

April 26, 1960

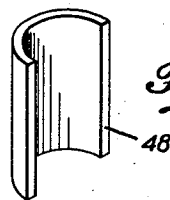
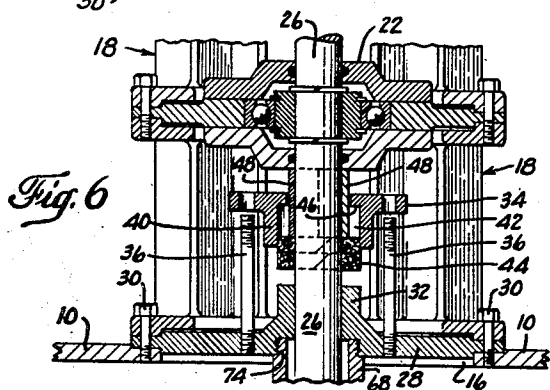
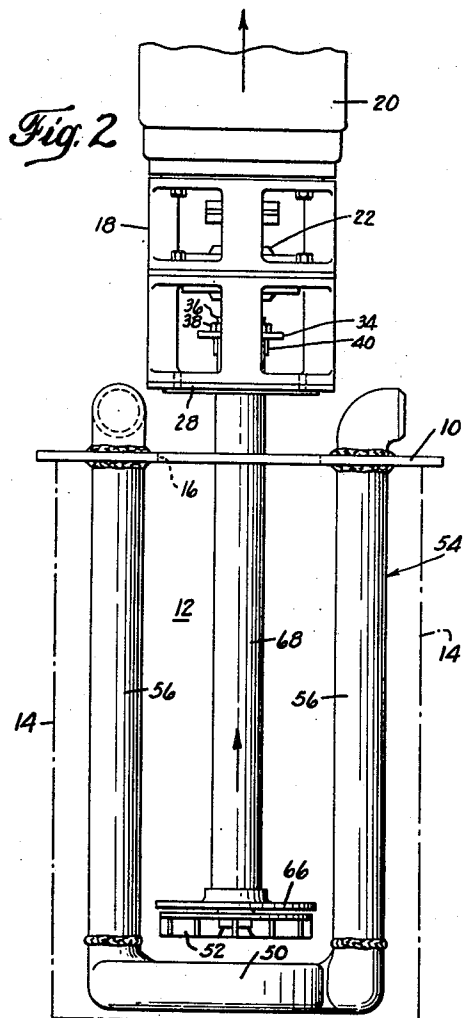
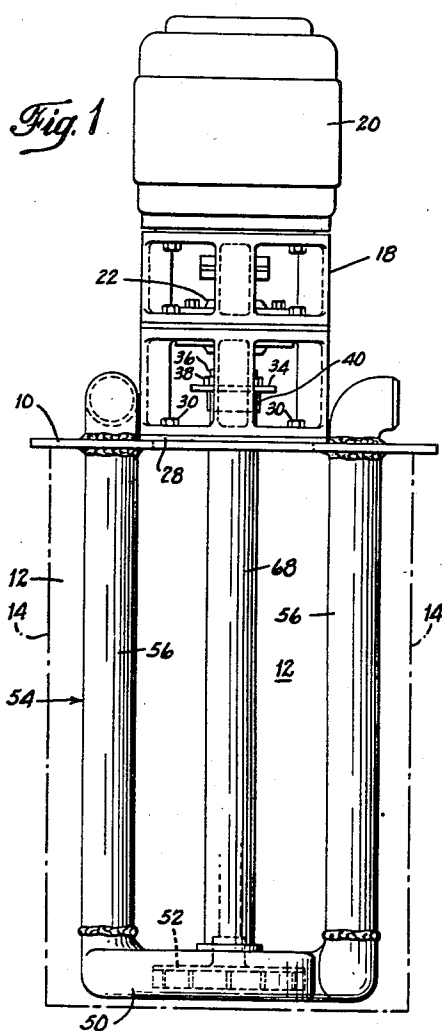
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2,934,245

DRAINAGE, SEWAGE OR PROCESS PUMP OF THE VERTICAL WET PIT TYPE

Filed Nov. 8, 1956

4 Sheets-Sheet 1



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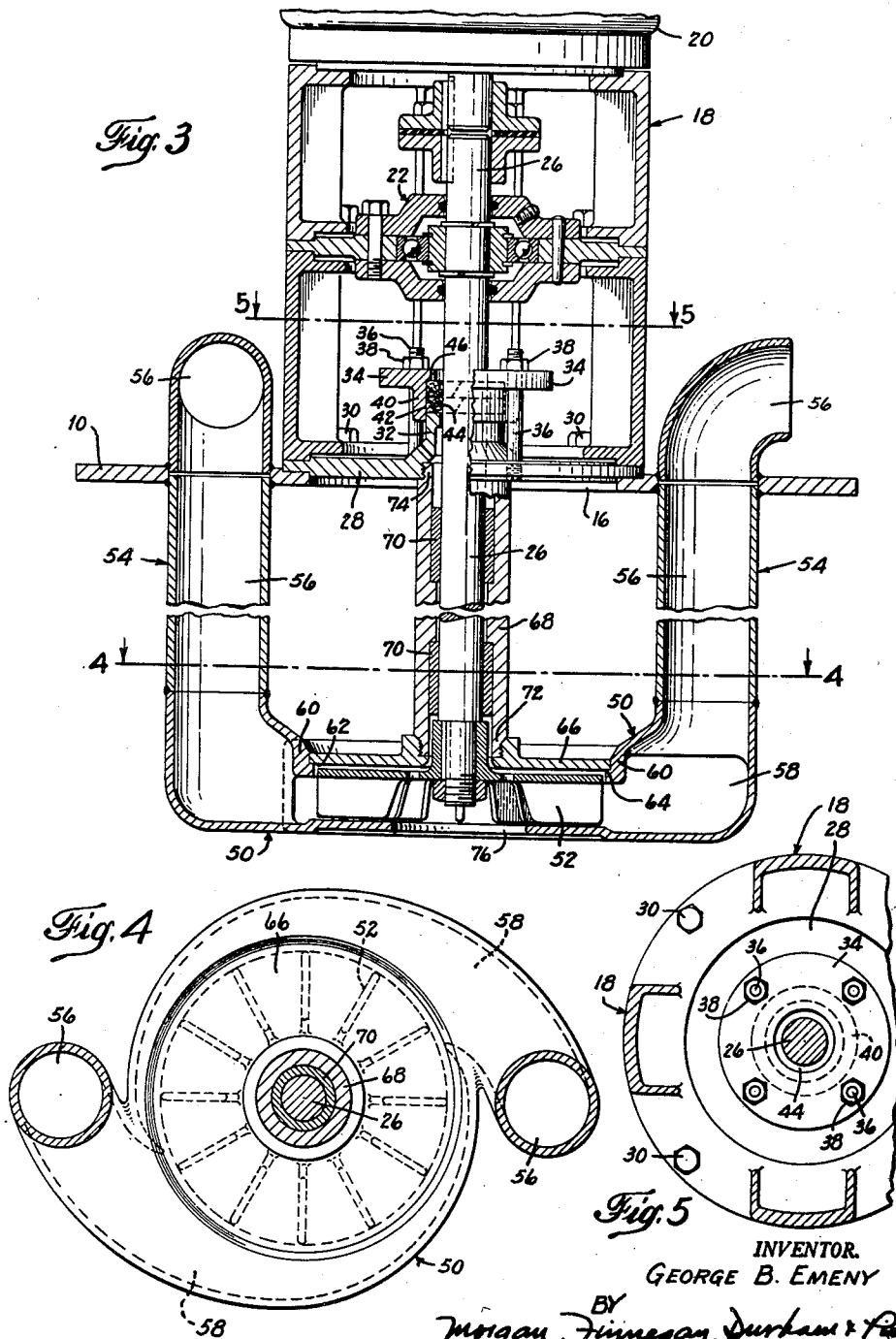
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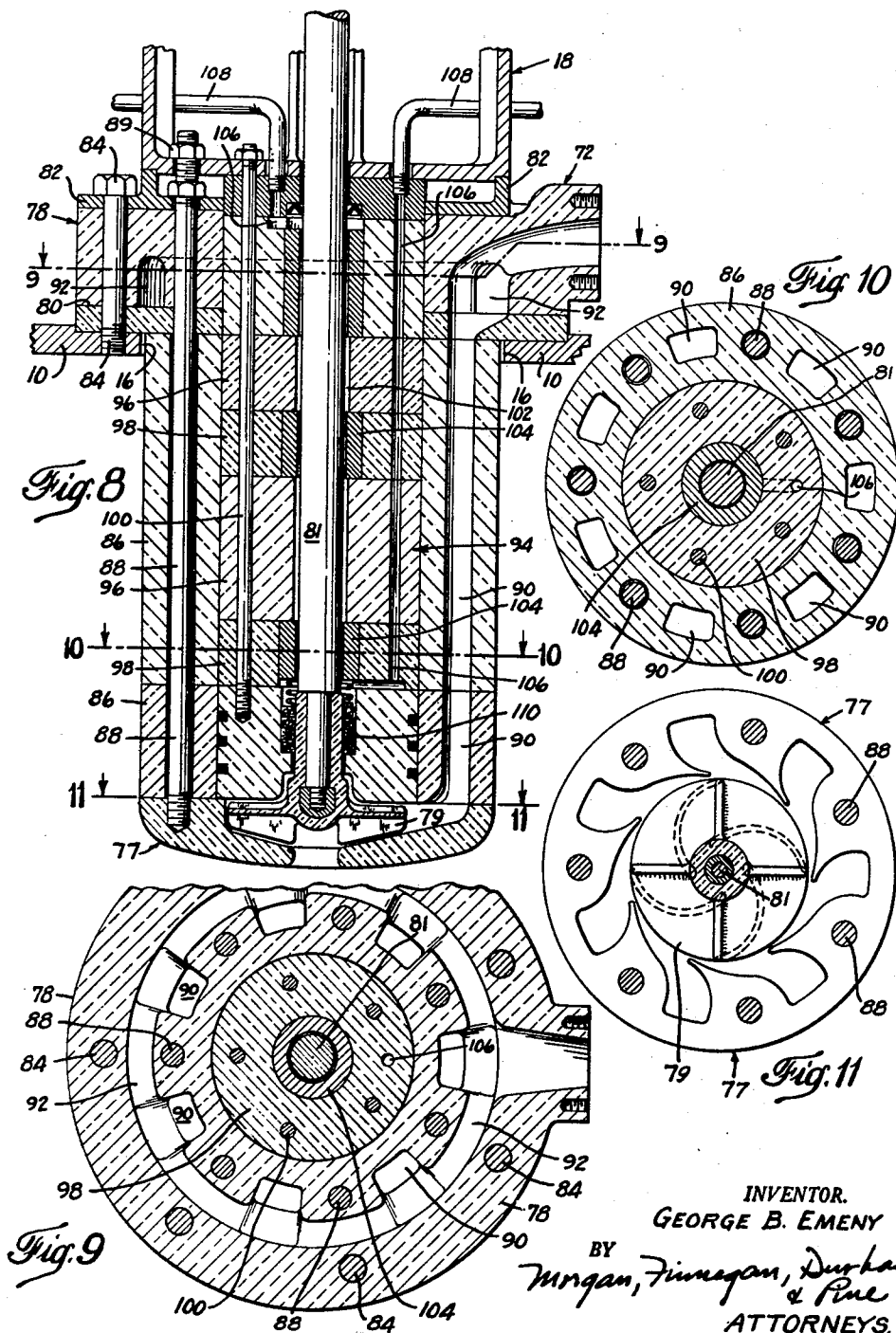
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4 Sheets-Sheet 3



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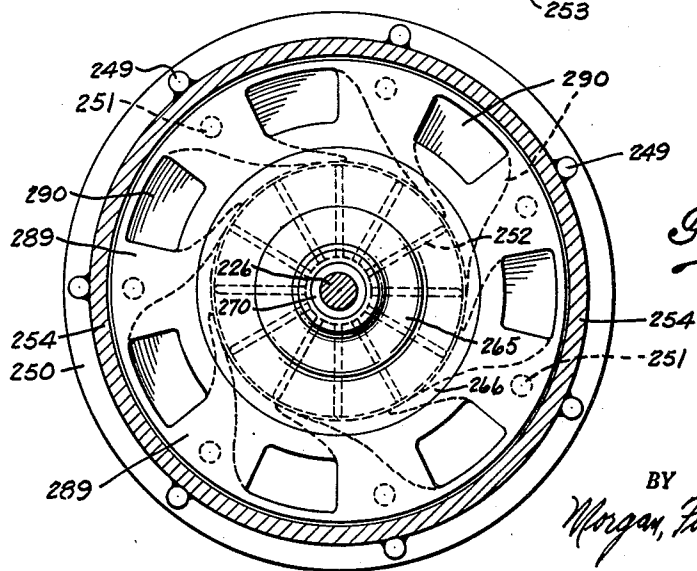
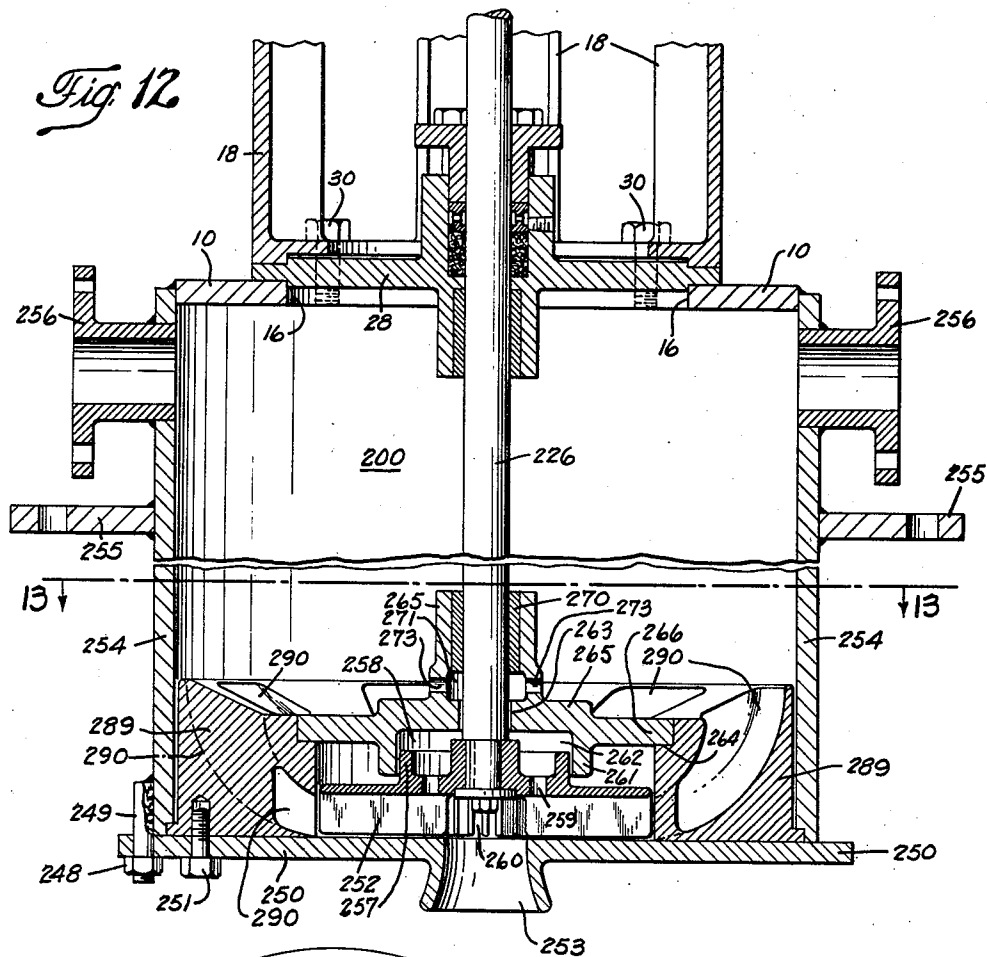
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4 Sheets-Sheet 4



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DRAINAGE, SEWAGE OR PROCESS PUMP OF THE VERTICAL WET PIT TYPE

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Application November 8, 1956, Serial No. 621,074

11 Claims. (Cl. 222—330)

This application is a continuation-in-part application of my earlier application Ser. No. 413,539, filed March 2, 1954, now abandoned.

The invention relates to pumps and more particularly to drainage, sewage or process pumps of the vertical wet pit type for pumping liquid from a sump, pit or tank.

One object of the invention is to provide a vertical pump which is so constructed as to be capable of removal of all its wearing parts from its mounting on a sump, pit or tank without the necessity of disconnecting any of its discharge connections.

Another object of the invention is to construct the pump in such a manner that the rotating elements and their guides members may be removed from the pit without disturbing the stationary members of the installation.

Another object of the invention is to provide a pump in which the discharge conduits support a pump casing within the pit.

Still another object of the invention is to provide a pump having a compact rigid structure which may be easily serviced.

Another object of the invention is to provide a vertical wet pit pump which is hydraulically balanced.

Another object of the invention is to provide a vertical pump with novel packing means which will allow the easy removal of the packing members.

Still another object of the invention is to construct a wet pit pump of non-metallic corrosion resistant material which incorporates all of the above features and may be easily disassembled.

Another object of the invention is to provide a sump pump having removable rotating parts held in firm contact with stationary members of the pump by the pump discharge pressure but which are readily removable therefrom.

Further objects and advantages of the invention will be set forth in part hereinafter and in part will be obvious herefrom, or may be learned by practice with the invention, the same being realized and attained by means of the instrumentalities and combinations pointed out in the appended claims.

The invention consists in the novel parts, construction, arrangements, and improvements herein shown and described.

Briefly, the invention comprises a cover, or pump support plate having an opening therein for locating and positioning the removable portion of the pump. Mounted on the cover or the pump supporting structure is the support for the driving motor. The rotary elements of the pump, namely, the drive shaft and the pump impeller depend from the support for the driving motor on the supporting structure through the opening in the pump supporting structure into a pump casing supported in the pit by a discharge conduit structure which is rigidly secured to the pump supporting structure and

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depends therefrom. The distance between the pump impeller and the motor supporting structure is such as to allow the pump impeller to engage the pump casing without being fixedly positioned with respect thereto by positive fastening means. The discharge conduits for the pump are positioned in such a manner that the impeller is in radial hydraulic balance. To this end the conduits are preferably either oppositely disposed with respect to each other, are equally spaced about a circle or are comprised by a single hollow casing.

In order to effect a seal around the drive shaft the closure for the opening in the cover is constructed to form a cylindrical housing for the shaft. The upper portions of this housing form a support for suitable packing elements which are placed around the shaft. A packing gland, having a cylindrical extension designed to bear on the housing of the closure and to compressively engage the packing elements is adjustably secured to the closure. The clearance between the packing gland and the shaft is sufficient to allow for the insertion of sleeve members to engage the packing elements when the gland is being removed from the packing.

Of the drawings:

Figure 1 is an elevation showing a vertical pump constructed in accordance with the teachings of the invention;

Figure 2 is a view similar to that of Figure 1 showing how the rotary elements may be withdrawn from the assembly without disturbing the stationary elements;

Figure 3 is a vertical section through the centerline of the pump showing the relation of the various parts;

Figure 4 is a transverse section taken along the line 4—4 in Figure 3 looking in the direction of the arrows;

Figure 5 is a transverse section taken along the line 5—5 in Figure 3 looking in the direction of the arrows;

Figure 6 is a vertical section through the centerline of the supporting structure showing the novel sealing structure for the pump;

Figure 7 is a perspective view of a sleeve member used to force the packing out of the gland;

Figure 8 is a vertical section through a modification of the invention;

Figure 9 is a transverse section taken along the line 9—9 in Figure 8 looking in the direction of the arrows;

Figure 10 is a transverse section taken along the line 10—10 in Figure 8 looking in the direction of the arrows;

Figure 11 is a transverse section taken along the line 11—11 in Figure 8 looking in the direction of the arrows;

Figure 12 is a vertical section through still another modification of the invention, and

Figure 13 is a transverse section through Figure 12 taken along the line 13—13 looking in the direction of the arrows.

Referring now to the drawings for a detailed description of the applicant's invention there is shown a pump support structure or cover 10 for a pit or tank 12 (indicated by the lines 14) into which liquid periodically drains and collects. An opening 16 is provided in the cover 10 having a sufficient diameter to permit the entrance and removal of the rotary elements of the vertical pump. Mounted on the cover is a supporting structure for the driving motor 20 comprising a suitable frame 18 to which the driving motor is fixedly joined. A thrust bearing housing 22 is also located within the inner portions of the frame 18 and supports the drive shaft 26 for the pump. The bottom of the frame 18 is secured to a closure 28 adapted to fit over the opening 16 in the support cover 10 by the bolts 30.

The closure 28 for the opening 16 in the pit cover 10

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in the embodiment shown in Figure 3 is a substantially flat, circular plate having a cylindrical projection 32 in the center which constitutes one end of a packing housing for the rotary drive shaft 26. A packing gland 34 is adjustably secured to the closure plate 28 by means of the studs 36 and nuts 38 and is constructed with a cylindrical projection 40 having a recess 42 of sufficient diameter to receive the cylindrical projection 32 on the closure plate 28. The inner portions of the recess 42 in the gland 34 are provided with suitable packing elements 44 which are placed around the rotary drive shaft 26 and compressed by the bottom surface 46 of the recess 42 whenever the gland 34 is drawn towards the plate. The clearance 47 between the packing gland and the rotary shaft is sufficient to permit the introduction of thin-walled sleeve members 48 which aid in removing the packing elements. When it is desired to remove the gland the sleeve members are inserted within this opening so as to abut the packing elements. As the gland is loosened and withdrawn from the cylindrical extension on the plate the sleeve members abut the underside of the bearing and force the packing elements out of the gland thereby doing away with the difficult task of digging the packing elements out of the gland.

The pump casing 50 for the impeller 52 is located at or near the bottom of the pit by means of a support structure 54 which is provided with discharge conduits 56 so arranged as to be hydraulically balanced. In the form of the invention shown in Figures 1-7 two oppositely disposed conduits are provided but it is to be understood that any suitable number of conduits may be used. In order to secure hydraulic balance the conduits may be arranged so as to be equally spaced about a circle. The pump casing 50 is shaped to correspond to the number of discharge conduits and is formed with two convolute chambers 58, each of which, terminates in a discharge conduit. Any pressures developed by the impeller in one volute are balanced by equal and opposite pressures in the other volute thereby eliminating side thrust in the pump casing.

The top portion 60 of the pump casing 50 is provided with an opening 62 through which the pump impeller 52 may be removably inserted. A seat 64 is provided on the casing for the casing guide flange 66 which rests on the seat and correctly positions the impeller in the casing. The flange 66 is detachably secured to one end 72 of the shaft guide pipe 68 which carries the shaft 26 and its bearings 70 and which is detachably secured at its opposite end 74 to the closure 28 for the opening 16 in the pit cover 10 through which the impeller 52 and shaft 26 depend. The guide pipe 68 is reversible and of such a length that the guide flange 66 firmly contacts the seat 64 on the casing 50 without requiring any fastening means. At the center of the underside of the casing 50 an opening 76 is provided adjacent the eye of the impeller through which the water or liquid in the pit or tank flows into the casing during the pumping cycle.

Whenever it is desired to disassemble the pump and to remove the rotary elements from the pit only the bolts 30 need be removed and the impeller 52 and drive shaft 26 lifted through the opening 16 in the cover 10. None of the stationary parts need be disturbed. Since it is the rotating parts which usually require occasional or frequent servicing this construction enables the servicing to be done easily and quickly.

The construction shown in Figures 8-11 is a modified form of the invention which is particularly suitable for applications where only non-metallic corrosion resistant materials, such as glass, ceramics or plastics may be exposed to the liquids to be pumped. In this form of the invention the closure for the opening 16 in the cover 10 comprises an annular collector ring 78 which is split, as at 80, so as to simplify its manufacture. An annular plate 82 is provided on the top of the collector ring 78 and the motor supporting structure 18 is mounted there-

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on. Suitable fastening means 84 are provided to secure the collector ring 78 and the plate 82 to the cover 10.

The supporting structure for the pump casing 77 preferably comprises a plurality of annular cylindrical sections 86 which are fastened to the collector ring 78 and the casing 77 by the tie bolts 88 and which depend through the opening 16 in the cover 10. A plurality of discharge conduits 90 are equally spaced around the center of the cylindrical sections 86 and communicate the pump impeller 79 with the passage 92 in the collector ring 78.

The pump impeller 79 and drive shaft 81, together with their supporting elements 94, are removably inserted within the central opening created by the annular collector ring 78 and cylindrical sections 86. These supporting elements preferably comprise a plurality of inner cylindrical sections 96, 98 joined together by the bolts 100. Each inner section has a central bore 102 to accommodate the drive shaft of the pump and each alternate section 98 is provided with a bearing 104 therefore while the intermediate sections 96 serve as spacers. In addition, the inner sections are provided with passages 106 for lubricating and sealing liquid, which liquid under pressure from one of the conduits 108 is conveyed along the shaft 81 to shaft packing 110 adjacent to the impeller 79 thence out of the other conduit 108 under sufficient pressure to prevent the seepage of corrosive fluids from the pit or pumping chambers of the pump from entering and coming into contact with the rotating parts assembly 81, 96, 98, 94 and 104.

In order to disassemble the rotary elements of this form of the invention only the conduits 108 and the nuts 89 for the tie bolts 88 need be removed before the inner sections 96, 98, pump shaft 81 and impeller 79 may be removed.

The construction shown in Figs. 12 and 13 is another modification of the invention in which the discharge from the pump impeller is used to hold firmly in place the top half impeller casing which contains the bottom guide bearing for the rotating elements. As in the other modifications frame 18 for the driving motor is removably mounted by bolts 30 to a closure 28 adapted to fit over an opening 16 in the pump supporting plate 10. In this form of the invention a hollow discharge chamber 254 is provided which is joined to the pump supporting plate 10 in any suitable manner so as to depend therefrom and to form therewith an internal chamber 200. Preferably, the discharge chamber 254 is cylindrical in form, but it will be understood that other forms could be employed as long as an internal chamber is defined.

A pair of flanged conduit couplings 256 are provided at the upper end of the discharge chamber to which suitable conduits (not shown) may be connected to carry off the pump's discharge and the discharge chamber 254 is also provided with a flange 255 adjacent the couplings for positioning the pump supporting structure adjacent the top of a pit. At its bottom the discharge chamber 254 is provided with a closure plate 250 removably fastened to the discharge chamber wall by means of the studs 249 and nuts 248. This closure plate forms a base to which the diffuser ring 289 of the pump may be secured, as by machine screws 251, and it forms the bottom half casing which encloses the impeller and is provided with a suction bell 253 at its center through which the liquid in the bottom of a pit may be withdrawn.

The diffuser ring 289 of the pump is annular in form and is provided with a plurality of equally spaced individual diffuser channels 290 by means of which the discharge of the pump impeller 252 is directed upwardly into the internal chamber 200 in the casing. Because of the equal positioning of the diffuser channels the pump is hydraulically balanced and all side thrust is eliminated. At its inner periphery the diffuser ring 289 is provided with a shoulder-like abutment 264 that forms a ledge or seat for the flange 266 of the bottom shaft bearing housing 265 whereby the rotating elements of the

pump are positioned in the lower discharge chamber and the casing. The driving shaft 226 for the pump passes through the bearing 270 in the housing 265 and through an opening 263 in the housing flange 266 and terminates within a recess 262 immediately underneath the flange 266 defined by an annular hub 261 formed in the underside of the flange. Mounted on the end of the drive shaft 226 is the pump impeller 252 having an annulus 257 which extends inwardly of the recess so as to form a chamber 258 therewith. Relief openings 259 formed in the impeller adjacent its eye connects the chamber 258 with the suction area 260 of the impeller. Just below the bearing 270 the housing 265 defines a small chamber 271 which is connected with the internal chamber 200 by means of openings 273.

The operation of the pump is as follows: The suction of the impeller 252 draws water through the suction bell 253 and pumps it into the diffuser ring 289 where the velocity is greatly reduced. Water under discharge pressure of the pump is thereby directed upwardly by the diffuser channels 290 to the internal discharge chamber 200 of the casing which is, in effect, a single large discharge conduit. From the chamber the water passes through the conduit couplings 256 to a point of use.

The bottom shaft bearing housing 265 is held firmly in contact with the diffuser ring 289 by the differential between the discharge pressure of the water in the internal chamber 200 acting on the upper side of the housing and the suction pressure of the impeller 252 acting on the chamber 258 formed by the recess on the underside of the housing and the impeller hub. Discharge pressure of the water in the internal chamber 200 is also placed on the small chamber 271 under the bearing 270 so that there will be no pressure differential across the bearing and little likelihood of any grit passing through the bearing.

The invention in its broader aspect is not limited to the specific mechanisms shown and described but departures may be made therefrom within the scope of the accompanying claims without departing from the principles of the invention and without sacrificing its chief advantages.

I claim:

1. A pump for pumping liquid from a pit, comprising, in combination, a support plate for the pump on which the pump is mounted serving as a cover for the pit and having an opening therein, a pump casing below said plate, oppositely disposed discharge conduits depending from the support plate cover and terminating in said pump casing having an opening in the upper portion thereof; and rotary elements for the pump including a driving member, a drive shaft and a pump impeller, said openings having a diameter larger than the pump impeller whereby said impeller may be removably inserted into said pump casing through the opening in the cover.

2. A pump for pumping liquid from a pit, said pump comprising, in combination, a support plate for the pump serving as a cover for the pit and having an opening therein, a driving member for the pump mounted on the cover, a casing for the pump located in the pit having an opening in the upper portion thereof, at least one pair of oppositely disposed discharge conduits for the casing depending from the cover and supporting said casing therebelow, and rotating elements for the pump including an impeller and a driving shaft, said openings having a larger diameter than the rotary elements to permit said elements to depend downwardly from the driving member through the opening in the cover and removably entering the pump casing in the pit.

3. A pump for pumping liquid from a pit comprising, in combination, a support plate for the pump serving as a cover for the pit and having an opening therein, a casing for the pump in the pit having an opening in the upper portion thereof, a pair of oppositely disposed dis-

charge conduits for the casing rigidly joined to and depending from the cover and supporting said casing therebelow, a driving member for the pump mounted on the cover, and rotary elements for the pump including a drive shaft and an impeller, said openings having a larger diameter than the rotary elements to enable said rotary elements to fit within the opening in the cover and depend from the driving member to removably engage the pump casing.

4. A pump for pumping liquid from a pit comprising, in combination, a support plate for the pump serving as a cover for the pit and having an opening therein, an annular collector ring mounted on the cover above the opening, a driving member for the pump mounted on the collector ring, an annular cylinder depending from the collector ring through the opening in the cover and terminating in a pump casing adjacent the bottom of said pit, said cylinder being provided with discharge conduits for the pump casing in communication with the collector ring, and rotating elements for the pump, including an impeller and a driving shaft, journaled in a cylindrical core depending from the driving member and removably inserted into the annular cylinder to position the pump impeller in the pump casing.

5. A pump as set forth in claim 4 in which the collector ring, annular cylinder, cylindrical core, and pump impeller are made from a corrosion resistant material.

6. A pump as set forth in claim 5 in which all of the material exposed to the liquid to be pumped from the pit is a non-metallic corrosion resistant material.

7. A pump for pumping liquid from a pit comprising, in combination, pump supporting means adapted to be positioned at the top of a pit and having an opening therein, casing means depending from said supporting means so as to extend within the pit to a point adjacent the bottom thereof, said casing means defining at least one discharge conduit for the pump having an opening in the upper portion thereof adjacent the bottom of the pit, and a driving member for the pump mounted above the pit on said pump supporting means and having rotating elements, including an impeller and a driving shaft, said openings having a diameter larger than the impeller so as to permit the rotating elements to be removably inserted through the opening in said pump supporting means, said impeller extending within the casing means without being fastened thereto.

8. A pump as set forth in claim 7 in which the discharge of the impeller is directed to the upper side thereof whereby the impeller is firmly held in contact with the casing means by pump discharge pressure.

9. A pump for pumping liquid from a pit comprising, in combination, hollow casing means defining a chamber therewithin adapted to be placed within a pit, an opening in the top of the casing means, a diffuser ring at the bottom of the casing means, and a driving member for the pump mounted on top of the casing means above the pit and having rotating elements, including an impeller and driving shaft, removably inserted through the opening in the top of said casing means, said rotating elements extending inwardly of the chamber in the hollow casing means so that the impeller rests upon the diffuser ring, said diffuser ring directing the discharge of the impeller into the hollow chamber.

10. A pump as set forth in claim 9 in which the impeller is provided with a backing plate that rests on the diffuser ring, and with relief parts which communicate the underside of the backing plate with impeller suction pressure.

11. A pump for pumping liquids from a pit comprising, in combination, a cover plate for the pit on which said pump is mounted and having an opening therein, a driving member for the pump mounted on the cover plate, a pump casing fixedly secured in the pit adjacent the bottom thereof with the upper side of said

pump casing adjacent the bottom of said pit and having an opening therein, an impeller for the pump mounted in the opening in the casing, a drive shaft depending through the opening in the cover plate and connecting the driving member to the impeller, and a closure for the opening in the upper side of the pump casing, said opening in the pump casing and the cover plate having a diameter larger than the pump impeller and the closure for the pump casing whereby said impeller, closure and drive shaft may be removed from the pit without disturbing the cover plate for the pit.

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