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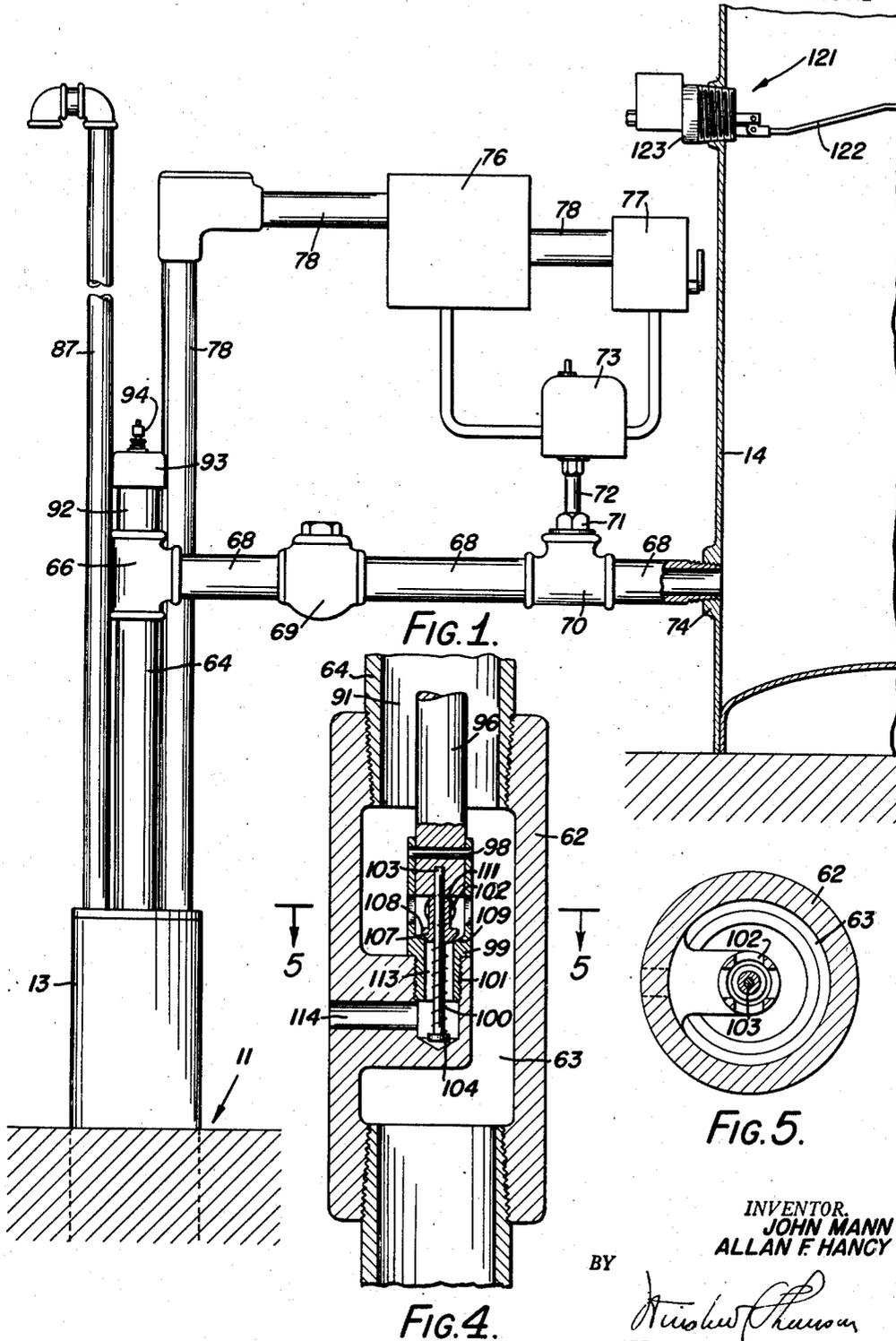
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AIR CHARGING SYSTEM FOR SUBMERSIBLE PUMPS

Filed June 30, 1953

2 Sheets-Sheet 1



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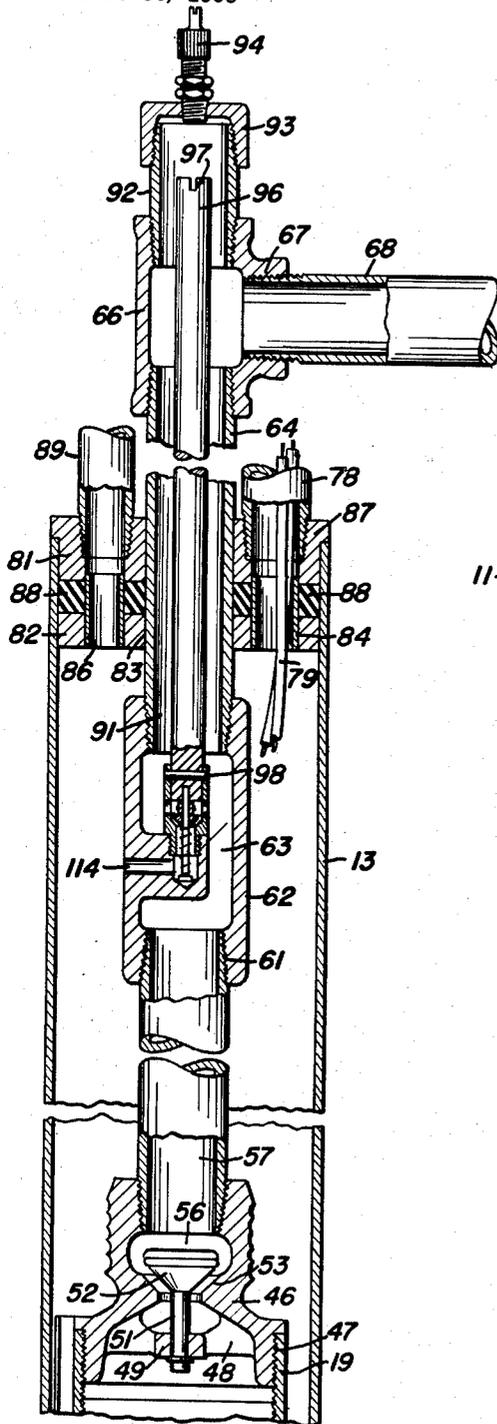


FIG. 2.

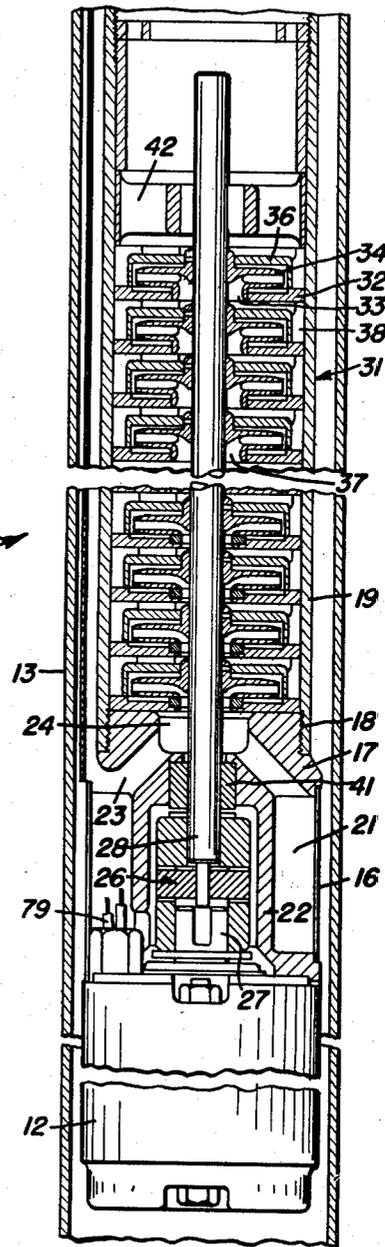


FIG. 3.

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## AIR CHARGING SYSTEM FOR SUBMERSIBLE PUMPS

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2 Claims. (Cl. 103—6)

Our invention relates to an apparatus or system for charging with air the pneumatic tank of a submersible type pump employed in a domestic water system.

An object of our invention is to provide an air charging system for submersible pumps which is of simple construction and reliable in operation.

Another object of our invention is to provide an air charging system for use in connection with a submersible pump wherein convenient means are provided for enabling the mechanical parts of the air charging system to be withdrawn from the well for easy cleaning or repairs.

More specifically, our invention contemplates the provision of an air charging system for a submersible pump in which a predetermined length of pipe adjacent the top of the well is filled with air each time the pump stops, the air being forced into the pneumatic tank when the pump starts again in measured volume predetermined for the particular size of the pneumatic tank employed, the air charging system also including means whereby the operating parts of the air charging system may be conveniently and easily withdrawn from the well for inspection, cleaning or repairs.

Other objects and advantages of our invention will be particularly set forth in the claims and will be apparent from the following description, when taken in connection with the accompanying drawings, in which:

Fig. 1 is a view somewhat diagrammatic showing such portions of our domestic submersible pump water system as lies above the ground level;

Fig. 2 is a sectional view showing the upper part of the well casing and showing the general assembly of the air charging system;

Fig. 3 is a sectional view showing the pump and the driving motor therefor which is located adjacent the bottom of the well;

Fig. 4 is an enlarged sectional view of a portion of the air charging system; and

Fig. 5 is a sectional view taken substantially on the line 5—5 of Fig. 4 in the direction indicated by the arrows.

The submersible domestic water system with which the air charging apparatus of our invention is employed comprises a pump generally indicated by the numeral 11; a submersible type electric motor 12, the motor and pump being mounted at the lower end of a well casing 13; and a pneumatic tank 14 (Fig. 1) located at or above ground level. It will be understood that the pump and its driving motor 12 may be located 100 or more feet below the surface level submerged below the normal liquid level in the well. Submersible pumps and motors of this general type are well known in the art with which this invention is concerned and need not be described in detail. This invention is primarily concerned with a pneumatic tank air charging system or apparatus particularly designed for use in connection with such a submersible pump domestic water system.

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The well casing 13 is driven into the ground so that the lower end thereof is well below the drawdown level of the well when the pump is pumped at a rate sufficient to supply the peak water needs of the user of the system. The motor 12 is of the submersible type and is located well below the normal water level. Water from the well enters the system and flows through a cylindrical screen 16 carried by a motor adapter 17.

The motor adapter 17 is bolted (not shown) to the casing of the motor 12 and the upper end thereof is threaded as shown at 18 into the threaded end of a pump casing 19. The motor adapter includes an annular chamber 21 extending in surrounding relation to a housing 22 formed in the adapter 17. The annular chamber 21 connects with four passages 23 which connect with the intake chamber 24 of the pump.

The housing 22 is open for free access of the liquid being pumped and encloses a coupling generally indicated by the numeral 26 by which the motor is connected to the pump 11. The end of the motor shaft has been indicated by the numeral 27 and the pump shaft has been indicated by the numeral 28.

The pump is of the multi-stage type, each pumping stage being indicated generally by the numeral 31. The stages are mounted in series so that the pressure builds up from the lowermost stage to the uppermost stage. Any desired number of stages may be employed in accordance with the pressure required to pump the water from the water level and maintain a desired pressure in the pneumatic tank in accordance with the needs of the user.

Each pumping stage includes a plate 32 having a central opening 33, an impeller 34, and an impeller casing 36. Since each stage is the same and each stage is largely conventional it is sufficient to state that each impeller includes a suction 37 and a discharge opening or openings formed around the impeller casing (not shown) which empty into a chamber 38 and from thence pass to the suction 37 of the next uppermost pumping stage. It will of course be understood that the impellers are keyed or otherwise secured to the pump shaft 28.

The pump shaft is supported by suitable bearings at intervals along its length some of which are not shown, but the lowermost and uppermost of which are shown at 41. The lowermost bearing 41 is supported in the adapter 22 and the uppermost is carried by a supporting structure 42 supported by the pump casing 19. The supports 42 may be spiders allowing the free passage of liquid upward around the uppermost bearing 41 with the upwardly flowing water entering the lower part of a valve casting 46 (Fig. 2).

The valve casting 46 is threaded on the upper end of the pump casing 19 as shown at 47 and includes a spider 48 which carries a central boss 49. The boss 49 is bored for the reception of the stem 51 of a valve 52. The valve housing or casting 46 includes a valve seat 53 upon which the conically shaped valve 52 seats. When the valve is open, as shown in Fig. 2, water passes upward above the valve into a valve body discharge chamber 56 and from thence into a pump discharge pipe 57 which is threaded into the valve body 46.

The discharge pipe 57 may be of 100 feet or more in length and its upper end as shown at 61 (Fig. 2) is threaded into a water drain valve body 62. The water drain valve body has a passage 63 for water and connects with what may be termed an air measuring pipe 64, the function of which will presently appear. The air measuring pipe is threaded into a T 66, the horizontal branch of the T being threaded for the reception of a conduit 68 as shown at 67.

As shown in Fig. 1, the conduit 68 has a check valve

69 mounted therein which may be of conventional construction. A T 70 also mounted in the conduit 68 has a bored plug 71 for the reception of the pressure pipe 72 of a pressure switch 73. The conduit 68 is threaded into a boss 74 formed on the wall of the tank 14.

The pressure switch 73 is of conventional construction well known in the art to which this invention applies and is adjustable, for example, to start the motor when the pressure in the pneumatic tank reaches 20 pounds and to stop the motor again when the pressure in the tank rises to 40 pounds. It will be understood that the pressure in conduit 68 is the same as the tank pressure. The upper and lower limits of pressure may be adjusted and the range between start and stop may also be adjusted by adjustments in the pressure switch as is well known in the art.

The electrical system includes suitable motor controls mounted in a control box 76 which has been diagrammatically shown and in the electrical system an "on" and "off" switch has been provided which has been indicated by the numeral 77. The electrical system includes conduits 78 for carrying electric wires 79 to the motor (see Figs. 2 and 3).

The top of the well pipe 13 carries a sanitary well pipe cap 81 which need not be described in detail since such well caps are well known in the art. In general, the well cap includes an annular plate 82 having a central bore for the reception of the air measuring pipe as shown at 83, a bore for the reception of a tubular member 84 through which the wires 79 pass, and a bore for the reception of a tubular member 86 which constitutes part of the vent pipe. The well cap also includes a second annular plate 87 which has bores corresponding to the bores in the lower annular plate 82 for the threaded reception of the electrical conduit 78 and the threaded reception of the vent pipe 89. The vent pipe 89 shown most clearly in Fig. 1 is open at its outer end and permits the entry of air into the well casing to replace the water withdrawn from the well. The well cap includes a suitable gasket or rubber seal 88 between the plates 82 and 87 to prevent the entrance of foreign matter into the well.

The air supplier with which our invention is primarily concerned comprises an air chamber 91 constituted by the air measuring pipe 64, the passages in the T 66, that portion of the conduit 68 which lies to the left of the check valve 69 (Fig. 1), a pipe 92 threaded into the upper end of the T 66, and a part of the valve body 63, as will presently appear. The pipe 92 has a cap 93 threaded on the upper end thereof adapted to receive a so-called snifter valve 94. The snifter valve 94 is of conventional construction employed in air volume controls and is generally somewhat similar to air valves of pneumatic tires. It is sufficient to state that when a pressure of water exists in the air chamber 91 the valve is closed against the egress of water. However, when a subatmospheric pressure exists in the air chamber 91, the valve 94 opens and allows the entry of air into the air chamber 91.

The air measuring chamber 91, together with the T 66 and the short length of pipe 92, house what may be termed a "reach rod" 96, the upper end of which has a screwdriver receiving slot 97. The reach rod extends downward through the air measuring pipe 64 into the air valve body 62.

On the lower end of the reach rod 96 a valve cage pin 98 is provided. The pin extends through the lower end of the rod and its projecting ends carry a valve cage 99. The valve cage is threaded at 101 for reception in a threaded bore formed in the air valve body 62. The valve cage includes four openings 102 extending around the valve cage through which water may freely pass into the interior of the valve cage. A valve guide rod 103 is pressed rigidly into the bottom of the reach rod 96 and extends downward through the bore formed in

the air valve body 62. The lower end of the valve guide rod is enlarged, as shown at 104, to form a seat for the lower end of a spring 100. The upper end of the spring presses against a valve 107 which is free to slide on the valve guide rod 103.

The valve 107 has an enlarged area 108 on its upper surface and the pressure of water on such surface normally holds the valve against its seat 109 against the pressure of the spring 100. When the pressure in the air measuring chamber 91 is sufficiently reduced, the spring 100 moves the valve 107 to a position off its seat 109 until the upper end 111 of the valve butts against the lower end of the reach rod 96.

In Fig. 2, we have shown the valve in its open position while in Fig. 4 we have shown the valve 107 in its closed position. In the latter position water from the air measuring chamber 91 may not pass between the valve and its seat through the passage 113 extending around the valve guide rod and through a passage 114 which opens into the well casing.

When the system is operating and the pressure switch 73 stops the motor when the pressure in the pneumatic tank 14 reaches, let us say, 40 pounds, water leaks from above the valve 107 through the passage 113 and the passage 114 into the well pipe. This leakage occurs by reason of the fact that a slight clearance is allowed between the valve guide rod 103 and the valve 107. This slight leakage relieves the pressure on the valve and the check valve 69 being at that time in the closed position, cuts off any leakage from the pneumatic tank.

At the same time the relief of the pressure above the valve 107 allows the spring 100 to throw the valve 107 to its open position in abutting relation to the lower end of the reach rod 96 as shown in Fig. 4. The opening of the valve allows the relatively free flow of liquid from above the valve and from the air measuring pipe through the passages 113 and 114 into the well pipe. Immediately upon attainment of a slight subatmospheric pressure in the air measuring chamber 91 the air inlet valve 94 opens allowing air to enter the air measuring chamber. Air will continue to enter the system as long as the pump is not restarted and until the level of the water drops to the level of the passage 114. It will be understood that the check valve 69 holds the water in the pneumatic tank and the valve 52 holds the water in the discharge pipe 57 up to the level of the passage 114.

When the pump starts again, the valve 94 is closed and the water pumped carries the air in the air measuring chamber 91 into the pneumatic tank to replace air withdrawn from the pneumatic tank with the water for use by reason of air absorption. The volume of the air measuring chamber 91 determines the amount of air supplied to the pneumatic tank each time the system cycles. It will be understood that this volume can be predetermined in accordance with the variables encountered in such systems, the principal variables being the size of the pneumatic tank and the pressure carried therein.

It will be understood that the volume which the air measuring chamber should have can be reasonably predetermined. However, due to the variables, this determination is not exact. It is therefore desirable to make the volume of the air measuring chamber 91 slightly in excess of requirements. To permit the escape of such excess air from the pneumatic tank, an air escape system generally indicated by the numeral 121 is provided. Such air escape mechanism is well known in the art and need not be particularly described. In general it comprises a float mounted on the end of a rod 122 which controls a valve (not shown) located in the fitting 123 which opens and closes an outlet port (also not shown) to atmosphere. In operation, when the water level drops, the float lowers to allow the valve to open and allow excess air to escape.

One of the important aspects of our invention lies in the means for cleaning the air valve and its passages, or re-

moving the air valve for inspection and repair. The air charging system is located adjacent the top of the well and the reach rod 96 is easily reached when the cap 93 is removed. By means of a screwdriver inserted in the screwdriver slot 97, the reach rod together with all parts connected thereto may be unthreaded from the air valve body and removed from the system for cleaning, inspection and repair. This is important in any water system but particularly where the water is likely to contain sand. It will be appreciated that the passages provided in the air charging mechanism are small and may in the course of use become clogged. Convenience in permitting cleaning of these parts and passages is important to the successful operation of the system. Various types of valves may be employed in place of the specific valve shown. For example, a reed or wafer valve may be employed as, in this aspect of the invention, the important fact is that the valve shall be withdrawable with the reach rod.

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

We claim:

1. An air charging system for submersible type domestic water systems comprising, in combination, a pump and driving motor therefor submerged in the well, a pneumatic tank, a pressure line leading from the well to the pneumatic tank, an air measuring chamber in said pressure line located in a position accessible from the ground level, a check valve between said pneumatic tank and the air measuring chamber, means for admitting air to said air measuring chamber when the pump stops, said means including a valve independent of said check valve located adjacent the bottom of said air measuring chamber, and means extending from adjacent the top of said air measuring chamber toward the bottom thereof for supporting said independent valve and enabling removal of said valve therewith for inspection and repair, said last-mentioned means comprising a reach rod carrying said independent valve and removable cap at the top

of the air measuring chamber which upon removal enables access to the reach rod.

2. An air charging system for the pneumatic tank of a domestic water system wherein a pump is located in a well comprising, in combination, a pressure line from the pump in the well to the pneumatic tank, an air measuring chamber incorporated in and constituting part of said pressure line, a check valve between the pump and said air measuring chamber and a check valve between said air measuring chamber and the pneumatic tank, an inlet valve adjacent the top of said air measuring chamber for admitting air from atmosphere to said air measuring chamber when a subatmospheric pressure exists in said air measuring chamber, a water escape valve independent of said check valves adjacent the bottom of said air measuring chamber, means for opening said water escape valve when the pump stops to allow the escape of water back to the well from the air measuring chamber to create a subatmospheric pressure in said air measuring chamber when the pump stops and the replacement of such water by air drawn in through said air valve, the air in the air measuring chamber being discharged into the pneumatic tank through said second check valve when the pump starts again, means for starting and stopping the pump when predetermined pressure conditions exist in the pneumatic tank, a removable cap at the top of the air measuring chamber and a reach rod extending from a position adjacent the lower side of said cap through the air measuring chamber, said water escape valve being carried by said reach rod whereby upon removal of said cap the reach rod is accessible to enable removal of said water escape valve for inspection and repair.

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