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F. D. FOOTTIT ET AL

2,346,372

MOTOR PUMP UNIT

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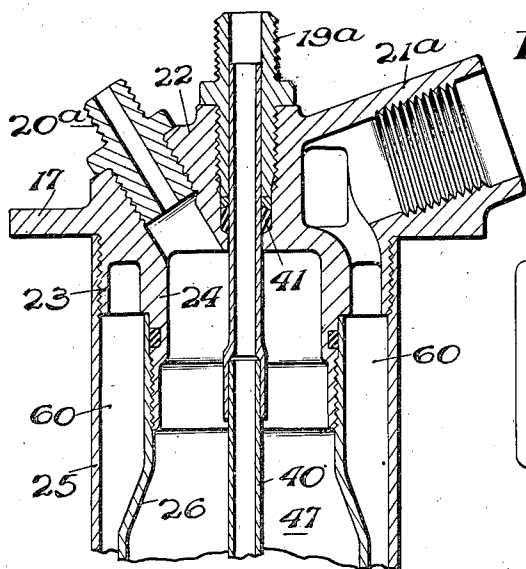


Fig. 3.

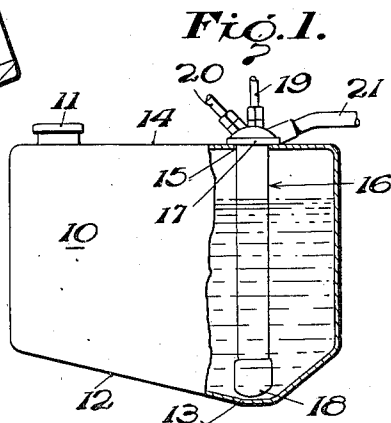


Fig. 1.

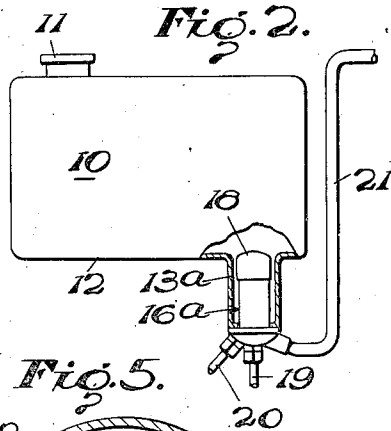


Fig. 2.

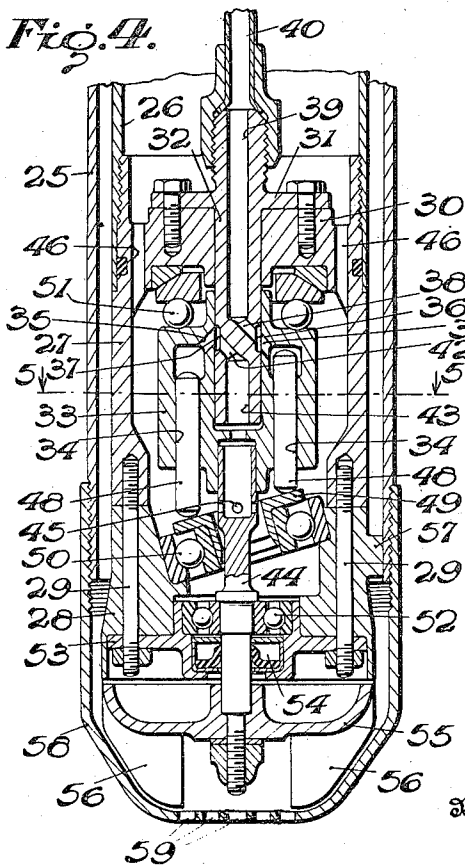


Fig. 4.

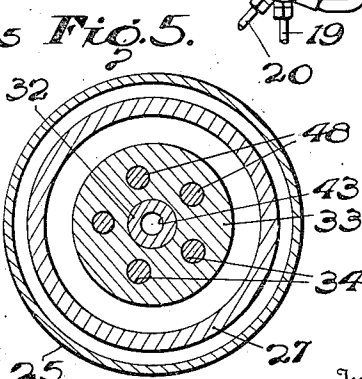


Fig. 5.

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UNITED STATES PATENT OFFICE

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MOTOR PUMP UNIT

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21 Claims. (Cl. 103—37)

This invention relates to motor pump units, and it has for its primary object to provide a simple and compact form of motor pump unit which is reliable and is nevertheless capable of dealing with a large output by comparison with its size.

It is a further object of the invention to provide a hydraulically driven motor pump unit which is suitable for emptying petrol tanks and like liquid containers.

According to the present invention a motor pump unit for operation by pressure fluid comprises in combination a pump having a rotatable driving shaft and a multi-cylinder fluid-operated motor having its cylinders arranged around the axis of said shaft and extending substantially parallel therewith.

There is further provided for removing liquid from a container a motor pump unit comprising in combination a hollow support having at least three mutually independent passages and an inlet opening adjacent the free end for incoming liquid, a multi-cylinder motor arranged to be actuated by pressure fluid fed through one of said passages and to pass the rejected working fluid through another thereof, and a rotary pump driven by the fluid pressure motor, said pump being arranged to deliver under pressure through the third passage the liquid which enters through the inlet opening.

Preferably the fluid pressure motor has an obliquely arranged swash-plate with which slidably engage a series of plunger members extending parallel with the axis of the pump, said plunger members conveniently being slidable within bores formed in a rotatable cylinder block, which latter is coupled with the pump by means of a shaft; a packing gland which surrounds this shaft may serve as the sole means for isolating the liquid to be pumped from the working fluid rejected by the motor. If desired the cylinder block may be rotatable upon a spigot and may form a rotary valve controlling the flow of working fluid into and out of the cylinders of the motor.

The above-mentioned hollow support may comprise an outer tube having a flange or other attachment fitting at one end, and an inlet for the liquid pump at the other, the hydraulic motor conveniently being carried by an inner tube maintained concentrically within the outer tube, so as to provide, between the inner and outer tubes, a passage for the liquid delivered by the pump; a pipe may extend longitudinally through the inner tube to supply pressure fluid to the

motor, the space between the interior of the inner tube and the exterior of the pipe conveniently forming a passage through which rejected working fluid leaves the motor.

The invention is illustrated by way of example in the accompanying drawing, in which:

Figure 1 is a diagrammatic partly-sectioned elevation of a petrol tank or like container having the improved pumping unit extending downwards from its top;

Figure 2 is a similar view with the pump unit fitted within a sump;

Figure 3 is a sectional elevation, to an enlarged scale, showing the upper end of the unit as seen in Figure 1;

Figure 4 is a sectional elevation, also to an enlarged scale, through the motor pump portion of the unit; and

Figure 5 is a sectional plan taken on the line 5—5 of Figure 4.

In the arrangement shown in Figure 1 a petrol tank or like container 10 having a filling cap 11 is shaped so that its bottom 12 slopes downwards towards a locality indicated at 13. The top 14 of the tank is bored at 15 for the reception of a motor pump unit, which is indicated generally at 16 and is of elongated cylindrical shape, so that when a fixing flange 17 is secured to the top 14, the bottom or inlet end 18 of the unit 16 is disposed closely adjacent the locality 13. Pressure liquid or other fluid under pressure is fed through an inlet pipe 19 so as to actuate the motor, which will be hereinafter described, the liquid or other fluid rejected from said motor being allowed to escape through an outlet pipe 20. In the meantime the petrol or equivalent which is drawn in through the intake 18 passes out under pressure through a delivery pipe 21.

In the arrangement shown in Figure 2 the bottom 12 of the tank 10 is formed with a cylindrical sump 13a within which the motor pump unit 16a is mounted in an inverted position, the arrangement being such that the intake 18 is substantially on a level with the bottom 12 of the tank. The inlet and outlet pipes for pressure fluid are again indicated at 19 and 20 and the petrol or equivalent liquid is arranged to be forced through a delivery pipe 21.

The internal construction of the motor pump unit is shown in Figures 3 to 5. The fixing flange 17 is formed upon a metal block 22, which latter has upon its under surface a pair of concentric depending flanges 23 and 24 respectively, these serving for the attachment of an outer tube 25

and an inner tube 26, which extend downwardly (in the embodiment shown in Figure 1) to the motor pump portion of the device illustrated in Figure 4. Thus there is screw-threaded into the lower end of the inner tube 26 an inverted cup-shaped member 27 constituting the upper part of the motor casing, the lower part of said casing being indicated at 28 and being secured to the upper part by studs 29. To the upper wall 30 of the motor casing a plate 31 is secured having a spigot 32 which extends through said wall 30 and projects therefrom to form a bearing for a rotatable cylinder block 33 having a circumferentially arranged series of bores 34 equally spaced around the axis of the spigot 32 and each being parallel with said axis. The general arrangement of the bores 34 is shown more clearly in Figure 5. From the upper end of each of the bores 34 a passageway 35 extends obliquely upwards to provide a port for co-operation with one or other of a pair of arcuate grooves 36 and 37 in that part of the spigot 32 disposed within the cylinder block 33. The groove 36 is for incoming pressure fluid, while the groove 37 is for exhaust fluid, the inner end of each passageway 35 communicating alternately with one or the other of the grooves 36 and 37 as the cylinder block 33 rotates, as is common practice in fluid pressure motors. The inlet groove 36 is connected by a passage 38 with a bore 39 in the upper part of the spigot 32, which bore is connected with a pipe 40 extending longitudinally through the inner tube 26 and through a packing gland 41 in the block 22, to a connection union 19a for the inlet pipe 19. In a similar manner the outlet groove 37 is connected by a passage 42 with a bore 43 in the lower end of the spigot 32 and the exhausted working fluid passes through this, into a hollow driving shaft 44 secured coaxially to the cylinder block 33 and then into the interior of the motor casing 27, 28 through one or more radial passages 45 formed in said shaft 44. The exhausted liquid can thence flow upwards through passages 46 in the circular wall 30 and reach the space 47 between the pipe 40 and the interior of the inner tube 26; the fluid then escapes through a union fitting 20a to the outlet pipe 20.

Each of the bores 34 in the rotatable cylinder block 33 is fitted with a slidable plunger rod 48, the lower end of which is rounded to engage slidably with a swash-plate disc 49 carried by a ball bearing 50, the outer race of which is mounted obliquely in the lower part 28 of the motor casing. The swash-plate disc 49 is thus able to rotate freely, but it is maintained at all times in its predetermined oblique plane. In order to reduce friction due to the upward thrust of the working fluid upon the cylinder block 33 a thrust ball bearing, indicated at 51, of the self-aligning type is interposed between the upper surface of the cylinder block 33 and the circular wall 30.

The driving shaft 44 which is secured to the cylinder block 33 extends downwards through the swash-plate disc 49 and the ball bearing 50 and runs in a ball bearing 52 secured in the lower part 28 of the motor casing by means of a plate fitting 53. The plate fitting 53 also carries a sealing device or gland 54 of the "hat-leather" type designed to prevent the flow of fluid along the shaft 44 in a downward direction. To the lower end of the shaft 44 is secured a pump impeller in the form of a domed disc 55 having a series of impeller blades 56 formed on its lower surface.

The outer tube 25, which is arranged to extend

downwards to a position adjacent the lower end of the motor casing 27, 28, is maintained truly concentric with respect to said casing by three or more equally spaced radial projections, one of which is indicated at 57. The lower end of the outer tube 25 is fitted with a domed cap 58, which fits with only slight clearance around the edges of the impeller blades 56, the central portion of said cap being formed with a group of relatively small inlet openings indicated at 59. Thus, owing to the centrifugal action of the blades 56, petrol or like liquid enters through the openings 59 constituting the intake 18 and is delivered in an upward direction through the converging passageway between the cap 58 and the upturned periphery of the impeller disc 55, said liquid thence flowing through the space 60 between the outer tube 25 and the inner tube 26 and so reaching an outlet connection 21a to which the delivery pipe 21 is attached. Thus when the unit has its lower end immersed in liquid, as shown in Figure 1, and pressure liquid or other fluid is fed through the inlet pipe 19, said fluid passes through the inlet groove 36, and entering the appropriate cylinders 34 causes the cylinder block to rotate owing to the action of the oblique swash-plate disc 49, the rejected fluid being expelled into the motor casing 27, 28 and being returned to the outlet by way of the space 47. It will therefore be seen that the sealing device or gland 54 can be of an exceptionally light nature, for the pressure of the rejected liquid within the motor casing 27, 28 is only very little greater in normal circumstances than the pressure head of petrol or equivalent acting upon the underneath of the seal or gland 54. Indeed, where the unit is used in a petrol tank and is operated by the liquid normally used by hydraulic control systems, it has been found that a slight leakage of hydraulic liquid into the petrol is quite harmless. It will be seen that as a result of the light nature of the seal or packing gland 54 very little power is wasted and the device is therefore quite efficient.

The lengths of the outer and inner tubes 25 and 26 and of the pipe 40 can be readily arranged to produce units of any desired length, depending upon the depth of the petrol tank or equivalent, or upon the depth at which it is required to position the intake 18. In order to arrange the unit in the manner shown in Figure 2 the tubes 25 and 26 and the pipe 40 are of such length that the motor casing 27, 28 is disposed closely adjacent the flange 17, the device in this instance, of course, running in an inverted position with the motor casing 27, 28 disposed below the pump impeller 55, 56. Whatever the direction of operation it will be seen that the unit is of relatively small cross-sectional area and thus requires only a hole of corresponding size to be formed in the petrol tank or equivalent for the installation of the unit.

It will of course be understood that the construction which has been described is given by way of example and that the invention may be carried into effect in different ways. For instance, other types of pumps, such as the eccentric vane type or the gear wheel type of pump, may be used, and it is conceivable that the device may be employed for pumping gases. Moreover the motor, if desired, may be driven pneumatically. In certain cases a filter can be incorporated in the unit, conveniently within the annular space between the tubes 25 and 26 of the hollow support, thus filtering the petrol or equivalent before it reaches the delivery pipe.

The invention thus provides an exceptionally compact, efficient and robust form of fluid pressure operated pumping unit which is particularly suitable for installation upon air and other craft.

What we claim is:

1. For removing liquid from a container, a motor pump unit comprising in combination a hollow support having at least three mutually independent passages and an inlet opening adjacent the free end for incoming liquid, a multi-cylinder motor arranged to be actuated by pressure fluid fed through one of said passages and to pass the rejected working fluid through another thereof, and a rotary pump driven by the fluid pressure motor, said pump being arranged to deliver under pressure through the third passage the liquid which enters through the inlet opening.

2. A motor pump unit of the type which is operable by fluid from a pressure source; comprising a hollow support having at least three mutually independent passages and an inlet opening adjacent the free end for incoming liquid, a multi-cylinder motor arranged to be actuated by fluid fed through one of said passages and to pass exhaust fluid through another thereof, said motor including a series of plungers mounted for reciprocation in said cylinders, a swash plate obliquely mounted on the support and adapted to impart rotation to the motor upon reciprocation of said plungers, and a rotary pump adapted to be driven by the motor for delivering under pressure through the third passage the liquid which enters the inlet opening.

3. A motor pump unit of the type which is operable by fluid from a pressure source; comprising a hollow support having at least three mutually independent passages and an inlet opening adjacent the free end for incoming liquid, a multi-cylinder motor arranged to be actuated by fluid fed through one of said passages and to pass exhaust fluid through another thereof, said motor including a rotatable cylinder block having a series of plungers mounted for reciprocation in said cylinders, a swash plate obliquely mounted on the support and adapted to impart rotation to the motor upon reciprocation of said plungers, and a rotary pump adapted to be driven by the motor for delivering under pressure through the third passage the liquid which enters the inlet opening.

4. A motor pump unit of the type which is operable by fluid from a pressure source; comprising a hollow support having at least three mutually independent passages and an inlet opening adjacent the free end for incoming liquid, a multi-cylinder motor arranged to be actuated by fluid fed through one of said passages and to pass exhaust fluid through another thereof, said motor including a series of plungers mounted for reciprocation in said cylinders, a swash plate obliquely mounted on the support and adapted to impart rotation to the motor upon reciprocation of said plungers, a rotary pump adapted to be driven by the motor and connected thereto by a shaft, and a packing gland surrounding the shaft and held by the support for separating the exhaust fluid from the delivery under pressure through the third passage of liquid which enters the inlet opening.

5. A motor pump unit of the type which is operable by fluid from a pressure source; comprising a hollow support having at least three mutually independent passages and an inlet opening adjacent the free end for incoming liquid, a multi-cylinder motor arranged to be actuated by

fluid fed through one of said passages and to pass exhaust fluid through another thereof, said motor including a rotatable cylinder block having a series of plungers mounted for reciprocation in said cylinders, a swash plate obliquely mounted on the support and adapted to impart rotation to the motor upon reciprocation of said plungers, a rotary pump adapted to be driven by the pump and connected thereto by a shaft, and a packing gland surrounding the shaft and held by the support for separating the exhaust fluid from the delivery under pressure through the third passage of liquid which enters the inlet opening.

6. A motor pump unit of the type which is operable by fluid from a pressure source; comprising a hollow support having at least three mutually independent passages and an inlet opening adjacent the free end for incoming liquid, a multi-cylinder motor arranged to be actuated by fluid fed through one of said passages and including a rotatable cylinder block having a series of plungers mounted for reciprocation in said cylinders, a spigot connected to the entrance passage and held by the support for forming a journal for the rotatable cylinder block and for forming a valve controlling the flow of actuating fluid to the cylinders, a swash plate obliquely mounted on the support and adapted to impart rotation to the motor upon reciprocation of said plungers, and a rotary pump adapted to be driven by the motor for delivery under pressure through the third passage the liquid which enters the inlet opening.

7. A motor pump unit of the type which is operable by fluid from a pressure source; comprising a hollow support having at least three mutually independent passages and an inlet opening adjacent the free end for incoming liquid, a multi-cylinder motor arranged to be actuated by fluid fed through one of said passages and including a rotatable cylinder block having a series of plungers mounted for reciprocation in said cylinders, a spigot connected to the entrance passage and held by the support for forming a journal for the rotatable cylinder block and for forming a valve controlling the flow of actuating fluid to the cylinders, a swash plate obliquely mounted on the support and adapted to impart rotation to the motor upon reciprocation of said plungers, and a rotary pump of the centrifugal vaned impeller type adapted to be driven by the motor for delivery under pressure through the third passage the liquid which enters the inlet opening.

8. A motor pump unit of the type which is operable by fluid from a pressure source; comprising a hollow support having at least three mutually independent passages and including a pair of concentric flanges depending therefrom, a multi-cylinder motor arranged to be actuated by fluid fed through one of said passages and to pass exhaust fluid through a second passage and enclosed in a tube secured to the inner of said concentric flanges, said motor including a series of plungers mounted for reciprocation in said cylinders, a swash plate obliquely mounted in the unsecured end of said tube and adapted to impart rotation to the motor upon reciprocation of said plungers, an outer tube concentric with the inner tube for enclosing a rotary pump driven by said motor and secured to the outer flange and connecting an inlet opening in said outer tube with the third passage in said support, said pump being adapted to deliver under pressure through

the third passage the liquid which enters the inlet opening.

9. The invention as defined in claim 8, wherein a pipe extends longitudinally through the inner tube to supply actuating fluid to the motor and the inner tube is connected to the second passage to pass the exhaust fluid from said motor.

10. A motor pump unit of the type which is operable by fluid from a pressure source; comprising a hollow support having at least three mutually independent passages and an inlet opening adjacent the free end for incoming liquid, a multi-cylinder motor arranged to be actuated by fluid fed through one of said passages and to pass exhaust fluid through another thereof, said motor including a series of plungers mounted for reciprocation in said cylinders, a swash plate obliquely mounted on the support and free to rotate in its oblique plane and adapted to impart rotation to said motor upon reciprocation of said plungers, a rotary pump adapted to be driven by the motor for delivering under pressure through the third passage the liquid which enters the inlet opening.

11. A motor pump unit of the type which is operable by fluid from a pressure source; comprising a hollow support having at least three mutually independent passages and an inlet opening adjacent the free end for incoming liquid, a multi-cylinder motor arranged to be actuated by fluid fed through one of said passages and to pass exhaust fluid through another thereof, said motor including a rotatable cylinder block having a series of plungers mounted for reciprocation in said cylinders, a swash plate obliquely mounted on the support and free to rotate in its oblique plane and adapted to impart rotation to the motor upon reciprocation of said plungers, and a rotary pump adapted to be driven by the motor for delivering under pressure through the third passage the liquid which enters the inlet opening.

12. A motor pump unit of the type which is operable by fluid from a pressure source; comprising a hollow support having at least three mutually independent passages and an inlet opening adjacent the free end for incoming liquid, a multi-cylinder motor arranged to be actuated by fluid fed through one of said passages and to pass exhaust fluid through another thereof, said motor including a series of plungers mounted for reciprocation in said cylinders, a swash plate obliquely mounted on the support and free to rotate in its oblique plane and adapted to impart rotation to said motor upon reciprocation of said plungers, a rotary pump, a shaft connecting said pump to said motor and passing through an opening in said swash plate and a packing gland held in said support intermediate the swash plate and the pump for separating exhaust fluid from the delivery under pressure through the third passage of liquid which enters the inlet opening.

13. A motor pump unit of the type which is operable by fluid from a pressure source; comprising a hollow support having at least three mutually independent passages and an inlet opening adjacent the free end for incoming liquid, a multi-cylinder motor arranged to be actuated by fluid fed through one of said passages and to pass exhaust fluid through another thereof, said motor including a rotatable cylinder block having a series of plungers mounted for reciprocation in said cylinders, a swash plate obliquely mounted

on the support and free to rotate in its oblique plane and adapted to impart rotation to said motor upon reciprocation of said plungers, a rotary pump, a shaft connecting said pump to said motor and passing through an opening in said swash plate and a packing gland held in said support intermediate the swash plate and the pump for separating exhaust fluid from the delivery under pressure through the third passage of liquid which enters the inlet opening.

14. A motor pump of the type which is operable by fluid from a pressure source; comprising a hollow support having at least three mutually independent passages and an inlet opening adjacent the free end for incoming liquid, a multi-cylinder motor arranged to be actuated by fluid fed through one of said passages and to pass exhaust fluid through another thereof, said motor including a series of plungers mounted for reciprocation in said cylinders, a swash plate obliquely mounted on the support and free to rotate in its oblique plane and adapted to impart rotation to the motor upon reciprocation of said plungers, a rotary pump adapted to be driven by the motor and connected thereto by a shaft, and a packing gland surrounding the shaft and held by the support for separating the exhaust fluid from the delivery under pressure through the third passage of liquid which enters the inlet opening.

15. A motor pump unit of the type which is operable by fluid from a pressure source; comprising a hollow support having at least three mutually independent passages and an inlet opening adjacent the free end for incoming liquid, a multi-cylinder motor arranged to be actuated by fluid fed through one of said passages and to pass exhaust fluid through another thereof, said motor including a rotatable cylinder block having a series of plungers mounted for reciprocation in said cylinders, a swash plate obliquely mounted on the support and free to rotate in its oblique plane and adapted to impart rotation to the motor upon reciprocation of said plungers, a rotary pump adapted to be driven by the pump and connected thereto by a shaft, and a packing gland surrounding the shaft and held by the support for separating the exhaust fluid from the delivery under pressure through the third passage of liquid which enters the inlet opening.

16. A motor pump unit of the type which is operable by fluid from a pressure source; comprising a hollow support having at least three mutually independent passages and an inlet opening adjacent the free end for incoming liquid, a multi-cylinder motor arranged to be actuated by fluid fed through one of said passages and including a rotatable cylinder block having a series of plungers mounted for reciprocation in said cylinders, a spigot connected to the entrance passage and held by the support for forming a journal for the rotatable cylinder block and for forming a valve controlling the flow of actuating fluid to the cylinders, a swash plate obliquely mounted on the support and free to rotate in its oblique plane and adapted to impart rotation to the motor upon reciprocation of said plungers, and a rotary pump adapted to be driven by the motor for delivery under pressure through the third passage the liquid which enters the inlet opening.

17. A motor pump unit of the type which is operable by fluid from a pressure source; comprising a hollow support having at least three mutually independent passages and an inlet open-

ing adjacent the free end for incoming liquid, a multi-cylinder motor arranged to be actuated by fluid fed through one of said passages and including a rotatable cylinder block having a series of plungers mounted for reciprocation in said cylinders, a spigot connected to the entrance passage and held by the support for forming a journal for the rotatable cylinder block and for forming a valve controlling the flow of actuating fluid to the cylinders, a swash plate obliquely mounted on the support and free to rotate in its oblique plane and adapted to impart rotation to the motor upon reciprocation of said plungers, and a rotary pump of the centrifugal vaned impeller type adapted to be driven by the motor for delivery under pressure through the third passage the liquid which enters the inlet opening.

18. A motor pump unit of the type which is operable by fluid from a pressure source; comprising a hollow support having at least three mutually independent passages and including a pair of concentric flanges depending therefrom, a multi-cylinder motor arranged to be actuated by fluid fed through one of said passages and to pass exhaust fluid through a second passage and enclosed in a tube secured to the inner of said concentric flanges, said motor including a series of plungers mounted for reciprocation in said cylinders, a swash plate obliquely mounted in the unsecured end of said tube and free to rotate in its oblique plane and adapted to impart rotation to the motor upon reciprocation of said plungers, an outer tube concentric with the inner tube for enclosing a rotary pump driven by said motor and secured to the outer flange and connecting an inlet opening in said outer tube with the third passage in said support, said pump being adapted to deliver under pressure through the third passage the liquid which enters the inlet opening.

19. The invention as defined in claim 18, wherein a pipe extends longitudinally through the inner tube to supply actuating fluid to the motor and the inner tube is connected to the second passage to pass the exhaust fluid from said motor.

20. A motor pump unit of the type which is operable by fluid from a pressure source; com-

prising a hollow support having at least three mutually independent passages and an inlet opening adjacent the free end for incoming liquid, a multi-cylinder motor arranged to be actuated by fluid fed through one of said passages and including a rotatable cylinder block having a series of plungers mounted for reciprocation in said cylinders, a spigot connected to the entrance passage and held by the support for forming a journal for the rotatable cylinder block and for forming a valve controlling the flow of actuating fluid to the cylinders, a swash plate obliquely mounted on the support and adapted to impart rotation to the motor upon reciprocation of said plungers, a rotary pump adapted to be driven by the motor for delivery under pressure through the third passage the liquid which enters the inlet opening, and a packing gland held by said support for separating the exhaust fluid from the delivery under pressure through the third passage of liquid which enters the inlet opening.

21. A motor pump unit of the type which is operable by fluid from a pressure source; comprising a hollow support having at least three mutually independent passages and an inlet opening adjacent the free end for incoming liquid, a multi-cylinder motor arranged to be actuated by fluid fed through one of said passages and including a rotatable cylinder block having a series of plungers mounted for reciprocation in said cylinders, a spigot connected to the entrance passage and held by the support for forming a journal for the rotatable cylinder block and for forming a valve controlling the flow of actuating fluid to the cylinders, a swash plate obliquely mounted on the support and adapted to impart rotation to the motor upon reciprocation of said plungers, a rotary pump of the centrifugal vaned impeller type adapted to be driven by the motor for delivery under pressure through the third passage the liquid which enters the inlet opening, and a packing gland held in said support for separating the exhaust fluid from the delivery under pressure through the third passage of liquid which enters the inlet opening.

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