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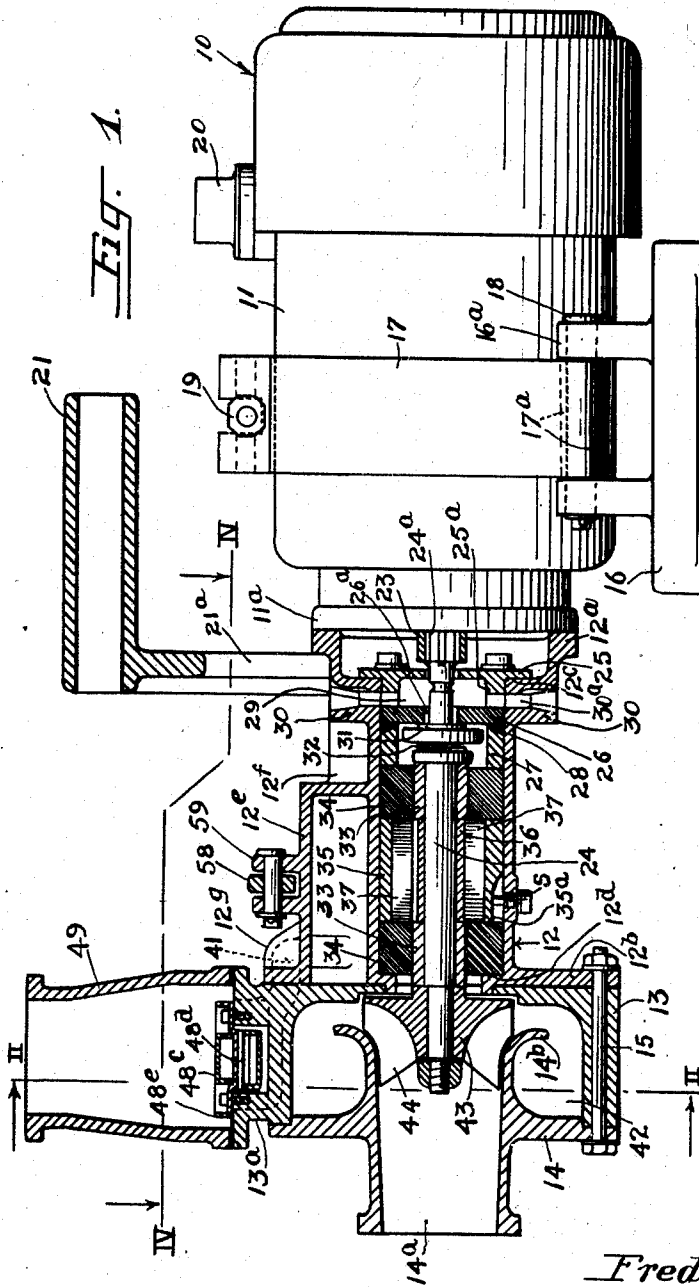
F. W. HECKERT ET AL

2,430,337

SELF-PRIMING PUMP

Filed March 25, 1944

3 Sheets-Sheet 1



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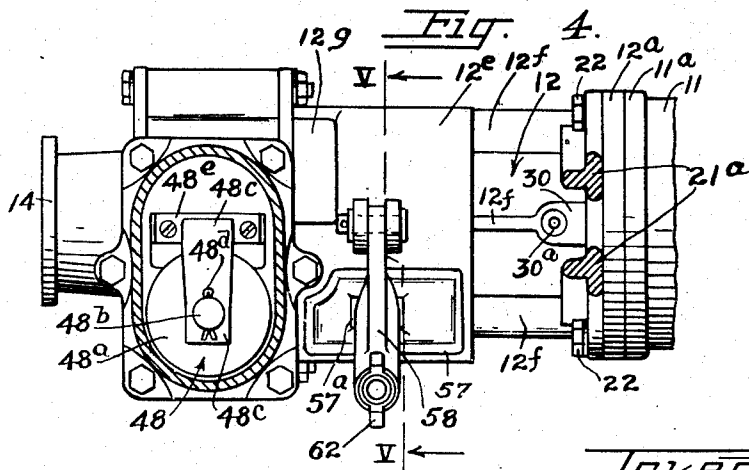
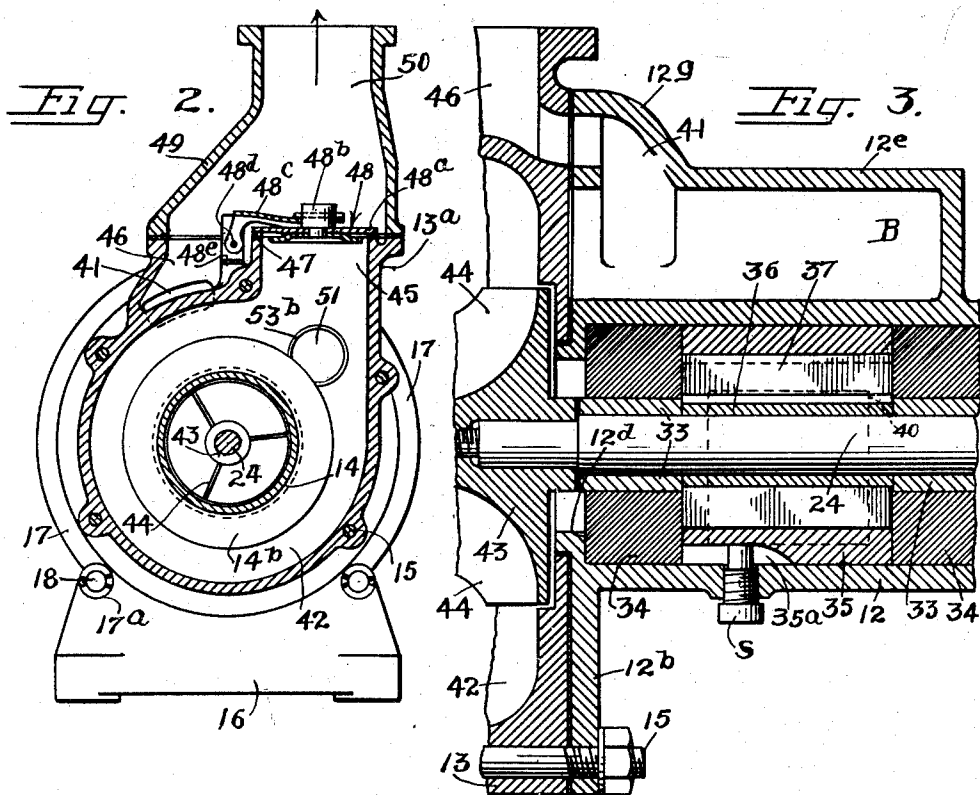
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3 Sheets-Sheet 2



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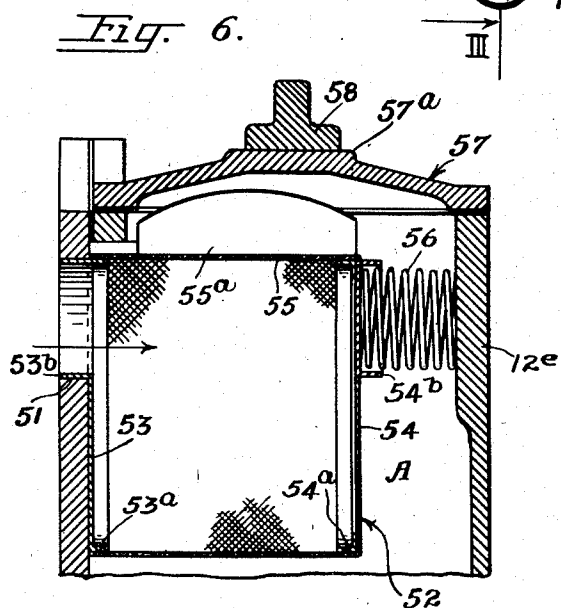
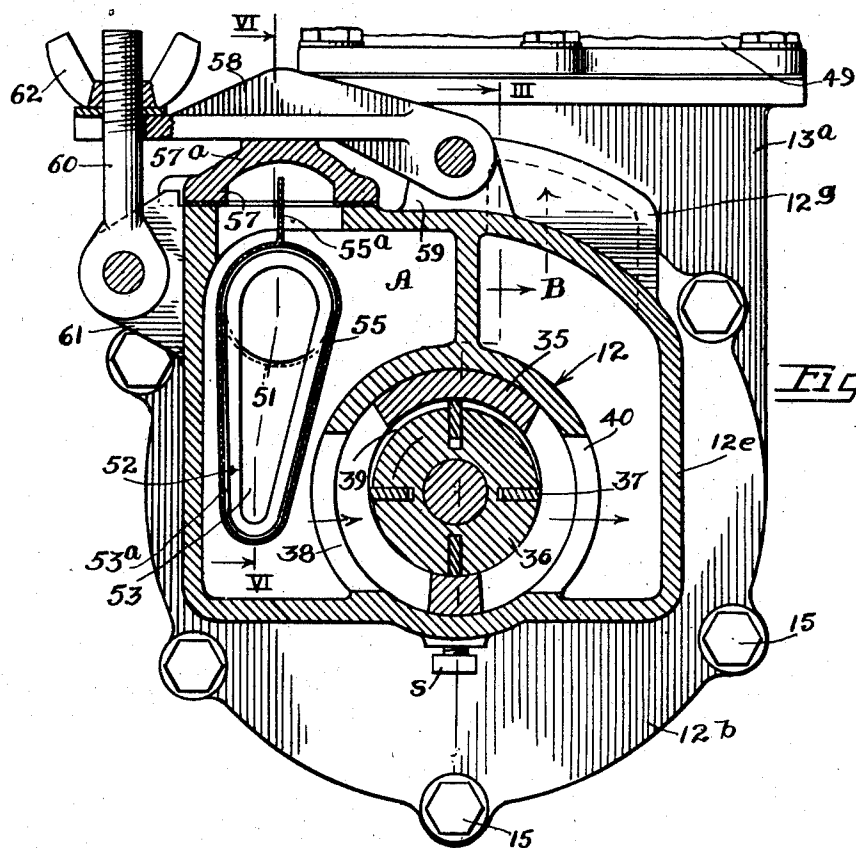
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,430,337

SELF-PRIMING PUMP

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9 Claims. (Cl. 103—113)

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This invention relates to a self-priming pump containing a centrifugal pump assembly and a positive displacement pump assembly for priming the centrifugal pump assembly.

Specifically the invention deals with a compact, portable electric motor driven self-priming fuel servicing pump especially well adapted for the rapid refueling or defueling of aircraft.

The invention will be hereinafter specifically described as embodied in a portable pump and motor unit that is compact but operates at high speed and has high delivery capacity, but it should be understood that the principles of the invention are applicable to pumps for other purposes including fixed permanently mounted pumps.

Refueling and defueling of aircraft, especially military aircraft, must frequently be accomplished at places where regulation pumping equipment is not available. Therefore, a compact, lightweight pump and motor unit adapted to be driven by the batteries of an airplane, and carried in the airplane as an accessory, is highly desirable.

Centrifugal pumps can be driven at very high speed and will have a higher delivery capacity than a positive displacement pump of corresponding size and weight. However, centrifugal pumps do not have material suction capacity unless the pumping chambers thereof are filled with liquid. Such pumps must therefore either be primed or receive liquid under pressure or hydraulic head.

To remedy the defects of high capacity centrifugal pump assemblies, the present invention provides a positive displacement pump for priming the centrifugal pump. The rotor of the positive displacement pump is preferably mounted on the same shaft carrying the impeller of the centrifugal pump. Since the positive displacement pump is only intended as a primer, it need not have high pumping capacity and therefore can be made very small and light in weight.

It is, thus, an object of the invention to provide a small, compact lightweight self-priming pump and motor unit especially suited as an aircraft accessory for fueling and defueling of the aircraft fuel tanks.

A further object of the invention is to provide an electric motor and pump unit wherein a single shaft carries the rotor of a positive displacement priming pump and the impeller of a centrifugal pump.

A still further object of the invention is to provide a pump and motor unit wherein a centrifugal pump has a central inlet and an annular

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pumping chamber with an impeller capable of drawing liquid through the inlet and centrifugally discharging the liquid through the pumping chamber into an outlet, and wherein the pumping chamber is primed by means of an adjacent rotary vane type pump.

Another object of the invention is to provide a multiple pump unit wherein the pumping chamber of one pump is primed by an adjacent pump.

A still further object of the invention is to provide a self-priming centrifugal pump and motor unit.

A specific object of the invention is to provide a compact, portable electric motor—positive displacement primer pump—centrifugal type main pump unit having high capacity.

A still further object of the invention is to provide a high speed self-priming pump assembly wherein a rotary vane type pump operates with a centrifugal pump of greater capacity and serves to prime the centrifugal pump.

Other and further objects of the invention will be apparent to those skilled in the art from the following detailed descriptions of the annexed sheets of drawings, which illustrate a preferred embodiment of the invention.

On the drawings:

Figure 1 is a longitudinal vertical cross-sectional view with parts in side elevation, of a portable self-priming pump and motor unit according to this invention.

Figure 2 is a transverse vertical cross-sectional view, with parts in elevation, taken along the line II—II of Figure 1.

Figure 3 is a fragmentary enlarged vertical cross-sectional view of a portion of the pump assembly taken along the line III—III of Figure 5.

Figure 4 is a horizontal cross-sectional view, with parts in plan, taken along the line IV—IV of Figure 1.

Figure 5 is an enlarged vertical cross-sectional view, with parts in end elevation, taken along the line V—V of Figure 4.

Figure 6 is a fragmentary vertical cross-sectional view taken along the line VI—VI of Figure 5.

As shown on the drawings:

In Figure 1 the reference numeral 10 designates generally a portable, self-priming pump and electric motor unit including an electric motor casing 11 with a flanged end 11a, a positive displacement pump casing 12 having a flanged end 12a secured to the portion 11a of the motor casing 11, a centrifugal pump casing

13, and a cover 14 for the casing bolted to a flange 12b of the casing 12 by means of thru bolts 15.

A cradle 16 supports the unit 10 and is secured to the motor casing 11 by means of a band 17 having eye ends such as 17a receiving pins 18 passed through legs 16a of the cradle 16 and carrying a clamping nut and bolt assembly 19 at the top end thereof for drawing the band 17 tight around the casing 11 to secure the cradle 16 on the casing. A plug housing 20 is provided on the casing 11 to receive an energizing wire for the electric motor in the casing (not shown).

A carrying handle 21 has a pair of legs 21a (Fig. 4) depending therefrom in front of the flange 12a of the casing 12 and secured to the unit by means of screws 22 which extend through the flange 12a into the flange 11a to also connect the casing 12 onto the casing 11.

As shown in Figure 1, the motor in the casing 11 has a drive shaft with an internally splined socket head 23 receiving an externally splined head 24a of a pump shaft 24. This pump shaft 24 extends completely through the casing 12 into the casing 13.

The casing 12 has an end face 12c receiving thereagainst the flange of a cap member 25 through which the pump shaft projects. This cap member 25 has a pilot portion 25a fitting into the cylindrical part of the casing 12 and abutting a graphic carbon seal disk or ring 26 in the casing. A liner sleeve 27 is disposed in the casing and holds a packing ring or gasket 28 against a face of the disk 26 to seal the disk around the periphery thereof in the casing 12.

As shown in Figure 1, the disk 26 has a bore 26a therethrough through which the shaft freely projects and a chamber 29 is provided receiving the shaft therethrough between the disk 26 and the end cap 25. Top and bottom bosses 30 are provided on the casing 12 adjacent the flanged end 12a thereof and the pilot portion 25a of the end cap and these bosses 30 are bored to provide ports 30a for draining the chamber 29 in the event that gasoline leaks past the seal disk 26.

A rotating seal member 31 is mounted on the shaft 24 and is urged by a spring 32 into sliding sealing contact with the disk 26.

The shaft 24 has bushings 33 therearound riding in plain carbon bearings 34 which are seated in the cylindrical part of the casing and held in spaced opposed relation by a liner sleeve 35. This liner sleeve 35 is held against rotation in the casing by means of a locking pin S which extends into an axial slot 35a in the outer face of the sleeve. The shaft 24 is thus rotatably mounted in the bearings 34. It will be noted that the casing 12 has an end wall or shoulder 12d receiving a bearing 34 thereagainst, and that the liner 35 holds the other bearing 34 in proper spaced relation from the first bearing. The spacer sleeve 27 is bottomed on the second bearing 34 and the seal disk 26 is bottomed by the spacer sleeve. Therefore the pilot portion 25a of the end cap, in thrusting against the disk 26, serves to hold all of the internal pump parts in the casing, in proper thrusting relation with each other.

The shaft 24 has a slotted rotor 36 secured thereon between the bearings 34 and pumping vanes 37 are slidably mounted in the slots of the rotor 36 to fly out under the influence of centrifugal force when rotated and ride on the inner wall of the liner 35 to act as pumping vanes. As shown in Figures 1, 4 and 5, the cylindrical

casing 12 has an enlarged housing portion 12e extending around the top and sides thereof adjacent the flange 12b. This enlarged part 12e terminates in spaced relation from the flanged end 12a and is connected to said flanged end 12a by means of reinforcing ribs 12f. The top rib 12f merges with the top port boss 30 as shown in Figure 4 while, as shown in Figure 1, no bottom rib 12f is provided. The ribs 12f therefore extend between the flanged end 12a and the enlarged housing part 12e on the sides of the casing 12 and extend from the top port boss 30 and the housing part 12e on the top of the casing 12. No bottom rib is provided.

As best shown in Figure 5, the housing 12e defines an inlet chamber A and an outlet chamber B on opposite sides of the pumping chamber provided by the liner 35 in the cylindrical portion 12 of the casing. This pumping chamber in the liner has an inlet port 38 cut through the liner and the casing 12 to connect the chamber A with the pumping chamber 39 between the liner and rotor 35. An outlet port 40 is cut through the liner 35 and casing 12 to join the pumping chamber 39 with the outlet chamber B.

A raised portion 12g on the housing 12e provides an outlet passageway 41 for the chamber B.

As shown in Figure 1, the cover 14 for the casing 13 defines a central inlet 14a and has a depending outwardly flared skirt portion 14b cooperating with the casing to define an annular pumping chamber 42 surrounding the inlet 14a.

A centrifugal impeller 43 is mounted on the portion of the shaft 24 that projects into the casing and has pumping vanes 44 thereon defining pumping channels connecting the inlet 14a with the pumping chamber 42 to centrifugally throw liquid from the inlet into the pumping chamber and force the liquid through the pumping chamber to a peripheral discharge passageway 45 provided by an upstanding nipple casing portion 13a.

As best shown in Figure 2 the upstanding casing portion 13a also defines a passageway 46 alongside of the passageway 45. A seat 47 is provided by the casing portion 13a around the mouth of the passageway 45 and a flap valve 48 cooperates with the seat 47 to close the passageway 45. The valve 48 is in the form of a disk 48a (Fig. 4) with a central pin 48b projecting through a lever arm 48c and secured therein by means of a cotter pin. The lever arm 48c is pivoted on a pin 48d carried by a bracket 48e secured in the passageway 46.

As best shown in Figures 2 and 3, the passageway 41 from the chamber B communicates with the passageway 46.

A conduit fitting 49 is bolted on the upstanding casing part 13a and defines a common passageway 50 communicating with the passageways 45 and 46 and large enough to accommodate swinging movement of the valve 48 away from its seat 47.

As best shown in Figure 2, the pumping chamber 42 adjacent the outlet passageway 45 thereof has a port 51. This port 51 communicates with the interior of a screen in the chamber A as best shown in Figure 6.

As best shown in Figures 5 and 6, a screen unit 52 is formed from end plates 53 and 54 having flanges 53a and 54a therearound. These plates 53 and 54 are elongated and have tapered side walls converging from an enlarged rounded head portion to a smaller rounded tail portion. A screen 55 is wrapped around the flanges 53a

and 54a of the plate and is secured thereon as by soldering or the like.

The plate 53 has a collar 53b projecting into the port 51 as best shown in Figure 6 and defining an inlet to the interior of the screen unit.

The plate 54 has a collar 54b extending from the rear face thereof to form a seating receptacle for a coiled spring 55 thrusting against a side wall of the housing 12e to force the collar 53b into the port 51 and thereby suspend the screen unit 52 from the port.

An end portion 55a of the screen 55 wrapped around the flanges 53a and 54a is turned upwardly and trimmed to provide an upstanding rib projecting above the screen unit 52 to facilitate mounting of the unit in position in the chamber A.

As shown in Figures 4, 5 and 6 the housing portion 12e above the chamber A has a rectangular opening therethrough closed by a cover 57 with a raised localized head portion 57a acted on by a lever 58 which is pivoted at one end to ears 59 on the top of the housing portion 12e and receives a swing bolt 60 through the other end thereof. The swing bolt 60 is pivoted on ears 61 formed on the side wall of the housing part 12e. A wing nut 62 threaded on the swing bolt 60 forces the lever 58 against the dome 57a to secure the cover 57 in sealing relation with the housing part 12a for closing the opening in the top of the chamber A. The cover can be removed by releasing the wing and nut and swing bolt from the lever 58 and the screen unit 52 is readily removable from the chamber for cleaning purposes.

The portable unit of this invention therefore has a positive displacement type priming pump and a centrifugal type main pump driven by a single drive shaft from an electric motor. The pumping chamber of the centrifugal pump communicates through a port and screen with the inlet side of the positive displacement pump. The discharge side of the positive displacement pump communicates with the discharge conduit from the pumping chamber of the centrifugal pump which conduit is closed off from the pumping chamber by a valve. The valve prevents the positive displacement pump from exerting suction in the conduit so that all intake suction during the priming of the main pump is exerted on the inlet of the main pump.

The unit operates by the positive displacement pump drawing air through the impeller of the centrifugal pump into the pumping chamber of this pump and thence through a port and screen into and through the pumping chamber of the positive displacement pump from which it is then exhausted on the discharge side of a flap check valve. The exhausting of the feed line by the positive displacement pump eventually draws fuel or other liquid received by the feed line into the impeller of the centrifugal pump to prime the pump and cause the discharge of the liquid through the flap valve. Once the pumping chamber of the centrifugal pump is filled with liquid this centrifugal pump will be primed and will continue to pump liquid to the discharge fitting 50. The pumping capacity of the priming pump is very small, being the order of about one-tenth of the capacity of the centrifugal pump.

When the centrifugal pump is primed and operating to pump liquid, full discharge pressure of the centrifugal pump is maintained on both the inlet and outlet sides of the positive displacement priming pump, since the inlet port 51 is

in full communication with the pumping chamber 42 while the outlet passageway 41 is in full communication with the discharge fitting 50.

From the above descriptions it will be understood that the invention provides a mixed flow centrifugal pump assembly and a positive displacement priming pump assembly driven on the same shaft from a single electric motor. The entire unit is compactly arranged, is lightweight, and portable to provide a highly desirable accessory for an airplane. The priming pump has sufficiently high suction capacity to draw air through the impeller of the centrifugal pump until liquid is drawn into the centrifugal pump to fill the pumping chamber thereof and thus prime the pump so that it becomes an effective suction pump.

It will, of course, be understood that various details of construction may be varied through a wide range without departing from the principles of this invention and it is, therefore, not the purpose to limit the patent granted hereon otherwise than necessitated by the scope of the appended claims.

We claim as our invention:

1. A portable compact pump and motor unit comprising a motor casing, an electric motor therein, a priming pump casing mounted on an end face of the motor casing, a centrifugal pump casing mounted on the priming pump casing, a shaft extending into both casings drivingly connected to said motor, a rotary vane type pump in said priming pump casing having a vaned rotor mounted on said shaft, a centrifugal pump impeller in said centrifugal pump casing mounted on said shaft, said centrifugal pump casing having a central inlet, an annular pumping chamber communicating with the inlet and a peripheral outlet, a discharge conduit mounted on the outlet part of the centrifugal pump casing, said priming pump casing having an inlet including the pumping chamber of the centrifugal pump casing and an outlet communicating with said discharge conduit, and a check valve between the centrifugal pump casing and the discharge conduit, said rotary vane pump being effective to evacuate and suck liquid into the pump chamber of the centrifugal pump for priming said pump, said check valve being closed during priming and open during normal operation of said centrifugal pump, a handle for carrying said unit, and a base connected to said motor casing for supporting said unit.

2. A self-priming pump and motor unit comprising an electric motor casing, a cradle support for said motor casing, a clamping band securing said support to said motor casing, an electric motor in said motor casing, a first pump casing secured to an end face of the motor casing, a second pump casing secured to an end face of the first pump casing, a handle projecting above said motor casing secured to said motor casing, a pump shaft extending through said first and second pump casings, means coupling said pump shaft to said electric motor for corotation, a vaned rotor on said pump shaft in said first casing, a centrifugal impeller on said shaft in said second casing, said first casing providing a pumping chamber for said vaned rotor, said second casing providing a pumping chamber for said impeller, means directly connecting said pump chamber of the second casing with the inlet side of the pump chamber of the first casing, and means providing a common outlet for both pumps,

said vaned rotor pump being effective to prime said centrifugal pump.

3. A pump and motor unit comprising an electric motor having an elongated annular casing with a flanged end face, a cradle support embracing the bottom portion of said casing, band means securing said cradle support on said casing, a positive displacement pump casing having an end face thrusting against the flanged end face of the motor casing, a handle for said unit, bolts extending through the flanged end face of the pump casing and the flanged end face of the motor casing and through the handle for securing both casings and the handle in assembled relation, a centrifugal type pump casing mounted on the end of the positive displacement pump casing, means defining passageways connecting said pump casings, the inlet and outlet of said positive displacement pump being connected to the peripheral outlet of the centrifugal pump, and pumping means in the pump casings to prime the centrifugal pump casing and to pump liquid through the primed casing.

4. An aircraft accessory comprising an electric motor having a casing therearound, an end head on said casing, a priming pump casing bolted on said end head, a main pump casing on the end of the priming pump casing, a support secured on the motor casing holding the casing in horizontal position with the pump casing above the ground line, pumping elements in said priming pump casing for priming the main pump casing and for high capacity pumping of liquid through the main pump casing, and valve means in the peripheral outlet of said main pump which bypasses said priming pump.

5. A pump assembly comprising a cylindrical pump casing having a fully opened end, and an intumed shoulder at the other end providing a reduced opening therethrough, a pump shaft projecting through the cylindrical casing, a first shaft bearing bottomed on said shoulder supporting said shaft, a pump liner bottomed on the first shaft bearing, a second bearing bottomed on the liner, a spacer sleeve bottomed on the second bearing, a seal ring bottomed on the spacer sleeve, an end cap on the fully opened end of the casing having a pilot portion projecting into the casing and thrusting against the seal ring to hold the spacer sleeve, the bearings, and the liner in assembled relation, a housing surrounding the top and sides of the cylindrical casing and defining separated inlet and outlet chambers for the casing, said liner and said casing having ports therethrough communicating with said chambers, a vaned rotor on said pump shaft between said bearings for pumping liquid from the inlet chamber to the outlet chamber, a removable cover on the inlet chamber, said inlet chamber having a port, a screen in said inlet chamber suspended from said port, and said outlet chamber having an outlet passageway.

6. A pump assembly comprising a cylindrical pump casing, pumping elements in said casing, housing means surrounding said casing defining inlet and outlet compartments, said casing having inlet and outlet ports therethrough communicating with said compartments, a centrifugal pump mounted on an end wall of said casing having an annular pumping chamber, a port directly connecting the annular pumping chamber of the centrifugal pump casing with the

inlet chamber, a screen in said inlet chamber receiving fluid from said port, a removable cover for said inlet chamber giving access to said screen, said centrifugal pump casing having a peripheral outlet, a flap valve for opening and closing said outlet, a discharge conduit receiving fluid from said outlet and flap valve, and housing structure defining a passageway connecting the outlet chamber with the conduit on the discharge side of said flap valve.

7. In a pump assembly a pump casing having an inlet chamber with an open top wall and a ported side wall, a readily removable cover for closing the open top of the casing, spring means, and a hollow screen unit having a flanged end face projecting into and resiliently held against said port by said spring means to suspend the unit from the port so that all fluid entering the chamber through the port must flow through the screen unit.

8. In a pump assembly means defining a pump chamber, a cover for closing the open top of said chamber, said chamber having an end wall with an inlet port therein, a screen unit having an end wall with an inlet port defined by a projecting collar, a second end wall on said screen unit having a projecting collar, a coil spring acting on said second end wall of the screen unit seated in said projecting collar for urging the first mentioned collar into said port, and a screen-removing tab readily accessible through the open top of said casing to remove the screen unit.

9. A screen unit for a pump comprising a first end wall having an aperture therein with a projecting collar around the aperture, a second end wall having a projecting collar thereon, flanges around said end walls, and a screen wrapped around said flanges connecting said end walls in spaced relation and defining a hollow screen unit, said collar around the aperture of the first end wall adapted to be seated in a port, and said collar on the second end wall adapted to receive the end of a spring, and a readily removable top wall for providing easy access to and removal of said screen unit.

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