United States Patent

Conery et al.

[15] **3,650,481**

[45] **Mar. 21, 1972**

[54] GRINDER PUMP

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[73] Assignee: **Hydr-O-Matic Pump Company,** Hayesville, Ohio

[22] Filed: **Apr. 1, 1971**

[21] Appl. No.: **130,276**

[52] **U.S. Cl.** .....**241/46.11,** 241/257 G, 241/258

[51] **Int. Cl.** **B02c 18/40**

[58] **Field of Search**.....241/46 A, 46 B, 46.11, 46.17, 241/257 R, 257 G, 258, DIG. 32

[56] **References Cited**

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2,714,045	7/1955	Simenson	241/DIG. 32
2,853,249	9/1958	Wilder	241/46.11 X
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Primary Examiner—Granville Y. Custer, Jr.

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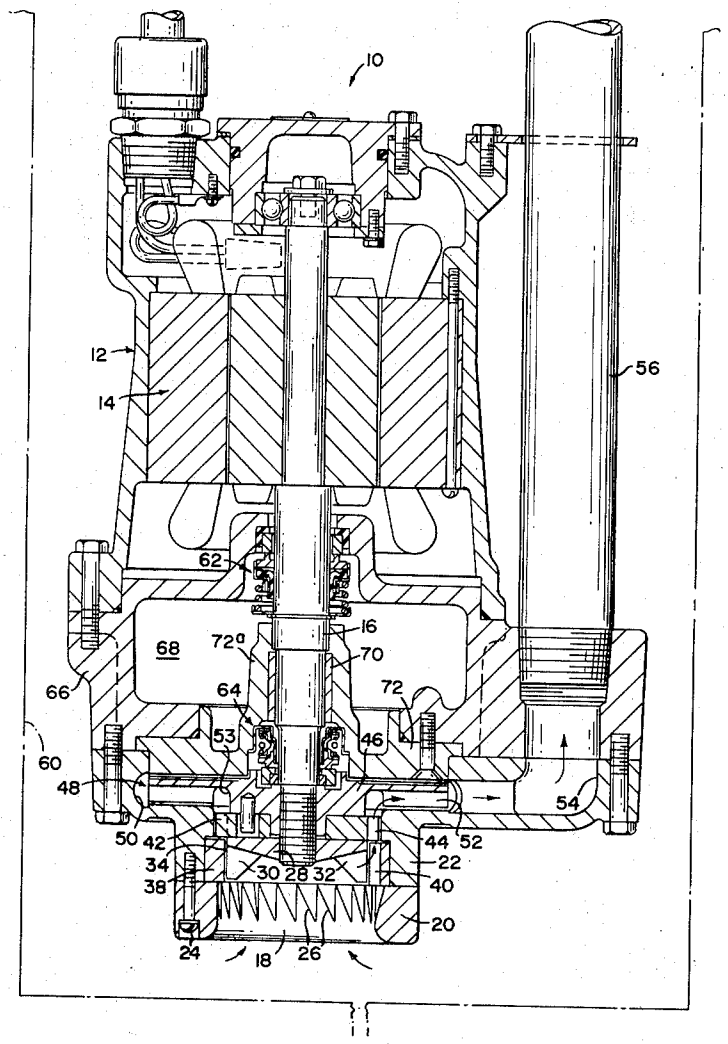
[57] **ABSTRACT**

The grinder pump includes an electric motor drive, cooperating cutter blade and grinder members one of which is secured to the motor shaft at an inlet for the grinder pump unit, an axial flow inducer impeller axially inwardly of and immediately adjacent to the cooperating cutter blade and grinder members, and a centrifugal pump means having an inlet directly connecting to and receiving the discharge from the axial flow inducer impeller, all of the driven members being controlled by and carried on the shaft of the electric motor.

11 Claims, 11 Drawing Figures



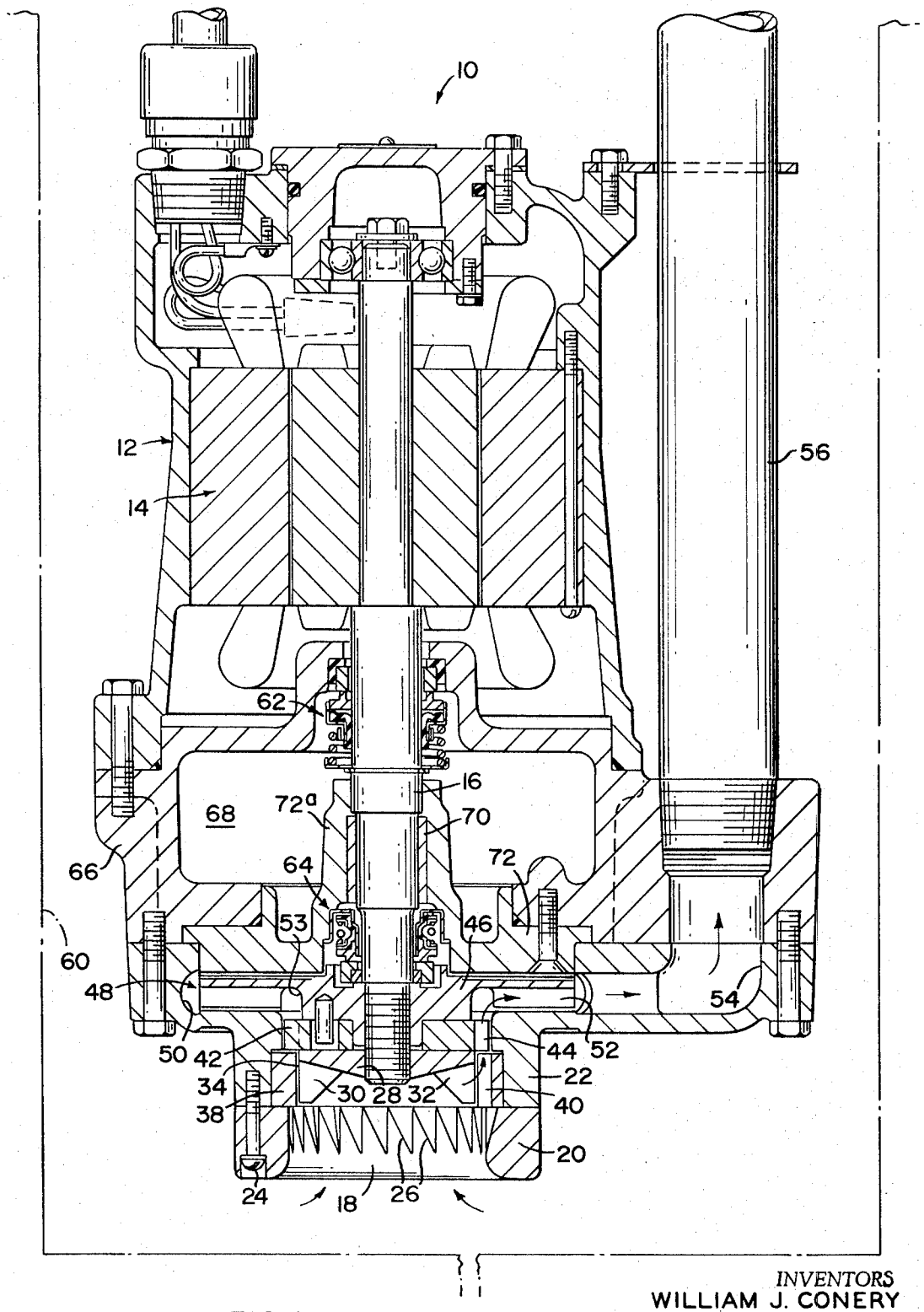


FIG. 1

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FIG. 2

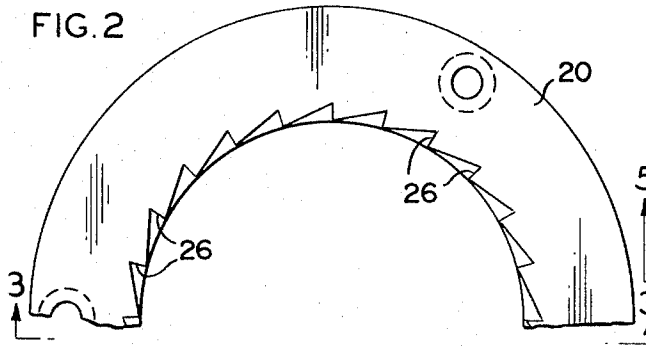


FIG. 4

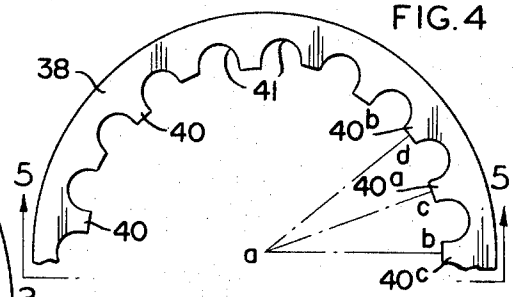


FIG. 3

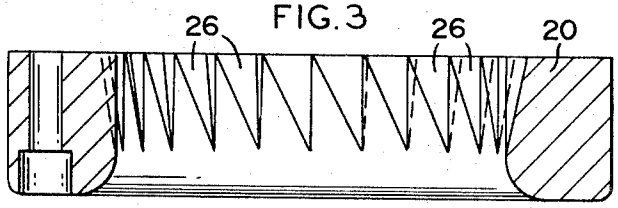


FIG. 5

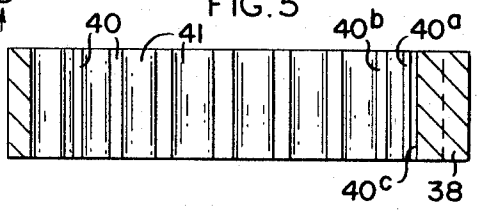
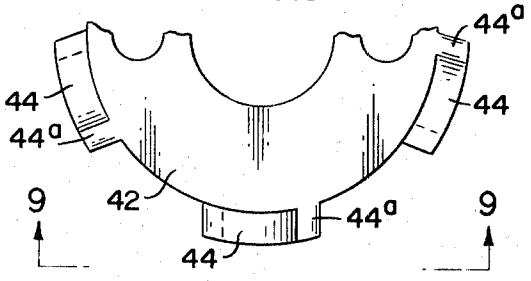


FIG. 8



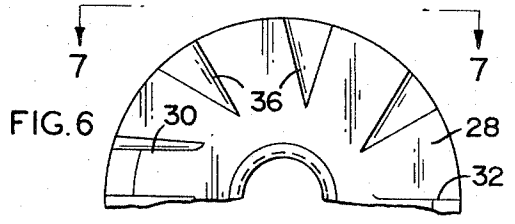


FIG. 6

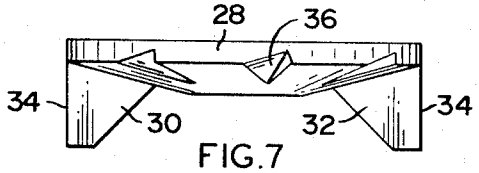


FIG. 7

FIG. 9

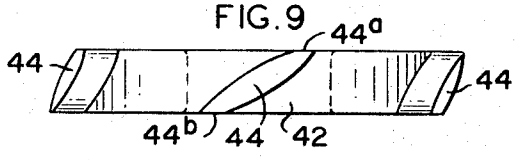
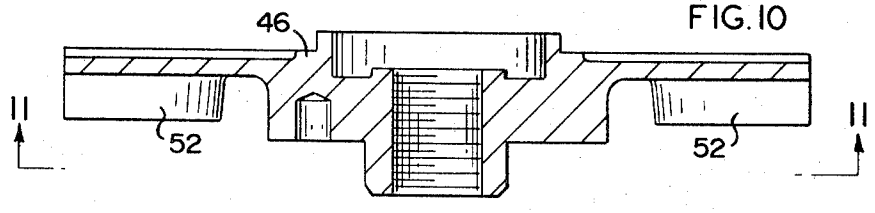


FIG. 10



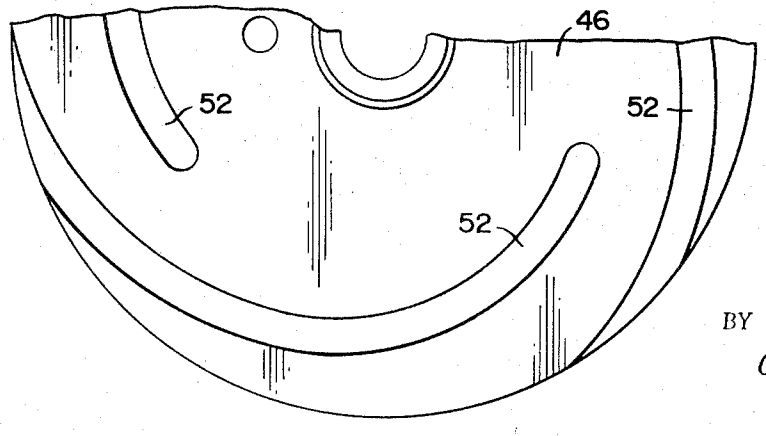


FIG. 11

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GRINDER PUMP

The present invention, in general, relates to a grinder pump unit having improved characteristics for pumping liquids, and cutting up solids in the volume of liquid being processed.

BACKGROUND OF THE INVENTION

Heretofore there have been various types of garbage grinders and other types of grinders wherein a driven rotatable cutter means is provided for breaking up solids and for forcing or moving a fluid or a liquid through the grinder unit. Some of these grinder units have been conventional garbage grinders or disposals as shown in U.S. Pat. No. 2,682,356, while other patented structures in the prior art have provided a double cutting or grinding action where after the material has passed through an initial inlet break-up and grinding or cutting zone, following grinding or cutting action is provided in the unit, as evidenced by the constructions shown in U.S. Pat. Nos. 2,853,249; 2,442,812; and 2,322,058. However, even in these multiple or double cutting units, it has been difficult to provide a grinder or disposer unit wherein substantially any solid material can be introduced into the device and be ground up into satisfactory small elements for flow through the grinder or disposal system. It furthermore has been customary in most instances for these grinder units to be located on vertical axes with some discharge means at the lower portion of the unit, and relatively small volumes of liquid are processed per minute.

In Wilder U.S. Pat. No. 2,853,249, the suggestion of having some type of pump impeller blades in the unit is proposed, but these blades are integral with the shearing or grinding member in the unit and a very inefficient pumping action is secured.

The general object of the present invention is to provide a novel and improved pump-grinder means which includes a separate pump to aid in drawing pumped liquids through the grinder unit of the invention at a desirable fast volume flow rate.

A further object of the invention is to provide improved grinder and/or cutting actions in the grinder unit; and to provide an axial flow inducer impeller which cooperates with the initial grinding or cutting section of the unit for additional cutting action and a drawing or forcing of the pumped liquid axially in the unit, and a centrifugal pump connected to and receiving the discharge from the axial flow inducer impeller for pumping it out of the unit.

Another object of the invention is to provide an improved association between an inlet rotating cutter blade and an associated stationary grinder ring means having a plurality of cutting and/or grinding teeth provided thereon and wherein alternate teeth in the grinder ring are of different radial lengths to improve the cutting action and axial flow of a liquid-solid mixture through the apparatus of the invention.

Another object of the invention is to provide a grinder pump unit which is adapted to process large volumes of sewage or other materials such as liquids having solids therein and including rags, garbage and other materials and wherein the grinder pump unit will break up the solids into small pieces for flow through the apparatus of the invention for processing large volumes of sewage or other materials rapidly and efficiently.

Further objects of the invention are to provide an improved grinder ring tooth assembly for use in association with a driven cutter blade at the inlet of the unit and for improved volume flow of materials through the apparatus with a minimum of vibration to the rotating cutter blade; to provide sizable passages for fluids in the initial cutting or grinding zone of the unit; to provide an improved secondary cutting action in a grinder pump assembly by a disc type of an axial flow inducer impeller located axially immediately adjacent the stationary grinder ring for a secondary cutting action between the initial cutting members and the axial flow inducer impeller in the apparatus; to provide an axial flow inducer impeller wherein the teeth thereon extend the full axial length of the impeller whereby the impeller can be turned over, after removal from the apparatus, and be replaced to provide a double cutting life for the impeller before requiring sharpening; to provide improved cooperation between the teeth on an axial flow inducer impeller and associated inlet cutting or grinding means in the apparatus, to provide an odd number of cutting teeth on the inlet grinder ring and with alternate teeth being a different radial length; to provide a grinder pump with a submersible electric motor so that the complete unit can be submerged in the pumped liquid; to provide the submersible motor with two seals having an oil chamber between the seals to avoid contamination of the motor with the pump material; to provide an improved bearing in the seal oil chamber directly adjacent to the initial impeller seal in the unit; to provide a grinder pump that can be used to force material axially therethrough in any desired position and to provide a submersible grinder pump which can be used in a sewage or other refuse-liquid receiving sump to force large volumes of material into a discharge system connected to the sump.

Reference now is made to the associated drawings wherein:

FIG. 1 is a vertical section through the grinder pump embodying the principles of the invention and diagrammatically showing such grinder pump positioned in a sump;

FIG. 2 is a fragmentary inlet end elevation of the grinder pump of FIG. 1;

FIG. 3 is a vertical section of the grinder ring means of FIG. 2;

FIG. 4 is a fragmentary elevation of the stationary grinder ring of the apparatus of FIG. 1;

FIG. 5 is an end elevation, partially in vertical section, of the stationary grinder ring of FIG. 4;

FIG. 6 is a fragmentary elevation of the cutter ring blade of the apparatus;

FIG. 7 is a side elevation of the cutter ring of FIG. 6;

FIG. 8 is a fragmentary plan of the axial flow inducer impeller of the apparatus;

FIG. 9 is an elevation of the impeller of FIG. 8 taken on line 9—9;

FIG. 10 is a vertical section through the pump impeller of the centrifugal pump in the grinder pump; and

FIG. 11 is a fragmentary plan view of a portion of the impeller of FIG. 10 taken on line 11—11.

When referring to corresponding members shown in the drawings and referred to in the specification, corresponding numerals are used to facilitate comparison therebetween.

INVENTIVE SUBJECT MATTER

In general, the present invention as one embodiment thereof, relates to a grinder pump unit adapted for forced flow of sewage or other material therethrough and wherein a housing and electric motor means is present and includes a shaft extending from the motor, the housing having an inlet provided therefor and cooperating cutter blade and grinder means members are positioned at the inlet for the unit with the cutter blade member being secured to the shaft, an axial flow inducer impeller is secured to the shaft axially inwardly immediately adjacent the cutter blade member, and a centrifugal pump means is provided within the housing and includes an impeller secured to the shaft. The pump has an inlet directly connecting to and receiving the discharge from the axial flow inducer impeller, and a discharge means is provided for the pump and connects thereto.

Reference now is particularly directed to the details of the structure shown in the drawings, and a grinder pump is indicated as a whole by the numeral **10**. This grinder pump includes a housing indicated as a whole by the numeral **12** with a suitable electric motor **14** being provided in one portion of the housing **12** which is shown made from several axially abutting sections. The electric motor **14** has a shaft **16** which protrudes therefrom and extends substantially to an inlet **18** provided at one end of the housing **12**. This inlet **18** is formed in an inlet ring **20** that is secured to a section **22** of the housing **12** as by cap screws **24** or the like. The inlet ring preferably has a plu-

rality of cutting or grinder teeth **26** formed therein and extending generally axially thereof.

The axially outer end of the motor shaft **16** has an inlet cutter blade member or rotor **28** secured thereto, and such cutter or grinder disc or member **28** has at least a pair of axially outwardly extending cutter blades **30** and **32** formed thereon or usually formed integrally therewith and terminating in axially directed outer edges **34** at the periphery of the disc as best shown in FIGS. **6** and **7** of the drawings. Any other suitable or conventional cutter or grinder means including smaller teeth **36** are provided on the axially outer face of the disc **28** for additional cutting, grinding or shredding action on materials being introduced into or flowing through the grinder pump of the invention.

The initial or primary grinding and/or cutting action is obtained in the grinder pump by cooperation of the disc **28** and the teeth thereon with a fixedly positioned grinder ring, means or member **38** that is of annular form and is suitably seated in a recess provided in the housing section **22** and secured thereto in any conventional manner. This grinder member **38** is of annular form and is shown in detail in FIGS. **4** and **5** of the drawings which indicate that a plurality of grinder teeth **40** are provided at circumferentially spaced radially inner portions of the grinder member **38** and with, preferably, a circumferentially outwardly curved recess **41** being provided intermediate each pair of the grinder teeth **40**. FIG. **4** of the drawings best shows, as a further feature of the invention, that an odd number of grinder teeth **40** are provided in the grinder ring **38** and with alternate ones of these teeth as indicated at **40***a* and **40***b* being of different radial length, as indicated by the different lengths of the lines *a–c* and *a–d* in FIG. **4**. For this paired relationship of alternately longer and shorter teeth to form a ring with an off number of teeth therein, one pair of adjacent teeth have the same radial length and in this instance, the tooth **40***c* is shown to be of the same length as its adjacent tooth **40***a* and where the spacing of this tooth from the center of the ring is indicated by the line *a–d*, which is of the same length as the line *a–c*. Thus, by this feature of the invention, a relatively large pathway is provided by the recesses **41** in the grinder ring **38** whereby the material being pumped can rapidly flow in volume through the operating grinder and/or cutting zone or assembly formed by the cutter or grinder disc **28** in association with the grinder ring **38** that encompasses the grinder disc. The circumferentially spaced axially extending cutting edges of the grinder teeth **40** are immediately adjacent and parallel to the straight edges **34** on the axially extending cutter blades **30** and **32** on the cutter disc **28** for effective cutting and grinding action by driven rotation of the shaft **16**.

As a further important feature in the grinder pump unit of the invention, an axial flow inducer impeller **42** is positioned immediately adjacent to the grinder disc **28** on the axially inner surface thereof and which impeller **42** is of generally disc shape. This axial flow inducer impeller has a plurality of blades or teeth **44** provided thereon which teeth **44** have an appreciably inclination, as shown in FIG. **9**, to the longitudinal axis of the grinder pump and which teeth likewise extend some appreciable circumferential distance around the periphery of the impeller **42**. In the present instance, only four of these teeth **44** are shown and they are circumferentially spaced from each other and with the ends of each of the teeth **44** terminating flush with an edge surface of the impeller as indicated at **44***a* and **44***b* of the drawings. This impeller **42** is suitably secured to the shaft **16** for drive thereby, and it should be noted that the axially outer edges **44***a* of the teeth **44** are positioned immediately adjacent and below the axially inner edges or ends of the individual teeth **40** provided on the grinder ring **38** whereby any elongate or fibrous members passing into the grinder pump have a secondary cutting or shredding action effected thereon by the relative rotation of the impeller **42** in relation to the grinder ring **38** and the teeth thereon.

Yet a further important feature of the invention is that a centrifugal pump is formed as a unit with the remaining portions of the apparatus and which unit includes an impeller **46** suitably secured to and carried by the motor shaft **16** for drive thereof as a unit with the grinder disc **28** and associated means. This impeller **46** is a portion of a centrifugal pump **48** that forms an enclosure around the impeller **46** by a portion of the housing section **22** that forms a pumping chamber **50** around the periphery of the impeller **46**. The impeller **46** may have any suitable circumferentially pumping vanes indicated at **52** provided on the face thereof adjacent to the inlet **53** for the pump **48**. Such inlet **53** is directly axially associated with and positioned immediately adjacent the discharge face or surface of the impeller **42**. The inlet is annular and is aligned with the axial flow of the pumped liquid provided by the axial flow inducer impeller **42**. A conventional outlet **54** is formed in a portion of the housing means **12** and an outlet pipe **56** connects thereto for discharge of the pumped material.

By this combination of an initial cutting and grinding action on the pumped material, plus a secondary cutting action between the axial flow inducer impeller and the grinder ring teeth, an effective cutting and/or shredding action is provided on the solids in the pumped liquid, and by use of a centrifugal pump directly connected to and receiving the outlet from the axial flow inducer impeller **42** and associated means, a positive flow of pumped liquid and materials can be obtained through the grinder pump of the invention. At the same time, any solid materials initially present in this liquid can be cut or ground up to small particle form whereby rags and other fibrous materials can pass through the grinder pump and be effectively processed to be moved on in the liquid treatment system for further action on the pumped fluid.

As yet a further feature of the invention, it is preferred that a submersible type of an electric motor **14** be used in the grinder pump so that the grinder pump can be positioned in a known manner as shown diagrammatically in FIG. **1**, in a sump **60**. The grinder pump **10** can be positioned in such sump in any conventional manner as being supported on the bottom of the sump by suitable leg or bracket means, or the unit can be positioned on a vertically extending support means of a known type. In this instance, the inlet **18** faces downwardly of the sump but is spaced from the bottom thereof and the liquid in the sump can rise above the motor **14**. Conventional controls would be provided for the motor to drive it upon predetermined depth of liquid received in the sump and for controlling motor drive until a predetermined lower liquid level is obtained in the sump.

For this electric motor **14** to be effectively used in the practice of the invention, it is important to separate the motor from the pumped material and thus in the present invention, a pair of axially spaced seal assemblies have been positioned in engagement with the motor shaft **16**. These seal assemblies are indicated as a whole by the numbers **62** and **64**. A separate housing section **66** is provided as a portion of the housing means **12** and is suitably attached thereto with the section **66** providing a chamber **68** between the seal **62** and **64**. Thus, a suitable material, such as oil, can be received in the chamber **68** and this forms an isolation chamber between the electric motor and the pumped liquid. It also is necessary to provide a bearing **70** that is carried by a separate end plate **72** formed as a portion of the casing of the pump **48** and which has a tubular extension **72a** extending therefrom in which the bearing **70** for the shaft is received to aid in positioning this shaft for efficient, maintenance free operation.

The seals **62** and **64** can be of any known mechanical type.

The provision of the axially spaced seals **62** and **64** with an oil chamber therebetween aids in the use of the invention with a submersible electric motor that can be adapted for upward pumping of liquid materials while grinding, shredding and cutting any solids present in such materials.

It should be noted that the axial flow inducer impeller **42** is of a flat disc shape and that the blades or teeth **44** formed thereon can be serviceable with rotation of the impeller in opposite directions. Thus, the impeller disc can be removed from the unit of the invention, be turned over and be replaced for

further pumping action. This gives a double life on the impeller 42 without any sharpening action being provided or required, so as to reduce maintenance and operation costs of the unit of the invention.

The unit of the invention has provided a high rate or volume of forced flow of materials from the grinder pump and at the same time solids in such pumped liquid have been cut or ground to suitable form for passage through the apparatus of the invention. Thus, it is believed that the objects of the invention have been achieved.

While one complete embodiment of the invention has been disclosed herein, it will be appreciated that modification of this particular embodiment of the invention may be resorted to without departing from the scope of the invention as defined in the appended claims.

What is claimed is:

1. A grinder pump comprising an electric motor means including a shaft extending therefrom, an inlet being provided for said housing, cooperating cutter blade and grinder means members one of which is secured to said shaft at an inlet for the unit, an axial flow inducer impeller positioned axially inwardly of and immediately adjacent said cutter blade member, said impeller being secured to said shaft, and a centrifugal pump means including an impeller secured to said shaft, said pump having an inlet directly connecting to and receiving the discharge from said axial flow inducer impeller.

2. A grinder pump unit as in claim 1 where teeth are provided on said grinder means and some teeth are longer than others.

3. A grinder pump as in claim 1 where said grinder means has an odd number of teeth therein and every other one of said teeth is radially shorter than the teeth adjacent thereto, except for one pair of adjacent teeth which are of the same length.

4. A grinder pump unit as in claim 1 where said axial flow inducer impeller has teeth thereon extending the axial length thereof and surfaces of said teeth cooperate with surfaces of said grinder teeth for additional cutting and/or grinding action.

5. A grinder pump unit comprising a housing and electric motor means, said electric motor including a shaft extending therefrom, an inlet being provided for said housing, an inlet cutter blade secured to said shaft, grinder ring means including grinder teeth carried by said housing and encompassing said inlet cutter blade, an axial flow inducer impeller positioned axially inwardly of and immediately adjacent said inlet cutter blade, said impeller being secured to said shaft, a centrifugal pump means within said housing and including an impeller secured to said shaft, said pump having an inlet directly connecting to and receiving the discharge from said axial flow inducer impeller, and a discharge means for said pump means connecting thereto.

6. A grinder pump unit as in claim 5 where some of said grinder teeth on said grinder ring means are radially longer than others, and where radially outwardly extending circular recesses are formed between said grinder teeth.

7. A grinder pump as in claim 5 where said grinder ring means has an odd number of teeth therein and every other one of said teeth is radially shorter than the teeth adjacent thereto, except for one pair of adjacent teeth which are of the same length.

8. A grinder pump unit as in claim 5 where said axial flow inducer impeller has teeth thereon extending the axial length thereof and flat end surfaces are formed on said teeth to cooperate with end surfaces of said grinder ring teeth for additional cutting and/or grinding action.

9. A grinder pump unit as in claim 1 where said motor is submersible.

10. A grinder pump unit as in claim 9 where said motor has two axially spaced seals with an oil chamber formed therein between said seals.

11. A grinder pump unit as in claim 1 where said axial flow inducer impeller, which is of disc shape, has teeth thereon extending the axial length thereof and end surfaces of said teeth are flat and said axial flow inducer impeller can be reversed for double use of said impeller without sharpening its teeth.

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