

March 21, 1961

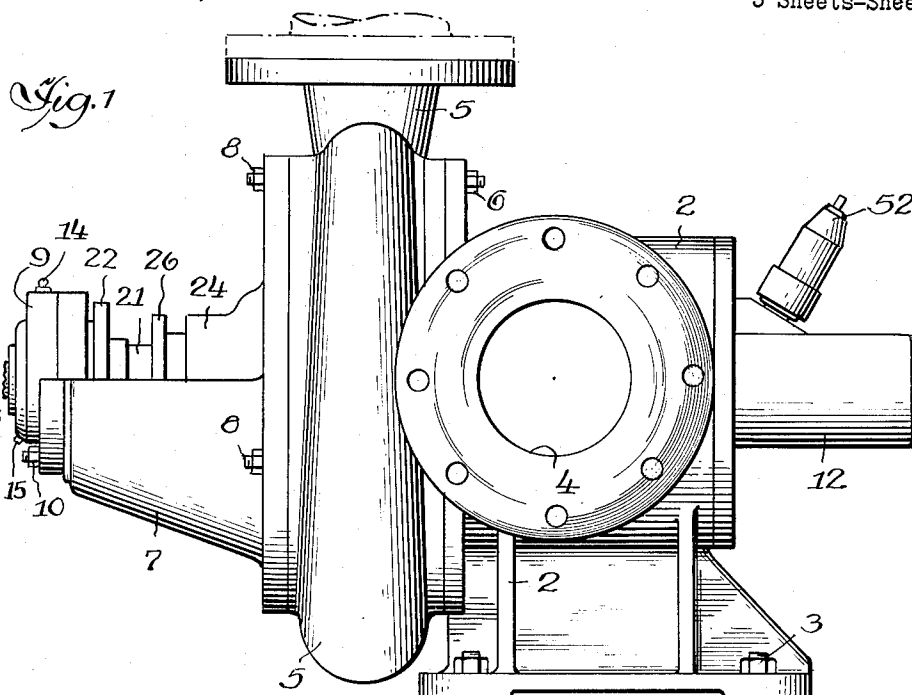
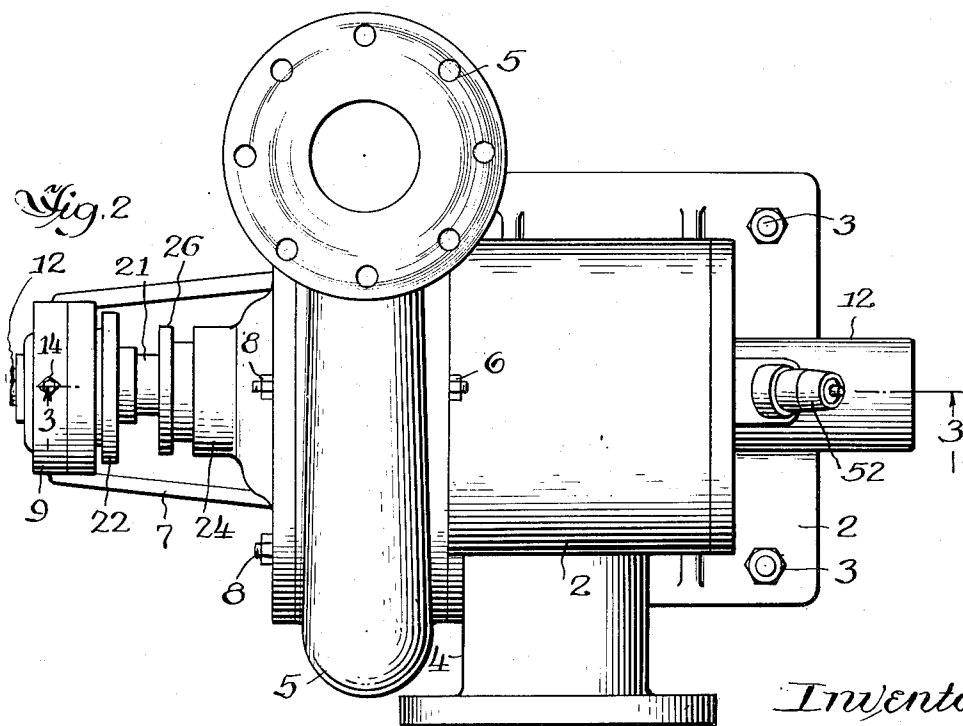
L. M. NECHINE

2,975,714

SCREW FEED CENTRIFUGAL PUMP

Filed Nov. 1, 1954

5 Sheets-Sheet 1



Inventor
Leonard M. Nechine
By: Schneider & Dressler, Attys.

March 21, 1961

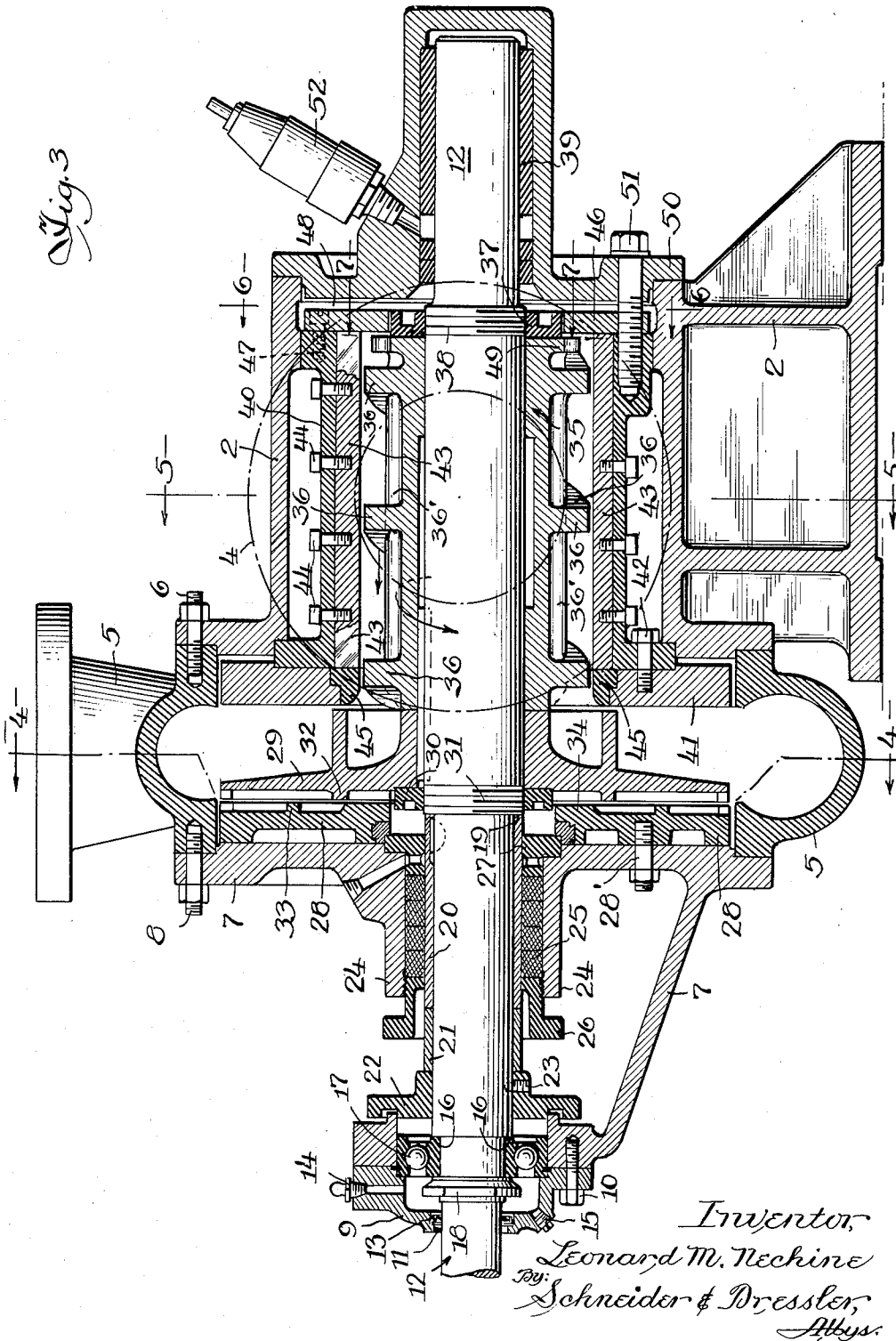
L. M. NECHINE

2,975,714

SCREW FEED CENTRIFUGAL PUMP

Filed Nov. 1, 1954

5 Sheets-Sheet 2



March 21, 1961

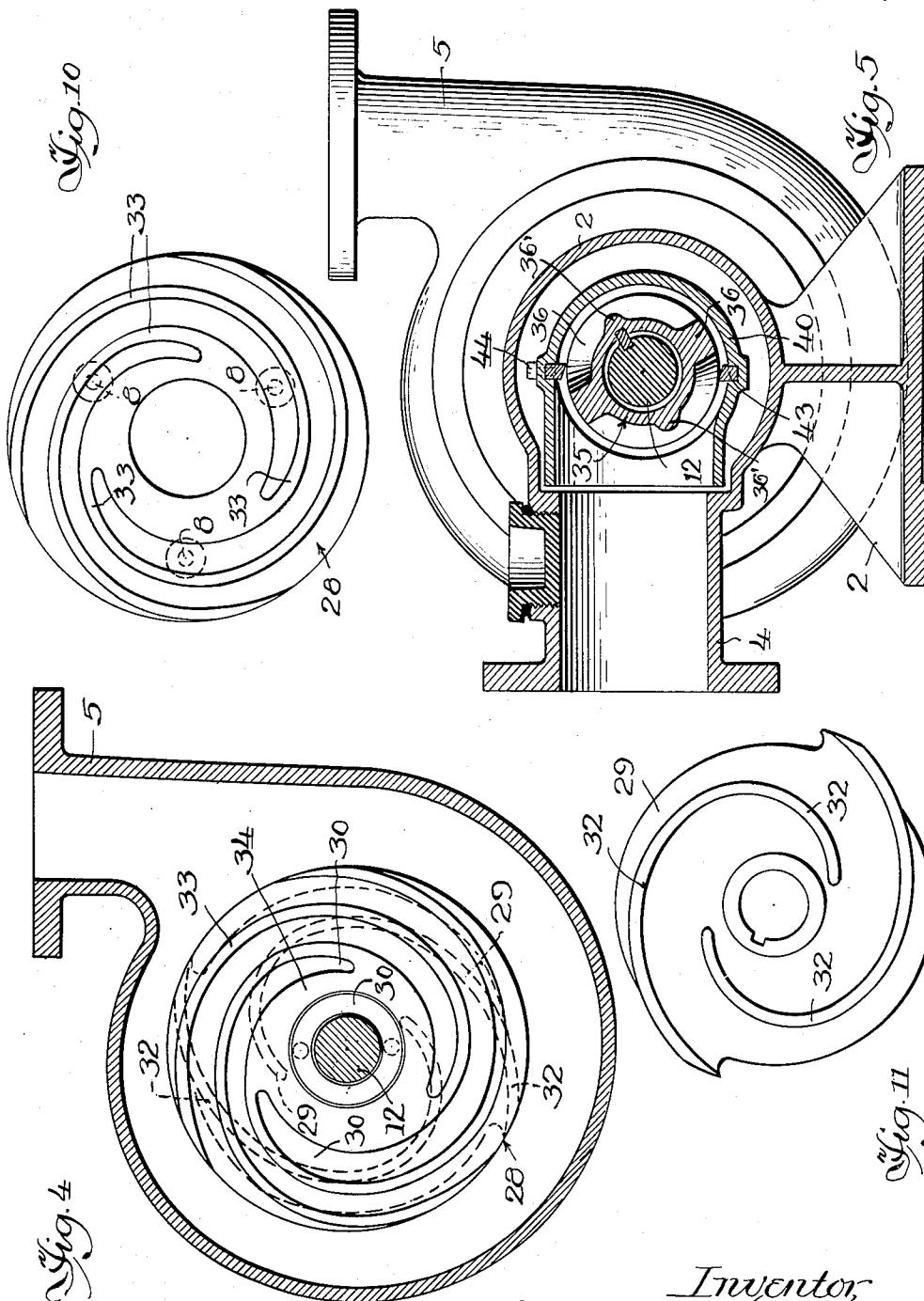
L. M. NECHINE

2,975,714

SCREW FEED CENTRIFUGAL PUMP

Filed Nov. 1, 1954

5 Sheets-Sheet 3



Inventor,
Leonard M. Nechine,
By: Schneider & Dressler,
Attys.

March 21, 1961

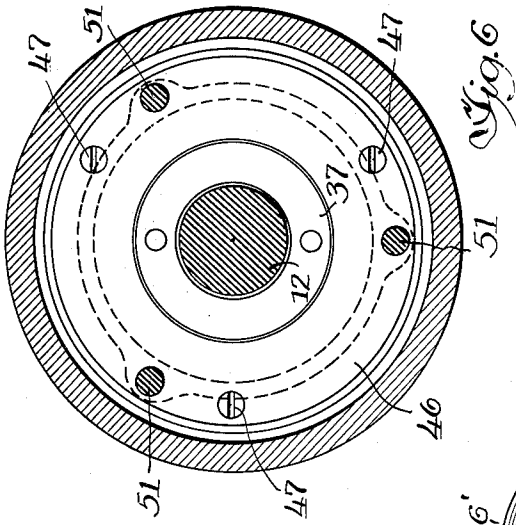
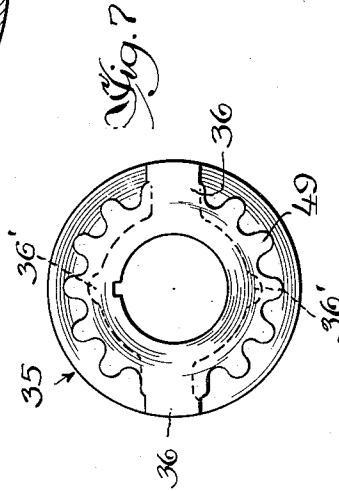
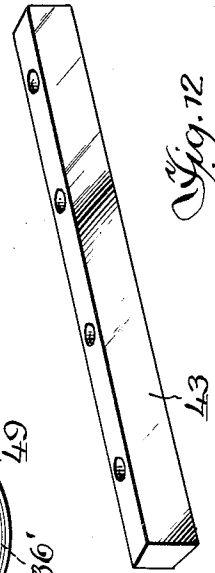
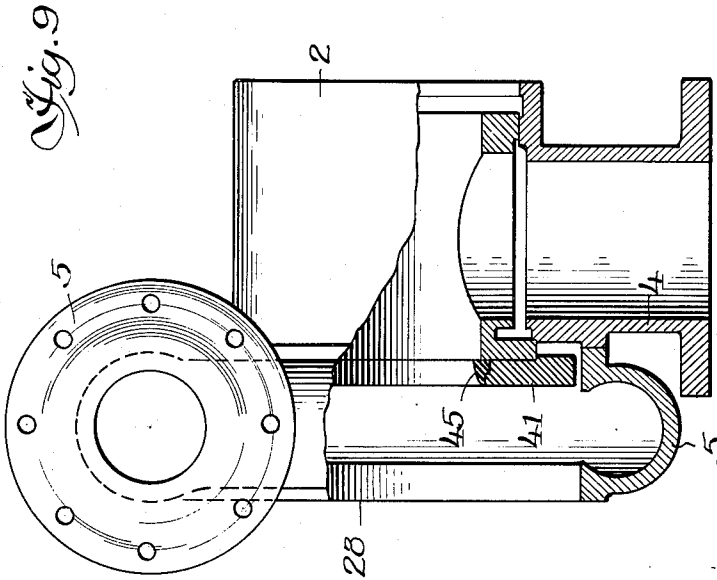
L. M. NECHINE

2,975,714

SCREW FEED CENTRIFUGAL PUMP

Filed Nov. 1, 1954

5 Sheets-Sheet 4



Inventor,
Leonard M. Nechine,
By Schneider & Dressler, Attys.

March 21, 1961

L. M. NECHINE

2,975,714

SCREW FEED CENTRIFUGAL PUMP

Filed Nov. 1, 1954

5 Sheets-Sheet 5

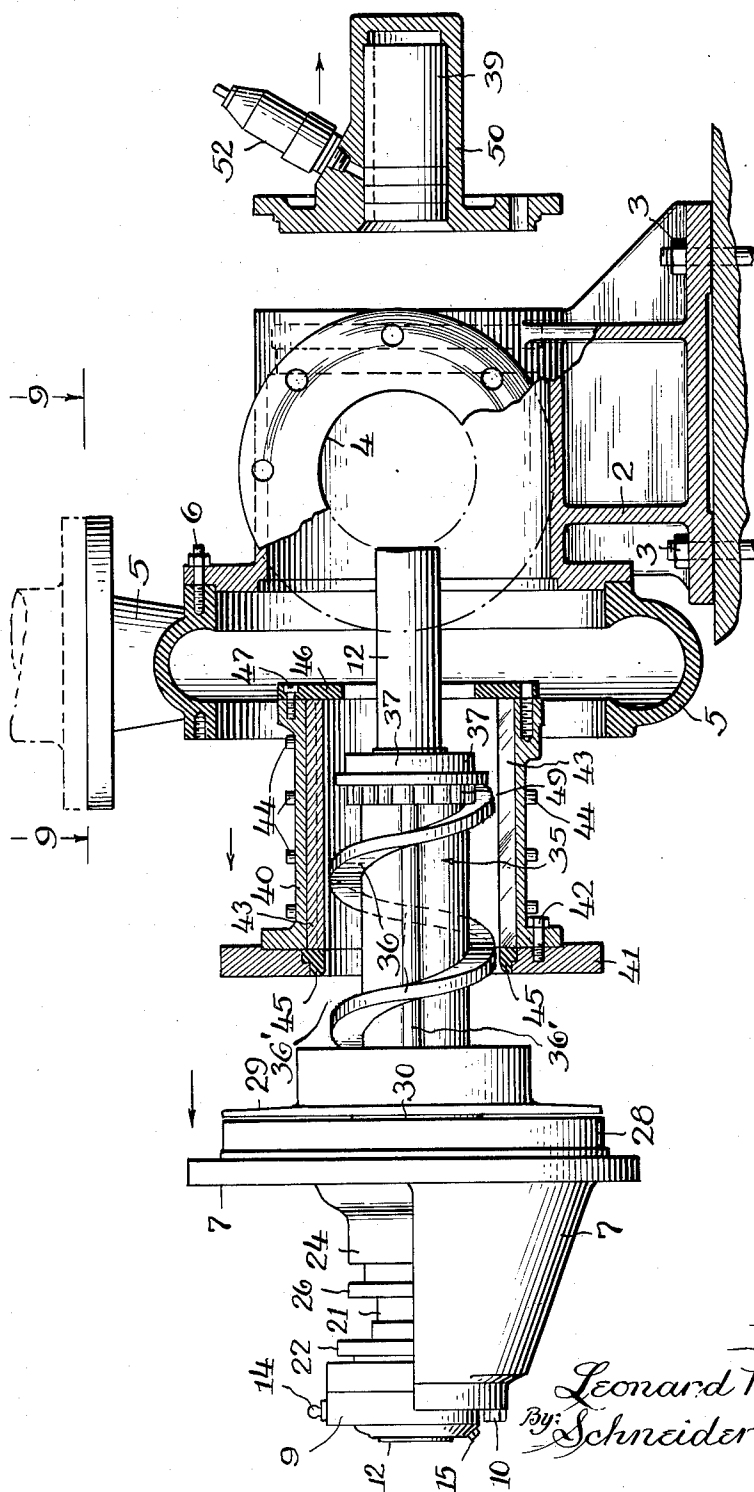


Fig. 8

Inventor,
Leonard M. Nechine,
By: Schneider & Dressler,
Attys.

1

2,975,714

SCREW FEED CENTRIFUGAL PUMP

Leonard M. Nechine, Highland Park, Ill., assignor, by mesne assignments, to Food Machinery and Chemical Corporation, Chicago Pump Company Division, San Jose, Calif., a corporation of Delaware

Filed Nov. 1, 1954, Ser. No. 465,935

15 Claims. (Cl. 103--88)

This invention relates to a screw feed centrifugal pump for pumping liquids containing solid or semisolid materials and is particularly concerned with means for comminuting the solid or semisolid material as it is being pumped along with the liquid, to prevent clogging of the pump.

The pump is designed particularly for pumping of sewage and the concomitant comminution of the larger sewage solids, but is capable of general use wherever it is necessary to pump any liquid which contains solid or semisolid material and comminute the solids.

In accordance with the present invention, the pump is provided with a screw conveyor in advance of the impeller, and the screw conveyor is provided with hardened screw flutes which cooperate with hardened axial shear bars to comminute a substantial proportion of the solid and semisolid material contained in the sewage or other liquid being pumped. The screw conveyor is also provided with axial ribs which serve to throw the solid and semisolid materials towards the cutting members. A sealing member is provided at one end of the screw conveyor to prevent entrance of abrasive bearing liquid or fine clogging material into the bearing chamber of the pump. A cog-shaped flange is provided adjacent the sealing member to produce a pumping action tending to impel the liquid towards the screw and thereby prevent the entrance of abrasive bearing liquid or fine clogging material into the sealing member.

The semi-shrouded impeller is provided with hardened cutting flutes adapted to cooperate with fixed flutes on an adjacent plate to provide a cutting or shearing action on any solid, semisolid or stringy material which might enter between the impeller and the plate. The plate adjacent the impeller has a surface portion flush with the fixed flutes to increase the efficiency of the counter-pumping action induced by the impeller flutes and also to aid in preventing the entrance of material into the lower pressure stuffing box area.

Another feature of the pump is that the principal wearing parts have renewable surfaces and can be removed without affecting the connection of the principal parts to the suction and discharge pipe lines through which the liquid is brought to the pump and through which the liquid is discharged from the pump. The various parts are arranged into three subassemblies which may be readily removed to leave the stationary support and suction housing, and the discharge casing, bolted together with all the removable wearing surfaces removed and with the piping connections unbroken. This arrangement facilitates replacement of any worn part that requires replacement.

The structure by means of which the above-mentioned and other advantages of the invention are attained will be described in the following specification, taken in conjunction with the accompanying drawings, showing a preferred illustrative embodiment of the invention, in which:

2

Figure 1 is a front elevational view of a pump embodying the invention;

Fig. 2 is a top plan view of the pump shown in Fig. 1;

Fig. 3 is a cross sectional view of the pump, taken along the line 3--3 of Fig. 2;

Fig. 4 is a cross sectional view, taken substantially long the line 4--4 of Fig. 3 and showing the rotating involute curved rotating blades in dotted lines;

Fig. 5 is a cross sectional view, taken along line 5--5 of Fig. 3;

Fig. 6 is a cross sectional view, taken along line 6--6 of Fig. 3;

Fig. 7 is a cross sectional view, taken along line 7--7 of Fig. 3 showing the cog-shaped flange for preventing abrasive bearing liquid from entering the sealing member;

Fig. 8 is a view, partly in section and partly in elevation, showing the subassembly of parts partially removed from the stationary support and discharge casing;

Fig. 9 is a top view looking downwardly from the plane 9--9 of Fig. 8, and partially broken away to show the main piping connections;

Fig. 10 is a front elevation of the plate adjacent and to the left of the impeller, as viewed in Fig. 3;

Fig. 11 is a front elevation of the impeller face, looking to the right, as viewed in Fig. 3; and

Fig. 12 is a detail perspective view of one of the axial shear bars positioned in the conveyor housing to cooperate with the screw flutes of the screw conveyor to cut the solid and semisolid material flowing through the conveyor to the impeller.

Referring to the drawings, the reference numeral 2 indicates a stationary support and suction housing which is secured to a suitable floor by bolts 3, or the like. An intake pipe 4 (Fig. 5) is integral with housing 2. A discharge casing 5 is secured to housing 2 by bolts 6 (Fig. 3). A bracket 7 is secured to the opposite side of discharge housing 5 by means of bolts 8. A bearing cap 9 (Fig. 3) secured to the end of bracket 7 by means of bolts 10 has an opening 11 to receive a shaft 12. Opening 11 is provided with a grease seal 13 which fits closely around the shaft. Bearing cap 9 is provided with a grease fitting 14 and a drain plug 15. Shaft 12 is offset near the bearing cap, as indicated at 16, Fig. 3, and a ball bearing assembly 17 is mounted on the shaft between offset 16 and a lock nut 18. The ball bearing assembly takes both radial and thrust loads.

Shaft 12 is provided with another offset 19 adjacent discharge housing 5. A hardened renewable wearing sleeve 20 mounted on the shaft abuts offset 19 at one end. The other end of sleeve 20 is held in place by a spacer 21 which abuts a flinger 22 at its other end. The flinger is secured to shaft 12 by a bolt 23. The bracket 7 is provided with a cylindrical flange 24 which is spaced outwardly from sleeve 20. The space between sleeve 20 and flange 24 is filled with packing 25 which is held in place by a gland 26 at one end and a sealing ring 27 at the other end.

A wear plate 28 is secured to the face of bracket 7 by means of bolts 28'. Wear plate 28 is positioned adjacent the rear face of impeller 29 which is keyed to shaft 12 so as to rotate therewith and is kept from longitudinal movement towards plate 28 by means of a lock nut 30 threaded onto threads 31 cut on the outer surface of shaft 12 adjacent offset 19. A plurality of involute curved flutes 32 extend laterally from the rear surface of impeller 29. A portion of wear plate 28 is also provided with involute curved flutes 33 which are fixed and are adapted to cooperate with flutes 32, which rotate with the impeller, to comminute any solid or semisolid mate-

rial which may enter between the wear plate and the impeller. Another portion 34 of wear plate 28 is flush with the fixed flutes to provide a sealing surface to increase the efficiency of the counter pumping action induced by flutes 32 and to aid in preventing the entrance of material into the lower pressure stuffing box area.

A screw conveyor 35 is keyed to shaft 12 adjacent one edge of impeller 29. The screw conveyor is provided with screw flutes 36 for carrying the liquid towards impeller 29 and axial ribs 36' to throw the solid and semisolid materials towards the cutting members. The other end of the conveyor is held against longitudinal displacement by a lock nut 37 threaded on to a thread 38 provided on shaft 12 adjacent the end of suction housing 2. The end of shaft 12 extends beyond screw conveyor 35 and is journaled in a bearing 39.

Suction housing 2 is provided with a removable liner 40 secured at one end to a wear plate 41 by bolts 42. Renewable cutting blades 43 are secured to liner 40 by means of bolts 44. The cutting edge of blade 43 cooperates with the outer edge of screw flutes 36 to comminute any solid or semisolid material carried by the liquid flowing from intake 4 to impeller 29. As conveyor 35 is rotated axial ribs 36' provide a centrifugal action in the liquid that tends to throw the solid and semisolid material in the liquid towards cutting blades 43 even when the flow is low, and thereby facilitate the comminution of the solid and semisolid material whenever any liquid flows towards the impeller. A throat cutting ring 45 is mounted within the center aperture of wear plate 41 and cooperates with screw flutes 36 adjacent the impeller to comminute solid and semisolid material in the liquid.

A labyrinth sealing plate 46 is secured to the opposite end of liner 40 by means of bolts 47. The space adjacent the sealing labyrinth is packed with hard fibrous grease. In order to prevent the liquid from flowing into the sealing labyrinth the screw conveyor 35 is provided at its end adjacent the labyrinth with a sealing impeller comprising an integral cog-shaped flange 49 having a scalloped peripheral surface which creates a turbulence at that point tending to throw the liquid outwardly toward flutes 36, and thereby keeps the liquid from entering the joint between the inner edge of plate 46 and lock nut 37. A bearing retaining plate 50, which encloses bearing 39, is secured to the end of liner 40 by means of bolts 51 which pass through labyrinth 46. A grease fixture 52 is secured to the bearing retaining plate to lubricate the portion of shaft 12 within bearing 39.

The operation of the pump is very simple. Liquid, such as sewage, containing solid and semisolid material passes through intake 4 and is carried by screw conveyor 35 to impeller 29. The rotary movement of axial ribs 36' on the conveyor throws the solid and semisolid material towards cutting blades 43 which cooperate with the outer edge of screw flutes 36 to comminute the solid and semisolid material so that the liquid reaching impeller 29 is substantially free of solid and semisolid material. If any solid or semisolid material falls between impeller 29 and wear plate 28 it is comminuted by the interaction of involute curved flutes 32 and 33. The liquid is discharged through discharge housing 5 by the impeller.

If any part of the apparatus becomes worn or breaks so as to require repair or replacement, it is easily accessible without dismantling the pump casings from the pipe lines. If bolts 8 are removed it is possible to remove bracket 7 along with bearing cap 9, shaft 12, ball bearing assembly 17, fingers 22, packing assembly 25-27, wear plate 28, impeller 29, and screw conveyor 35 as a complete subassembly. Bearing 39 and its retaining plate 50 may be removed by removing bolts 51. The entire liner subassembly, including liner 40, cutting blades 43, throat cutting ring 45, wear plate 41 and labyrinth plate 46 may then be removed as a unit, leaving

only stationary support and suction housing 2, and discharge casing 5, with the piping connections unbroken.

While I have described a preferred embodiment of my invention in considerable detail, it will be understood that the description thereof is intended to be illustrative, rather than restrictive, as many details may be modified or changed without departing from the spirit or scope of the invention. Accordingly, I do not desire to be restricted to the exact construction described.

I claim:

1. A screw feed centrifugal pump for pumping liquid containing solid and semisolid material, said pump comprising a suction housing, a discharge casing fixed to said housing, a liner subassembly comprising a liner, cutting blades, and a labyrinth sealing plate insertable into and removable from said housing as a unit, and another subassembly also insertable into and removable from said housing as a unit, said second subassembly comprising a shaft, a screw conveyor keyed to said shaft and having screw flutes adapted to cooperate with said cutting blades to comminute solid and semisolid material in the liquid being pumped, and an impeller keyed to said shaft and operable to pump liquid through said discharge casing.

2. A screw feed centrifugal pump for pumping liquid containing solid and semisolid material, said pump comprising a suction housing, a discharge casing fixed to said housing, a liner subassembly comprising a liner, cutting blades, a throat cutting ring, and a labyrinth sealing plate insertable into and removable from said housing as a unit, and another subassembly also insertable into and removable from said housing as a unit, said second subassembly comprising a shaft, a screw conveyor keyed to said shaft and having screw flutes adapted to cooperate with said cutting blades and said throat cutting ring to comminute solid and semisolid material in the liquid being pumped, an impeller keyed to said shaft and operable to pump liquid through said discharge casing, and a wear plate adjacent said impeller, the adjacent surfaces of said wear plate and said impeller having involute curved flutes projecting therefrom and cooperating to comminute any solid or semisolid material entering therebetween.

3. In a screw feed centrifugal pump, a suction housing, a removable liner positioned within said housing, a plurality of cutting blades secured to said liner and removable therewith as a unit, a shaft extending through said housing, a screw conveyor keyed to said shaft to rotate therewith, said shaft and said screw conveyor being removable from said housing as a unit, axial ribs integral with said conveyor, said ribs being arranged to throw liquid being pumped towards said cutting blades, and screw flutes on said conveyor to cooperate with said cutting blades to comminute any solid or semisolid material in said liquid.

4. In a screw feed centrifugal pump, a suction housing, a removable liner positioned within said housing, a plurality of cutting blades secured to said liner and removable therewith as a unit, and a bearing retaining plate secured to said liner, said plate holding said liner and cutting blades against removal from said housing.

5. In a screw feed centrifugal pump, a suction housing, a removable liner positioned within said housing, a plurality of cutting blades secured to said liner and removable therewith as a unit, a screw conveyor mounted in said housing, said conveyor having screw flutes adapted to cooperate with said cutting blades to comminute solid and semisolid material flowing along in the liquid being pumped.

6. A screw feed centrifugal pump for pumping liquid containing solid and semisolid material, said pump comprising a suction housing, a discharge casing fixed to said housing, a liner subassembly comprising a liner, cutting blades, a throat cutting ring, and a labyrinth sealing plate insertable into and removable from said

5

housing as a unit, and another subassembly also insertable into and removable from said housing as a unit, said second subassembly comprising a shaft, a screw conveyor keyed to said shaft and having screw flutes adapted to cooperate with said cutting blades and said throat cutting ring to comminute solid and semisolid material in the liquid being pumped, an impeller keyed to said shaft and operable to pump liquid through said discharge casing, said screw conveyor having a cog-shaped flange integral with one end adjacent said sealing plate operable, upon rotation, to impel liquid away from said sealing plate and thereby prevent entrance of abrasive bearing liquid to said sealing plate.

7. A screw feed centrifugal pump for pumping liquid containing solid and semisolid material, said pump comprising a suction housing, a discharge casing fixed to said housing, a liner subassembly comprising a liner, cutting blades, and a labyrinth sealing plate, said liner subassembly being insertable into and removable from said housing as a unit, and another subassembly also insertable into and removable from said housing as a unit, said second subassembly comprising a shaft, a screw conveyor keyed to said shaft and having screw flutes adapted to cooperate with said cutting blades to reduce solid and semisolid material in the liquid being pumped, and a cog-shaped flange integral with one end of said screw conveyor, said flange being operable, upon rotation of said conveyor, to impel liquid away from said sealing plate to prevent entrance of abrasive bearing liquid to said sealing plate.

8. A screw feed centrifugal pump for pumping liquid containing solid and semisolid material, said pump comprising a suction housing, a discharge casing fixed to said housing, a liner subassembly comprising a liner, cutting blades, a wear plate, and a labyrinth sealing plate, said liner subassembly being insertable into and removable from said housing as a unit, and another subassembly also insertable into and removable from said housing as a unit, said second subassembly comprising a shaft, a screw conveyor keyed to said shaft and having screw flutes adapted to cooperate with said cutting blades to reduce solid and semisolid material in the liquid being pumped, and a cog-shaped flange integral with one end of said screw conveyor, said flange being operable, upon rotation of said conveyor, to impel liquid away from said sealing plate to prevent entrance of abrasive bearing liquid to said sealing plate, an impeller keyed to said shaft and operable to pump liquid through said discharge casing, said impeller and said wear plate being positioned adjacent each other, adjacent surfaces thereof having involute curved flutes projecting therefrom and cooperating to reduce any solid or semisolid material entering therebetween.

9. A screw feed centrifugal pump for pumping liquid containing solid and semisolid material, said pump comprising a suction housing, a discharge casing fixed to said housing, a pair of subassemblies insertable through opposite ends into said housing, one of said subassemblies comprising a bearing and a bearing retaining plate, said other subassembly comprising a shaft having one end supported in said bearing, a wear plate, an impeller adjacent said wear plate, said wear plate and impeller having involute flutes projecting towards each other and cooperating to reduce any solid or semisolid material entering therebetween, a screw conveyor keyed to said shaft, and a labyrinth sealing plate, said bearing retaining plate being secured to sealing plate between said bearing and said conveyor, said conveyor having a cog-shaped flange integral with one end adjacent said sealing plate, said flange being effective, upon rotation of said conveyor, to impel liquid away from said sealing plate to prevent entrance of abrasive bearing liquid into said sealing plate.

10. A screw feed centrifugal pump for pumping liquid containing solid and semisolid material, said pump comprising a suction housing, a discharge casing fixed to said

6

housing, a pair of subassemblies insertable through opposite ends into said housing, one of said subassemblies comprising a bearing and a bearing retaining plate, said other subassembly comprising a shaft having one end supported in said bearing, a screw conveyor keyed to said shaft, and a labyrinth sealing plate, said bearing retaining plate being secured to sealing plate between said bearing and said conveyor, said conveyor having a cog-shaped flange integral with one end adjacent said sealing plate, said flange being effective, upon rotation of said conveyor, to impel liquid away from said sealing plate to prevent entrance of abrasive bearing liquid into said sealing plate.

11. In a screw feed centrifugal pump, a suction housing, a removable liner positioned within said housing, a labyrinth sealing plate adjacent one end of said liner, a bearing and bearing retaining plate secured to said sealing plate and said liner, a shaft having one end extending into said bearing, a screw conveyor keyed to said shaft, one end of said screw conveyor having an integral cog-shaped flange adjacent said labyrinth sealing plate, said flange being effective, upon rotation of said conveyor to impel liquid away from said bearing and to prevent entrance of abrasive bearing liquid to said sealing plate.

12. In a screw feed centrifugal pump, a suction housing, a removable liner positioned within said housing, cutting blades secured to said liner, a labyrinth sealing plate adjacent one end of said liner, a bearing and bearing retaining plate secured to said sealing plate and said liner, a shaft having one end extending into said bearing, a screw conveyor keyed to said shaft, said conveyor having screw flutes adapted to cooperate with said cutting blades to reduce solid and semisolid material in the liquid being pumped, one end of said screw conveyor having an integral cog-shaped flange adjacent said labyrinth sealing plate, said flange being effective, upon rotation of said conveyor to impel liquid towards said screw flutes, whereby abrasive bearing liquid is kept from said sealing plate.

13. In a screw feed centrifugal pump, a screw conveyor having a plurality of screw flutes to advance liquid from the intake towards the discharge end of the pump, a plurality of cutting blades adapted to cooperate with said screw flutes to comminute solid and semisolid material in said liquid as it is flowing towards the discharge end, and a plurality of axial ribs on said screw conveyor adapted to throw liquid being pumped, along with solid and semisolid material present in the liquid, towards said cutting blades.

14. In a screw feed centrifugal pump, a suction housing, a discharge casing connected to said suction housing, a bearing secured against one side of said suction housing, a shaft having one end rotatably mounted in said bearing, a sealing member protecting said bearing from the liquid being pumped, a screw conveyor having a plurality of screw flutes to advance the liquid towards said discharge casing, an impeller integral with one end of said conveyor adjacent said sealing member to throw the liquid away from said sealing member, thereby protecting said sealing member against entrance of abrasive bearing liquid, a plurality of cutting blades in said suction housing, said cutting blades being adapted to cooperate with said screw flutes to comminute solid and semisolid material present in the liquid, and an axial rib projecting from said conveyor to throw the liquid being pumped, along with said solid or semisolid material, towards said cutting blades.

15. In a screw feed centrifugal pump, a suction housing, a discharge casing connected to said suction housing, a bearing secured against one side of said suction housing, a shaft having one end rotatably mounted in said bearing, a sealing member protecting said bearing from the liquid being pumped, a screw conveyor having a plurality of screw flutes to advance the liquid towards said discharge casing, an impeller integral with one end of said conveyor adjacent said sealing member to throw the liquid away from said sealing member, thereby protecting said sealing

member against entrance of abrasive bearing liquid, a plurality of cutting blades in said suction housing, said cutting blades being adapted to cooperate with said screw flutes to comminute solid and semisolid material present in the liquid, an axial rib projecting from said conveyor 5 to throw the liquid being pumped, along with said solid or semisolid material, towards said cutting blades, an impeller in said discharge casing, and a wear plate adjacent said last mentioned impeller, the adjacent surfaces of said wear plate and said last mentioned impeller having involute curved flutes projecting therefrom and co- 10 operating to comminute any solid or semisolid material entering therebetween.

References Cited in the file of this patent

UNITED STATES PATENTS

1,791,547	Yoder	Feb. 10, 1931
2,027,015	Bell	Jan. 7, 1936
2,029,766	Durdin	Feb. 4, 1936
2,343,714	Swenson	Mar. 7, 1944
2,365,058	Crawford	Dec. 12, 1944
2,371,681	Durdin	Mar. 20, 1945
2,458,068	Fuller	Jan. 4, 1949

FOREIGN PATENTS

63,412	Switzerland	Jan. 22, 1913
268,572	Great Britain	Apr. 17, 1927