United States Patent [19]

Neidl

[11] **3,738,582**

[45] **June 12, 1973**

[54] **APPARATUS FOR COMMINUTING, SEPARATING, MANIPULATING AND PUMPING MATERIALS**

[76] Inventor: **Georg Neidl,** IM Bisch 664, Schaan, Liechtenstein

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[52] **U.S. Cl.** **241/46.11**

[51] **Int. Cl.** **B02c 13/10**

[58] **Field of Search** 241/46.11, 46.17, 241/73, 79.2, 251, 255, 260, 261

[56] **References Cited**

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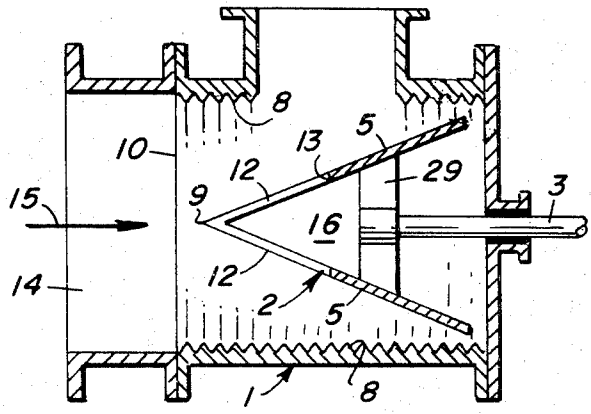
Primary Examiner—Granville Y. Custer, Jr.

Attorney—Christen & Sabol

[57] **ABSTRACT**

Apparatus for pumping and comminuting, and otherwise treating viscous and semi-solid materials includes a housing having an axial inlet and tangential outlet and a rotor in the housing having at least one semi-cylindrical blade disposed at an angle to the axis of rotation, the straight edge of the blade facing the inlet and having a medially disposed recessed cut out portion to prevent back-up and jamming of materials.

22 Claims, 9 Drawing Figures



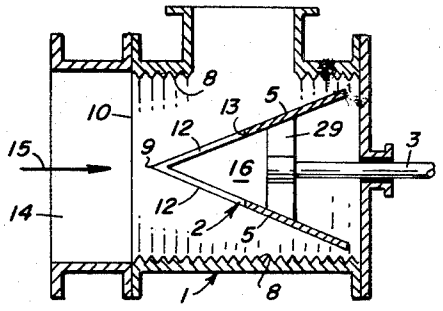


FIG. 1

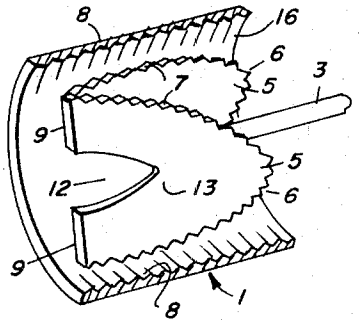


FIG. 2

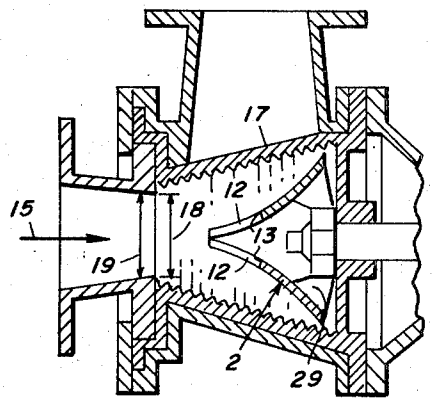


FIG. 3

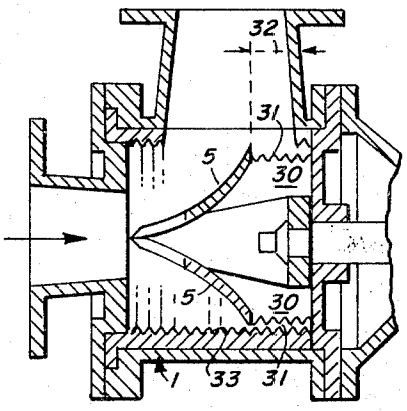


FIG. 4

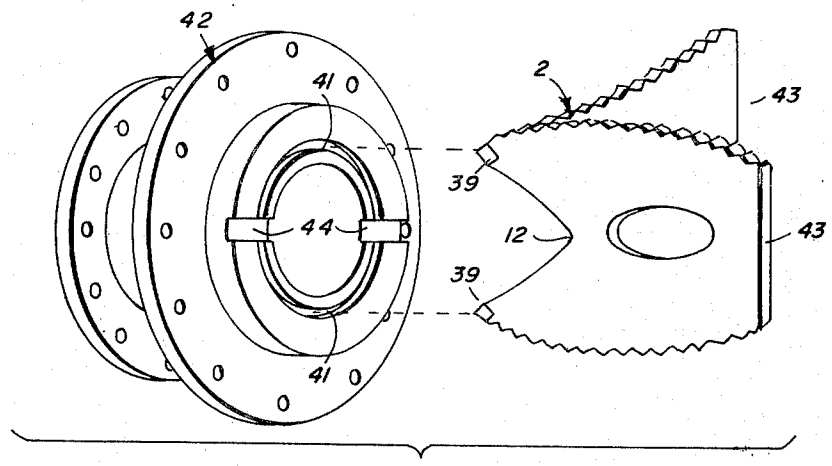


FIG. 5

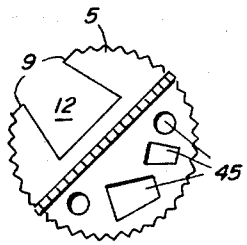


FIG. 6

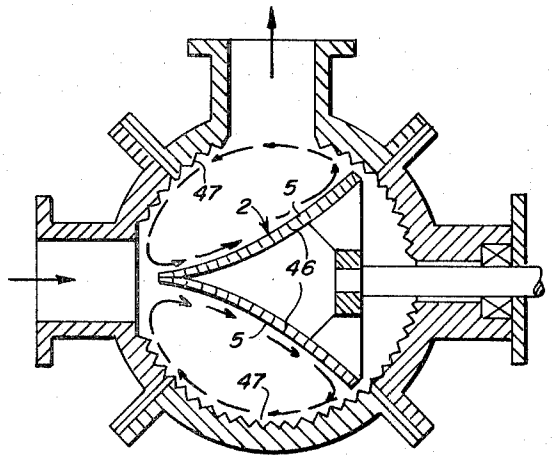


FIG. 7

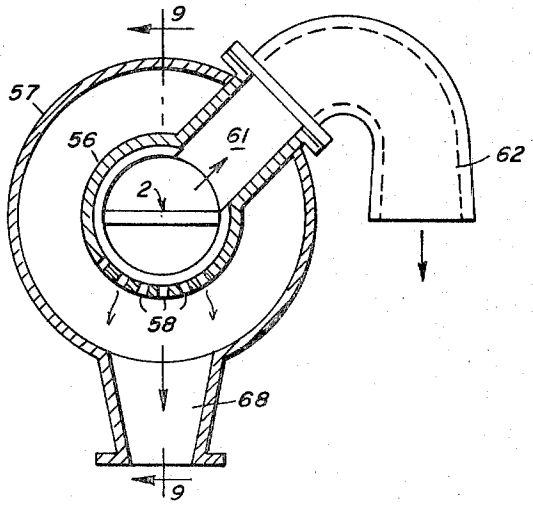


FIG. 8

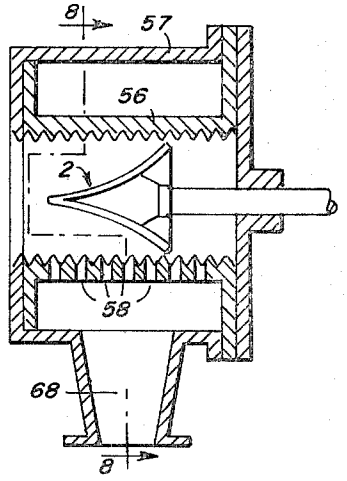


FIG. 9

APPARATUS FOR COMMINUTING, SEPARATING, MANIPULATING AND PUMPING MATERIALS

The invention concerns a device for the comminution, separation, manipulation, processing, pumping and similar treatment of substances of various kinds.

Devices for comminution of impurities contained in sewage, of thick substances, etc. have been known where the barrel of a pump formed as an eliptical disc has been attached in a cylindrical housing on a shaft disposed concentrically in relation to the housing and slantingly in relation to the axis of the shaft, which barrel on its periphery has teeth, serrations, or similar projections, which are in engagement with grooves disposed at the inside periphery of the housing.

These known devices, to be sure, generally fulfill the requirements made of them. However, particular difficult conditions may arise which would seem to make it desirable to assure to an even stronger degree not only a comminution but a processing and manipulation of the substances to be treated.

In pump construction, moreover, a device has become known where in two symmetrical semi-circular discs are attached to the shaft in such a way that their lines of symmetry cross the axis of the shaft.

According to the disclosure of German Pat. No. 1,528,778 the proposal has already been made in the case of devices of the initially described variety, for the use of a rotor which consists of at least two discs disposed obliquely in relation to the axis of the shaft, which discs are formed as semi-circular discs, and which are attached on the shaft in pairs symmetrically and obliquely in relation to the axis of the shaft and at a slant in relation to one another in such a way that their common line of connection forms the edge of a vertex intersecting the axis of the shaft and facing the inlet.

The invention is based on the task, of carrying out, with devices of the above mentioned type and even in the case of occurrence of difficult operational conditions, both a comminution as well as a preparation, separation, manipulation, pumping and similar treatment reliably and still more effectively in continuous operation, without any stalling or premature wear of the device.

According to the invention, this task is solved in such a way that in the case of a device of the initially described type the rotor consists of two semi-circular discs which are attached on the shaft in pairs symmetrically and obliquely in relation to the axis of the shaft and slanting in the relation to one another such that their joint connecting line intersects the axis of the shaft, facing the inlet connection, and in which recesses open toward the middle portion of the edge of the vertex, have been provided in both discs.

The invention has the advantage that the edge of the vertex of the rotor facing the inlet connection achieves a partial division of the material fed in while another portion of the material in the center enters into the two recesses in the discs and thus moves behind the two discs, and is moved here radially to the outside, on the inside surfaces of the discs adjacent the bearing. The result is that the edge of the vertex which is divided in two parts will have a certain peripheral speed all along its radial length so that beside the splitting effect, that portion of the edge of the vertex which would have only very small peripheral speeds, or none at all, and which could cause a damming effect is entirely eliminated because of the recessed openings. In this manner, clogging or plugging of the inlet will be avoided even in the case of the most difficult substances.

The drawings show the invention by way of embodiments shown as examples.

FIG. 1 shows an axial cross-section through a device with flat surfaced semi-circular discs disposed at acute angle in relation to one another,

FIG. 2 shows a perspective presentation of a part of another embodiment with arched semi-circular discs,

FIG. 3 shows an embodiment similar to that of FIG. 2, in axial section inclusive of the entire housing and with housing formed in a manner of a cone,

FIG. 4 shows another embodiment with additional discs disposed cross-shaped,

FIG. 5 shows embodiment similar to that of FIG. 2 in which only the inlet portion is shown, with the inlet and the two discs in perspective, and wherein grooves are provided on the inlet,

FIG. 6 is a top view of one of the semi-circular discs with additional perforations,

FIG. 7 shows an embodiment similar to that of FIG. 2 in which the housing is formed as a flattened sphere,

FIG. 8 is a further embodiment shown in cross-section on line 8—8 of FIG. 9 in which the housing is encased by a jacket, and

FIG. 9 shows an axial section through the device of FIG. 8 following the line 9—9 of FIG. 8.

According to the embodiment of the FIG. 1, a rotor 2 is taper bore mounted by means of an attaching web 29 on a driving shaft 3 inside a cylindrical housing 1, said rotor consisting of two flat semi-circular discs 5 disposed at an acute angle in relation to one another and symmetrically in relation to the shaft 3, the free edges 6 of said discs being equipped with teeth 7 which engage with peripheral grooves 8 disposed concentrically on the inside wall of the housing 1. The discs 5 meet in a common vertex edge 9 in such a way that the latter intersects the axis of the shaft and runs parallel to the transverse plane 10 of the housing 1. Each of the semi-circular discs is provided with a recess 12 which begins at the central portion of the vertex 9 and extends rearwardly to about the mid-portion 13 of each side.

Because of this construction of the discs the material entering, for example, at the vertex 9 upon striking said vertex is divided into two streams which flow along on the outside surface of each disc 5, so that the material is thrown toward the outside under the effect of centrifugal force and reaches the area of the peripheral grooves 8 and is comminuted in these grooves through cooperation with the teeth 7 on the discs 5 and is homogenized and mixed.

The recesses 12 have the purpose of permitting an undisturbed, continued inward movement in the direction indicated by arrow 15 to a portion of the material that is to be treated, and especially to that part which is located in the vicinity of the center of the inlet connection 14, so that these portions will reach the inside space 16 between the two discs 5 and are seized there by the inside surfaces of the discs 5 and are thrown outwardly under the effect of centrifugal force, so that these potions of the material that are to be treated, will also finally reach the area of the peripheral grooves 8 coacting with the teeth 7 and are comminuted, manipulated, etc. here.

The recesses **12** have the further advantage that in the neighboring area of the rotational axis, in which the peripheral speed of the vertex **9** would be low, for example, practically zero, the material that is to be treated will reach the inside space **16** by passing unimpeded through the recess so that in this area no disadvantageous stoppages can develop and while the material meeting only those parts of the vertex **9** which have higher peripheral speeds, are not only separated from the edge of the vertex by the material following through from the inlet connection **14**, but they are, at the same time, also moved on into the outlet.

FIG. **2** shows a device similar to the one in FIG. **1** where the semi-circular discs **5** are arched as viewed in a direction normal to a plane disposed at right angles to the vertex **9**.

According to FIG. **3**, the housing **17** is formed with a conical configuration so that the smallest diameter **18** of the cone corresponds to the inside diameter **19** of the inlet connection **14**. As a result, the danger of plugging up will be avoided in a still more efficient manner because the housing is adapted to the wedge shape of the rotor **2**.

The conical configuration of the housing has the particular advantage that the entering material which is to be treated on the annular grooves, follow paths having increasing diameters and thus is exposed to progressively larger centrifugal forces. As a result, the transition from the inlet connection, up to the full radial groove diameter is not as abrupt. A further advantage consists in this, that the axial forces caused by the rotor acting against the bearing of the driving shaft in the inside of the housing due to the constricted space between the rotor and the inlet by the conical widening to a certain extent, so that the danger of stoppage will largely be avoided.

In view of a conical shape of the housing, it is also necessary to make the serrations on the rotor conical. In this modification of the device, even fibrous components will also be torn apart in a particularly effective manner, which components are not comminuted by the customary beater mills. Even sinews from slaughter waste, as well as meat, and particularly tough textiles made of synthetic fibers such as nylon, perlon, etc. are comminuted without difficulty by the device according to the invention. Even exceedingly resistant straw can be improved to a high degree with the device according to the invention.

In the case of the embodiment shown in FIG. **4**, transverse radial plates **30** are provided additionally on the side of the discs **25** facing the shaft, which engage with their teeth **31** along the length indicated by numeral **32** with the corresponding grooves **33** of the housing.

This embodiment has the advantage that the substance is put into even more intensive rotation, so that the manipulating effect of the two discs **5** is assisted by the radial plates **30**, and as a result of that, it is possible to achieve particularly favorable continuation and homogenization effects.

As shown in the perspective view of FIG. **5**, special teeth **39** may be provided on the vertex which are disposed to coact with annular grooves **41** running concentrically in relation to the axis of the housing and on the inside inner surface of the inlet cover **42**. The two rear edges **43** of the rotor **2** can also be provided with teeth in the same way, which teeth engage with annular grooves on the bearing side of the cover of the housing.

At the same time, transverse channels **44** can be provided on the inlet cover **42** as well as on the cover on the bearing side.

By use of the teeth **39**, in connection with the grooves **41** and the transverse channels **44**, any possibility of jamming developing in the area of the two inside surfaces of the covers and any stalling of the rotor can be avoided.

According to FIG. **6**, perforations **45** of various shapes, including circular, elliptical, rectangular, or irregular variations thereof, can be provided in the discs **5** in addition to the recess **12**, through which for one thing the resistance, in the case of particularly thick material that is to be conveyed, is lowered, because parts of this conveyed material can pass through these additional openings during the rotational movements of the discs. For another thing, these perforations have an additional comminuting effect since comminution, homogenization, etc. is accomplished, particularly at the edges of the perforations, by impact and kneading processes. Besides, as a result of that, considerably greater turbulences occur within the material which are advantageous for their processing.

In FIG. **7**, the housing is formed, in cross-section, in the shape of a body of revolution especially a sphere, whereby the rotor **2** is provided with teeth **46** which engage with corresponding annular grooves **47** on the inside surface of the housing.

The development in the form of a body of revolution has the advantage that the arched shape of the discs **5** oppose the arched inside surfaces of the housing in such a way that, as viewed in radial cross-section, essentially elliptical receiving spaces are provided for the material that is to be treated, which are indicated in the figure by dotted lines. As a result, whirling effects within the material will be achieved which bring about a particularly favorable comminuting result.

According to the embodiment of the FIG. **8** and **9**, the rotor **2** moves in a cylindrical housing **56** provided with perforations **58**, which housing is enclosed by a jacket **57**. In this way, the material is not only comminuted, but is also sifted, since the perforations **58** act in the manner of a sieve and the more finely comminuted material will reach the space **57** in the jacket between the housing **56** and the jacket **57**, from which it is removed through the outlet connection **68** extending downwards while the part of the material which has not been comminuted as thoroughly, will reach the outlet connection **62** via the lateral inside connection **61**.

I claim:

1. Apparatus for comminuting, processing and pumping materials comprising a housing having an interior defined by a surface of revolution, said housing being provided with an axial inlet at one end for material to be processed and a transverse outlet for processed material disposed medially of the housing, a rotor in said housing mounted concentrically with the axis of said surface of revolution, said rotor being provided with two semi-circular discs disposed obliquely with respect to said axis and converging inwardly towards each other in the direction of said inlet to intersect each other along a line transverse to said axis, at least one of said discs being provided with a cut-out opening which includes an area of the disc defined on one side by a medial portion of said line of intersection.

2. Apparatus defined in claim 1, wherein the outlet is disposed generally tangentially with respect to said surface of revolution.

3. Apparatus defined in claim 1, wherein the outlet is disposed generally radially with respect to the axis of said surface of revolution.

4. Apparatus defined in claim 1, wherein the surfaces of said discs facing the inlet are arcuately formed with their concavities facing the inlet.

5. Apparatus defined in claim 1, wherein said surface of revolution defining the interior of the housing is generally a frustum of a cone, the smallest radius thereof being adjacent the inlet.

6. Apparatus defined in claim 1, wherein said surface of revolution defining the interior of the housing is generally defined by a curved generatrix the concave side of which faces the interior of the housing.

7. apparatus defined in claim 6, wherein said surface of revolution is generally a frustum of an ellipse.

8. Apparatus defined in claim 6, wherein said surface of revolution is generally a frustum of a sphere.

9. Apparatus defined in claim 1, wherein both of said discs are provided with cut-out openings which include areas defined on one side by a medial portion of said line of intersection between the two discs, and the curved peripheral margins of said discs include a series of teeth which are engageable with annular grooves provided in the interior surface of the housing.

10. Apparatus defined in claim 1, wherein said rotor also includes at least two longitudinally extending radially outwardly projecting plates disposed behind said discs and engaging with the interior of the housing along no more than one-half the length thereof.

11. Apparatus defined in claim 1, wherein the peripheral margins of said plates are provided with teeth which engage with annular grooves provided in the interior surface of the housing.

12. Apparatus defined in claim 1, wherein the margins of said discs defined by said line of intersection are provided with teeth, and the interior surface of the housing surrounding the inlet is provided with annular grooves which are engaged by the teeth on the discs.

13. Apparatus defined in claim 1, wherein the rotor includes a concentric driving shaft projecting outwardly of the housing opposite to said inlet, said housing including bearing means to rotatably support the shaft, the interior surface of the housing surrounding the bearing means being generally planar and being provided with at least one annular groove, the rear margins of said rotor being provided with teeth engageable with said groove surrounding the bearing means.

14. Apparatus defined in claim 13, wherein the interior surface of the housing surrounding the inlet is generally planar and is provided with at least one annular groove, the margins of the discs defined by said line of intersection being provided with teeth engageable with said groove surrounding the inlet.

15. Apparatus defined in claim 13, wherein said surface surrounding the bearing means is also provided with transverse channels.

16. Apparatus defined in claim 14, wherein said surface surrounding the inlet is also provided with transverse channels.

17. Apparatus defined in claim 1, wherein each of said discs is provided with a cut-out opening which includes an area defined on one side by a medial portion of said line of intersection, said discs being symmetrical mirror images of each other.

18. Apparatus defined in claim 17, wherein portions of the margins of said discs are provided with teeth engageable with annular grooves provided in the interior surface of the housing.

19. Apparatus defined in claim 18, wherein said discs are also provided with an additional aperture to permit portions of incoming material to pass directly to the rear of a disc.

20. Apparatus defined in claim 1, wherein said housing is circumferentially surrounded by a jacket having an interior space therein, said housing being provided with perforations establishing communication between the interior of the housing and the interior space of the jacket.

21. Apparatus defined in claim 20, wherein said outlet of the housing is in communication only with a space exterior of the jacket, and said jacket is provided with a separate outlet means.

22. Apparatus defined in claim 21, wherein the axis of said housing extends horizontally, said perforations in the housing extend over the lower portion thereof and the separate outlet means for the jacket extends downwardly from a lower portion of the jacket.

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