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Crisafulli

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[54] **VERTICALLY ADJUSTABLE CENTRIFUGAL PUMP FOR USE IN MANHOLES**

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[51] **Int. Cl.**.....**F01d 13/00,** F01d 15/00, F04b 17/00

[58] **Field of Search** .....415/98, 501, 143, 74, 121 B, 415/122; 417/424

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[57] **ABSTRACT**

A portable centrifugal pump for use in vertically extending cavities such as a manhole. A centrifugal pump having a force feed blade assembly is located in the cavity and empties into a discharge duct extending upward out of the cavity. A drive shaft extends downward from a gear box located above the cavity and drives the pump. The gear box is adjustable to accommodate horizontally extending power shafts at varying heights. The pump may be adjustably positioned at varying depths through the use of a vertically adjustable transverse support member which mounts the centrifugal pump in the cavity and is supported by a depending framework from the bottom of the cavity.

10 Claims, 5 Drawing Figures

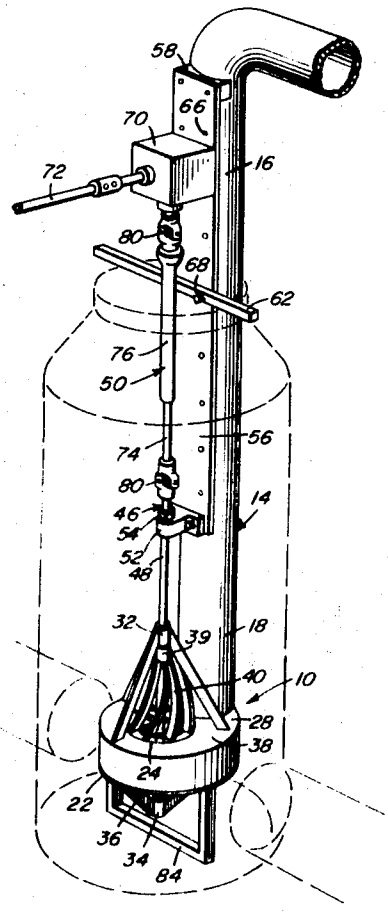

Fig. 1

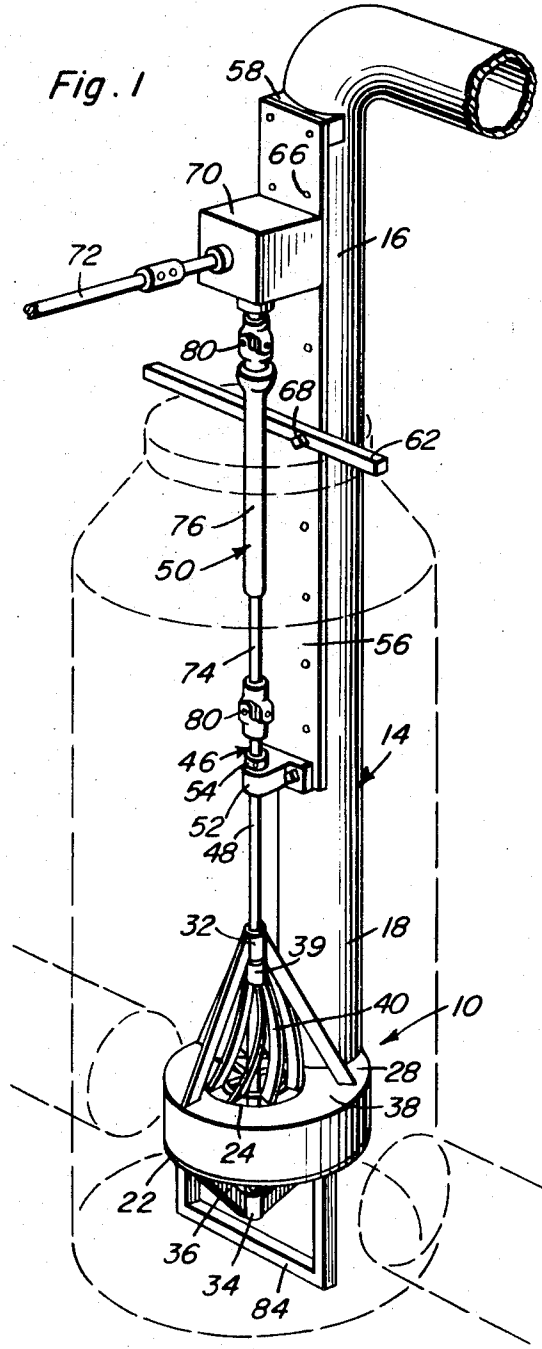

Fig. 3

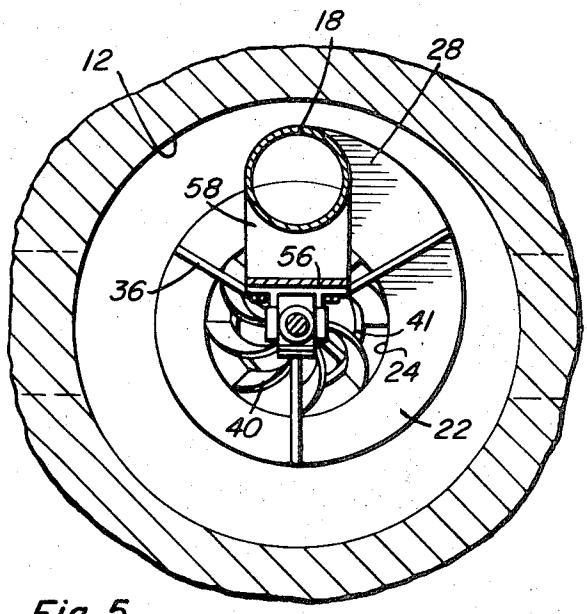

Fig. 5

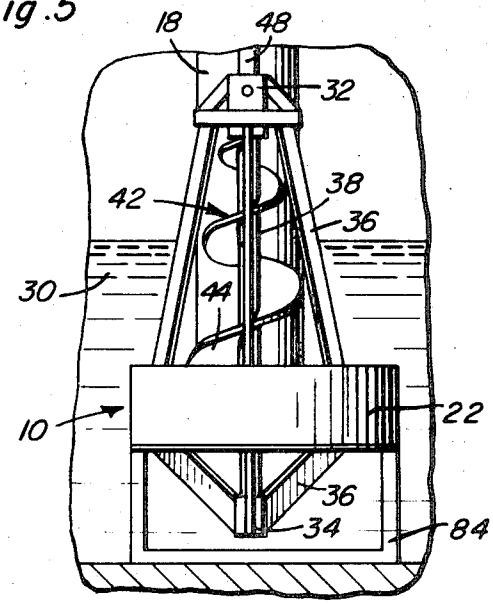

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Fig. 2

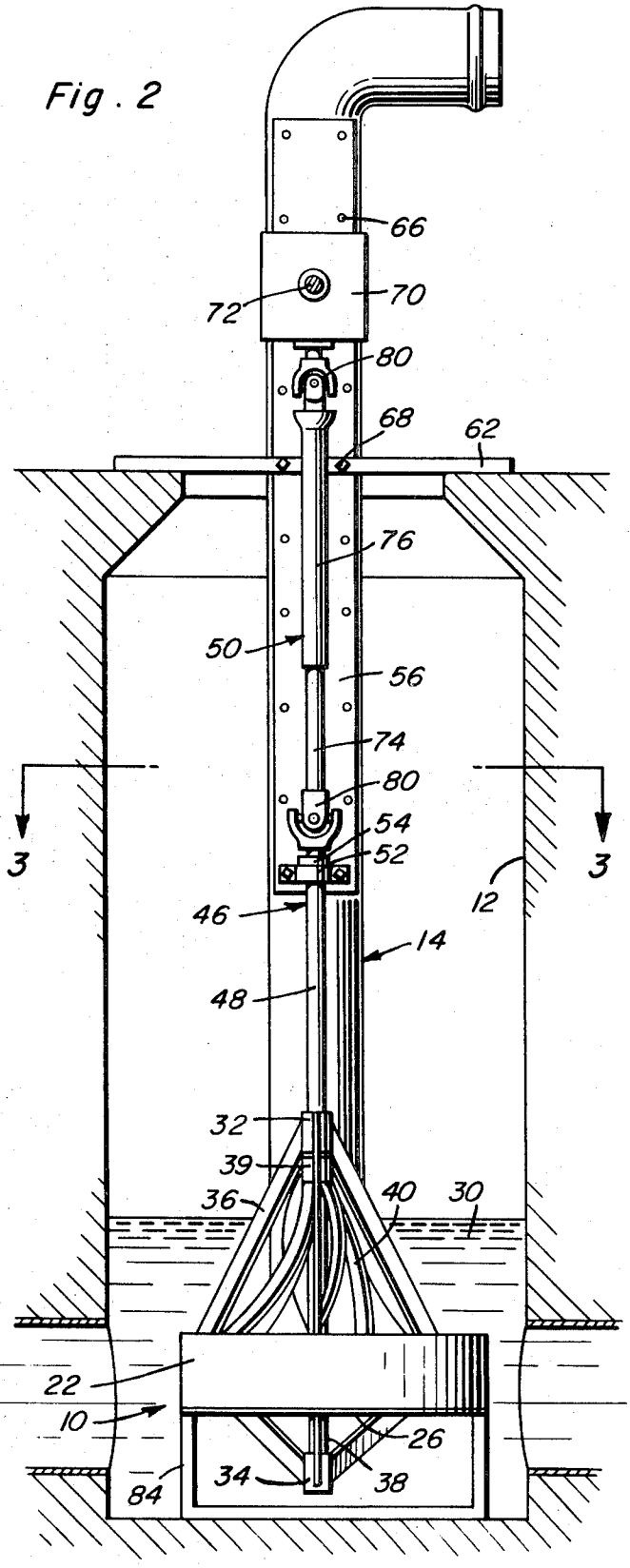
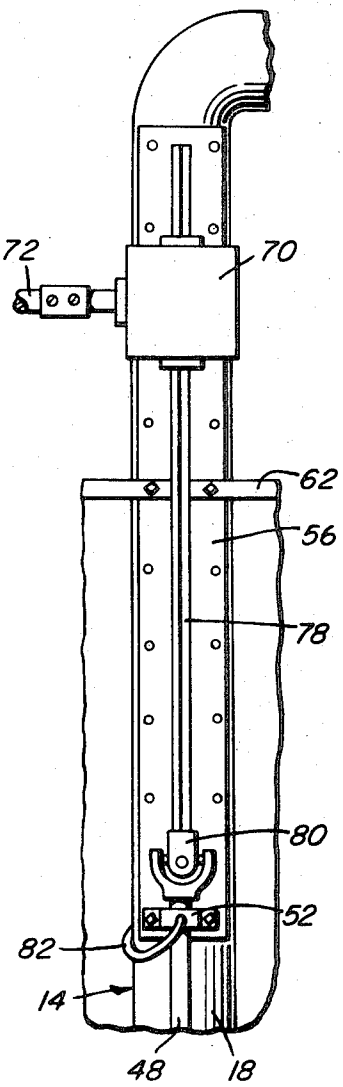


Fig. 4



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VERTICALLY ADJUSTABLE CENTRIFUGAL PUMP FOR USE IN MANHOLES

This invention relates to a portable centrifugal pump such as shown in prior U.S. Pat. No. 3,371,614 used in a vertically extending cavity.

Heretofore, portable pumps have frequently been used for liquid pumping operations where it is convenient to use as a power source a power take-off from a farm tractor or other similarly equipped vehicle. Not infrequently this power take-off takes the form of a shaft rotating about a horizontal axis. In suction pumps where the pumping mechanism is located above the surface of the cavity, there is seldom a problem of power transmission since the pumping mechanism may be positioned to accommodate the horizontal or downwardly angled power take-off shaft. A disadvantage of such pumps, however, is that they require the utilization of suction piping extending down into the cavity, suction foot valves, or the like in order to convey the liquid to be pumped to the pump suction inlet. A considerable amount of time is therefore required to set up suction piping and to prime suction pumps of this type. This expenditure of time occurs during the initial stages of the pumping operation when speed of operation is most important.

An alternative type of portable pump is submersible pumps that are mechanically driven by a vertically extending shaft. These pumps have invariably been inflexible for operation with varying cavity depth, varying liquid level in the cavity and varying height of a horizontal power take-off. The improvements of the present invention have been introduced to render submersible mechanical driven pumps more flexible and to facilitate their initial set up. The submersible pump of this invention is readily adaptable for use in pumping liquid from wells, manholes, and a variety of other vertically extending cavities.

It is an object of this invention to provide a submersible mechanically driven pump which is readily adaptable for use with power take-off shafts from farm tractors or other similarly equipped vehicles where the power shafts rotate about horizontal axes at varying heights above a surface into which a vertically oriented cavity extends. According to this invention, a gear box for changing rotary motion about a horizontal axis to rotary motion about a vertical axis is positionable at selected and varying distances above the brim of the cavity.

It is a further object of this invention to provide a portable centrifugal pump, including a submersible mechanically driven pump means, with a means for adjusting the depth at which the pump means is located. This provides the pump with increased flexibility for use in cavities of varying depths and in water levels of varying depths. Thus, there is no tendency for the pump means to be forced to the bottom of a cavity and possibly damaged in the process, nor is there a tendency for the pump means to be carried too high and become air locked after a relatively short period of operation.

Still further objects of the preferred embodiments of the invention include the provision of a guard member for the protection of the pump means from debris at the bottom of cavities to be pumped, and the provision of bearings for an impeller longitudinally displaced from the pump casing. By incorporating this latter feature, neither wear rings nor impeller rings are required, and the pump may thereby be produced more economically and operated with fewer maintenance problems arising.

In a broad aspect, this invention is a submersible portable centrifugal pump for use in vertically extending cavities comprising a vertically extending discharge duct having upper and lower ends, a rotary centrifugal pump means carried by and discharging into the lower end of said discharge duct, a vertically extending drive shaft means having upper and lower portions driving said pump means and supported at said lower portion by and rotatably journaled in spaced relation to said discharge duct, a transverse support member fastened to said discharge duct and extending laterally in opposing directions therefrom, and a transmission gear box means for changing rotary motion about a horizontal axis to rotary motion about a vertical axis operatively connected to the upper portion of said drive shaft means and longitudinally positionable with respect to the lower portion of said drive shaft means, whereby said transverse support member is positionable to span the walls of a cavity and support said pump means which is suspended therefrom, and said gear box means is positionable at varying distances above said transverse support member to accommodate horizontally extending power shafts at varying heights. A force feed blade assembly facilitates input of water into the pump means.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIG. **1** is a perspective view of a pump according to this invention positioned in a cavity.

FIG. **2** is a side elevational view of the pump of FIG. **1**.

FIG. **3** is a cross-sectional view taken along the lines **3—3** of FIG. **2**.

FIG. **4** is a view of a modified drive shaft for the pump.

FIG. **5** is a side elevational view of a modified force feed blade assembly.

Referring now to the drawings there is shown a portable centrifugal pump indicated generally at **10** positioned in a vertically extending cavity **12**. The pump **10** is disclosed in U.S. Pat. No. 3,371,614 issued Mar. 5, 1968 which is incorporated herein by reference with pump **10** being disposed with the axis thereof vertically disposed and including a vertically extending discharge duct **14** having an upper end **16** and a lower end **18**. The pump **10** is comprised of a dual suction intake port pump casing **22** provided with vertically aligned and axially opposed intake ports **24** and **26**, and a tangential discharge port **28** in communication with the lower end **18** of the discharge duct **14** with the pump being immersed in water **30**. A pair of vertically aligned bearings **32** and **34** are longitudinally displaced from and attached to the pump casing **22** by bearing support members **36**. The provision of longitudinally disposed bearings **32** and **34** obviates the need for wear rings in the casing **22** about the impeller therein, and

the bearing support members **36** serve as baffles to reduce a vortex formation of the liquid being pumped.

The impeller of the pump **10** is mounted on a vertical shaft **38** which may be driven by an electric motor, internal combustion engine or the like and is supported in bearings **32** and **34** as disclosed in prior U.S. Pat. No. 3,371,614. Mounted on a collar **39** on shaft **38** is a plurality of impeller blades **40** of generally arcuate configuration which radiate from and are rigid with the collar **39** on shaft **38**. The lower end of the blades are interconnected by ring **41** rigid with shaft **38** by a spider type supporting assembly. An alternative arrangement illustrated in FIG. **5**, has an impeller **42** in the form of a single helical screw blade **44** mounted on shaft **38**. As illustrated, the diameter of blade **44** increases axially downwardly from the upper end of the shaft **38**. The blades **40** also increase in diameter and both embodiments form an emulsifier and force feed screw which can also be used on the bottom of the pump if desired to facilitate entry of water into the inlet openings.

A drive shaft means **46** is spaced from and parallel to the discharge duct **14**. Drive shaft means **46** has an upper portion **50** and a lower portion **48**. The lower portion **48** is connected to and forms a continuation of the impeller **30** and thereby drives the pump means **10**. Drive shaft means **46** is supported at its lower portion **48** by a bearing bracket **52**, which surrounds the lower portion **48** and supports the annular collar **54** extending radially outward from the upper end of lower portion **48**. Bearing bracket **52** is bolted to a mounting plate **56** which is welded to or otherwise secured to discharge duct **14**. Mounting plate **56** is elongated with supports **58** at the ends thereof welded to discharge duct **14** and plate **56** extends in longitudinal alignment with discharge duct **14**. A transverse support member **62** is fastened to the discharge duct **14** by means of the plate **56**. Support member **62** extends laterally in opposite directions from discharge duct **14** and thereby supports the entire portable pump **10** in the cavity **12**. The ends of support member **62** spans the walls of cavity **12**, and the pump **10** is thereby suspended at the same depth in any cavity in which the pump is positioned. As illustrated the transverse support member **62** is adjustably fastened to plate **56** by bolts or fasteners **68**, which serve as releasable support member fastening means and fasten the transverse support member **62** to selected fastening points or holes **66** in plate **56**. It can be seen that the transverse support member **62** is thereby adjustably positionable along the length of discharge duct **14** and the pump **10** is thereby positionable at varying depths in the cavity. Moreover, if a deep cavity is encountered, fasteners **68** may be passed through support member **62** into an upper pair of tapped holes **66** and pump **10** will be suspended lower. Conversely, to raise pump **10** for use in a shallow cavity, fasteners **68** are secured through support member **62** in a lower pair of holes **66**. The flexibility of the pump **10** is thereby increased for use in cavities of varying depths.

A gear box **70** is also adjustably positionable at varying distances along support plate **56** by suitable fasteners extending through holes **66** which enables the gear box to accommodate horizontally extending power shafts **72** at varying heights. Transmission gear box **70** is a device for changing rotary motion about a horizontal axis to rotary motion about a vertical axis. This is achieved using gears placed at right angles to each other as is well known in the field of mechanical power transmission. Horizontal shaft **72** represents the driving shaft of a power take-off from a tractor or other similarly equipped vehicle. Power is transmitted from shaft **72** through gear box **70** to the upper portion **50** of drive shaft means **46**, which is operatively connected to the pump **10**, as illustrated. In FIG. **1**, the upper portion **50** of the drive shaft means **46** is comprised of a shaft member **74** and a sleeve member **76** mounted in telescopic relation to shaft member **74**. The shaft member **74** and the sleeve member **76** are keyed to each other or of corresponding polygonal shape to rotate together and are longitudinally adjustable with respect to each other. The gear box means **70** is thereby longitudinally positionable with respect to the lower portion **48** of the drive shaft means **46**.

Gear box **70** may also be adjustable positionable with respect to the lower portion **48** of the drive shaft means **46** by the modified construction of FIG. **4**. In FIG. **4**, the upper portion **78** of the drive shaft means is a shaft member having a non-circular cross-section. Upper portion **78** has a square cross-section, though a variety of other cross-sectional configurations would work equally as well. For example, the cross-section of the upper portion could be generally circular but with a longitudinal keyway milled along the length of the upper portions. Whatever the form of the non-circular cross-section of the upper portion of the drive shaft means, the gear box **70** has a horizontally disposed driven gear wherein is defined a centrally located aperture of a cross-section conforming to the cross-section of the shaft member **78**. The driven gear is axially positioned about the shaft member **78** and longitudinally slidably receives shaft member **78** in a well known manner. The gear box **70** thereby drives the shaft member **78** and is longitudinally positionable along the upper portion of the drive shaft means above the transverse support member **62**.

In the embodiments described, the various portions of the drive shaft means may be connected together by U-joints **80** to compensate for minor misalignment of the working parts of the portable pump of this invention. In addition, a grease fitting tube **82** may extend from the bearings to the surface above the cavity in order to provide proper lubrication, as in FIG. **4**.

Also, the lower ends of the spiral blades **40** may be rigidified and supported by a connecting ring and radial arms extending to a collar rigid with shaft **38**. A similar reinforcement may be provided on the lower end of blade **44**.

As a further refinement of this invention, a guard member **84** is attached to and is at least as wide as the pump **10**. Guard member **84** is U-shaped and extends longitudinally downward beyond the pump **10** to protect the pump from debris in the cavity **12** by assuring that the pump will be spaced above the bottom of the cavity. Also, the pump **10** may be driven by any suitable internal combustion engine such as a stationary engine drivingly connected to the drive shaft in any suitable manner. An electric motor of appropriate horsepower may also be used to drive the pump at the desired speed for efficient operation.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed as new is as follows:

1. A portable centrifugal pump for use in vertically extending cavities comprising a vertically extending discharge duct having upper and lower ends, a submersible rotary centrifugal pump discharging into the lower end of said discharge duct, a vertically extending drive shaft means having upper and lower portions driving said pump and supported at said lower portion by and rotatably journaled in spaced parallel relation to said discharge duct, a transverse support member fastened to said discharged duct and extending laterally in opposite directions therefrom, and a transmission gear box means for changing rotary motion about a horizontal axis to rotary motion about a vertical axis operatively connected to the upper portion of said drive shaft means and longitudinally adjustably positionable with respect to the lower portion of said drive shaft means, whereby said transverse support member is positionable to span the walls of a cavity and support said pump which is suspended therefrom, and said gear box means is positionable at varying distances above said transverse support member to accommodate horizontally extending power shafts at varying heights.

2. The portable centrifugal pump of claim 1 wherein said upper portion of said drive shaft means is further comprised of a shaft member and a sleeve member in telescopic relation to said shaft member, said shaft member and said sleeve member being keyed to each other to rotate together and being longitudinally adjustable with respect to each other.

3. The portable centrifugal pump of claim 1 wherein a mounting means having spaced fastening points is interposed between said transverse support member and said discharge duct and is longitudinally aligned with and secured to said discharge duct, and releasable fastening means fastening said transverse support member to selected fastening points, whereby said transverse support member is adjustably positionable along the length of said discharge duct and said pump is thereby positionable at varying depths in a cavity.

4. The portable centrifugal pump of claim 1 wherein a mounting means having spaced fastening points is interposed between said gear box means and said discharge duct and is longitudinally aligned with and secured to said discharge duct, and releasable gear box fastening means fastening said gear box to selected fastening points, whereby said gear box means is adjustably positionable in secured relation along the length of said discharge duct above said transverse support member.

5. The portable centrifugal pump of claim 1 wherein said upper portion of said drive shaft means is further comprised of a shaft member having a non-circular cross-section and said gear box means has a horizontally disposed driven gear wherein is defined a centrally located aperture of a cross-section conforming to the cross-section of said shaft member and said driven gear is axially positioned about said shaft member and is longitudinally slidable with respect to said shaft member, whereby said gear box means drives said shaft member and is longitudinally positionable along said upper portion of said drive shaft means above said transverse support member.

6. The portable centrifugal pump of claim 1 wherein said pump further comprises a dual suction intake port pump casing provided with vertically aligned and axially opposed intake ports and a tangential discharge port in communication with said discharge duct, and feed means vertically aligned and rotatably mounted in bearings longitudinally displaced from and attached to said pump casing, said feed means including a central vertical shaft and a plurality of impeller blades of generally arcuate configuration radiating from said shaft downwardly from adjacent the upper bearing for said shaft.

7. The portable centrifugal pump of claim 1 wherein said pump further comprises a dual suction intake port pump casing provided with vertically aligned and axially opposed intake ports and a tangential discharge port in communication with said discharge duct, and feed means vertically aligned and rotatably mounted in bearings longitudinally displaced from and attached to said pump casing, said feed means including a central vertical shaft having upper and lower ends and a single blade in the shape of a helical screw mounted on said central shaft and increasing in diameter axially downwardly from adjacent the upper bearing for said shaft.

8. The portable centrifugal pump of claim 1 further comprising a guard member attached to and at least as wide as said pump and extending longitudinally downward beyond said pump.

9. In combination with a centrifugal pump immersed in liquid to be pumped and including a casing having a rotatable impeller therein, a shaft driving the impeller disposed within the casing, said casing having a centrally located inlet through which the shaft extends, said casing including a peripheral outlet having a vertically extending discharge duct connected rigidly therewith, feed means oriented axially in alignment with the inlet and adjacent thereto, said feed means being mounted on the shaft and driven thereby to feed liquid into the inlet to facilitate pumping thereof by the impeller, means attached to said casing for limiting the movement of the casing into the liquid thereby enabling the pump to be lowered vertically into a manhole or the like until said means engages the bottom thereof thereby assuring that the pump will be spaced from the bottom, adjustable support means suspending said pump from a support above the surface of the liquid to be pumped, said support means including a laterally extending support member vertically adjustably connected with said discharge duct for engagement with a manhole or the like for adjustably suspending the pump from the upper end portion of the manhole, said shaft being disposed in generally parallel relation to the discharge duct and journaled therefrom, said shaft including means varying the driving length thereof independent of the supported position of the pump.

10. The combination of claim 9 together with a transmission connected with the upper end portion of the

shaft, said transmission being adjustably supported from said discharge duct thereby enabling independent vertical adjustment of the transmission with respect to the support member, said support member being disposed below the transmission and extending laterally from opposite sides of the discharge duct for engagement with the opposed walls of a manhole or the like.

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