May 9, 1939. H. S. MURRAY 2,157,141

PUMP AND PUMPING SYSTEM

Filed Feb. 12, 1936 4 Sheets-Sheet 1

Fig. 1

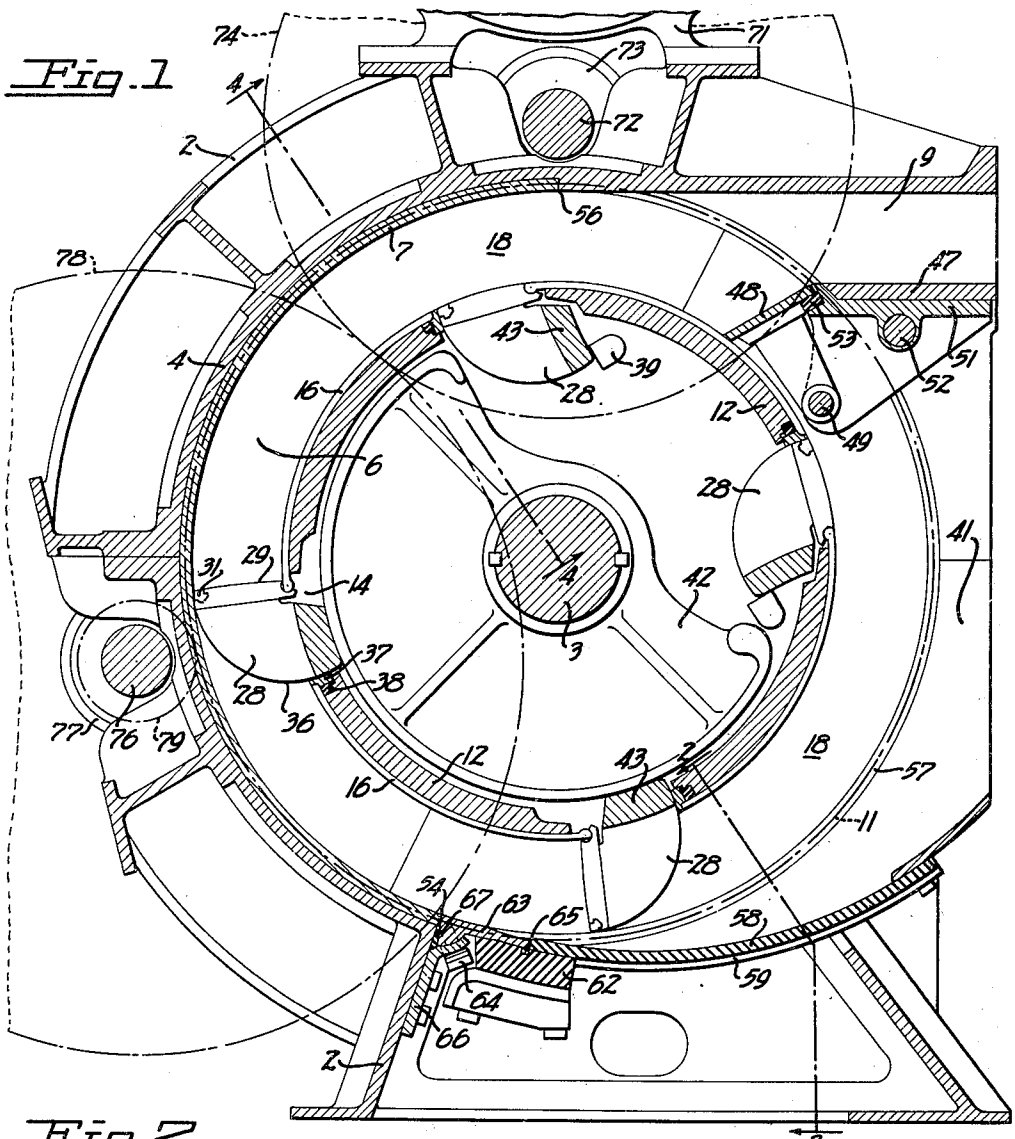
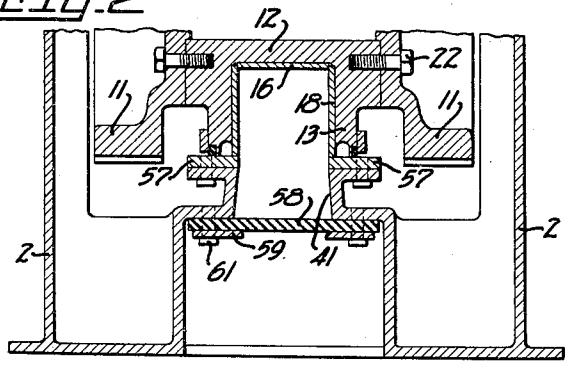


Fig. 2



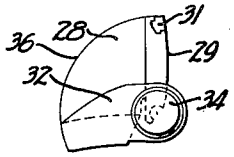


Fig. 3

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PUMP AND PUMPING SYSTEM

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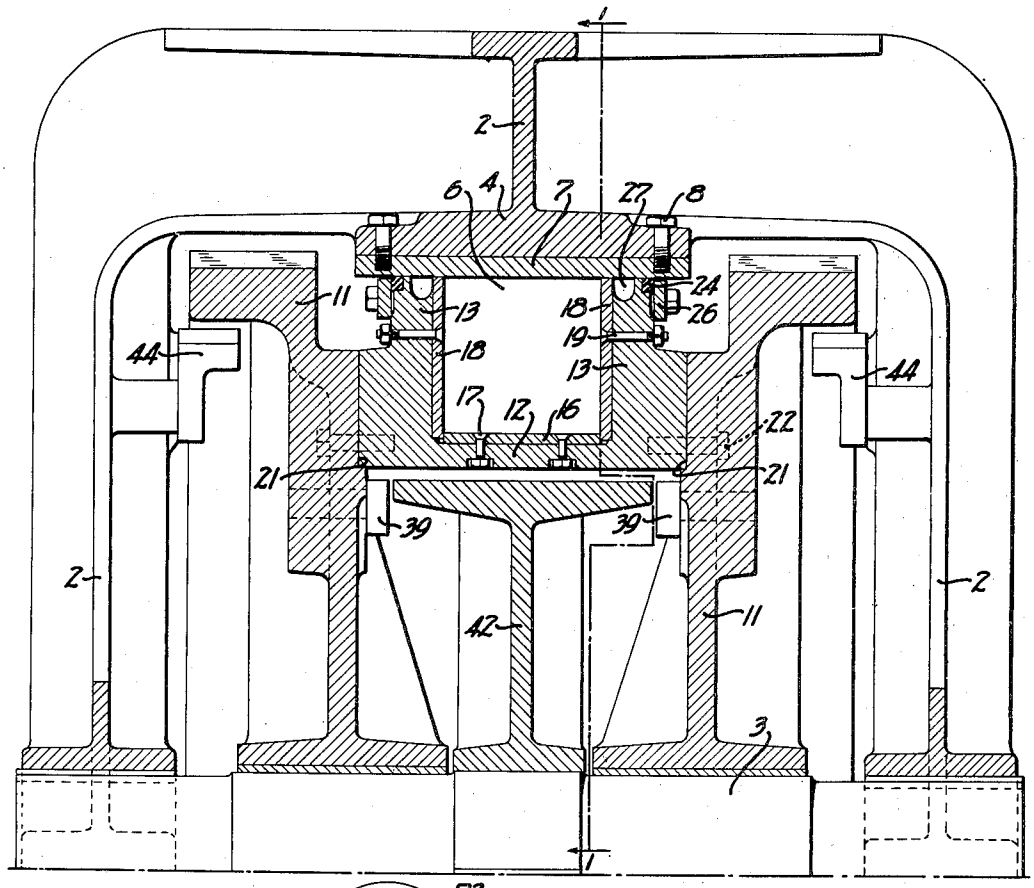


Fig 4

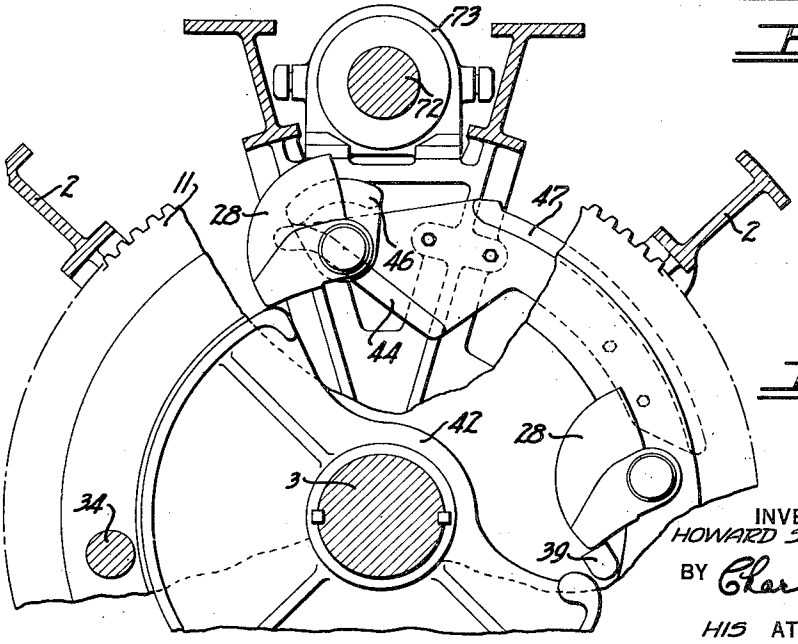


Fig. 5

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PUMP AND PUMPING SYSTEM

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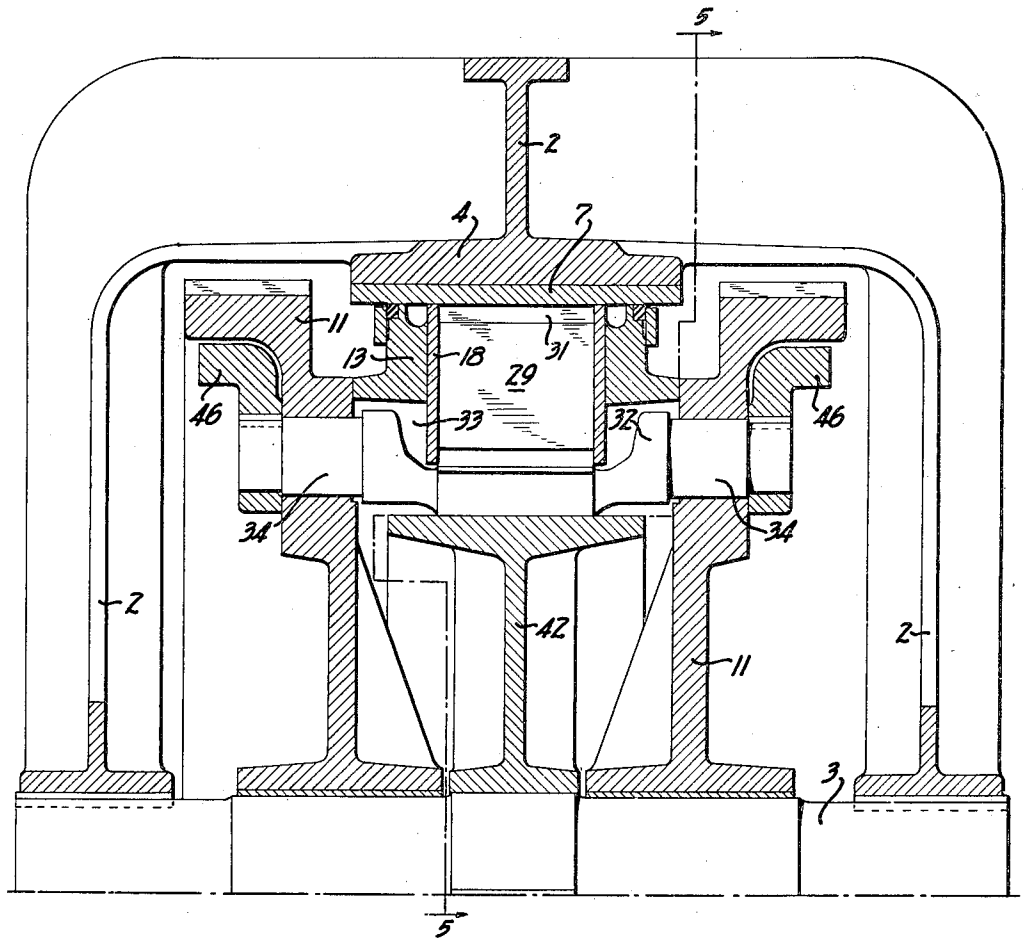


Fig. 6

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PUMP AND PUMPING SYSTEM

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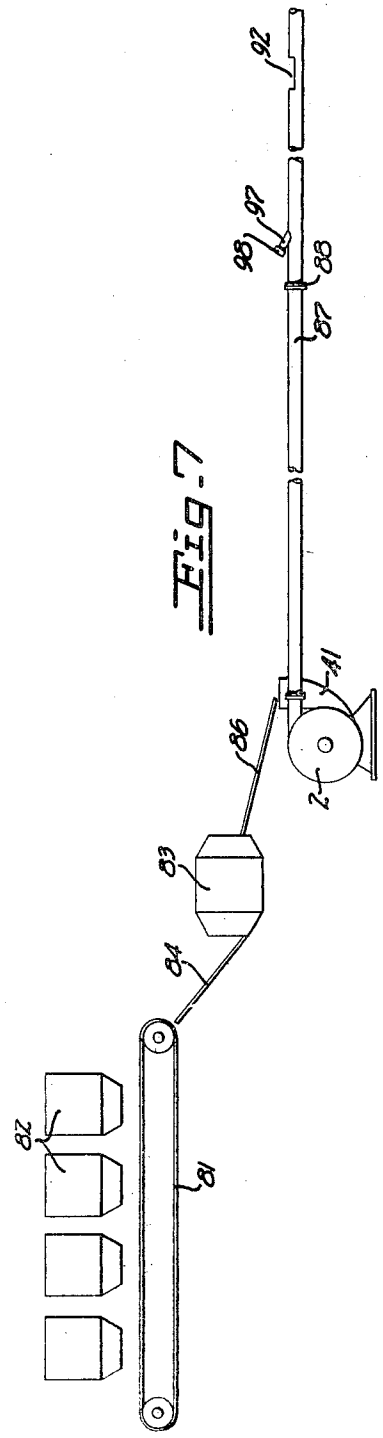


Fig. 7

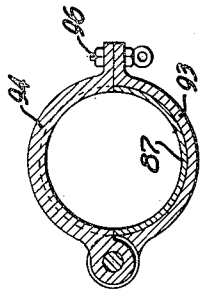


Fig. 10

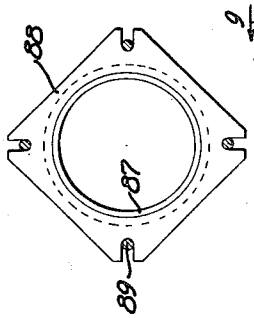


Fig. 9

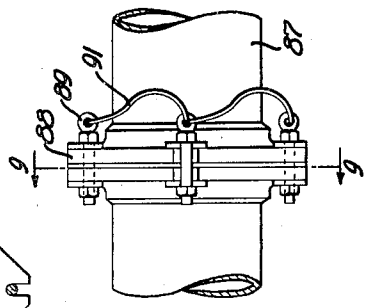


Fig. 8

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Patented May 9, 1939

2,157,141

UNITED STATES PATENT OFFICE

2,157,141

PUMP AND PUMPING SYSTEM

Howard Slater Murray, Los Angeles, Calif., assignor to Uniflow Pump Company, Las Vegas, Nev., a corporation of Nevada

Application February 12, 1936, Serial No. 63,600

7 Claims. (Cl. 103—83)

My invention relates to the conveying of heavy materials, such as concrete; and more particularly to a system for pumping concrete thru a pipe line.

It is among the objects of my invention to provide a system for conveying heavy materials over comparatively long distances thru a pipe line, and without clogging the line or requiring excessive pressures for driving the material thru the line.

Another object of my invention is to provide an improved rotary pump for pumping the material thru the pipe line.

A further object of the invention is to provide means for cleaning the line after pumping has stopped.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description of my invention. It is to be understood that I do not limit myself to this disclosure of species of my invention, as I may adopt variant embodiments thereof within the scope of the claims.

Referring to the drawings:

Figure 1 is a transverse vertical sectional view of a pump embodying the improvements of my invention, the plane of section being taken along the inner face of the forward side wall of the pumping chamber as indicated thru the upper half of the pump by the line 1—1 of Figure 4.

Figure 2 is a fragmentary vertical sectional view thru the lower end of the collection chamber, taken in a plane indicated by the line 2—2 of Figure 1.

Figure 3 is a detail view showing one of the impellers.

Figure 4 is a radial sectional view thru the upper portion of the machine, taken in a plane indicated by the line 4—4 of Figure 1.

Figure 5 is a transverse vertical sectional view looking at the inside face of one of the gears, taken in a plane indicated by the line 5—5 of Figure 6; two of impellers being shown in elevation and a portion of the gear being broken away to illustrate the construction more clearly.

Figure 6 is a radial sectional view similar to that shown in Figure 4, but taken to include one of the impellers.

Figure 7 is a diagrammatic view showing the system for pumping concrete embodying my invention.

Figure 8 is a side view showing one of the pipe couplings; and

Figure 9 is a vertical sectional view thru a coupling; taken in a plane indicated by the line 9—9 of Figure 8.

Figure 10 is a vertical sectional view taken across one of the discharge openings, and showing the closure in place.

This case is for improvements in a pump of the type disclosed in my co-pending application, Serial No. 728,701. Among the improvements disclosed herein over the structure shown in my said co-pending application is the provision of a pumping chamber having a side wall movable with the rotor, instead of a side wall fixed to the housing. Other improved features include removable liners in the pumping chamber; a yieldable wall section of flexible material, such as rubber; and a cam for controlling the retracting movement of the impellers. The present case also discloses improvements in a pipe line system for pumping concrete.

In terms of broad inclusion, my system for pumping heavy materials comprises a rotary pump connected with a duct for delivering the material under constant pressure to a point remote from the pump. The cross-sectional areas of the pumping chamber and delivery duct are substantially equal, and this area is uniform thruout to keep the resistance to flow as low as possible. Sections are cut from the upper portions of the duct to provide spaced outlets, and means are provided for closing the openings and to restore the duct to its original diameter. Improved means are also provided for cleaning the duct when pumping is stopped.

The rotary pump used in my system comprises a fixed cam, and an annular pumping chamber disposed circumferentially about the cam. A rotor is also provided, and an impeller is mounted on the rotor to ride on the cam. The pumping chamber has a fixed outer peripheral wall and movable side and inner peripheral walls, and the latter are mounted on the rotor to move with the impeller. This reduces the resistance between load and pumping chamber. The pumping chamber is provided with an inlet and outlet, and the impeller is mounted on the rotor for movement into the chamber adjacent the inlet and out adjacent the outlet.

The fixed central cam is designed to move the impeller into the chamber and hold it there during the pumping stroke, and side cams are also preferably provided for controlling the cam movement into retracted position. A collection chamber is provided at the bottom of the pump adjacent the inlet, and a wall section of yieldable material is provided in the collection chamber

to prevent particles in the material being pumped from clogging under the impellers.

In greater detail, and referring particularly to Figures 1 to 6 of the drawings, the pump embodying my invention comprises a split frame or housing 2 carrying a fixed shaft 3. The housing also carries a fixed annular plate 4 which forms the outer peripheral supporting wall of the pumping chamber 6. This wall is provided with a removable liner 7 fastened by studs 8. See Figure 4. The liner is preferably of steel, but may be made of any other suitable material, such as rubber. The liner is preferably built in sections, separated along the split in the housing to facilitate assembly. This is the only fixed wall in the pumping chamber, and it extends from the inlet adjacent the bottom of the pump to an outlet duct 9 running off tangentially at the top.

The other three walls of the annular pumping chamber are movable, and are formed as part of a rotor journaled on the fixed shaft 3. The rotor comprises a pair of large gears 11 journaled on the shaft and carrying between them an annular one-piece casting providing the inner peripheral wall 12 and the side walls 13 of the pumping chamber. The inner peripheral wall 12 is provided with impeller openings 14, and is also provided with replaceable liner sections 16 secured by bolts 17.

The annular side walls 13 of the pumping chamber are also provided with replaceable liners 18 fastened by suitable bolts 19. The pumping chamber or channel thus formed is seated in annular recesses 21 provided in the inner sides of the gears 11, and the casting is fixed for rotation with the gears by suitable studs 22. Liner 7 of the fixed outer peripheral wall is wide enough to project out beyond the side walls 13, and the joints between these elements are sealed by packing rings 24 held by retaining rings 26. Annular grooves 27 are also cut in the peripheral edges of the side walls to provide return channels for material squeezing out past the liner.

By this arrangement the side walls 13 and the inner peripheral wall 12 of the pumping chamber 6 are adaped to move bodily with the load in the chamber, thereby eliminating the friction that would otherwise be developed if the load of material had to slide past these walls. As best shown in Figures 1 and 6, the impellers 28 of the pump are mounted on the rotor in the openings between the wall sections 12, and are each provided with a forward driving face 29 having a replaceable wearing tip 31.

Since the impellers have to move back out of the pumping chamber adjacent its outlet, in order to clear the wall structure, the impellers are pivotally mounted for movement from an extended position in the chamber to a retracted position within the rotor. As shown in Figures 3 and 6, the impellers are provided with outwardly and forwardly extending arms 32 underlying the side wall liners and disposed in openings 33 in the side walls 13. The forward ends of these arms carry trunnions 34 journaled in the gears 11; the axis of the trunnion mounting being located at the lower edge of the driving face 29, which edge is cut back in a circular recess to provide a socket for receiving the rounded edge of the adjacent liner section 16.

In order to seal the back of the impeller, the latter is provided with an arcuate back face 36 concentric with the pivot axis, so that the face always lies adjacent the edge of the following wall section 12. A sealing element 37 backed by a rubber strip 38, is also preferably provided at this junction. In their retracted positions the impellers are held by suitable stops 39 mounted on the gears 11, so that the driving face 29 lies in and provides a continuation of the surface of the inner liner 16.

A collection chamber 41 is provided at the bottom of the pump adjacent the intake of the pumping chamber. This collection chamber is in the nature of a hopper for receiving the material to be pumped, and is designed to hold the material in a body into which the impellers may dip for pushing a load into the pumping chamber. The impellers are extended before they reach the collection chamber, and for this purpose a fixed cam 42 is provided on the shaft 3 inside the inner peripheral wall 12 of the pumping chamber.

This cam is designed to engage the curved base 43 of the impellers to extend the latter, and is also designed to hold the impellers extended during their pumping stroke. After the impellers ride off the cam, they are forced back in retracted position by the back pressure of the material being pumped.

The retracting movement of the impeller at this time is controlled and held from violent throw by the presence of side cams 44 mounted on the inside of gears 11, and engaged by followers 46 secured to the outer projecting ends of trunnions 34. These cams lower the impellers slowly into their retracted positions. Another cam 47 is also preferably provided for engaging the opposite edge of the follower to positively hold the impeller in its retracted position. These cams are clearly shown in Figure 5.

A sealing element is also preferably provided between the peripheral wall of the rotor and the wall 47 at the outlet of the pump. This element preferably comprises an inclined plate 48 pivoted about a backing pin 49. An abutment plate 51 is preferably provided under the wall 47, and is supported by a cross rod 52. This plate is machined to provide an angular notch along its abutment edge for receiving a rubber strip 53, against which the sealing element bears. Plate 48 also functions as a doctor for scraping and cleaning the peripheral surface of the rotor; the inner edge of the plate being preferably beveled, as shown.

The side wall liners 18 extend completely around the rotor, but the outer fixed liner 7 terminates adjacent the inlet and outlet, as indicated at 54 and 56. Between these two points the outside liner continues merely as two strips or rails 57 arranged along each side of the pumping channel and against which the side walls 13 and side wall liners 18 may ride. This opens up the channel along the side which carries the collection chamber. Figure 2 shows how the collection chamber is formed as a part of the housing structure, and also illustrates the manner of mounting the fixed liner strips 57 on the walls of the collection chamber. Another feature shown in Figure 2 is the outward flaring of the collection chamber side walls; a flare of about 30° being preferably provided at the outer end of the collection chamber. This flaring of the chamber walls facilitates the operation of the impellers in picking up a load of material.

It is found that the pieces of rock in concrete tend to be caught under the tip of the impeller as it approaches the peripheral wall of the collection chamber. If this wall were rigid, heavy stresses would be placed on the parts and breakage would result. To prevent this, the bottom wall 58 of the

collection chamber is made of a yieldable material, such as rubber. The rubber sheet is fastened to the housing by steel bands 59 extending along the edges of the sheet and bolted to the housing by studs 61. A heavy rubber sheet, preferably reinforced along the edges with fabric, is used for this wall.

The end of the rubber sheet adjacent the pumping chamber is supported by a rubber block 62, and a flexible joint is formed between the end of the rubber sheet and the liner 7 by a pivotally mounted plate 63. A bolt 64 passing thru a slot in a bracket 66 provides a yieldable pivot mounting for the plate 63. A lip 65 on the free end of the plate extends down into a groove provided in the rubber block 62, and a wedge shaped rubber strip 67 is interposed between the pivoted end of the plate and the housing. This arrangement provides a joint which may yield slightly, and which insures a continuous smooth surface between the yieldable wall 58 of the collection chamber and the fixed wall 4 of the pumping chamber.

The pump is preferably driven by a motor 71 mounted on top of the housing. A shaft 72 is journaled on the housing under the motor in suitable bearings 73, and carries a gear 74 meshed with a suitable pinion on the motor shaft. A second shaft 76 is also preferably journaled on the side of the housing in bearings 77, and carries a gear 78 meshed with the gear 74. This latter shaft is also provided with a pair of pinions 79, one of which is shown in Figure 1, meshed with the gears 11 of the rotor. The gear reduction thus provided causes the rotor to turn comparatively slowly.

Figure 7 shows the pump installed in a system for pumping concrete. The system preferably comprises a suitable conveyor 81 for receiving the component parts of the mix from hoppers 82 and delivering them to a mixer 83 down a chute 84. From the mixer the concrete passes down a second chute 86 into the collection chamber 41 of the pump. From the pump the mix is delivered to the desired location thru a duct or pipe 87. The pipe used is preferably a lap welded or seamless tubing run over a mandrel to insure a uniform inside diameter, and the cross-sectional area of the pipe is equal to that of the pumping chamber. These features of the system are important in preventing the building up of prohibitive pressures.

The pipe line is built in sections, and the coupling flanges 88 are welded to the ends of the pipe and are preferably milled across the face to insure a close-fitting butt joint between the pipe ends, and a nearly perfect alignment of the pipe sections. The flanges are preferably bolted together with eye bolts 89 connected by a cord 91 to prevent loss in the muck.

The discharge outlets in the pipe line, one of which is shown in Figure 7, comprise an opening 92 formed by cutting an upper half section from the pipe. These outlets are preferably provided at comparatively frequent intervals along the line, so that the concrete may be discharged near the point of placement, since concrete sliding down a long chute tends to separate. The type of outlet shown is important because it may be closed to restore the original pipe diameter, thereby avoiding air pockets.

Figure 10 shows a closure for the outlet, comprising a lower half section 93 about the lower half of the pipe, and an upper half section 94 pivoted to the lower section and having an inside diameter equal to that of the pipe. The upper section is sufficiently long to cover the opening, and the sections are clamped about the pipe by suitable bolts 96.

Means are also provided for removing the concrete from the pipe after pumping is stopped. For this purpose short cut-in ducts 97 are provided. These ducts all slope toward the discharge end of the pipe line, and are positioned, say every hundred feet, along the line. While pumping, the ducts 97 are closed with a cap 98. When it is desired to clear the line, an air hose is connected to the cut-in duct adjacent the discharge end of the line, and compressed air is introduced to blow out the concrete between this point and the end of the line. Connection is then made with the next cut-in duct, and the next "plug" of concrete is blown out. This is continued until the line is cleared. The line is then filled with water and thoroughly washed out to remove all the concrete and cement from the pipes.

An important feature of my system is that a continuous pressure is applied to the column of concrete in the line, so that the concrete flows steadily and uniformly. The inertia of the concrete in the line does not have to be overcome at the end of each stroke, as is the case in a reciprocating pump. Furthermore, a continuous flow of concrete does not disturb the mix as does an intermittent motion. In the latter case the pulsations cause heavier pieces of aggregate to settle down in the pipe and engage the pipe wall, which creates excessive friction. With a smooth continuous flow the fines in the mix form a matrix for the larger aggregates, and provides a lubricant between the latter and the pipe.

These advantages lead to smaller equipment and pipe sizes, and also makes it possible to pump over much greater distances. With a reciprocating pump it is possible to pump concrete 1200 feet on the level; with my system it is possible to pump over 3000 feet on the level.

I claim:

1. A pump comprising a collection chamber for receiving material to be pumped, a pumping chamber leading from the collection chamber, an impeller for pushing material from the collection chamber into the pumping chamber, a yieldable wall in the collection chamber, and a pivotally mounted aligning element interposed between said wall and the pumping chamber.

2. A pump comprising a housing having an annular portion forming the outer peripheral wall of a pumping chamber, a shaft fixed in the housing, a central cam fixed on the shaft, rotor sections journaled on the shaft adjacent each side of the cam, a channel-shaped rotor section carried by said side rotor sections and interposed between the cam and said peripheral wall portion, said channel-shaped rotor section forming the side and inner peripheral walls of the pumping chamber, and a retractable impeller pivotally mounted on the rotor and riding on said cam.

3. A pump comprising a housing having an annular portion forming the outer peripheral wall of a pumping chamber, a shaft fixed in the housing, a central cam fixed on the shaft, rotor sections journaled on the shaft adjacent each side of the cam, a channel-shaped rotor section carried by said side rotor sections and interposed between the cam and said peripheral wall portion, said channel-shaped rotor section forming the side and inner peripheral walls of the

pumping chamber, and a retractable impeller pivotally mounted on the rotor and riding on said cam, an outlet for the pumping chamber, and a sealing element between a wall of the outlet and the rotor.

4. A pump comprising a housing having an annular portion forming the outer peripheral wall of a pumping chamber, a shaft fixed in the housing, a central cam fixed on the shaft, rotor sections journaled on the shaft adjacent each side of the cam, a channel-shaped rotor section carried by said side rotor sections and interposed between the cam and said peripheral wall portion, said channel-shaped rotor section forming the side and inner peripheral walls of the pumping chamber, a retractable impeller pivotally mounted on the rotor and riding on said cam, a collection chamber connected with the inlet of the pumping chamber, and a yieldable wall section in the collection chamber.

5. A pump comprising a housing having an annular portion forming the outer peripheral wall of a pumping chamber, a shaft fixed in the housing, a central cam fixed on the shaft, rotor sections journaled on the shaft adjacent each side of the cam, a channel-shaped rotor section carried by said side rotor sections and interposed between the cam and said peripheral wall portion, said channel-shaped rotor section forming the side and inner peripheral walls of the pumping chamber, a retractable impeller pivotally mounted on the rotor and riding on said cam, a liner for the outer peripheral wall of the pumping chamber, and liners in said channel-shaped rotor section.

6. A pump comprising a housing having an annular portion forming the outer peripheral wall of a pumping chamber, a shaft fixed in the housing, a central cam fixed on the shaft, rotor sections journaled on the shaft adjacent each side of the cam, a channel-shaped rotor section carried by said side rotor sections and interposed between the cam and said peripheral wall portion, said channel-shaped rotor section forming the side and inner peripheral walls of the pumping chamber, a retractable impeller pivotally mounted on the rotor and riding on said cam, said cam having a cut-out portion whereby the impeller may be retracted, and a second cam for controlling the impeller during its retracting movement.

7. A pump comprising a collection chamber for receiving material to be pumped, a pumping chamber leading from the collection chamber, an impeller for pushing material from the collection chamber into the pumping chamber, a sheet of flexible material forming one of the walls of the collection chamber for giving way under the impeller as the latter approaches the pumping chamber, and an aligning plate pivotally mounted at one end adjacent the pumping chamber and connected at the other end to the flexible sheet.

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