April 26, 1960 W. J. CONERY ET AL 2,934,021

SHALLOW WELL SELF-PRIMING JET PUMP

Filed Oct. 9, 1956 4 Sheets-Sheet 1

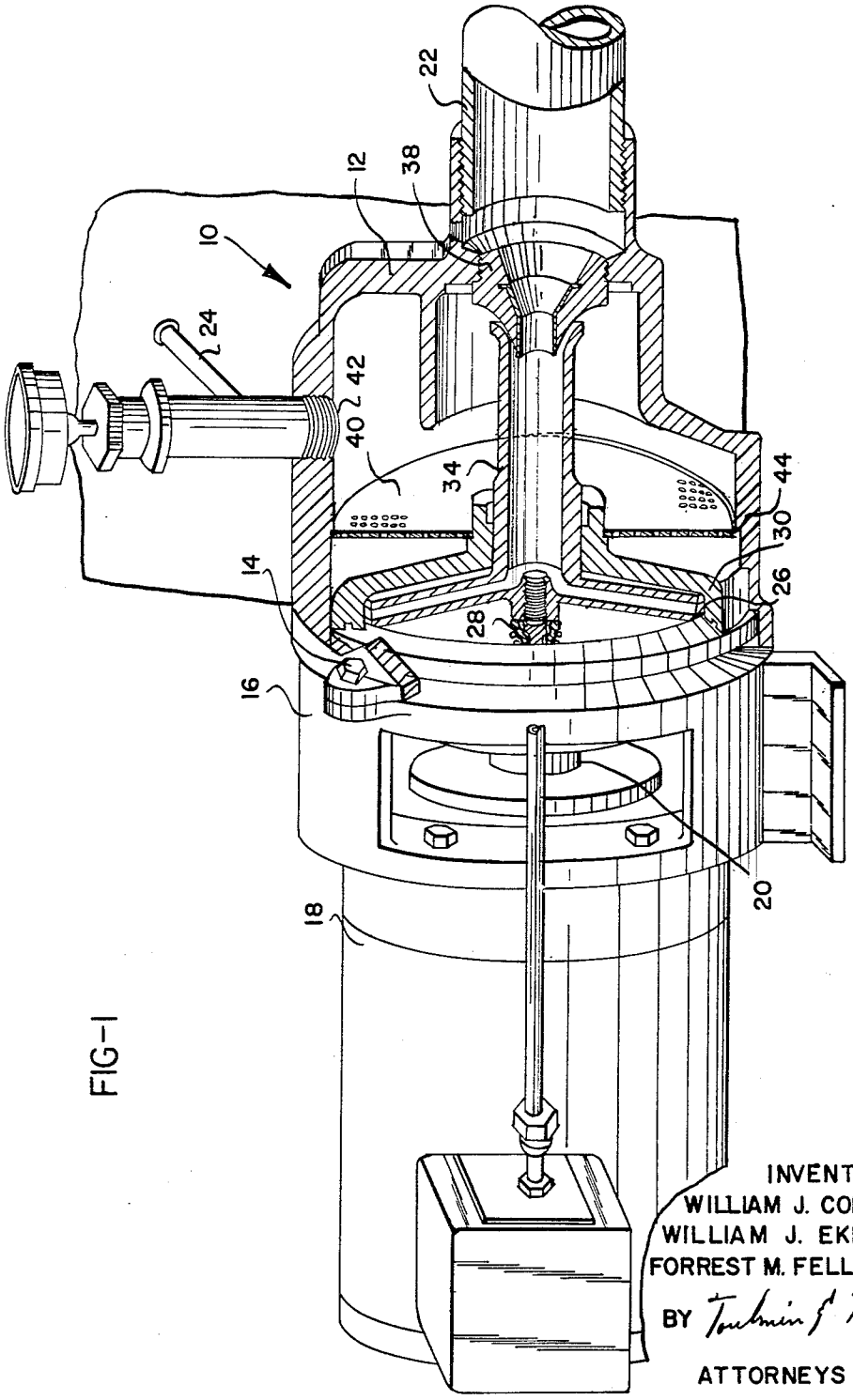

FIG-1

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SHALLOW WELL SELF-PRIMING JET PUMP

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FIG-3

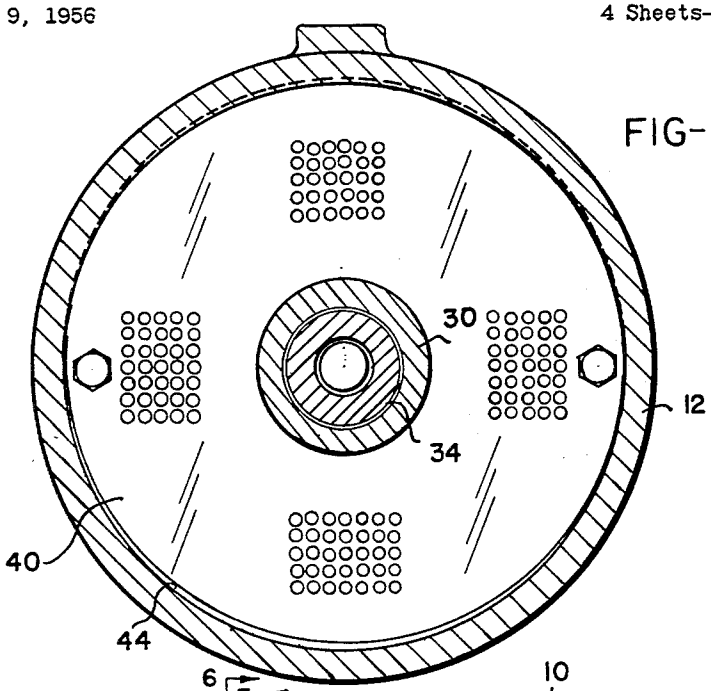
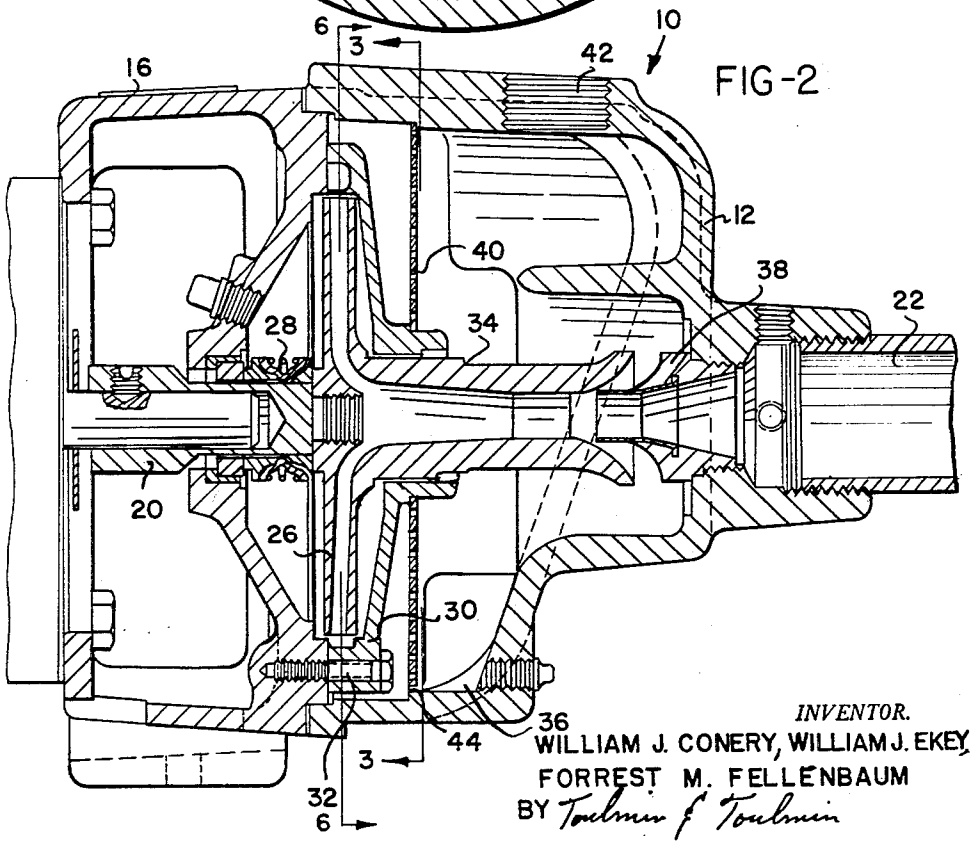


FIG-2



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SHALLOW WELL SELF-PRIMING JET PUMP

Filed Oct. 9, 1956 4 Sheets-Sheet 3

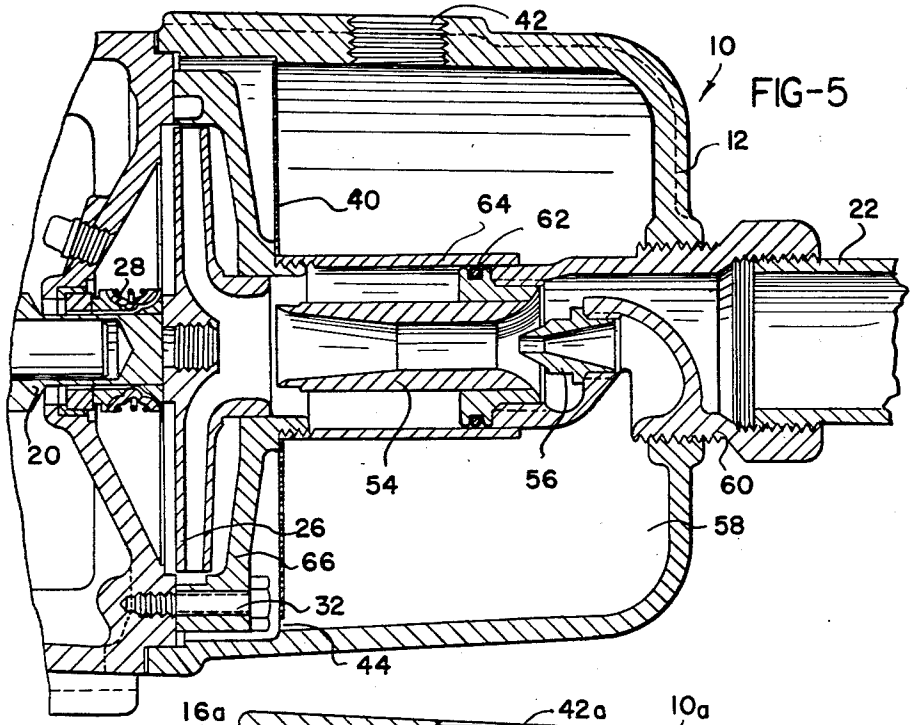

FIG-5

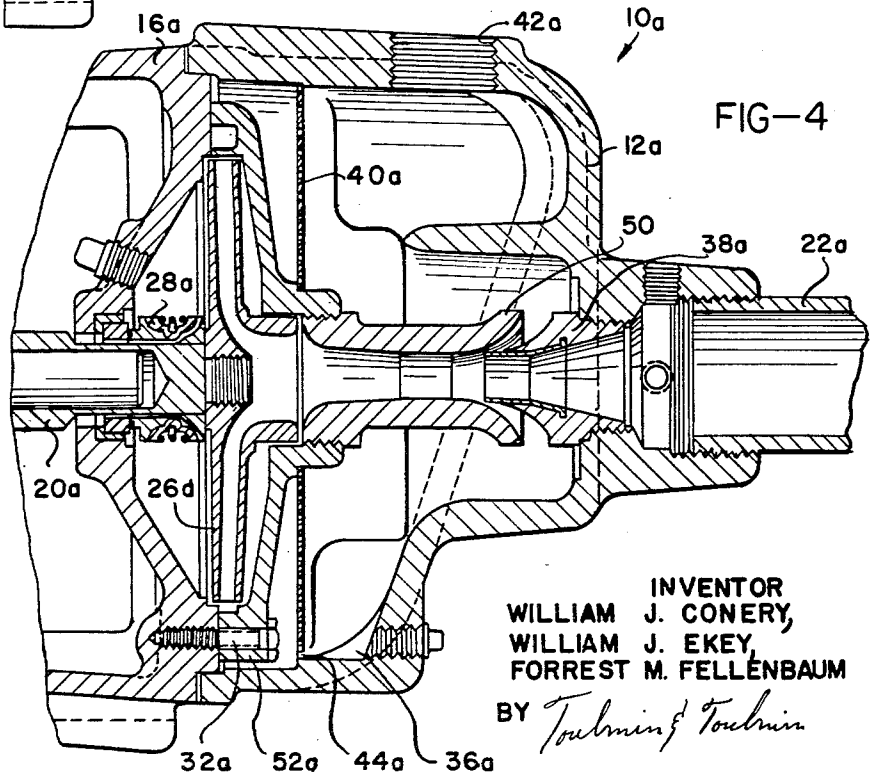

FIG-4

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SHALLOW WELL SELF-PRIMING JET PUMP

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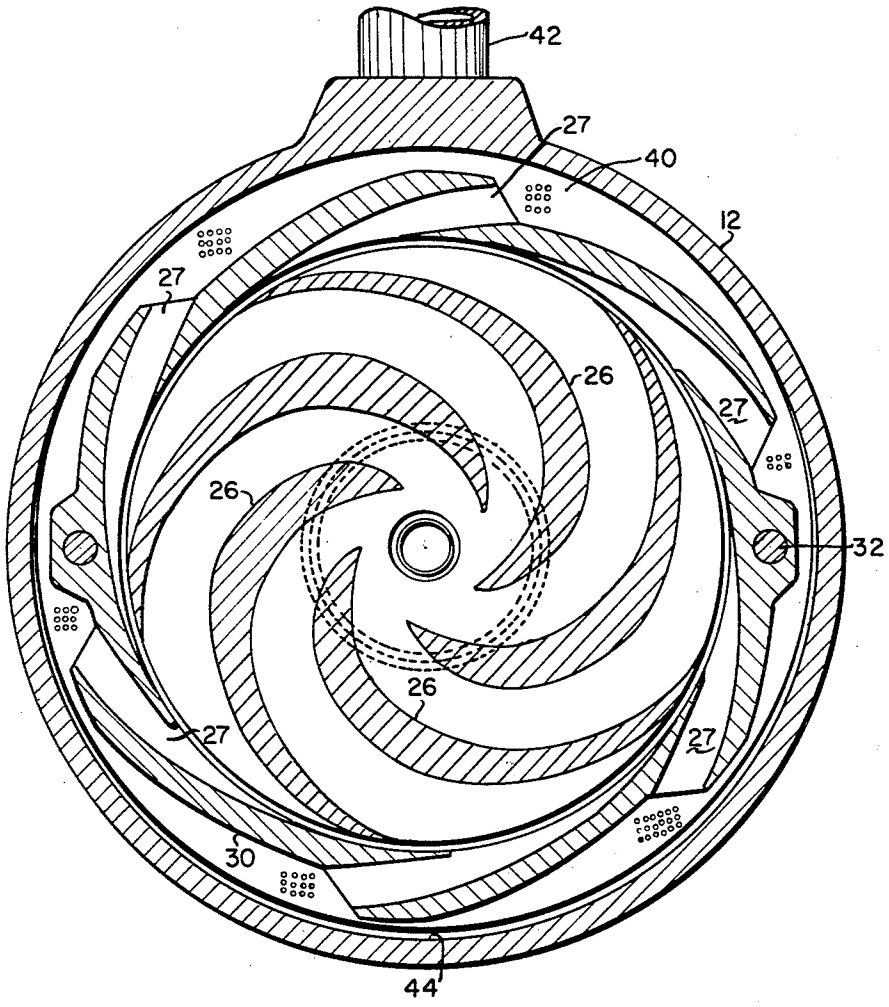

FIG-6

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SHALLOW WELL SELF-PRIMING JET PUMP

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Application October 9, 1956, Serial No. 614,939

13 Claims. (Cl. 103—5)

This invention relates to a shallow well pump, and particularly to a shallow well jet pump and a method of operation thereof, particularly with respect to the priming of the pump.

Shallow well pumps of the type with which this invention is concerned, and which comprise a centrifugal pump in series with a jet pump, are well known and are widely used for domestic and farm pumping installations.

Most of these pumps, from time to time, must be primed in order to start them or when they become at least partially filled with air, particularly if the pump sits idle or there is a suction drawn on the inlet of the pump during idle periods. Because of this many times a shallow well pump of this nature is operating under conditions where it is necessary for the pump to be primed periodically in order that it will develop proper suction on the inlet pipe and draw the liquid being pumped into the pump.

It is in connection with the particular feature of priming a pump of this nature that the present invention deals.

The primary object of the present invention is to provide a shallow well centrifugal pump which is extremely rapid in its priming action and which is self-priming, but which has an exceptionally small capacity reservoir for the storage of self-priming fluid.

Another object of the present invention is the provision of a self-priming shallow well jet pump which is relatively compact and which can be manufactured at low cost while still retaining the highly important feature of rapid self-priming.

A further object of the present invention is the provision of a shallow well self-priming jet pump which is adapted for having associated therewith any of the several well known types of jet pump arrangements while still retaining the same highly efficient rapid self-priming characteristics in the same pump structure.

A still further object of the present invention is the provision of a method of operating a shallow well self-priming jet pump to effect extremely rapid self-priming of the pump with a minimum amount of priming fluid being retained within the reservoir of the pump.

These and other objects and advantages of this invention will become more apparent upon reference to the following specification taken in connection with the accompanying drawings, wherein:

Figure 1 is a perspective view showing somewhat diagrammatically and partly in section a pumping installation according to the present invention;

Figure 2 is a vertical sectional view through a pump constructed according to this invention and utilizing a reverse ejector and venturi tube that rotates with the pump impeller;

Figure 3 is a sectional view indicated by line 3—3 on Figure 2 and showing the arrangement within the reservoir of the pump casing of a screen according to the present invention;

Figure 4 is a sectional view similar to Figure 2, but showing a modified type arrangement wherein the verturi tube is stationarily mounted;

Figure 5 is a sectional view similar to Figures 2 and 4, but showing a more or less conventional type of ejector; and

Figure 6 is a sectional view on line 6—6 of Figure 2 showing the passages from the impeller into the casing.

Referring to the drawings somewhat more in detail, Figure 1 shows a pump generally designated at 10 which comprises a casing 12 that attaches by means of bolts 14 to a motor bracket 16 that forms the back closure wall of the pump casing. Motor bracket 16 also supports a drive motor 18 that is adapted for connection with the pump shaft 20 of the pump.

A suction conduit 22 leads into the inlet of the pump and preferably has located therein at some convenient point a check valve to permit flow toward the pump but not away from the pump in the inlet conduit. A discharge conduit 24 is connected with the pump casing and leads to a supply tank or the like.

The interior of the pump casing forms a pumping unit that comprises an impeller 26 secured to the end of pump shaft 20 and being in sealing relation with the motor support bracket 16 by means of the rotary seal element 28.

The impeller 26 discharges into volute passages 27 of a conventional arrangement that is formed within a back or vane plate 30 attached to the motor bracket by cap screws 32. Back plate 30 is centrally apertured and rigid with the rotary impeller, or detachably mounted thereon is a venturi tube 34 that extends into the pump casing coaxially with the inlet conduit 22.

The venturi tube 34 extends into the cavity 36 formed in the pump casing within which the priming fluid for the pump is retained. The venturi tube forms a reverse ejector and a nozzle 38 is arranged to cooperate with the ejector so that water passes from the inlet conduit to the nozzle directly into the venturi tube and into the eye of the impeller. The nozzle may advantageously comprise a plastic material such as nylon, with a wear and corrosion-resistant sleeve such as stainless steel in the end thereof.

A particular feature of the present invention resides in the provision of the screen 40 immediately adjacent back plate 30, and which screen, it will be noted, is a substantial distance from the outlet port 42 to which the discharge conduit leading from the pump casing is connected.

As will be seen in Figure 3, the screen 40 is preferably set slightly off-center or is formed so that the center hole is slightly eccentric relative to the outside diameter of the screen, whereby arcuate slit 44 exists between the edge of the screen and the side and bottom walls of the pump casing.

In operation, the pump usually has the check valve referred to above installed in the suction conduit, either near the suction inlet into the pump casing or submerged in the liquid at the lower end of the suction conduit.

Before the pump is initially started, the pump casing 12 is filled with liquid and thereupon the drive motor 18 may be started. When the motor is started the liquid within the pump casing is actuated by the impeller 26, and some of the liquid is discharged through the discharge port 42 leaving an air space in the upper end of the reservoir 36.

The perforated screen 40 is at this time effective to maintain a liquid-air mixture adjacent the back plate 30 so that the liquid level in the reservoir falls a substantial distance below the discharge port 42 whereby substantially liquid-free air is discharged through the said discharge

port, whereas substantially air-free liquid is supplied to the inlet end of the venturi tube from the reservoir.

The air drawn in from the suction conduit **22** is discharged through the perforated screen and thence through outlet port **42**. Due to the opening **44** around the bottom edge of the screen there is free passage of substantially air-free water from the impeller side of the screen over to the reservoir **36** and thence into the inlet end of the venturi tube.

The action described above continues until the air is exhausted from the suction line and the pump commences to pump all water, and the action will automatically repeat itself if for any reason more air enters the suction line.

The priming action is extremely rapid due to the presence of the perforated screen **40** which maintains a liquid ring or layer in the vicinity of the back plate **30**, and thus prevents excessive dissipation of the supply of priming liquid through the outlet **42**. This results in very rapid priming and it will be apparent that the previously mentioned spacing between the screen **40** and the outlet port is effective for preventing the rapid loss of the priming liquid from the outlet port.

It will also be apparent that screen **40** would not have to be off-center, as illustrated in Figures 2 and 3, but could be on-center if so desired although the priming speed is enhanced by the opening **44** around the bottom of the screen.

It will also be apparent that the screen serves as a strainer to prevent foreign particles from entering the ejector which might enter through the suction conduit, and which particles could possibly lodge between the ejector and the end of the nozzle or cause severe wear in passing therethrough.

The arrangement in Figure 4 is substantially identical with that illustrated in Figure 2, and for that reason carries the same reference numerals, with the exception of the addition of a subscript *a* where such numerals are applicable. The principal difference between the Figures 2 and 4 modifications resides in the fact that in the Figure 4 arrangement the venturi tube **50** is stationarily mounted by being threaded into the back end of the back plate **52**. In all other respects the construction of the Figure 4 modification is the same as that in the Figure 2 modification.

The modification of Figure 5 is similar, basically, to the modifications of Figures 2 and 4 except that in Figure 5 the suction conduit **22** is connected with the inlet end of the stationary venturi tube **54** into which a nozzle **56** discharges, with the nozzle **56** being connected to receive fluid from the cavity **58** in the pump casing.

The nozzle and venturi tube are mounted in a fitting **60** threaded into the end of the pump casing, and an annular O ring **62** seals between the inner end of the fitting and a tube **64** extending rearwardly from the back plate **66** of the pumping arrangement.

The Figures 2 and 4 modifications have the advantageous features of compactness and straight line flow of fluid from the suction conduit to the eye of the impeller, whereas the Figure 5 modification is of a more conventional structure and utilizes the known and efficient combination of a pressure jet and a venturi tube.

In all cases a characterizing feature is found in the perforated plate or screen shown which, as mentioned before, may be centrally located within the pump casing or may be so arranged as to leave an arcuate slit around the side and bottom, as indicated at **44** in Figure 3.

This screen impedes the flow of pumped liquid from about plate **30** into reservoir **36** and, because of the circumferential movement of the liquid on the side of screen **40** toward plate **30** as the liquid emerges from volute passages **27**, the hereinbefore described ring of liquid is established about the periphery of plate **30** that causes the extremely rapid priming referred to.

The operation of all the embodiments is identical with respect to the essential features of the present invention,

and with particular respect to the new and novel feature of the screen or perforated plate which serves as a water-retaining baffle and also as a strainer screen.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and conditions, and accordingly it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

We claim:

1. In combination, in a shallow well pump; a pump casing, a centrifugal pump unit within said casing discharging peripherally into the casing, a jet pump unit within said casing positioned to discharge into the inlet of the centrifugal pump unit, a casing surrounding said pump units having an outlet and also having an inlet supplying said jet pump, and baffle screen means in said pump casing between the centrifugal pump outlet and the outlet from the casing extending substantially to the casing in all directions whereby to be operable to impede the free flow of fluid from the centrifugal pump unit to the outlet in the pump casing thereby to retain a ring of fluid about the centrifugal pump during the priming period thereof.

2. In combination, in a shallow well pump; a pump casing having an inlet and an outlet, a centrifugal pump unit within said casing toward one end thereof having an outlet discharging tangentially into the casing and also having an inlet, a jet pump in the casing positioned to discharge into the inlet of the centrifugal pump, means for supplying pressure fluid from the casing to the nozzle of said jet pump and for connecting the inlet of the jet pump with the said inlet of the pump casing, the outlet from said pump casing comprising a discharge port in the upper part of said casing toward the other end thereof from said centrifugal pump, and baffle screen means extending transversely of said casing and substantially the full width of the casing in all directions adjacent said centrifugal pump unit on the side thereof toward the outlet from the pump casing operable to impede fluid flow away from the centrifugal pump unit thereby to retain a ring of fluid about the centrifugal pump unit during the priming period of the pump.

3. In combination, in a shallow well pump; a pump casing having an inlet, a centrifugal pump unit in one end of the casing having an outlet constructed to discharge tangentially into the casing and having an inlet, a jet pump also in said casing extending from the inlet in the pump casing into the inlet of the centrifugal pump and having the nozzle thereof connected to receive pressure fluid from the pump casing, an outlet in the top of the casing adjacent the opposite end from the centrifugal pump, and a baffle screen mounted transversely of the casing immediately adjacent the said centrifugal pump unit on the side thereof toward the outlet in the pump casing and a substantial distance from the said outlet operable to impede fluid flow away from the centrifugal pump unit thereby to retain a ring of fluid about the centrifugal pump unit during the priming period thereof and to prevent loss of the priming fluid through said outlet, said baffle screen extending substantially the full width of the casing in all directions.

4. In combination, in a shallow well pump; a pump casing, a centrifugal pump unit in one end of the casing having outlet means constructed and arranged to discharge tangentially into the casing, a jet pump extending from the other end of the casing into the inlet of the centrifugal pump and comprising a jet and inductor, said pump casing having an inlet connected to the inductor, an outlet in the casing remote from the centrifugal pump unit, means connecting the jet of the jet pump to the lower portion of said casing to receive pressure fluid therefrom, and a baffle screen mounted within said casing transversely thereof immediately adjacent said centrifugal pump unit and between the centrifugal pump unit and said outlet in the pump casing operable to impede fluid

flow away from the centrifugal pump unit thereby to retain a ring of fluid about the centrifugal pump unit during the priming period thereof, said baffle screen extending substantially the full width of the casing in all directions.

5. In combination, in a shallow well pump; a pump casing, a centrifugal pump unit in one end of the casing having outlet means constructed and arranged to discharge tangentially into the casing and also having an inlet, a jet pump extending from the other end of the casing into the inlet of the centrifugal pump and comprising a jet and an inductor, an outlet in the casing remote from the centrifugal pump unit, an inlet in the pump casing connected to said inductor, means connecting the jet of the jet pump to the lower portion of said casing to receive pressure fluid therefrom, and a baffle screen mounted within said casing transversely thereof immediatelly adjacent said centrifugal pump unit between the centrifugal pump unit and said outlet in the pump casing operable to impede fluid flow away from the centrifugal pump unit thereby to retain a ring of fluid about the centrifugal pump unit during the priming period thereof, said baffle screen extending substantially the full width of the casing in all directions and comprising a foraminous member having apertures therein of a size less than the space between the said inductor and the jet whereby foreign matter carried into the pump via the inlet thereof cannot lodge in the space between the jet and inductor.

6. In combination, in a shallow well pump; a pump casing, a centrifugal pump unit in one end of the casing having outlet means constructed and arranged to discharge tangentially into the casing and also having an inlet, a jet pump extending from the other end of the casing into the inlet of the centrifugal pump and comprising a jet and inductor, an outlet in the casing remote from the centrifugal pump unit, an inlet in the pump casing connected to said inductor, means connecting the jet of the jet pump to the lower portion of said casing to receive pressure fluid therefrom, and a baffle screen mounted within said casing transversely thereof immediately adjacent said centrifugal pump unit and between the centrifugal pump unit and the said outlet in the pump casing operable to impede fluid flow away from the centrifugal pump unit thereby to retain a ring of fluid about the centrifugal pump unit during the priming period thereof, said baffle screen extending substantially the full width of the casing in all directions and the periphery of the screen and said casing defining a narrow arcuate slit at the bottom of the casing providing for a degree of unrestricted fluid flow between the opposite sides of said baffle screen.

7. In combination, in a shallow well pump; a pump casing, a centrifugal pump unit in one end of the casing having outlet means constructed and arranged to discharge tangentially into the casing and also having an inlet, a jet pump extending from the other end of the casing into the inlet of the centrifugal pump and comprising a jet and inductor, outlet means in the casing remote from the centrifugal pump unit, an inlet in the pump casing connected to said inductor, means connecting the jet of the jet pump to the lower portion of said casing to receive pressure fluid therefrom, and a baffle screen mounted within said casing transversely thereof immediately adjacent said centrifugal pump unit and between the centrifugal pump unit and the said outlet in the pump casing operable to impede fluid flow away from the centrifugal pump unit thereby to retain a ring of fluid about the centrifugal pump unit during the priming period thereof, said baffle screen being mounted within said casing so as to leave only a small slit between the edge of the screen and the bottom of the casing to permit a degree of free flow of fluid past the screen during the priming period of the pump.

8. In combination, in a shallow well pump; a pump casing, a centrifugal pump unit in one end of the casing having outlet means constructed and arranged to discharge tangentially into the casing and also having an inlet, a jet pump extending from the other end of the casing into the inlet of the centrifugal pump and comprising a jet and inductor, an outlet in the casing remote from the centrifugal pump unit, an inlet in the pump casing connected to said inductor, means connecting the jet of the jet pump to the lower portion of said casing to receive pressure fluid therefrom, a baffle screen mounted within said casing transversely thereof immediately adjacent said centrifugal pump unit and between the centrifugal pump unit and the said outlet in the pump casing operable to impede fluid flow away from the centrifugal pump unit thereby to retain a ring of fluid about the centrifugal pump unit during the priming period thereof, said baffle screen extending substantially the full width of the casing in all directions, said jet and inductor being provided by mounting a nozzle within the casing coaxially with the inlet therein, and connected therewith, and mounting a venturi tube coaxially therewith having its one end slightly spaced from the end of the nozzle so as to receive fluid into the said one end from the casing and whereby the flow of fluid into the said one end creates a jet, and the other end of the tube communicating with the eye of the impeller of the centrifugal pump unit.

9. In combination, in a shallow well pump; a pump casing, a centrifugal pump unit in one end of the casing having outlet means constructed and arranged to discharge tangentially into the casing and also having an inlet, a jet pump extending from the other end of the casing into the inlet of the centrifugal pump and comprising a jet and inductor, an outlet in said casing remote from the centrifugal pump unit, an inlet in the pump casing connected to said inductor, means connecting the jet of the jet pump to the lower portion of said casing to receive pressure fluid therefrom, a baffle screen mounted within said casing transversely thereof immediately adjacent said centrifugal pump unit operable to impede fluid flow away from the centrifugal pump unit thereby to retain a ring of fluid about the centrifugal pump unit during the priming period thereof, said baffle screen extending substantially the full width of the casing in all directions, said jet and inductor being provided by mounting a nozzle within the casing on the axis of the said inlet therein, and mounting a venturi tube coaxially therewith having its one end slightly spaced from the end of the nozzle whereby the flow of fluid therebetween creates a jet, and the other end of the tube communicating with the eye of the impeller of the centrifugal pump unit, said tube being connected with the impeller to rotate therewith.

10. In combination, in a shallow well pump; a pump casing, a centrifugal pump unit in one end of the casing having a back plate with outlet means constructed and arranged to discharge tangentially into the casing and also having an inlet, a jet pump extending from the other end of the casing into the inlet of the centrifugal pump and comprising a jet and inductor, an inlet in the pump casing connected to said inductor, means connecting the jet of the jet pump to the lower portion of said casing to receive pressure fluid therefrom, a baffle screen mounted within said casing transversely thereof adjacent said centrifugal pump unit and between the centrifugal pump unit and the outlet in the pump casing operable to impede fluid flow away from the centrifugal pump unit thereby to retain a ring of fluid about the centrifugal pump unit during the priming period thereof, said jet and inductor being provided by mounting a nozzle within the casing on the axis of the inlet therein and connected therewith, and mounting a venturi tube coaxially therewith having its one end slightly spaced from the end of the nozzle whereby the flow of fluid therebetween creates a jet, and the other end of the tube communicating with the eye of the impeller of the centrifugal

pump unit, said tube being fixedly mounted in the back plate of said centrifugal pump unit.

11. In combination, in a shallow well pump; a pump casing, a centrifugal pump unit located in one extreme end of said casing and discharging tangentially therein, a jet pump unit extending from the other end of said casing into the inlet of said centrifugal pump unit, an outlet in the casing spaced from the centrifugal pump unit, said jet pump unit comprising a jet creating nozzle and an inductor tube, said inductor tube opening into the eye of the impeller of the centrifugal pump unit at its one end, an inlet in the pump casing connected to the other end of the inductor tube, said nozzle discharging into said inductor tube and having its inlet communicating with the lower part of said casing, and a baffle screen extending transversely of said casing immediately adjacent the centrifugal pump unit operable to impede fluid flow away from the centrifugal pump unit thereby to retain a ring of liquid thereabout during the priming period.

12. In combination, in a shallow well pump; a pump casing, a centrifugal pump unit located in one extreme end of said casing and discharging tangentially therein, a jet pump unit extending from the other end of said casing into the inlet of said centrifugal pump unit, an outlet in the casing spaced from the centrifugal pump unit, said jet pump unit comprising a jet creating nozzle and an inductor tube, said inductor tube opening into the eye of the impeller of the centrifugal pump unit at its one end, an inlet in the pump casing connected to the other end of the inductor tube, said nozzle discharging into said inductor tube and having its inlet communicating with the lower part of said casing, and a baffle screen extending transversely of said casing immediately adjacent the centrifugal pump unit to impede fluid flow away from the centrifugal pump unit thereby to retain a ring of liquid thereabout during the priming period, there being an outlet leading from said casing on the opposite side of said screen from the centrifugal pump unit.

13. In combination, in a shallow well pump; a pump casing, a centrifugal pump unit located in one extreme end of said casing and discharging tangentially therein, a jet pump unit extending from the other end of said casing into the inlet of said centrifugal pump unit, an outlet in the casing spaced from said centrifugal pump unit, said jet pump unit comprising a jet creating nozzle and an inductor tube, said inductor tube opening into the eye of the impeller of the centrifugal pump unit at its one end, an inlet in the pump casing connecting to the other end of the inductor tube, said nozzle discharging into said inductor tube and having its inlet communicating with the lower part of said casing, and a baffle screen extending transversely of said casing immediately adjacent the centrifugal pump unit to impede fluid flow away from the centrifugal pump unit thereby to retain a ring of liquid thereabout during the priming period, there being an outlet leading from said casing on the opposite side of said screen from the centrifugal pump unit, said nozzle and inductor tube being mounted in a single fitting, said fitting being screw-threaded into the end of said casing on the axis of rotation of the impeller of said centrifugal pump, and a tube extending between the centrifugal pump unit and said fitting for effecting a fluid-tight seal therebetween.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,934,021 April 26, 1960

William J. Conery et al.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 14, for "a casing" read -- said casing --; same line, after "units" insert -- and --.

Signed and sealed this 18th day of October 1960.

(SEAL)
Attest:
KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents