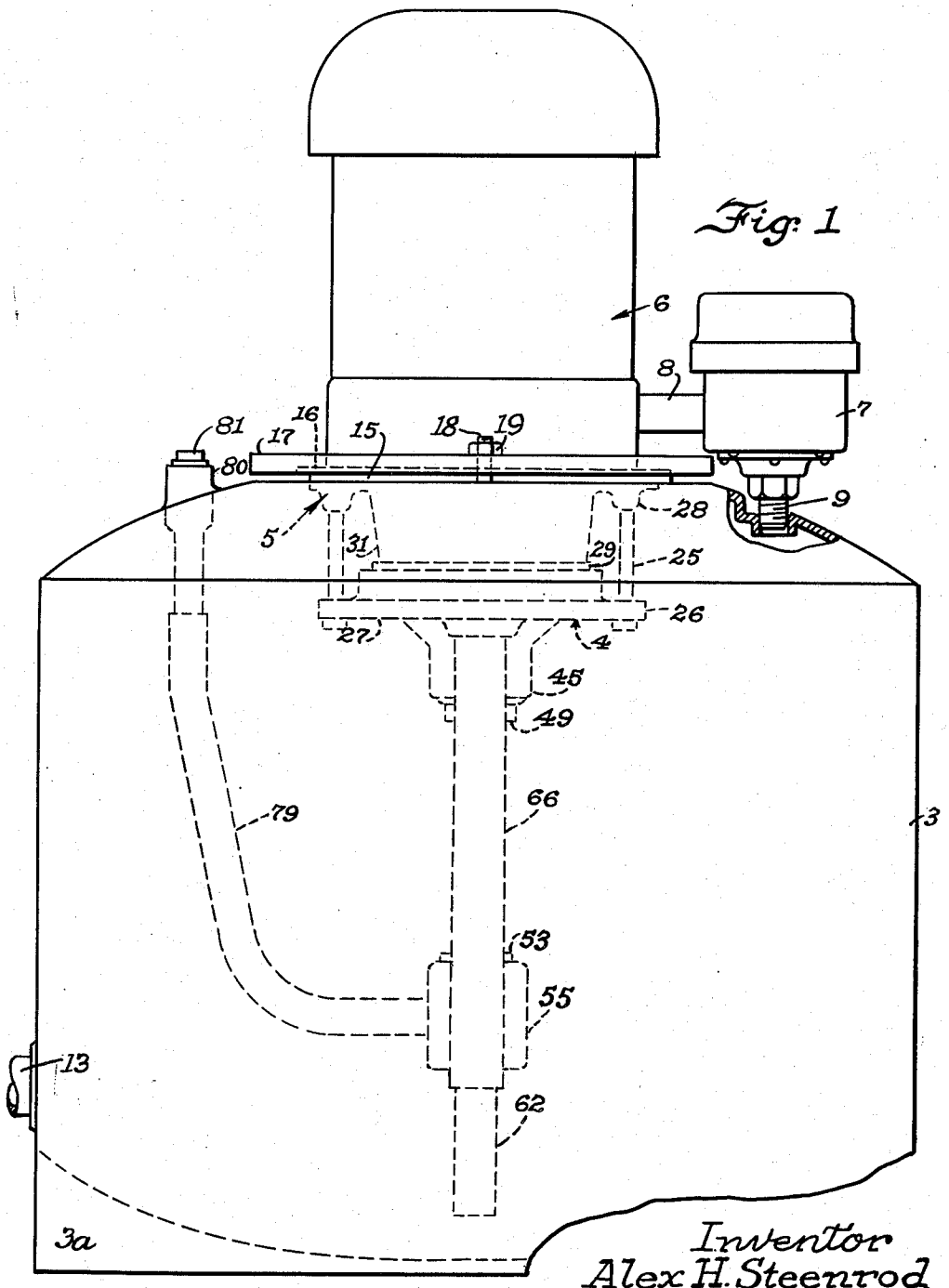
Jan. 5, 1954 A. H. STEENROD 2,664,823

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Fig. 1



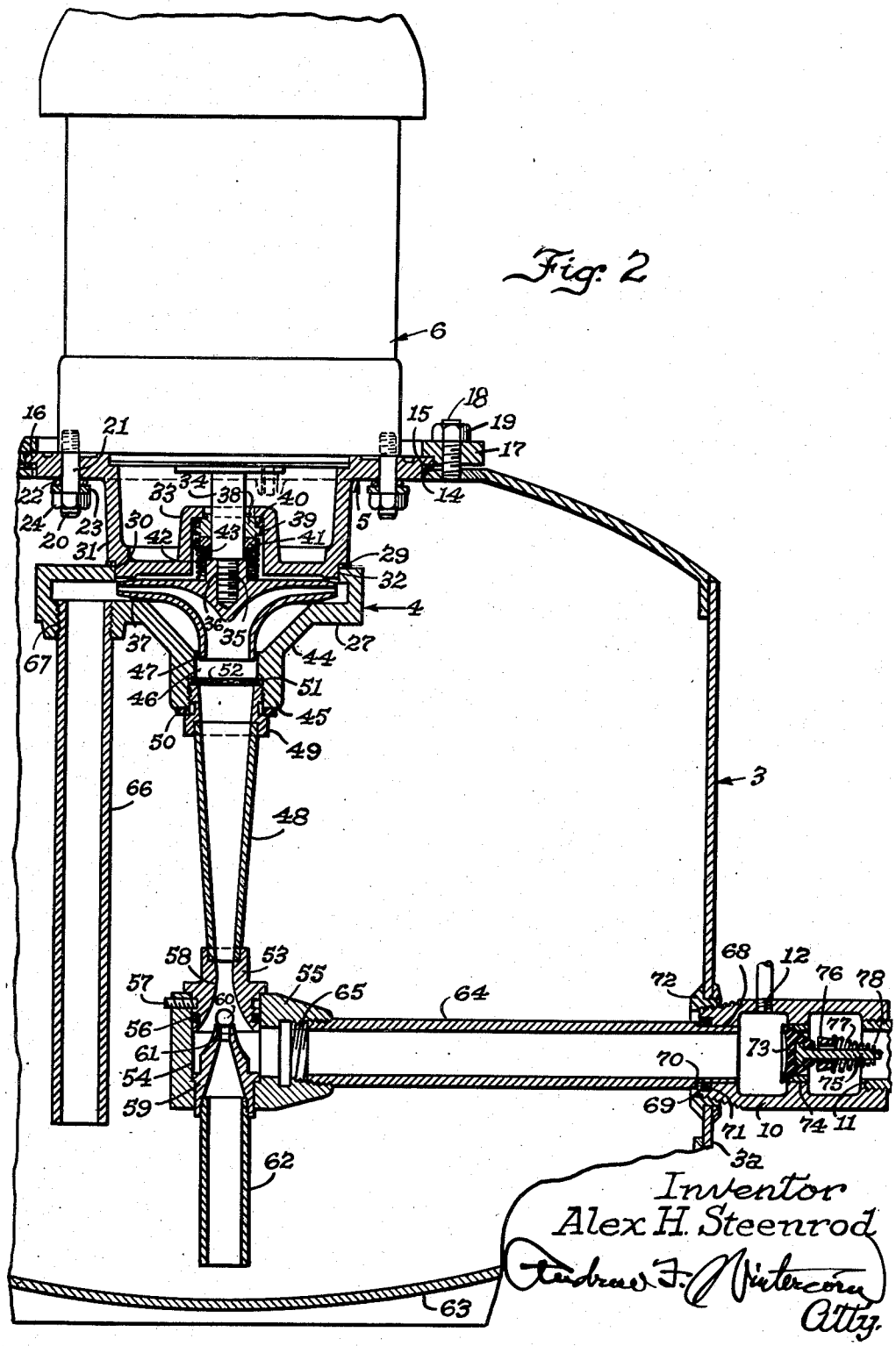
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Fig. 2



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This invention relates to pump units for domestic water systems, and is more particularly concerned with an improved, shallow well, jet pump designed to be mounted directly inside the storage tank, suspended by means of a plate from the top wall thereof, and to have its impeller driven directly off the armature shaft of an electric motor that is supported directly on top of the tank on a vertical axis, whereby maximum compactness is obtained and at the same time neatness in appearance. The unit is, moreover, preferably made up completely assembled, including pressure switch, air volume control, and check valve, ready for installation between the well and the service system.

A salient feature of the present invention is the provision of a light weight metallic or plastic ball in connection with the injector nozzle of the jet pump, to serve as a check valve to seal the nozzle opening automatically after each operation of the pump, so that water is trapped in the suction pipe and venturi up to the level of the centrifugal pump impeller, keeping the pump primed and ready for instant operation again, although the ball, which is adapted to be retained in the venturi by a screen, provided preferably just below the centrifugal pump, cannot interfere in any way with the operation of the pump. By virtue of this ball, it is possible to provide the space required for the air head and yet keep the pump impeller primer, although the impeller is above the normal level of the water and near the top wall of the tank, and it, therefore, requires the pouring in of only a small amount of water through the priming tube to make the pump ready for use, because only the suction pipe and Venturi tube have to be filled in the priming operation.

Another advantage of this construction is the fact that the storage tank serves as the separating chamber, the air entrained with the water pumped from the well having an ample opportunity of separating out, thereby insuring the bypassing from the tank of virtually air-less water to the impeller through the injector nozzle and venturi. Also, the construction permits passing of almost unlimited amounts of air through the pump and into the tank without danger of the pump losing its prime and requiring repriming.

Another feature is the provision of a vertical discharge pipe extending downwardly from the centrifugal pump housing in substantially parallel relation to the venturi and having its lower end always submerged, this pipe serving during

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periods of idleness of the pump unit to siphon water up into the centrifugal pump to keep it primed, in the event there is any tendency for leakage of water past the ball valve downwardly through the injector nozzle, thereby more or less insuring trouble-free continuous operation and making it practical to mount the pump inside the tank.

Another feature is the provision of a slip connection for the suction pipe in the inlet check valve fitting that is adapted to be threaded into a spud in the side wall of the tank for easy removal and replacement, so that the pump may be removed from the tank without too much difficulty, if that should ever be necessary.

Still another feature is the provision in connection with the injector nozzle of a pipe extending downwardly to a level near the bottom of the tank, to insure delivery of water through the injector nozzle under pressure whenever the pump is thrown into operation, so long as there is any water left in the tank, this pipe being of a small diameter in relation to the suction pipe, so as to bypass the correct amount of water to the injector nozzle.

The invention is illustrated in the accompanying drawings, in which—

Fig. 1 is a side view of a pump unit made in accordance with my invention, and

Fig. 2 is a vertical section through the unit in a plane at right angles.

The same reference numerals are applied to corresponding parts throughout the views.

Referring to the drawings, the pump unit of my invention, generally speaking, comprises a vertical storage tank, indicated by the reference numeral 3, supported on a base portion 3a, formed as an apron extension of the side walls, as shown, a centrifugal pump 4 disposed on a vertical axis inside the tank and suspended from a plate 5 that is supported on top of the tank, and an electric motor 6 for driving the pump supported on a vertical axis on top of the plate 5. The unit includes a pressure switch 7 electrically connected, as indicated at 8, with the motor 6 and having its pressure responsive diaphragm subjected to the air pressure in the head space in tank 3 through nipple 9 to control the operation of the motor in response to drop and rise in such air pressure in the usual way, and thus maintain a given supply of water available in the tank under a predetermined pressure. The unit further includes a check valve fitting 10, to which the pipe 11 leading to the well is connected, this fitting having an opening 12, in which an air volume

control of the usual kind is adapted to be threaded, so as to entrain air in a suitable volume with the water as it is pumped into the tank from the shallow well. Water is delivered from the tank to a service system through a pipe 13 under the predetermined pressure for which switch 7 is set.

The plate 5 fits in an opening 14 provided in the center of the top wall of the tank, and has a compressible gasket ring 15 under its annular flange 16 to seal the joint, the flange having a hold-down ring 17 fitting thereon, as shown, and fastened, as by studs 18 and nuts 19, to the top of the tank to clamp the plate 5 in place with a pressure-tight joint. The motor 6 has studs 20, for the fastening thereof, extending downwardly from its housing through holes 21 provided therefor in the plate 5, and compressible O-rings 22, which fit tightly around the studs, are arranged to be compressed by washers 23 when nuts 24 are tightened, whereby to fasten the motor securely and at the same time provide pressure-tight joints at all of the fastening studs. Bolts 25, which extend upwardly through holes in lugs 26 on the housing 27 of pump 4, are threaded in bosses 28 on the bottom of plate 5, and serve to support the pump suspended from the plate and compress a gasket ring 29 to seal the joint where the reduced lower end 30 of the hollow, cup-shaped, central portion 31 of the plate 5 fits in an opening 32 provided in the top wall of the pump housing. A hollow hub 33 provided in the center of the cup-shaped extension 31 has the armature shaft 34 of the motor 6 extending through it for the threaded connection of its reduced and threaded end portion 35 with the upwardly projecting hub 36 of the centrifugal pump impeller 37. Any suitable rotary seal to prevent leakage of water under pressure along the shaft 34 may be provided inside the hub 33, the one here shown consisting of a stationary brass seal ring 38 fitting freely on shaft 34 and having an annular flange 39 compressing a rubber seal ring 40 between the flange on the ring and the end wall of hub 33, whereby to effect a water-tight joint around the ring 38 and hold it against turning, this ring cooperating with a relatively rotatable seal ring 41 of fiber, or other composition material, which is held in engagement with ring 38 by a coiled compression spring 42 that surrounds the shaft and is caged in compressed condition between the impeller 37 and ring 41. A rubber sleeve 43 is of U-shaped section and has its inner wall fitting tightly around shaft 34 for a good seal at that joint, and has its outer wall tightly enclosing the ring 41 for a good seal at that joint while also connecting the ring 41 with the shaft 34 to turn with it. The spring 42 bears against the ring-enclosing portion of the sleeve to help keep these parts connected while urging the ring 41 into close sealing engagement with ring 38.

The pump housing 27 has a downwardly tapered central portion 44 terminating in a hub 45 having a central bore 46 coaxially aligned with the armature shaft 34 and impeller 37, and having the axially arranged intake neck portion 47 of the impeller extending therein, as shown. A Venturi tube 48 is suspended by means of a threaded nipple 49 from the hub 45, and the nipple has an annular shoulder defined on the outer end portion thereof, behind which a compressible gasket ring 50 is arranged to be clamped to seal the joint. The nipple also serves to clamp the rim portion 51 of a fairly coarse screen 52, the principal purpose of which will soon appear, although it will serve generally to catch any foreign objects entrained with the incoming water and prevent the same from reaching and fouling the impeller. The restricted throat end of the venturi is provided in a fitting 53 suitably secured to the small end of the tube 48 and entered in a bore 54 in a T-fitting or housing 55. An O-ring 56 received in one of the two annular grooves in the fitting 53 seals the joint and permits turning the motor and pump assembly as a unit relative to the tank preparatory to tightening the nuts 19 fastening the hold-down ring 17, as required in getting the motor leads adjacent the pressure switch 7 for connection therewith. A screw 57 threaded in the fitting 55 and received in the other annular groove in the fitting 53 holds the latter in place. Mounted in the other end of the bore 54 in coaxial alignment with the restricted throat 58 in fitting 53 is an injector nozzle 59, the reduced tip end of which projects slightly into the flared entrance end of the throat 58, leaving a space annularly of the nozzle in said flared entrance that is just too narrow to permit passage of a ball 60, that is adapted to seat, at 61, on the end of the nozzle to seal it like a check valve. The ball 60, in other words, is confined to movement in the venturi 48 between the nozzle 59 and screen 52, the screen serving to stop the ball when it rises with the water drawn into the impeller 37, so that the ball cannot escape and get into the impeller. The ball 60 may be of a light metal, such as aluminum, or may be made of plastic material. A pipe 62, secured to the nozzle 59 and projecting downwardly therefrom to a point near the concave bottom 63 of the tank at the center thereof, supplies water under pressure for discharge through the nozzle 59 as soon as the impeller is driven and there is a reduction in pressure created in the venturi 48 as a result of it. This is where the pump gets its name "jet pump," and the jet of water delivered through the venturi entrains with it water from the suction pipe 64 that is threaded in the transverse bore 65 in the fitting 55. The water discharged from the pump is delivered through a pipe 66 directly into the tank, this pipe being threaded into a hole 68 provided in the discharge portion of the pump housing 27. The pipe extends downwardly substantially parallel to the venturi 48 and always has a substantial portion of its length submerged. Consequently, if, when the pump unit stands idle for any appreciable length of time, there should be any appreciable leakage of water past the ball valve 60 downwardly through the nozzle 59, water will be siphoned upwardly through the pipe 66 to keep the impeller 37 primed. The ball valve 60 seats immediately after each operation of the pump and traps water in the venturi 48 and suction pipe 64, so as to keep the pump primed regardless of the fact that the impeller 37 is in the head space well above the water level in the tank. The most efficient injector action is obtained with this jet pump because the water supplied through the pipe 62 is air-free, inasmuch as the tank 3 serves as a separation chamber allowing the air that is entrained with the water delivered through the suction pipe 64 to separate out as soon as the water is discharged into the tank from pipe 66. The small diameter of pipe 62 in relation to suction pipe 64 insures the bypassing of just the right amount of water for the injector action.

The suction pipe 64 has a slip-in connection with the check valve fitting 10, as indicated at

68, and an O-ring 69, tightly surrounding the reduced end portion 70 of the suction pipe and received in a counterbore 71 in the fitting 10, serves to seal the joint. The fitting 10 is threaded into a spud 72 welded in an opening in the side wall of the tank 3. Hence, if it should ever be found necessary or desirable to remove the pump assembly from the tank, that can be done by removing the fitting 10 and unfastening the hold-down ring 17, after which the whole pump assembly can be removed through the opening 14 in the top wall of the tank. The fitting 10 has a spring closed check valve 73 provided therein, the head of which is preferably of fiber or other composition material and arranged to engage a brass seat insert 74. The stem 75 of the valve is slidable in a guide 76 provided in the fitting and has a coiled conical spring 77 surrounding it and caged in compressed condition between a cross-pin 78 on the outer end of the stem and the guide 76. This check valve 73 eliminates the necessity for a foot valve in the well pipe.

In conclusion, attention is called to Fig. 1, in which there is illustrated a priming tube 79 extending from the fitting 55 upwardly to a nipple 80 that is suitably welded in an opening in the top wall of the tank and has a screw plug 81 threaded therein as a closure therefor. After installation of the unit, when the tank 3 is still empty, the pump 4 can be primed easily by pouring water through the tube 79 and filling the suction pipe 64, venturi 43, and at least the lower portion 44 of the pump housing 27. The ball valve 60 in this priming operation is, of course, seated and traps the water so that it requires only a small fraction of the amount that would otherwise be required if the tank had to be filled up to the level of the impeller 37 to prime the pump.

It is believed the foregoing description conveys a good understanding of the objects and advantages of my invention. The appended claims have been drawn to cover all legitimate modifications and adaptations.

I claim:

1. In a self-contained pump unit, the combination of a tank having intake and discharge openings located below the normal water level in said tank, an electric motor mounted on a vertical axis on top of said tank having an armature shaft extending downwardly into a centrifugal pump housing that is disposed inside the upper portion of the tank and suspended from the top wall thereof, said pump housing containing an impeller drivingly secured to the end of said shaft, a discharge pipe that is short in relation to tank height extending downwardly from the peripheral discharge portion of said pump housing to below water level in the tank, a venturi disposed over an injector nozzle in another housing spaced below the pump housing at below water level in said tank, said Venturi housing communicating through said injector nozzle directly with the bottom portion of the tank and being suspended from the pump housing by a pipe that is shorter than the discharge pipe and communicating through said suspension pipe with an axial intake opening provided in said impeller, and an intake pipe extending laterally from that portion of the Venturi housing between the venturi and nozzle to the intake opening in the tank.

2. In a self-contained pump unit, the combination of a tank having intake and discharge openings located below the normal water level in said tank, an electric motor mounted on a vertical axis on top of said tank having an armature shaft extending downwardly into a centrifugal pump housing that is disposed inside the upper portion of the tank and suspended from the top wall thereof, said pump housing containing an impeller drivingly secured to the end of said shaft, a discharge pipe that is short in relation to tank height extending downwardly from the peripheral discharge portion of said pump housing to below water level in the tank, a venturi disposed over an injector nozzle in another housing spaced below the pump housing at below water level in said tank, said Venturi housing communicating through said injector nozzle directly with the bottom portion of the tank and being suspended from the pump housing by a pipe that is shorter than the discharge pipe and communicating through said suspension pipe with an axial intake opening provided in said impeller, a check valve preventing downflow through the injector nozzle, and an intake pipe extending laterally from that portion of the Venturi housing between the venturi and nozzle to the intake opening in the tank.

3. A pump unit as set forth in claim 2, including a priming tube connected with that portion of the Venturi housing between the venturi and nozzle and extending upwardly to a tubular fitting in the top wall of the tank for convenience in priming with a small amount of water, the water flowing by gravity in said tube to the Venturi housing and thence upwardly in the suspension pipe to fill the centrifugal pump housing, said fitting having a removable closure plug therein.

4. In a self-contained pump unit, the combination of a tank having intake and discharge openings located below the normal water level in said tank, an electric motor mounted on a vertical axis on top of said tank having an armature shaft extending downwardly into a centrifugal pump housing that is disposed inside the upper portion of the tank and suspended from the top wall thereof, said pump housing containing an impeller drivingly secured to the end of said shaft, a discharge pipe that is short in relation to tank height extending downwardly from the peripheral discharge portion of said pump housing to below water level in the tank, a venturi disposed over an injector nozzle in another housing spaced below the pump housing at below water level in said tank, said Venturi housing communicating through said injector nozzle directly with the bottom portion of the tank and being suspended from the pump housing by a pipe that is shorter than the discharge pipe and communicating through said suspension pipe with an axial intake opening provided in said impeller, the nozzle having its discharge end portion in concentric closely spaced relation to the venturi and adapted to serve as a seat for a ball check valve, a ball check valve arranged to engage said seat, said ball check valve being too large to pass downwardly through the space between the nozzle and venturi but being adapted to pass upwardly through the venturi, a strainer in said Venturi tube which retains the ball check valve during pumping operation, and an intake pipe extending laterally from that portion of the Venturi housing between the venturi and nozzle to the intake opening in the tank.

5. In a pump unit, the combination of a tank having intake and discharge openings, an electric motor mounted on a vertical axis on top of said tank having an armature shaft extending downwardly into a centrifugal pump housing

that is disposed inside the upper portion of the tank and suspended from the top wall thereof, said pump housing containing an impeller drivingly secured to the end of said shaft, a discharge pipe extending downwardly from the peripheral discharge portion of said pump housing to below water level in the tank, a venturi disposed over an injector nozzle in another housing spaced below the pump housing at a low level in said tank, said Venturi housing being suspended by a pipe from the pump housing and communicating through said pipe with an axial intake opening provided in said impeller, an intake pipe extending laterally from that portion of the Venturi housing between the venturi and nozzle to the intake opening in the tank, and a pipe delivering water to the injector nozzle under pressure from the inside of the tank, said pipe being of small diameter in relation to the intake pipe.

6. In a self-contained pump unit, the combination of a tank having intake and discharge openings located below the normal water level in said tank, an electric motor mounted on a vertical axis on top of said tank having an armature shaft extending downwardly into a centrifugal pump housing that is disposed inside the upper portion of the tank and suspended from the top wall thereof, said pump housing containing an impeller drivingly secured to the end of said shaft, a discharge pipe that is short in relation to tank height extending downwardly from the peripheral discharge portion of said pump housing to below water level in the tank, a venturi disposed over an injector nozzle in another housing spaced below the pump housing at below water level in said tank, said Venturi housing communicating through said injector nozzle directly with the bottom portion of the tank and being suspended from the pump housing by a pipe that is shorter than the discharge pipe and communicating through said suspension pipe with an axial intake opening provided in said impeller, an intake pipe extending laterally from that portion of the Venturi housing between the venturi and nozzle to the intake opening in the tank, and an inlet fitting for said tank adapted to be connected to the suction pipe of a well, the same being threaded in said intake opening and having a telescoping connection with the adjacent outer end portion of the intake pipe.

7. In a pump unit, a tank having intake and discharge openings and having a top wall in which is provided an enlarged opening, a motor mounting plate closing said opening and resting on a gasket on the top wall around said opening, a hold-down ring overlying said plate and bolted to the top wall so that the plate may be rotatably adjusted before being clamped in place, a centrifugal pump housing carried by said plate inside said tank, an electric motor mounted vertically on said plate and having an armature shaft extending downwardly into said pump housing and drivingly connected with an impeller therein, a delivery pipe and a discharge pipe extending downwardly from the central and peripheral portions of said housing, respectively, a venturi fixed on the lower end of said delivery pipe, a housing in which said venturi is swivelled and containing an injector nozzle communicating with the inside of the tank for discharge of water under pressure through said venturi, a check valve allowing only inflow through said nozzle, and a pipe communicating through the intake opening with the well from which water is to be pumped and having connection with said Venturi housing between the venturi and the nozzle.

8. A pump unit as set forth in claim 7, including a primer tube extending from the Venturi housing upwardly and adapted to be filled with water from the outside of the tank.

9. A pump unit as set forth in claim 7, including a water delivery tube for the injector nozzle which restricts the input of water from the tank in a predetermined ratio to the intake of water through the last named pipe.

10. A pump unit as set forth in claim 7, including an inlet fitting threading in the intake opening in the tank and having a telescoping connection with the last named pipe, said fitting having a check valve therein which seats outwardly.

11. A pump unit as set forth in claim 1, wherein the discharge opening is near the bottom of the tank and wherein the discharge pipe extending downwardly from the pump housing terminates at the approximate level of the discharge opening, the delivery pipe to the injector nozzle extending to a lower level nearer the bottom of the tank.

12. In a pump unit, the combination of a tank having intake and discharge openings, an electric motor mounted on a vertical axis on top of said tank having an armature shaft extending downwardly into a centrifugal pump housing that is disposed inside the upper portion of the tank and suspended from the top wall thereof, said pump housing containing an impeller drivingly secured to the end of said shaft, a discharge pipe extending downwardly from the peripheral discharge portion of said pump housing to below water level in the tank, a venturi disposed over an injector nozzle in another housing spaced below the pump housing at a low level in said tank, said Venturi housing being suspended by a pipe from the pump housing and communicating through said pipe with an axial intake opening provided in said impeller, an intake pipe extending laterally from that portion of the Venturi housing between the venturi and nozzle to the intake opening in the tank, a pipe delivering water to the injector nozzle under pressure from the lower portion of the tank, and a check valve preventing downflow through the last mentioned pipe.

13. In a pump unit, the combination of a tank having intake and discharge openings, an electric motor mounted on a vertical axis on top of said tank having an armature shaft extending downwardly into a centrifugal pump housing that is disposed inside the upper portion of the tank and suspended from the top wall thereof, said pump housing containing an impeller drivingly secured to the end of said shaft, a discharge pipe extending downwardly from the peripheral discharge portion of said pump housing to below water level in the tank, a venturi disposed over an injector nozzle in another housing spaced below the pump housing at a low level in said tank, said Venturi housing being suspended by a pipe from the pump housing and communicating through said pipe with an axial intake opening provided in said impeller, an intake pipe extending laterally from that portion of the Venturi housing between the venturi and nozzle to the intake opening in the tank, a pipe delivering water to the injector nozzle under pressure from the lower portion of the tank, and a primer tube communicating with the centrifugal pump hous-

ing and extending to a higher level in said tank and adapted to be filled with water from the outside of the tank.

14. In a pump unit, the combination of a tank having intake and discharge openings, an electric motor mounted on a vertical axis on top of said tank having an armature shaft extending downwardly into a centrifugal pump housing that is disposed inside the upper portion of the tank and suspended from the top wall thereof, said pump housing containing an impeller drivingly secured to the end of said shaft, a discharge pipe extending downwardly from the peripheral discharge portion of said pump housing to below water level in the tank, a venturi disposed over an injector nozzle in another housing spaced below the pump housing at a low level in said tank, said Venturi housing being suspended by a pipe from the pump housing and communicating through said pipe with an axial intake opening provided in said impeller, an intake pipe extending laterally from that portion of the Venturi housing between the venturi and nozzle to the intake opening in the tank, a pipe delivering water to the injector nozzle under pressure from the lower portion of the tank, and an inlet fitting threading in the intake opening in the tank and having a telescoping connection with the intake pipe, said fitting having a check valve therein which seat outwardly.

15. In a pump unit, the combination of a tank having intake and discharge openings, an electric motor mounted on a vertical axis on top of said tank having an armature shaft extending downwardly into a centrifugal pump housing that is disposed inside the upper portion of the tank and suspended from the top wall thereof, said pump housing containing an impeller drivingly secured to the end of said shaft, a discharge pipe extending downwardly from the peripheral discharge portion of said pump housing to below water level in the tank, a venturi disposed over an injector nozzle in another housing spaced below the pump housing at a low level in said tank, said Venturi housing being suspended by a pipe from the pump housing and communicating through said pipe with an axial intake opening provided in said impeller, an intake pipe extending laterally from that portion of the Venturi housing between the venturi and nozzle to the intake opening in the tank, a pipe delivering water to the injector nozzle under pressure from the lower portion of the tank, a check valve preventing downflow through the last mentioned pipe, and an inlet fitting threading in the intake opening in the tank and having a telecoping connection with the intake pipe, said fitting having a check valve therein which seats outwardly.

16. In a pump unit, the combination of a tank having intake and discharge openings, an electric motor mounted on a vertical axis on top of said tank having an armature shaft extending downwardly into a centrifugal pump housing that is disposed inside the upper portion of the tank and suspended from the top wall thereof, said pump housing containing an impeller drivingly secured to the end of said shaft, a discharge pipe extending downwardly from the peripheral discharge portion of said pump housing to below water level in the tank, a venturi disposed over an injector nozzle in another housing spaced below the pump housing at a low level in said tank, said Venturi housing being suspended by a pipe from the pump housing and communicating through said pipe with an axial intake opening provided in said impeller, an intake pipe extending laterally from that portion of the Venturi housing between the venturi and nozzle to the intake opening in the tank, a pipe delivering water to the injector nozzle under pressure from the lower portion of the tank, a check valve preventing downflow through the last mentioned pipe, an inlet fitting threading in the intake opening in the tank and having a telescoping connection with the intake pipe, said fitting having a check valve therein which seats outwardly, and a primer tube communicating with the centrifugal pump housing and extending to a higher level in said tank and adapted to be filled with water from the outside of the tank.

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