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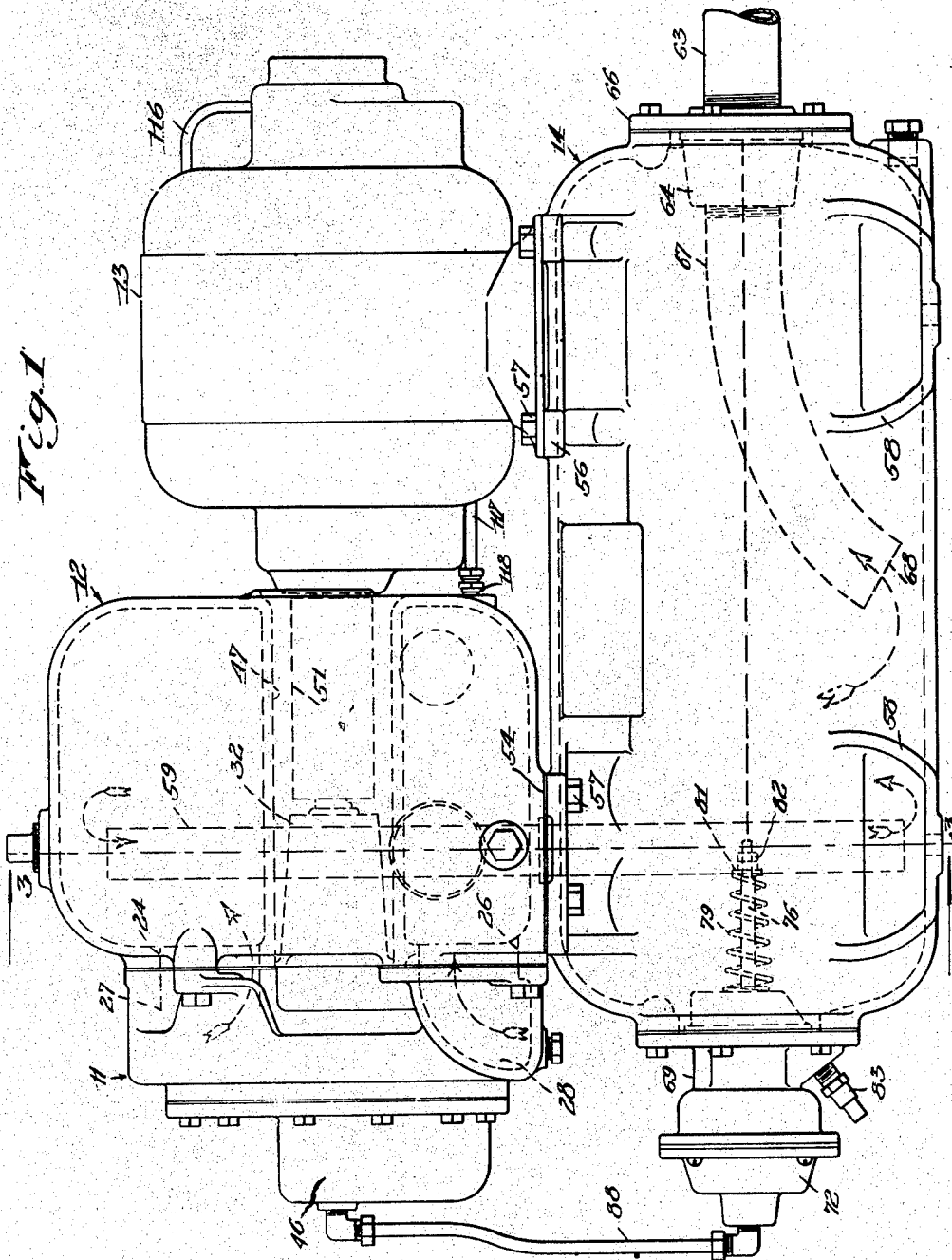
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2,440,611

PUMPING APPARATUS

Filed Feb. 14, 1945

4 Sheets-Sheet 1



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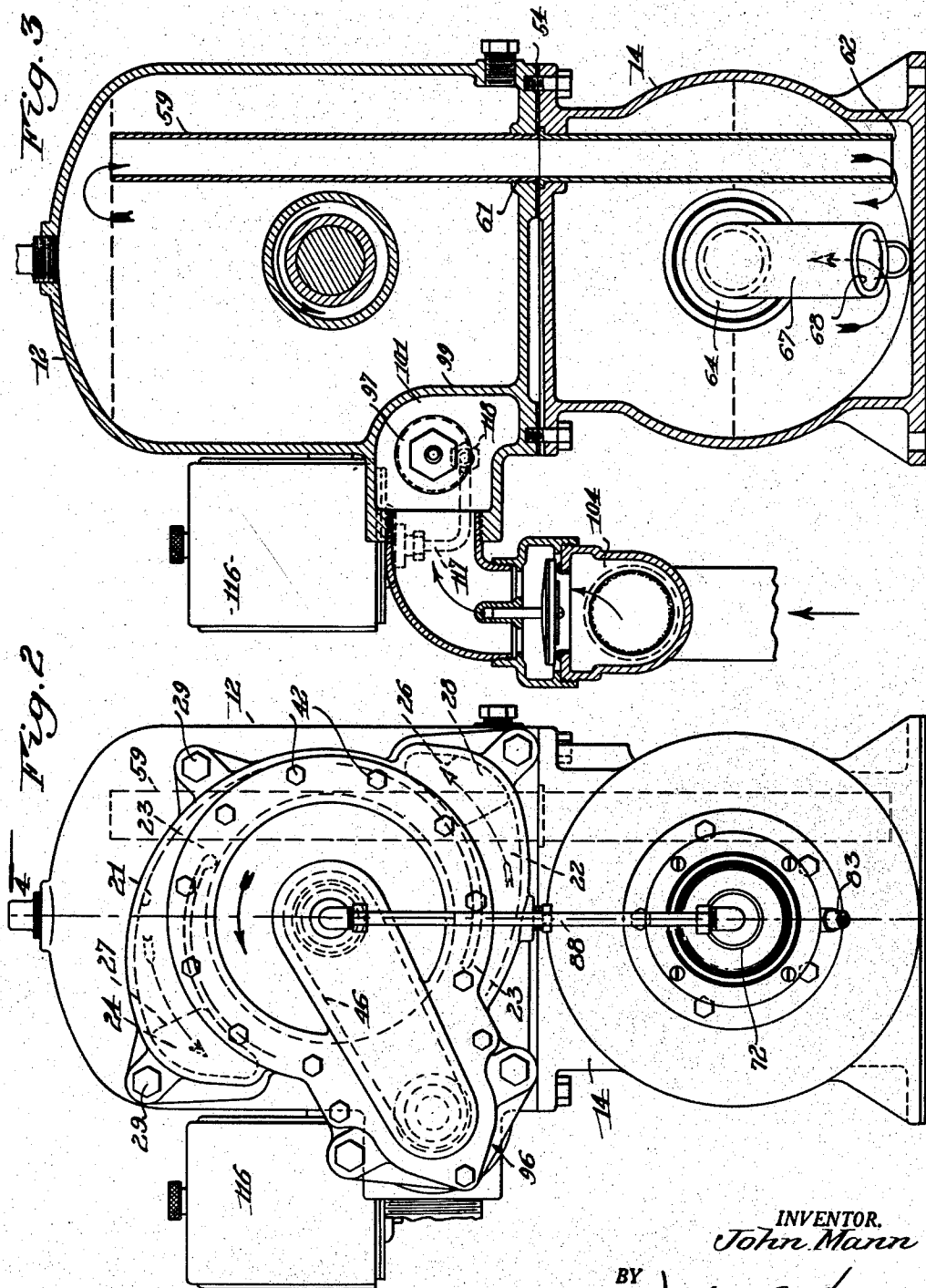
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PUMPING APPARATUS

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4 Sheets-Sheet 2



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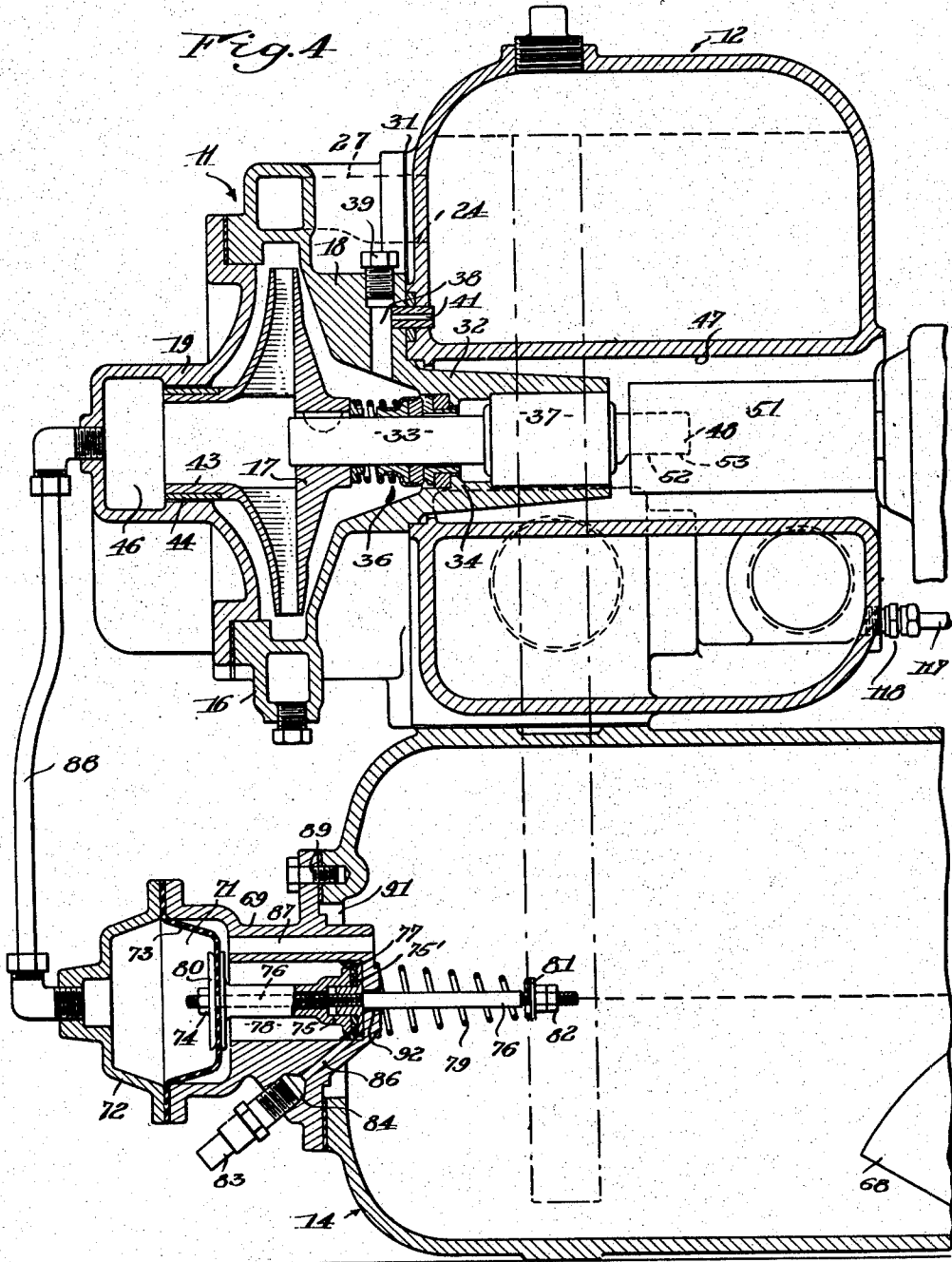
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Fig. 5

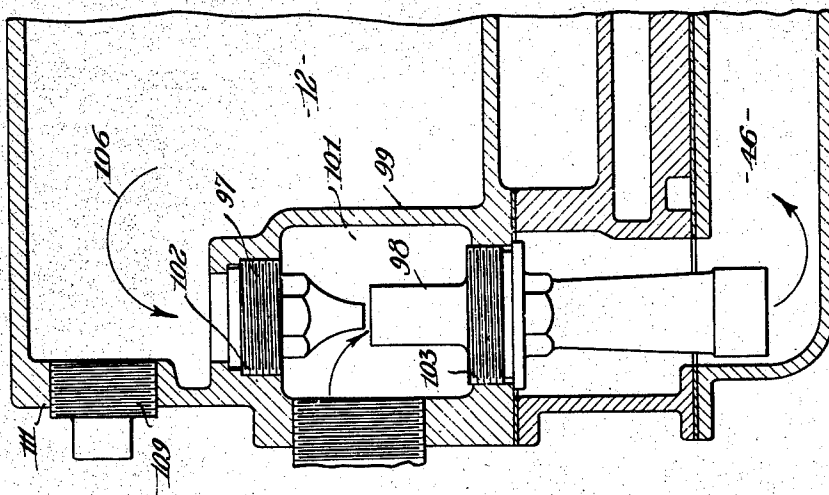
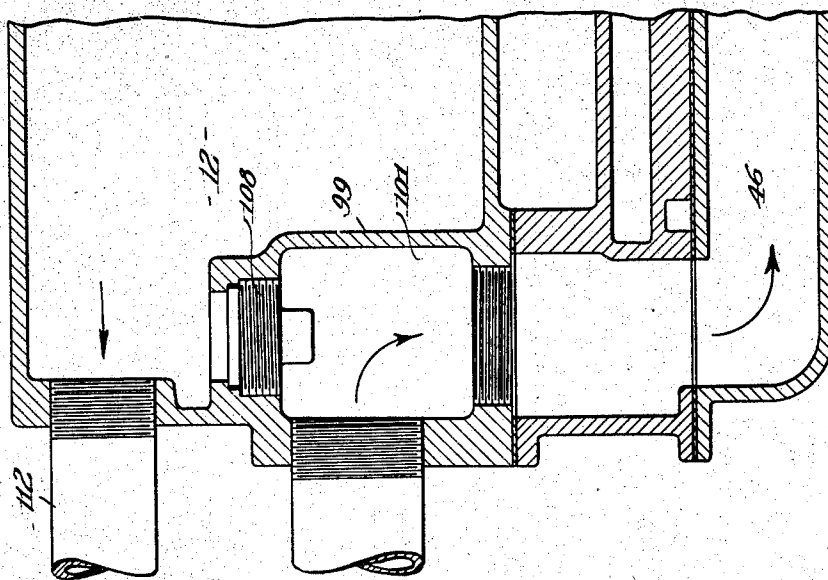


Fig. 6



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UNITED STATES PATENT OFFICE

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PUMPING APPARATUS

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Application February 14, 1945, Serial No. 577,879

8 Claims. (Cl. 103—5)

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My invention relates to a pumping apparatus or system and more particularly to water systems of the so-called jet type particularly suitable for use, for example, in homes or buildings removed from city or village water supply.

An object of my invention is to provide an improved water system which is reliable in operation, occupies a minimum of floor space and which may be produced at a reasonable cost.

Another object of my invention is to provide a water system which may be readily converted into a straight self-priming, centrifugal pump; a shallow well water system of the jet type; or a deep well water system of the jet type depending upon conditions of operation encountered in the particular installation.

Another object of my invention is to provide a compact water system pumping assembly which includes an air separating chamber for supporting the pump assembly and a pneumatic pressure chamber which supports the air separating chamber and the motor for driving the pump.

A further object of my invention is to provide improved means for maintaining the centrifugal pump of the system flooded under all normal conditions of operation so that the system may be maintained in a primed condition.

My invention further contemplates the provision of an improved assembly of the functional elements of a water system to provide a compact unitary assembly and still enable easy removal of the pump or the motor for repair or replacement without disturbing the pipe connections to the system or any other parts of the system.

Other objects and advantages of my invention will be apparent from the following description, when taken in connection with the accompanying drawings, in which:

Fig. 1 is a side elevation of the pumping system of my invention with parts thereof shown in dotted lines better to illustrate the invention;

Fig. 2 is an end elevation showing the pump end of the system with parts thereof indicated in dotted lines;

Fig. 3 is a vertical sectional view taken substantially on the line 3—3 of Fig. 1 in the direction indicated by the arrows;

Fig. 4 is a vertical longitudinal sectional view taken approximately on the line 4—4 of Fig. 2 in the direction indicated by the arrows;

Fig. 5 is a horizontal sectional view taken through the jet pump assembly showing the parts of the jet pump as the system is arranged for shallow well operation, and

Fig. 6 is a view similar to Fig. 5 showing the jet

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pump removed from the pump assembly and the system as it is arranged for deep well operation.

The pumping system of my invention, as shown in Fig. 1, comprises a pump assembly generally indicated by the numeral 11; an air separation chamber generally indicated by the numeral 12; a motor or prime mover 13 for driving the pump; and a pneumatic pressure chamber indicated in general by the numeral 14.

The pump assembly is shown most clearly in Fig. 4 and comprises a pump casing 16 and an impeller 17 which is enclosed by the casing. The pump casing is made up of a main casing part 18 and a cover part 19. The main casing part 18 is provided preferably with two volutes 21 and 22, indicated in dotted lines in Fig. 2. The volutes receive the liquid discharged from the impeller through volute throats 23. The volutes which gradually increase in cross sectional area from the throats, terminate in openings 24 and 26 which open sidewardly from the pump casing. The openings 24 and 26, as shown in dotted lines in Fig. 4, communicate respectively with passages 27 and 28 which open into the air separating chamber 12.

The pump shown, when used in combination with an air separating chamber, is a self-priming unit. It is unnecessary to set forth the details of construction and operation of the pump which enable it to prime itself since the subject matter of the self-priming unit is described and claimed in my co-pending application Serial Number 595,019, filed May 21, 1945. It is sufficient to state that means are provided in the air separating chamber, as will presently appear, to maintain a quantity of liquid therein under all normal conditions of operation.

When the air separating chamber and pump are primed should air enter or exist in the suction pipe and this air is attempting to pass through the impeller of the pump, liquid flows from the air separating chamber through passage 28, opening 26 and volute 22 to supply liquid to the impeller of the pump. This liquid mixes with or entrains the air and insures passage of the air through the pump and the discharge of the air and liquid through the volute 21, opening 24 and passage 27. The air discharged with the liquid separates from the liquid in the air separating chamber and substantially air free liquid is recirculated through the passage 28 to supply additional liquid to the pump for the entrainment of air. When the suction pipe and the pump have been cleared of air both volutes 21 and 22 become discharge volutes and liquid is discharged

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from the impeller through both passages 27 and 28 into the air separating chamber 12.

The main casing part 18 is bolted or otherwise secured as shown at 29 (Fig. 2) to the side wall of the air separating chamber, the meeting surfaces of the air separating chamber and the pump casing being planary and being provided with a gasket interposed therebetween, as shown at 31 in Fig. 4. The main casing part includes a rearwardly extending housing 32 for the reception of a shaft 33 upon the end of which the pump impeller 17 is keyed or pressed.

The bore of the housing 32 is provided with a shoulder 34 between which and the impeller there is interposed a mechanical seal, generally indicated by the numeral 36. Since mechanical seals of the type employed herein are well known in the art and the particular mechanical seal employed constitutes no part of my present invention no further description thereof is believed to be necessary.

The housing 32 also supports a bearing assembly 37 for the shaft 33 and the impeller 17. A passage 38 is provided in the casing which may be closed at its upper end by a threaded plug 39. The passage 38 is in communication with the air separating chamber 12 through a tube 41 of restricted diameter. The tube 41 and the passage 38 insure a supply of cool liquid from the air separating chamber to the mechanical seal for the purpose of preventing overheating and consequent break down of the materials of which the mechanical seal is made.

The cover plate 19 of the casing is bolted, as shown at 42, to the main casing part 18 and contains an enlargement for the reception of the annular liquid entrance flange 43 of the impeller. The flange 43 carries a press fitted sleeve 44 which extends concentric with the adjacent portions of the casting forming the cover part of the pump casing. The sleeve constitutes a renewable wearing ring for the impeller to minimize leakage from the pump casing back to the suction of the impeller. The cover plate also is provided with a passage 46 which communicates with the source of liquid supply, as will presently appear.

An important feature of my invention lies in the arrangement of parts and the provision of means enabling the main assemblies of the system—the pumping unit, air separating chamber, the motor and the pneumatic pressure chamber—to be arranged compactly. For this purpose the air separating chamber casting 12 has cored therein a walled opening 47 which extends entirely through the air separating chamber.

When the pump casing is bolted to the air separating chamber, the housing 32 enters the walled opening 47 with the end 48 of the shaft 33 protruding from the housing 32. The prime mover or motor for driving the pump impeller is supported in a manner to be presently described, and the motor shaft 49 is provided with a flexible sleeve or coupling 51. The protruding end of the shaft 48 has a flat side, as shown at 52, for cooperation with a flat side 53 formed in an opening in the flexible coupling 51. The end 48 of the shaft enters the coupling 51 for the purpose of forming a detachable driving connection between the motor shaft 49 and the pump impeller shaft 33.

With the arrangement above described the pump assembly, the air separating chamber and the motor are compactly arranged so as to occupy a minimum of space. The pump and motor shafts, together with the shaft coupling and

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bearing, are housed substantially entirely within the confines of the air separating chamber so that the unit not only presents a pleasing appearance but in addition the arrangement has the advantage of maximum compactness.

Should it be desired to repair or replace the motor, the motor may be loosened from its support and removed from the unit by slipping the end of the coupling 51 off the end of the shaft 48 without disturbing the pump casing or any of the pipe connections to the pump assembly. Similarly, should replacement of the pump or access to the pump be desired in addition to that afforded by removal of the cover part 19 of the pump casing, the bolts 29 may be taken out so as to enable removal of the entire pump assembly without disturbing the motor or any of the pipe connections to the system, as will presently appear. Thus either the pump assembly or the motor assembly may be removed from the system without disturbing any other part of the system.

The pneumatic pressure chamber 14 is provided at its upper portion with bosses on each side thereof which have platform surfaces 54 and 55 (Fig. 1) for the reception respectively of the air separating chamber 12, together with the pump assembly 11, and the motor 13, the parts being bolted together as shown at 57. The bottom of the pneumatic air chamber is provided with bosses 58 on each side thereof which serve as supports upon which the unit rests upon any suitable foundation or floor space.

Liquid discharged into the air separating chamber 12 from the pump casing rises in the air separating chamber and then overflows into a tube 39, as indicated by the arrow in Fig. 1. The tube 39 is made in two parts, as shown in Fig. 3, and the separate parts are assembled respectively in the air separating chamber and the pneumatic pressure chamber, as shown at 61 in Fig. 3. The lower end of the tube 59 extends substantially to the bottom of the pneumatic pressure chamber, as shown at 62, and discharges liquid into the pneumatic pressure chamber from the air separating chamber. The point of discharge of liquid into the pneumatic pressure chamber is brought substantially to the bottom thereof so that a pressure may be built up in the pneumatic pressure chamber during the operation of the system.

A discharge pipe 63 is connected to an adapter 64 which has a flange 66 bolted to the pneumatic pressure chamber. The adapter 64 is arranged to receive a pipe 67 which is curved downwardly, as shown in the drawings, so that the entrance opening thereto is adjacent the bottom of the pneumatic pressure chamber, as shown at 68. This arrangement enables the draining of substantially all of the liquid from the pneumatic pressure chamber through the pipe 63 which extends to the house service lines, a large pneumatic storage tank if one is used or other point of use of the liquid.

The tube 59 rises to a point adjacent the top of the air separating chamber which insures the maintenance of a head of liquid over the pump impeller to maintain the pump primed. Air separated from the liquid collects at the top of the air separating chamber and passes with liquid down the tube.

Means are provided for supplying air to the pneumatic pressure chamber for insuring the maintenance of at least a minimum quantity of air in such chamber. The particular means employed herein are novel but the subject matter

thereof is described and claimed in my copending application Serial Number 614,052, filed September 1, 1945. The air supplier or air pump comprises a fitting 69 which carries part of the walls forming a chamber 71. The remainder of the walls of the chamber are formed by a cup shaped member 72.

A diaphragm 73 is interposed between the meeting flanged faces of these walls and is connected, as shown at 74, to a rod 76. The rod 76 carries a piston comprising parts 75 and 75' with a cup leather 77 interposed between them. The part 75 includes a sleeve which is flanged at its end and the diaphragm is confined between this flange and a plate 80. The assembly is held in position by a nut, as shown.

The piston operates in a cylinder 78 formed in the fitting 69. The rod 76 extends through an opening formed in the fitting and is provided with a spring 79. The spring is interposed between a seat formed on the fitting 69 and a backing plate 81 confined by a nut assembly 82. The spring normally urges the piston in a direction to the right as viewed in Fig. 4.

A conventional air valve 83 preferably of the Schrader type is threaded in a bore formed in the fitting 69, as shown at 84, which registers with a passage 86 formed in the fitting. A passage 87 is formed in the fitting so that liquid in the pneumatic pressure chamber has access to one side of the diaphragm 73. The other side of the diaphragm is exposed through a tube 88 to the pressure existent at the suction of the pump. The air supplier or air pump assembly is bolted to the pneumatic pressure chamber, as shown at 89, and extends into an opening 91 formed in the pneumatic pressure chamber.

When the pump is not running the parts of the air supplier are in the position shown in Fig. 4, both sides of the diaphragm being exposed to the pressure existent in the system and the spring 79 urging the diaphragm and piston to the right as viewed in Fig. 4. That is, when the pump is at rest the pressures on opposite sides of the impeller are equalized so that the pressures on opposite sides of the diaphragm are the same. The spring 79 then urges the parts into the position shown in Fig. 4.

When the pump is started a sub-atmospheric or lesser pressure is created at the suction of the pump impeller and in the passages leading thereto which not only draws liquid into the impeller but creates a sub-atmospheric or lesser pressure in the tube 88 and on the left side of the diaphragm. This pressure is usually sub-atmospheric and the discharge pressure existent on the other side of the diaphragm shifts the diaphragm to the left, as viewed in Fig. 4, against the action of the spring 79. This movement of the diaphragm shifts the piston 77 to the left and creates a sub-atmospheric pressure behind the piston.

A slight clearance exists around the piston rod 76 at 92. This passage forms an opening through which air may flow comparatively unrestricted should air exist in the pneumatic pressure chamber at the level of the clearance. The resistance to air flow through the clearance is less than the resistance to air flow through the Schrader valve. However, should liquid be at this level the resistance to flow of liquid through the clearance is sufficiently great so that under these conditions air will be taken into the system through the Schrader valve 83 and the passage 86. Should air be at the level of the clearance 92, air will flow

therethrough instead of through the Schrader valve, to satisfy the vacuum existent behind the piston.

When the pump stops again the pressures on opposite sides of the diaphragm are equalized, the piston is actuated by the spring and the air or liquid in the cylinder is forced into the pneumatic pressure chamber by escaping past the cup leather and flowing through the passage 78. The level of the clearance thus determines the level of liquid in the pneumatic pressure chamber, this level being indicated by the dotted line in the drawings. This is the level at which air will be taken into the system should the liquid level be above this clearance at the time or shortly after the pump starts. At the completion of the pump operation the liquid level will, of course, be substantially above this level, the exact level depending upon the pressure limits at which the motor of the system is set to start and stop.

As previously mentioned the air supplier is claimed in my application Ser. No. 614,052, filed September 1, 1945. For present purposes it is sufficient to state that the system is maintained at all times charged with at least a minimum quantity of air. The action of the air supplier is positive since the operation of the air supplier is dependent upon the difference in pressure on opposite sides of the impeller when running or the pressure developed by the impeller which is always a constant quantity regardless of the conditions under which the system is operating.

The system of my invention is adapted for use as a straight centrifugal pump, a shallow well jet pump system or a deep well jet pump system. When the system is used as a shallow well jet pump system the jet pump is located at the side of the assembly, as generally indicated by the numeral 96 and as shown most clearly in Fig. 5. The jet pump comprises a nozzle 97 and a diffuser 98. A wall 99 is formed in the air separating chamber to provide a suction or water inlet compartment 101. The nozzle is threaded in position as shown at 102 while the diffuser is threaded in position as shown at 103, the nozzle and diffuser being in spaced axial alinement with each other as shown.

A suction pipe 104 extends into the well or other source of liquid supply and is threaded into the casting so as to discharge liquid into the liquid inlet compartment 101. The nozzle and diffuser may be of conventional construction and the proportions thereof are designed in accordance with the conditions under which the system is to operate.

Liquid discharged into the air separating chamber from the pump casing divides into two parts. A portion flows through the tube 59 into the pneumatic pressure chamber while the remainder flows, as indicated by the arrow 106, to the nozzle of the jet pump. This liquid has substantially all of the air removed therefrom since the jet pump is located adjacent the bottom of the air separating chamber. Since the air separating chamber is relatively large in volume the air has an opportunity to separate from the liquid and rise to the top of the air separating chamber while substantially air free liquid flows to the nozzle.

As well known in the art to which this invention applies the flow of liquid through the nozzle under pressure is converted in the jet to velocity energy. The velocity of the jet stream passing across the space between the tip of the nozzle and the entrance of the diffuser entrains air or

liquid adjacent the jet stream and induces a flow of air or liquid from around the nozzle body and thereby creates a vacuum which, combined with the pressure on the surface of the liquid in the well, draws the air or liquid through the suction pipe 104 and into the diffuser.

In the diffuser the velocity energy is at least partially reconverted into pressure energy. The liquid or mixture of liquid and air then flows from the diffuser into the passage 46 which as previously mentioned connects with the suction inlet of the centrifugal pump impeller. As previously mentioned the system is self priming after the air separating chamber has been initially filled with liquid. That is, when the system is started the suction pipe may be filled with air. The flow of liquid through the jet creates a vacuum in the suction pipe and the pressure of air on the surface of the liquid in the well forces air and liquid up the pipe as long as the lower end of the suction pipe is covered with liquid and the level thereof below the pump is within the vacuum producing abilities of the pump which is approximately 30 feet.

Since liquid from the air separating chamber is free to recirculate through the centrifugal pump, as previously mentioned, a sufficient quantity of liquid is always maintained in the pump to entrain the air and gradually discharge the air into the air separating chamber from whence it flows to the pneumatic pressure chamber. The lower end of the suction pipe may be provided with a foot valve so that after being initially started the suction pipe will be filled with liquid. However, I prefer to employ a check valve, generally indicated by the numeral 105, close to the pump. The valve may be of any suitable type which will open with only a slight difference in pressure on opposite sides thereof. It is pointed out that the system is self priming so that if the check valve should leak the pump will nevertheless operate as long as current is available to the motor and the pressure switch is operating. Moreover, the air separating chamber and the pump casing contain enough liquid to allow for moderate leakage through the valve should the current be off for a reasonable interval.

In Fig. 6 I have shown the system arranged for deep well operation. In this arrangement the nozzle 97 and the diffuser 98 are located in the well, a foot valve being located in the tail pipe below the jet pump. A plug 108 closes the opening between the air separating chamber and the liquid inlet chamber 101. A plug 109 which normally closes an opening 111 when the pump is used for shallow well operation, as shown in Fig. 5, is removed and a pressure pipe 112 substituted. With this arrangement liquid from which air has been removed flows from the air separating chamber 12 down the pressure pipe 112 into the jet pump located in the well. This liquid flowing through the jet pump in the well, together with the air pressure acting on the surface of the liquid in the well, supplies the energy necessary to lift the liquid from the well to a point within the liquid lifting abilities of the centrifugal pump.

When the system is to be used as a straight centrifugal pump the nozzle 97 and the diffuser 98 are removed and the plug 108 inserted in place of the nozzle 97. In other respects the arrangement is as shown in Fig. 5.

The system is arranged so that the motor will start and stop at lower and upper pres-

sure limits. For example, the system may be arranged so that the motor cuts out when the pressure in the system reaches 35 pounds and cuts in again when the pressure in the system drops to, for example, 20 pounds. For this purpose a pressure switch, generally indicated by the numeral 116, is provided. Pressure switches suitable for use are well known in the art to which this invention applies. The diaphragm of the pressure switch is connected by a pipe 117 to a point 118 located on the discharge side of the centrifugal pump. Thus the pressure switch may be exposed to the pressure existent in the pneumatic pressure chamber, the air separating chamber or in the line leading to the house service.

In the drawings I have shown a small pneumatic pressure chamber which is sufficient in a large percentage of installations. However, under some conditions of operation it is desirable to use a large pneumatic storage tank, as is the conventional practice in water systems of the type with which my invention is concerned. I contemplate having liquid from the pneumatic pressure chamber 14 discharge into a large pneumatic storage tank before passing to the house service lines.

While I have shown and described the preferred form of my invention, it will be appreciated that various changes and modifications may be made, particularly in the form and relation of parts, without departing from the spirit of my invention as set forth in the appended claims.

I claim:

1. A pumping system comprising, in combination, a chamber having a walled opening extending therethrough, a pump casing mounted at one side of said chamber and having an impeller therein, a prime mover mounted at the other side of said chamber, means extending through said walled opening for driving the pump impeller from said prime mover, and means for conveying liquid from said casing to said chamber.

2. A pumping system comprising, in combination, a chamber having a walled opening extending therethrough, a pump assembly including an impeller carried by one side of said chamber, a prime mover assembly mounted at the other side of said chamber, driving means extending through said walled opening for driving the pump impeller from said prime mover, said driving means being disconnectable to enable removal of either of said assemblies without disturbing the other, and means for conveying liquid from said casing to said chamber.

3. A pumping system comprising, in combination, an air separating chamber, a pump casing mounted at the side of said air separating chamber and having an impeller discharging into said air separating chamber, a prime mover for driving said impeller, a pneumatic pressure chamber upon which said air separating chamber and said motor are mounted and into which said air separating chamber discharges, and means for maintaining a predetermined quantity of liquid in said air separating chamber.

4. A pumping system comprising, in combination, a pump casing having an impeller mounted therein, an air separating chamber, a plurality of discharge passages between said casing and said chamber, a pneumatic pressure chamber below said air separating chamber and into which said air separating chamber discharges, and means for maintaining a quantity of liquid in said

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air separating chamber to maintain at least one of said passages flooded.

5. A pumping system comprising, in combination, a pump casing having an impeller mounted therein with its axis of rotation horizontal, an air separating chamber on the side of which said casing is mounted, a plurality of discharge passages between said casing and said chamber, a pneumatic pressure chamber below said air separating chamber and into which said air separating chamber discharges, and means for maintaining a quantity of liquid in said air separating chamber to maintain at least one of said passages flooded.

6. A pumping system comprising, in combination, a pump casing having an impeller mounted therein, an air separating chamber having a connection to the casing through which liquid is discharged to the air separating chamber, a pneumatic pressure chamber mounted below said air separating chamber, and a discharge tube extending from adjacent the top of said air separating chamber into the pneumatic pressure chamber.

7. A pumping system comprising, in combination, a pump casing having an impeller mounted therein, an air separating chamber having a connection to the casing through which liquid is discharged into the air separating chamber, a pneumatic pressure chamber mounted below said air separating chamber and a discharge tube extending from adjacent the top of said air separating chamber into the pneumatic pressure chamber to a point adjacent the bottom of said pneumatic pressure chamber and well below the normal liquid level therein.

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8. A pumping system comprising, in combination, a pump casing having an impeller mounted therein, an air separating chamber having a plurality of connections to the casing through which liquid is discharged into the air separating chamber, said air separating chamber maintaining at least one of said connections flooded, a jet pump having a connection to the air separating chamber for receiving liquid therefrom and discharging such liquid together with liquid from the source of supply to the suction of the impeller, a pneumatic pressure chamber mounted below said air separating chamber and a discharge tube extending from adjacent the top of said air separating chamber into the pneumatic pressure chamber to a point adjacent the bottom of said pneumatic pressure chamber and well below the normal liquid level therein.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,491,989	Kettering	Apr. 29, 1924
1,625,892	Hollander	Apr. 26, 1927
1,960,659	Burks	May 29, 1934
2,117,563	McMillan	May 17, 1938
2,274,987	Lung	Mar. 3, 1942
2,292,529	LaBour	Aug. 11, 1942
2,335,109	Conery	Nov. 23, 1943
2,375,571	Mann	May 8, 1945