter means carried by the pump and disposed within the fluid medium, and agitating means disposed within the filter means and controlled by said working pistons for agitating the fluid medium an amount sufficient to prevent foreign matter from accumulating on the filter means.

2. A pump according to claim 1, including a fluid actuated buffer means for each of said working pistons, a passageway between said fluid actuated means and buffer means, said passageway functioning as inlet and exhaust line in accordance with the position of said fluid actuated means and the working pistons.

3. A pump according to claim 1, including manually operable shock absorbing means cooperating with said fluid actuated means.

4. A constant pressure fluid pump comprising; a block having a plurality of laterally spaced and selectively proportioned cylinders therein, fluid actuated reciprocating differential working pistons disposed parallel to each other, each of said working pistons having a relatively large low pressure fluid receiving chamber at one end and a relatively small high pressure fluid pumping surface at the other end thereof, a slide valve in fluid driving communication with said pistons to control the sequence of piston reciprocation through the supply and exhaust of the piston actuating fluid, a fluid regulating valve in fluid communication with said high pressure chamber and said slide valve for admitting said low pressure therein, a control valve in fluid communication with said low pressure therein, a control valve in fluid communication with said low pressure chamber and said slide valve for conveying the driving fluid thereto, an exhaust valve in fluid communication with said low pressure chamber, the control valve and said slide valve for exhausting the actuating fluid from said low pressure chamber, a reservoir in said block from which a fluid medium is to be pumped during a pumping operation, a supply passageway in fluid communication with said reservoir and the high pressure cylinders, a discharge passageway in fluid communication with the high pressure chambers and a discharge port, and check valves in said supply and discharge passageways to maintain the flow of the fluid medium in a predetermined path.

5. A constant pressure hydraulic pump comprising; a low pressure fluid supply line, adjustable means disposed in said line for controlling the amount of said fluid flowing therefrom, a housing block with spaced low pressure cylinders therein, low pressure pistons slidably retained for movement in said cylinders, piston rods carried by and extending from said pistons, high pressure cylinders proportionally reduced with respect to said low pressure cylinders, high pressure pistons integrally formed with said rods and slidably retained within said

high pressure cylinders, a jacket forming a reservoir surrounding said housing block, fluid passageways from said reservoir to the high pressure cylinders, check valves in the fluid passageways to direct fluid flow in a predetermined path, slide valve means selectively operated with and fluid actuated through the movement of the alternately reciprocating pistons in the low pressure cylinders, first valve means in fluid communication with said low pressure and the slide valve and operated by said fluid as said low pressure piston moves a predetermined amount for controlling the operation of said slide valve, and second valve means in fluid communication with said low pressure chamber and said slide valve for controlling the exhaust of the fluid from said low pressure cylinder when said low pressure piston has moved said predetermined amount and said first valve means are operated, a passageway interconnecting said first valve means in communication with said slide valve for venting the first valve means as said first valve means are operated, and means on said high pressure pistons alternately admitting and sealing off the low pressure fluid supply line at predetermined intervals during the reciprocation of the pistons.

6. A constant pressure fluid pump comprising: a block having a plurality of laterally spaced and selectively proportioned cylinders therein, fluid actuated reciprocating differential working pistons disposed parallel to each other, each of said working pistons having a relatively large low pressure fluid receiving chamber at one end and a relatively small high pressure fluid pumping surface at the other end thereof, a slide valve in fluid driving communication with said pistons and alternately moved from one position to another position to control the sequence of piston reciprocation through the supply and exhaust of the piston actuating fluid, a fluid regulating valve in fluid communication with said high pressure chamber and said slide valve for admitting low pressure fluid therein, a control valve in fluid communication with said low pressure chamber and the slide valve for conveying the driving fluid thereto, an exhaust valve in fluid communication with the low pressure chamber, the control valve and the slide valve for operation by the low pressure fluid to exhaust the fluid from the low pressure chamber, a reservoir surrounding said block and containing a quantity of fluid therein to be pumped, an inlet passageway in communication with said reservoir and the high pressure chamber, an intake valve in said passageway to maintain the flow of fluid medium constant from said reservoir into said high pressure cylinder during a pumping operation, a discharge passageway in communication with said high pressure chamber, a discharge valve in said discharge passageway to maintain the flow of fluid medium constant from said high pressure cylinder during said pumping operation, and further passageway in fluid communication with the control valve and the slide valve for venting the slide valve as the slide valve is alternately driven from said one position to the other position.

7. A pump according to claim 6, including a buffer chamber, a buffer disposed within said buffer chamber and cooperating with said working pistons to limit the movement thereof in an upwardly direction during said pumping operation, port means in communication with said buffer chamber and said slide valve and controlled thereby to alternately admit and exhaust the actuating fluid from the buffer chamber during said movement of the slide valve from said position to the other position.

8. A constant pressure fluid pump comprising: a block having a plurality of mutually spaced and selectively proportioned cylinders therein, fluid actuated reciprocating differential working pistons disposed parallel to each other, each of said working pistons having a relatively large low pressure fluid receiving chamber at one end and a relatively small high pressure fluid pumping surface at the other end thereof, means including a slide

valve in fluid driving communication with said pistons to control the sequence of piston reciprocation through the supply and exhaust of the piston actuating fluid, adjustable fluid regulating means in fluid communication with said high pressure chamber and said slide valve for controlling the amount of actuating fluid entering said chamber, a control valve in fluid communication with said low pressure chamber for conveying the driving fluid thereto in accordance with the position of said pistons, an exhaust valve in fluid communication with said low pressure chamber, the control valve and said slide valve for exhausting the actuating fluid from the low pressure chamber in accordance with the position of said piston, a container in said block and having a quantity of fluid medium therein and to be pumped therefrom during a pumping operation, a supply passageway in communication with the container and the high pressure cylinders, a discharge passageway in fluid communication with the high pressure chambers and a discharge port, and check valves in said supply and discharge passageways to maintain the flow of the fluid medium in a predetermined path during said pumping operation, and a supply reservoir surrounding said block in fluid communication with said container for supplying said fluid medium to the container during said pumping operation.

9. A pump according to claim 8, including filter means carried by said block and disposed within said fluid medium in the jacket, an agitator carried by said block and slidably arranged within a chamber formed in the block, said agitator being disposed within said filter and reciprocated in response to actuating fluid for agitating said fluid medium in said reservoir an amount sufficiently to remove foreign matter from said filter, passageways in fluid communication with said chamber and the slide valve and controlled by the position of said slide valve for alternately supplying and discharging the actuating fluid from said chamber during reciprocation of said agitator.

10. A pump according to claim 8 wherein said agitator includes a stem slidably disposed in said block and having a piston formed on one end and a fluid agitating member on the other end thereof, said member having an annular inclined wall and a plurality of openings extending therethrough.

11. A constant pressure fluid pump assembly comprising: a source of low pressure fluid, a reservoir containing a quantity of fluid medium to be pumped, a supply means in fluid communication with said reservoir for supplying the fluid medium to be pumped from said reservoir, discharge means for high pressure fluid medium, an exhaust vent including a ball check for venting low pressure fluid, pump means for pumping high pressure fluid medium from said reservoir to the discharge means, valve means in fluid communication with the pump means for alternately connecting the pump means to said source and exhaust vent, means including an additional ball check in fluid communication with the pump means and the valve means for alternately connecting the pump means to said valve means, filter means in fluid communication with the reservoir for cleaning the fluid medium as the fluid medium is pumped from the reservoir by said pump means, and means controlled by said pump means and responsive to said low pressure fluid during the pumping operation for agitating the fluid medium as the fluid medium is pumped from said reservoir thereby to prevent foreign matter from accumulating on the filter means.

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