

June 10, 1941.

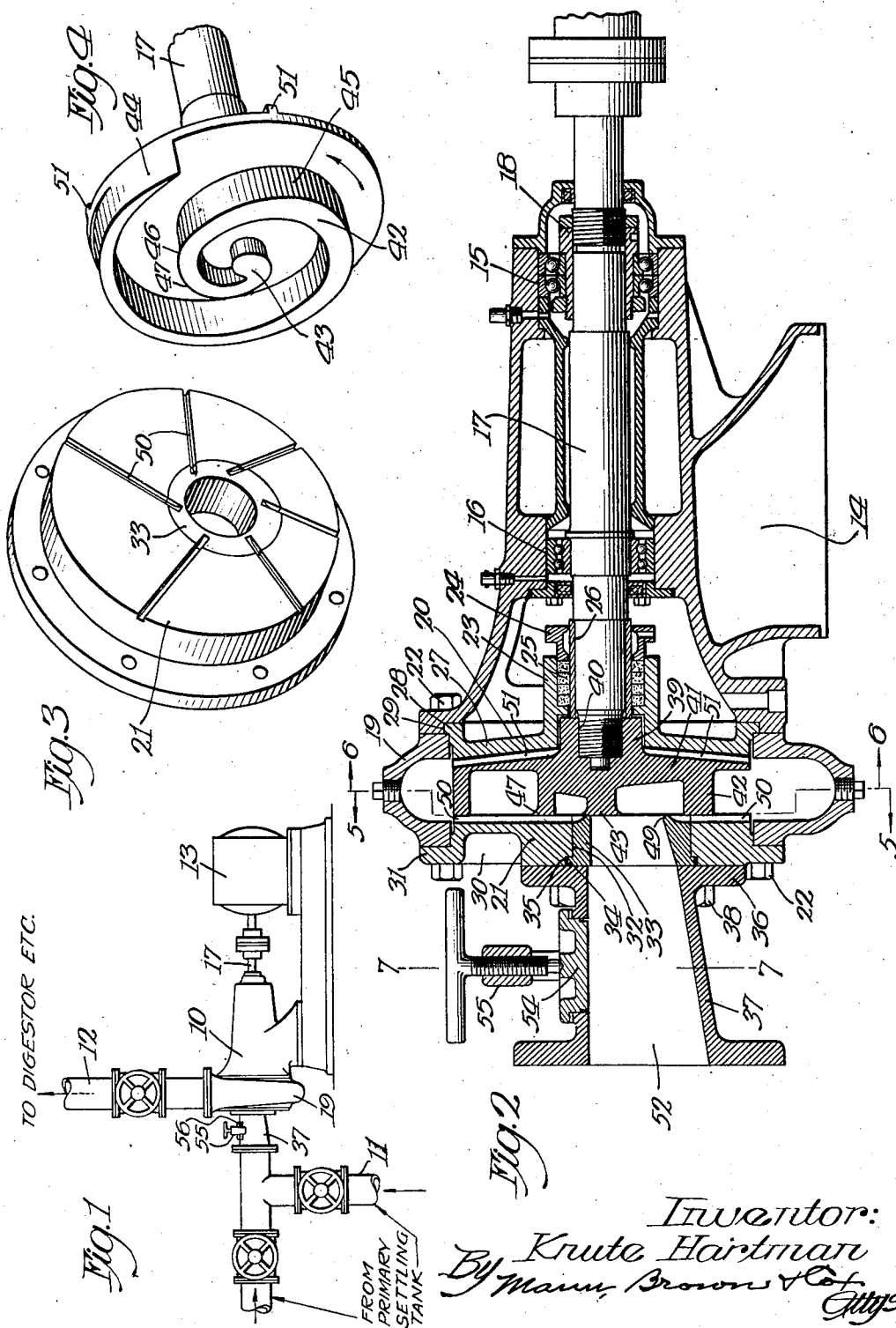
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CENTRIFUGAL SLUDGE PUMP

Filed Feb. 13, 1939

2 Sheets-Sheet 1



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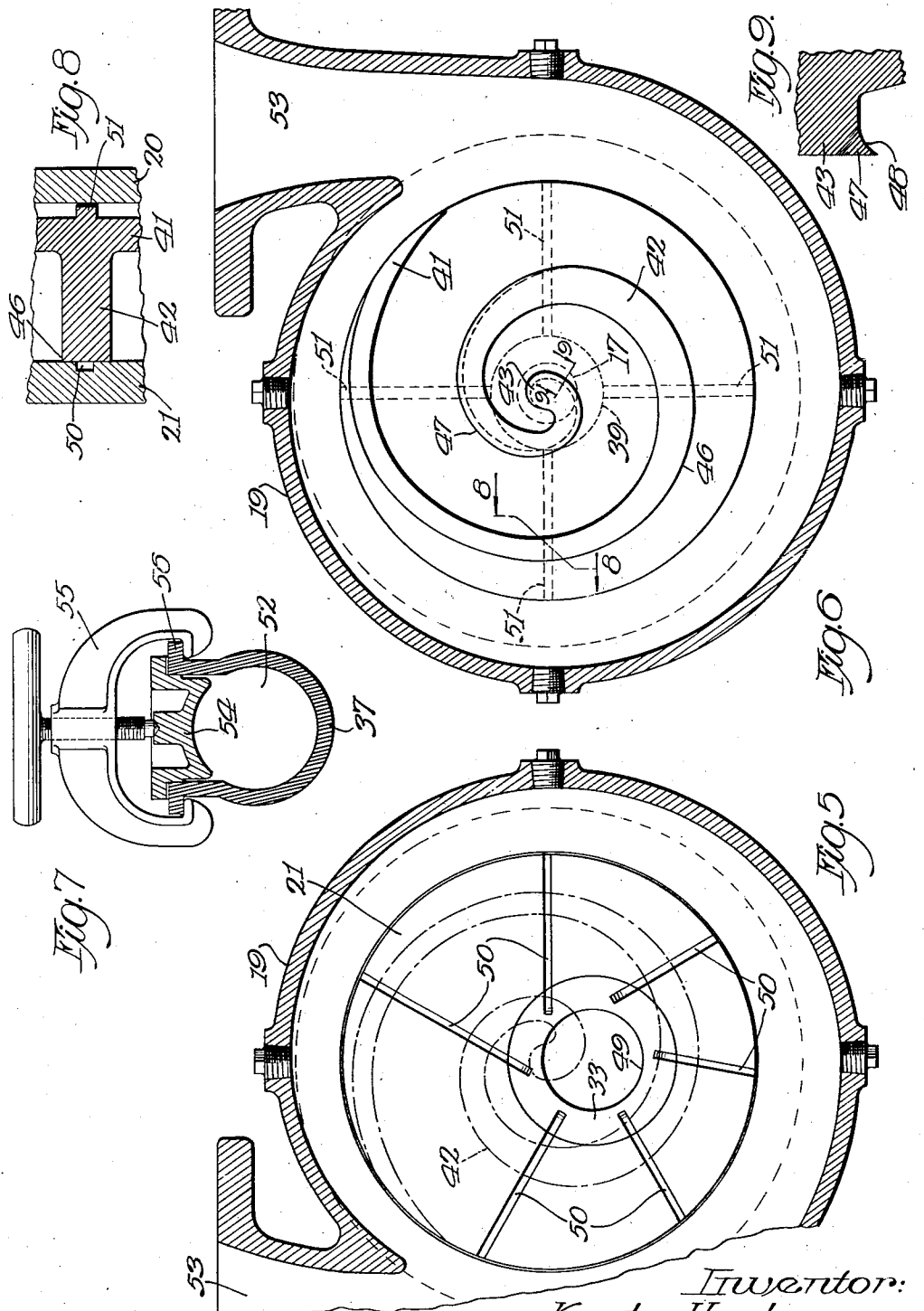
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UNITED STATES PATENT OFFICE

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CENTRIFUGAL SLUDGE PUMP

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12 Claims. (Cl. 103-111)

The principal object of this invention is to provide a pump for handling such things as primary sludge that will not be clogged by the various solids commonly found therein, including stringy and rubbery materials. Generally speaking, this object is obtained by using an impeller with a spiral blade having a cutting edge at its fore side cooperating with a cutting edge, or cutting edges at the suction-side of the pump casing. Further objects and advantages of the invention will appear as the description is read in connection with the accompanying drawings of the preferred embodiment, in which

Fig. 1 is a diagrammatic side elevation of the pump connected in a sewage treatment system; Fig. 2 is a vertical longitudinal section through the pump;

Fig. 3 is a perspective view of the suction side of the casing illustrated as a suction cover and cutting ring;

Fig. 4 is a perspective view of the impeller;

Figs. 5 and 6 are transverse vertical sections taken as indicated by the broken line and arrows 5-5 and 6-6 on Fig. 2;

Fig. 7 is a vertical transverse section on the line 7-7 of Fig. 2;

Figs. 8 and 9 are sections taken on the lines 8-8 and 9-9 of Fig. 6.

But these specific illustrations and the corresponding description are used for the purpose of illustration only and are not intended to place unnecessary limitations on the claims.

In Fig. 1, the pump generally indicated by 10, is shown connected with piping 11, leading from primary settling tanks of a sewage system and piping 12 leading to a digester, or such like. And in this view the power to drive the pump is furnished by a motor 13.

Turning to Fig. 2, it will be seen that the pump includes a base casting 14 finished to receive ball bearings 15 and 16, for the impeller shaft 17, which is adjustable lengthwise by a threaded sleeve 18.

At the left in Fig. 2, the casting 14 is finished to cooperate with a pump casing, including a shell 19, a back, or stuffing box cover 20, and a suction cover plate 21, all of which are secured together and to the casting 14, by bolts 22.

The back, or stuffing box cover 20 has a cylindrical portion 23, cooperating with a gland 24 and packing 25, to make a tight stuffing box for the shaft 17, fitted with a Meehanite sleeve 26, where it passes through the stuffing box. At the left end of the cylindrical portion 23 the back, or stuffing box cover takes the form of a dished

disk 27, terminating in a flange 28, received in a counterbore 29 in the casting 14, where it is held by the adjacent portion of the shell 19.

The suction cover plate is cored out at 30 and has a peripheral flange 31 fitted to the outside of the shell 19. The suction cover plate also has an eccentric bore 32, for a cutting ring 33, having a flange 34 held in a counterbore 35 by the flange 36 on the suction nozzle 37, secured to the left side of the pump by bolts 38.

The impeller (see Figs. 2 and 4) includes a hub 39, threaded to the left end of the shaft 17 at 40, a dished shroud 41 on the left face of which is a single spiral blade 42, developing from a central eye 43, through outwardly diverging convolutions, to the periphery of the impeller at 44, and it will be noted that the blade grows deeper, or wider, as it extends outwardly from the eye 43.

The outer, or what will be called the fore side, 45 of the blade, is provided with a cutting edge 46 at the left corner in Figs. 2 and 4, which is preferably made by welding Stellite, or some similar hard alloy 47 on the corner and grinding it sharp. This cutting edge cooperates with a stationary cutting edge, or cutting edges on the suction side of the pump casing. As shown, the first of these is at the inner corner 49 of the cutting ring 33, and others of which are shown as the corners formed by inclined grooves 50, made partly in the suction cover plate 21 and partly in the cutting ring 33. These cutting edges, or at least the edge of the ring 33, are also formed by welding on Stellite, or some equivalent alloy, and grinding them sharp. As will be seen from Figs. 9, 6 and 5, that portion of the cutting edge 46 that cooperates with the corner 49 of the cutting ring 33 is hollow ground at 48. It will be observed that in addition to such shearing function as they may perform, the grooves 50 lie at a steep angle with respect to the blade and hence will cooperate therewith to force to the periphery any solid particles which might otherwise jam between the blade and the cover 21.

With this arrangement the resulting shears can be adjusted by means of the threaded sleeve 18 to provide just the sort of shearing action necessary to cut all entrained solid matter into small particles in passing through the pump, thereby preventing any clogging.

It will be observed that the ring 33, together with the cutting edge 46, form what might be called a cutting trap in that any material which is being sheared by them will not escape by being slid along the cutting edges to a non-shearing position. Thus, if we start with the parts in Fig. 5 and consider some material at the inter-

section of the spiral blade and the ring, it might be possible that this material would be slid along the edge of the ring for a short distance. However, as it approaches the bottom of the ring, as seen in Fig. 5, the cooperating portions of the ring and the spiral blade would so closely approach parallelism that the material would not be slid farther but would be sheared. As a matter of fact, the present structure forms an even more reliable trap by virtue of the fact that, even if the material was slid at this point, it would shortly thereafter reach a point where it could not slide at all because of the inward turn of the ring 33.

The right, or back side of the impeller shroud 41 is equipped with several vanes 51, which serve as an auxiliary impeller to put a slight suction on the stuffing box and prevent any solid matter from working down between the back of the impeller and the stuffing box cover.

The suction opening 52 is tapered through the suction nozzle 37 and the cutting ring 33 (Fig. 2) and the discharge opening 53 (Fig. 6) is tapered in the reverse way through the periphery of the shell 19. By preference these openings are not less than four inches for a pump having the impeller 9 $\frac{1}{8}$ inches outside diameter and the height of the blade varying from $\frac{1}{2}$ " to $1\frac{1}{2}$ " at the periphery. In such a pump, grooves 50, $\frac{1}{4}$ " wide and $\frac{1}{8}$ " deep, 30° to the radius have been found eminently satisfactory.

Preferably nickel chromium iron is used for the parts of the casing except the cutting ring, which should be made of one per cent (1%) manganese steel, or the equivalent. The impeller should be made of the same material as the cutting ring, or the equivalent.

The suction nozzle 37 is provided with a large hand hole cover 54 (Figs. 2 and 7) conforming to the shape of the suction opening at the inner side and held in place by a screw clamp 55, engaging shoulders 56 on the nozzle. Removing this cover gives ready access to the interior of the nozzle for taking out coils of wire and such like as will not pass through the suction opening. Removing the suction nozzle gives ready access also to the eye of the impeller.

A pump of the size indicated is preferably run at 690 to 1200 R. P. M. The embodiment here illustrated has shown unique ability to handle solids in sludge without clogging. The positive cutting or shearing feature enables it to handle rope, rags, rubber, etc., without difficulty. The Stellite cutting edges have a hardness of 700 Brinell.

In applying the invention, those skilled in the art will choose forms and materials and make designs suited to conditions.

I claim as my invention:

1. In a pump, an impeller including a shroud with a spiral blade thereon having a cutting edge at its fore side and a casing enclosing the impeller including a suction cover having an opening eccentric to the impeller axis, one point of the opening approximately coinciding with the axis of the impeller to prevent material from straddling the axial end of the impeller; the suction cover and opening forming a suction passage which is substantially unobstructed other than by the blade, and a substantial peripheral and generally arcuate portion of the opening forming a cutting edge cooperating with the cutting edge of the spiral blade.

2. In a pump, an impeller including a shroud

with a spiral blade thereon having a cutting edge at its fore side and a casing enclosing the impeller including a suction cover having an inlet, the edges of which are in shearing relation with the blade, the cover lying substantially in contact with the blade throughout most of the area of the inner face of the cover and having widely spaced outwardly directed grooves therein disposed to form a wide angle with the blade and extending approximately from the inlet to the periphery of the impeller, the edges of the grooves cooperating with the cutting edge of the blade.

3. In a pump, an impeller including a shroud with spiral blade means thereon and a casing enclosing the impeller and having a suction cover having a suction inlet adjacent to the impeller and sufficiently eccentric with respect to the axis thereof to prevent solid objects catching at the axis of the impeller, and having at least a substantial peripheral part of its edge cooperating with the blade means forming a cutting edge, the blade means comprising not over two blades traversing the suction inlet, each blade cooperating with the cutting edge.

4. In a pump, an impeller including a shroud with a spiral blade thereon having a cutting edge at its fore side and a casing enclosing the impeller including a suction cover having a stationary cutting edge, two spaced portions of which are crossed simultaneously by a portion of the cutting edge of the blade rotating as one arm about the axis before said cutting edge of the blade crosses the intermediate portion of the stationary cutting edge; said edges cooperating to cut solid particles in the pumped fluid.

5. In a pump, an impeller including a shroud with a blade thereon having a cutting edge at its fore side and a casing enclosing the impeller including a suction cover having a stationary cutting edge, two spaced portions of which are crossed simultaneously by a portion of the cutting edge of the blade rotating as one arm about the axis before said cutting edge of the blade crosses the intermediate portion of the stationary cutting edge; said edges cooperating to cut solid particles in the pumped fluid.

6. In a pump, an impeller including a shroud with a spiral blade thereon having a cutting edge at its fore side and a casing enclosing the impeller including a suction cover having a suction opening formed by a cutting ring cooperating with the cutting edge of the blade and eccentric to the impeller axis; a portion of the blade which cooperates with a part of the ring remote from the axis being approximately parallel with that part.

7. In a pump, an impeller including a shroud with a blade thereon having a cutting edge at its fore side and a casing enclosing the impeller including a suction cover having a suction opening formed by a cutting ring with a substantial length of the ring forming a cutting edge cooperating with the edge of the blade; the axis of the impeller being approximately at least as far from the center of said ring as the edge of the ring.

8. In a pump, an impeller including a shroud with a spiral blade thereon having a cutting edge at its fore side and a casing enclosing the impeller and having an outlet at the periphery of the impeller, including a shell and a suction cover adjacent to the shroud having a suction inlet eccentric to the impeller axis and defined at least in part by a stationary cutting edge cooperating with the cutting edge of the impeller, the stationary cutting edge having at least its

portion last crossed by the blade approximately parallel with the portion of the cutting edge of the blade cooperating therewith and of such disposition and extent that any solid particles engaged between the blades will not be wiped along and off of the cutting edges.

9. In a pump, an impeller including a shroud with a spiral blade thereon having a cutting edge at its foreside and a casing enclosing the impeller including a shell and a suction cover adjacent to the shroud having a suction inlet eccentric to the impeller axis and a stationary cutting edge cooperating with the cutting edge of the impeller, the stationary cutting edge having a portion which is approximately parallel with the portion of the cutting edge of the blade cooperating therewith, and having another portion crossed by the blade just before it crosses the first-named portion and which is at a greater angle to the blade but slopes toward the first-named portion so that any movement of material along the said another portion will be toward the first-named portion.

10. In a pump, an impeller including a shroud with a spiral blade thereon having a cutting edge at its foreside and a casing enclosing the impeller including a shell and a suction cover adjacent to the shroud having a suction inlet eccentric to the impeller axis and a stationary cutting edge cooperating with the cutting edge of the impeller along the entire portion of the blade which is at times exposed to the inlet; the cutting edge of the cover having two spaced portions thereof crossed simultaneously by a portion of the blade rotating as one arm about the axis of the blade

before the blade crosses the intermediate portion thereof.

11. In a pump, an impeller including a shroud with a blade thereon having a cutting edge at its foreside and a casing enclosing the impeller including a suction cover having a suction opening and a stationary cutting edge adjacent the opening, two spaced portions of which stationary cutting edge are crossed simultaneously by a portion of the cutting edge of the blade rotating as one arm about the axis before said cutting edge of the blade crosses the intermediate portion of the stationary cutting edge; said edges cooperating to cut solid particles in the pumped fluid.

12. In a pump, an impeller including a shroud with a blade thereon having a cutting edge at its foreside and a casing enclosing the impeller including a suction cover having a suction opening and a stationary cutting edge adjacent the opening, two spaced portions of which stationary cutting edge are crossed simultaneously by a portion of the cutting edge of the blade rotating as one arm about the axis before said cutting edge of the blade crosses the intermediate portion of the stationary cutting edge; said edges cooperating to cut solid particles in the pumped fluid, and said cover also having grooves therein disposed to form a wide angle with the blade and extending approximately from the inlet to the periphery of the impeller, the edges of the grooves cooperating with the cutting edge of the blade to sweep toward the periphery any material jammed between the blade and the cover.

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