Feb. 6, 1951 R. C. HOPKINS 2,540,883

VERTICAL ACID SLUDGE MILL

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Fig. 1

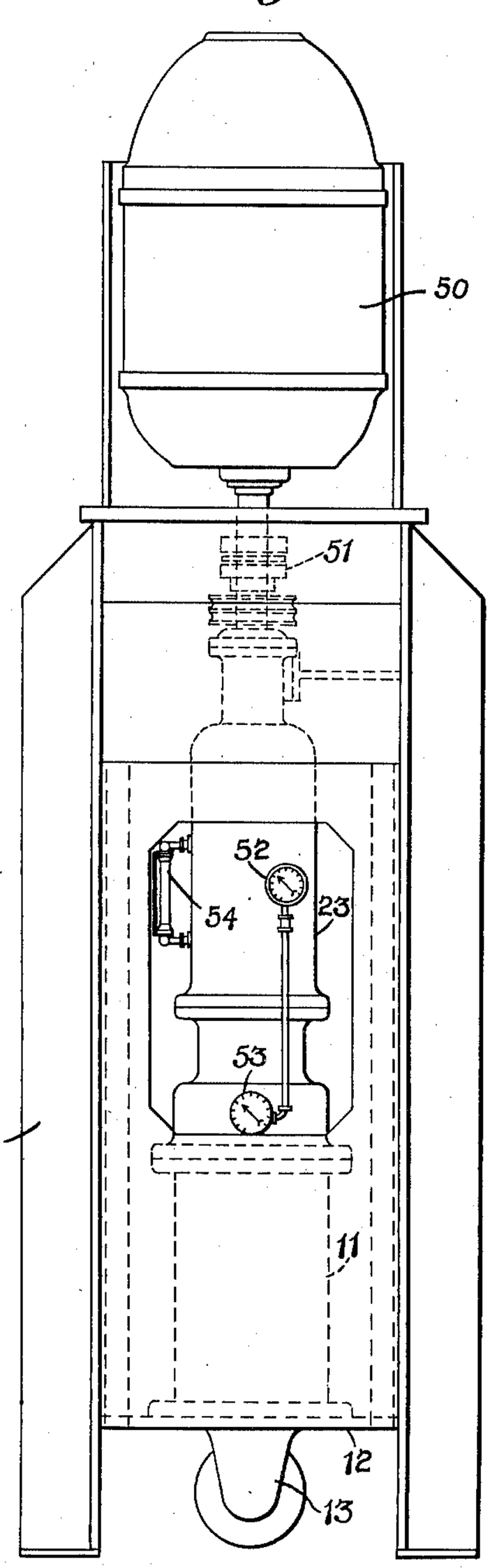


Fig. 2

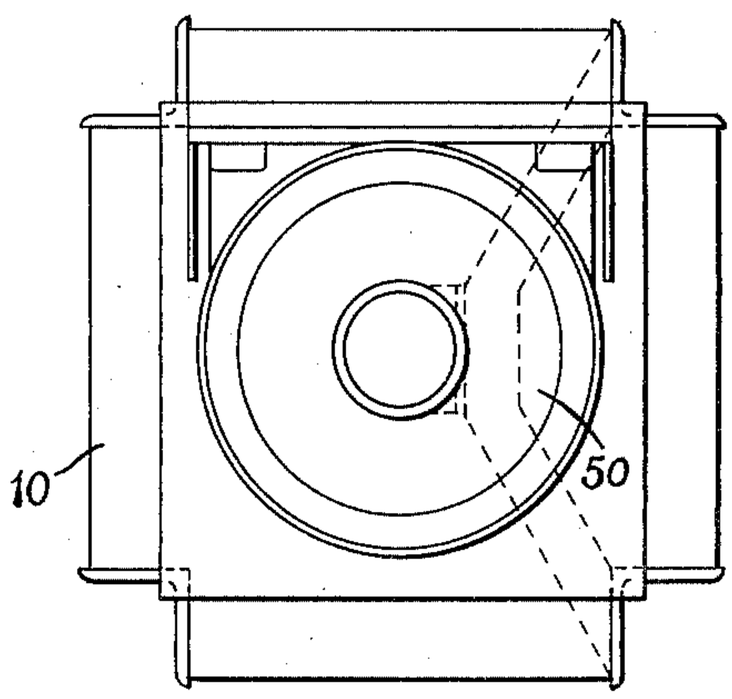
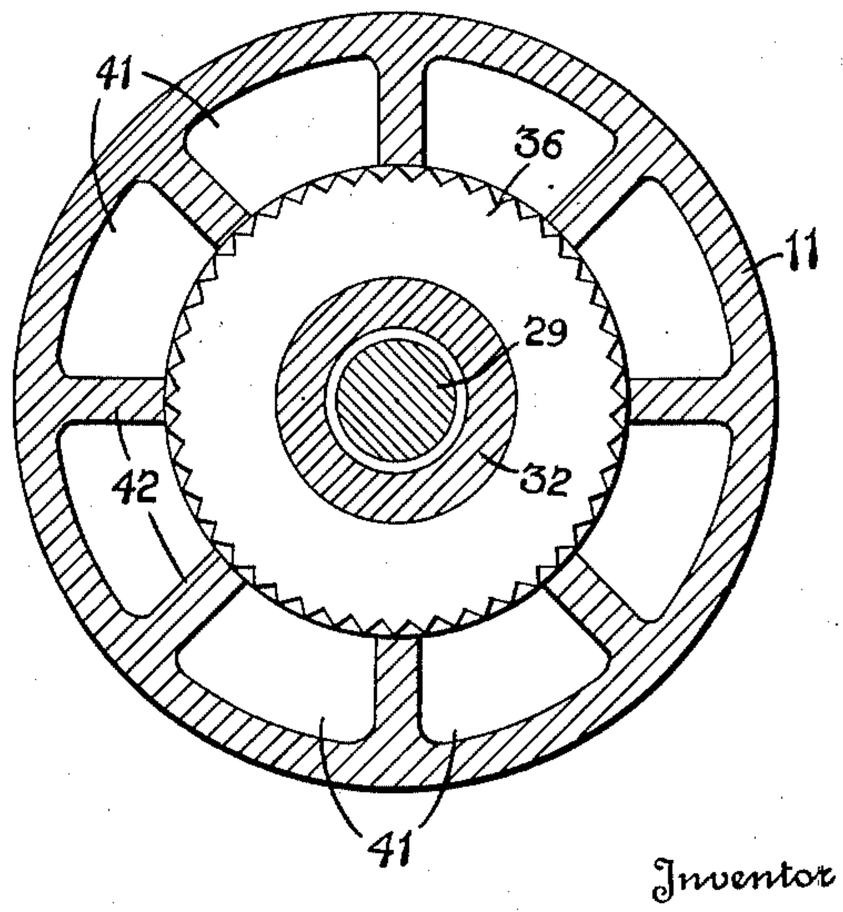


Fig. 4



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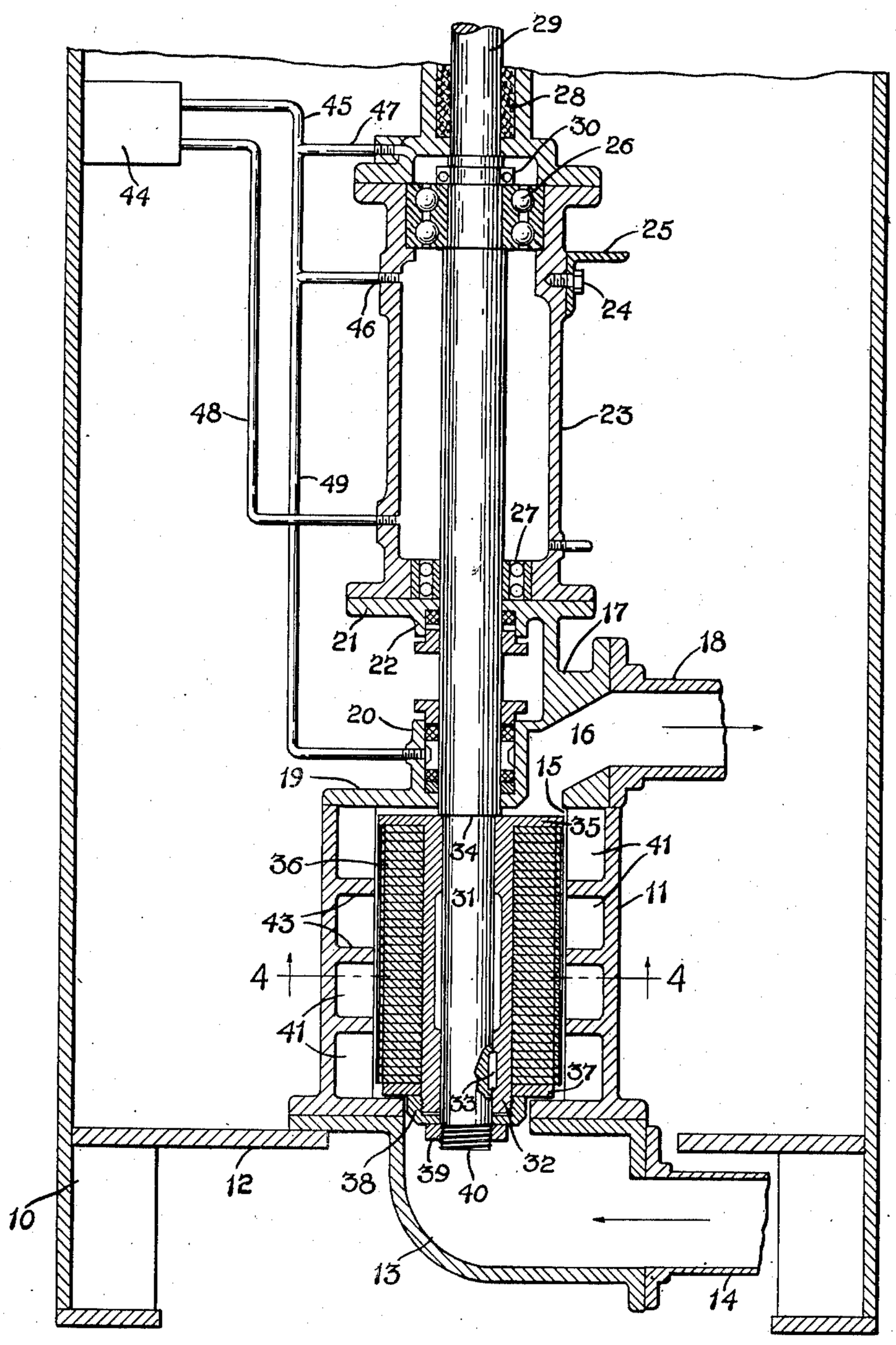

Fig. 3

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VERTICAL ACID SLUDGE MILL

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3 Claims. (Cl. 241—46)

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The invention relates to rotary mills for the processing of acid sludge, and the like, and more particularly to a vertical type of mill in which the bearings are located entirely outside of the milling chamber.

In the processing of fuels made up of acid sludge, a refinery by-product, it is found that this is not only the most corrosive substance encountered anywhere in the industry, with the exception of nitric acid pickling solution, but that it is also errosive on account of the near solids contained in the acid sludge mass.

Applicant has patented, and has in operation, a number of types of horizontal mills, but it has been found by experience that the bearings and shaft of such mills wear out from the combined action of the acid and the solids, or near solids, contained in the acidulated sludge.

The object of the present invention is to provide a mill for the processing of acid sludge, bunker C oil and similar materials, which will overcome the above mentioned difficulties and disadvantages in the use of the present types of mills.

Another object is to provide a mill of this character in which the bearings are located entirely outside of the milling chamber so as not to come into contact with the acid sludge or other material being processed in the mill.

A further object is to provide a rotary mill in which oil under pressure is circulated through the bearings.

Still another object of the invention is to provide such a mill in which oil under pressure is forced through the packing chamber surrounding the shaft at the outlet end of the mill, setting up a pressure to resist the out-flow of the acid sludge from the mill through the packing chamber.

A further object is to provide a vertical mill in which the pressure in the milling chamber is upward thereby relieving the bearings of a portion of the load.

A still further object is the provision of a mill of the type referred to in which the parts subject to vibration are low enough upon the foundation to prevent any troublesome vibrating condition.

Another object is to provide a vertical mill adapted to any kind of motor drive or vertical steam turbine drive and which may be belt driven as well as directly by the motor.

Still another object of the invention is to provide a mill of the type referred to in which all

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parts are easily accessible for inspection, adjustment or repair.

The above objects, together will others which will be apparent from the drawings and following description, or which may be later referred to, may be attained by constructing the improved vertical acid sludge mill in the manner illustrated in the accompanying drawings, in which;

Figure 1 is a side elevation of a mill embodying the invention;

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

Fig. 3 an enlarged, vertical, longitudinal, sectional view through the milling chamber and bearings; and

Fig. 4 a transverse sectional view through the milling chamber, taken as on the line 4—4, Fig. 3, and drawn on a larger scale than Fig. 3.

The mill is mounted within an upright frame, indicated generally at 10, and the vertically disposed mill housing indicated generally at 11, is shown supported upon the horizontal bottom plate 12 of the frame and having its lower end communicating centrally with the curved inlet passage 13, to which is connected an inlet pipe 14 leading from any suitable source of acid sludge, bunker C oil or other material under pressure which is to be processed in the mill.

The upper end of the mill housing 11 is provided with an eccentric discharge opening 15 communicating with the upwardly inclined outlet opening 16 formed in the casting indicated generally at 17 and communicating at its outer end with the discharge pipe 18 through which the processed material may be conveyed to any desired location.

The casting 17 includes a base portion 19 which is supported upon the upper end of the mill housing 11 and has the concentric packing box 20 formed thereon. A disc platform 21, concentric with the base 19, is formed upon the upper end of the casting 17 and has a concentric stuffing box 22 depending therefrom.

The upright cylindrical bearing chamber housing 23 is mounted upon the platform 21 and may be attached as by the screw 24 to an angular cross brace 25.

Upper and lower ball bearings indicated generally at 26 and 27 respectively are located in the upper and lower ends of the bearing chamber housing and a stuffing box 28 may be provided at the upper end of the bearing chamber housing 23 and surrounding the vertical shaft 29 which extends longitudinally through the mill.

A collar or shoulder 30 is formed or fixed upon

the shaft 29 in contact with the upper ball bearing 26 so that at least a part of the load of the shaft, and milling apparatus to be later described, is carried by this bearing.

The shaft extends downwardly through the bearing chamber and through the lower bearing 27 and the stuffing box 22 and packing box 20, and the lower portion of the shaft is preferably reduced in diameter as at 31 and extends longitudinally entirely through the mill housing 11, terminating adjacent to the inlet end thereof.

A rotary cutting unit is carried upon the reduced lower end portion of the shaft and may be in the form of a plurality of disc saws. For this purpose a hub 32 may be fixed upon the shaft as by the key 33. A shoulder 34 is formed upon the shaft, at the point where it is reduced, to engage the upper end of the hub 32, to position the same relative to the shaft and an annular flange 35 is formed upon the upper end of the hub.

A plurality of disc saws 36 is mounted upon the hub and extends from the flange 35 to a point near the lower end of the hub, at which point a ring flange 37 may be located around the hub and clamped against the adjacent end of the gang of disc saws as by a nut 38 threaded upon the lower portion of the hub thus clamping the gang of saws tightly between the flange 35 and the ring flange 37. A nut 39 may be located upon the threaded lower end portion 40 of the shaft for locking the nut 38 in adjusted position upon the hub.

A plurality of attrition chambers 41 may be formed within the housing by means of longitudinal partition walls 42 and tranverse partition walls 43 extending inward from the housing to a point closely adjacent to the peripheries of the gang of saws 36.

For the purpose of maintaining a constant circulation of lubricating oil through and around the bearings 26 and 27, means may be provided for pumping oil under pressure through the bearing chamber 23, and in the drawings this means is shown as an oil pump indicated generally at 44 having an oil pipe 45 connected thereto for pumping oil into the bearing chamber as at 46, and a branch of said pipe for pumping oil above the upper bearing 26, and a return pipe 48 for returning oil from the bearing chamber to the pump 44.

If desired, a pipe 49 may lead from the pump 44 or from a second pump, for pumping oil into the central portion of the packing chamber 20 in order to maintain a pressure therein to resist the out-flow of acid sludge around the shaft at the upper end of the mill housing and into the packing chamber.

This vertical mill is adapted to any kind of motor drive, vertical steam turbine drive or may be belt driven. For the purpose of illustration, a motor 50 is shown directly connected to the upper end of the shaft, preferably through a clutch 51. A pressure gauge 52 may be provided for the milling chamber as well as a thermometer 53, and a sight gauge 54 may be provided upon the bearing chamber to indicate the oil level therein.

From the above it will be evident that the upper ball bearing 26 carries at least a part of the weight of the shaft and the saw assembly, and part of the weight thereof will be supported by the upward pressure of the material being milled which enters the mill at the lower end and discharges from the upper end thereof. Also the upward flow of the material being processed through the sectional attrition chambers is good practice in any reduction machine.

It will also be obvious that there is no contact of the material being processed with the bearings and this is especially important where acidulated substances are being processed and in the preparation of foods.

It will further be seen that the circulation of lubricant in the bearing chamber has a tendency to keep the lubricant in a state of uniform mixture as well as to hold it at a minimum temperature, the running shaft and bearings tending to warm up the lubricant while the circulating pump and the volume of oil act as a temperature adjustment.

I claim:

1. Apparatus of the character described comprising a support, vertically spaced ball bearings carried by the support, a bearing chamber enclosing the bearings and means for circulating lubricant under pressure through the bearing chamber, a cantilever rotatable, vertical shaft having its upper end portion journalled in said bearings, the free end of the shaft extending downwardly beyond the bearing, rotor mounted upon the free end of the shaft, a housing enclosing the rotor, a packing box surrounding the shaft at the upper end of the housing, means for admitting oil under pressure to the packing box and means for passing liquid upward through the housing thereby supporting a portion of the load of the shaft and rotor.

2. A rotary mill including a vertical, cylindrical mill housing having a central inlet at its lower end and an eccentric outlet at its upper end, a vertical shaft located through the upper end of the housing and terminating at its lower end within said inlet, a cylindrical gang of disc saws mounted upon the shaft within the mill housing, a packing box surrounding the shaft at the upper end of the housing, a platform surrounding the shaft at a point spaced above said packing box, means upon the top of the housing supporting the platform in spaced relation above said packing box, an upright cylindrical bearing chamber mounted upon said platform and surrounding the shaft, spaced ball bearings in opposite ends of the bearing chamber, the shaft being journalled in said ball bearings, a stuffing box at each end of the bearing chamber and means for maintaining the bearing chamber filled with oil under pressure.

3. A rotary mill including a vertical, cylindrical mill housing having a central inlet at its lower end and an eccentric outlet at its upper end, a vertical shaft located through the upper end of the housing and terminating at its lower end within said inlet, a cylindrical gang of disc saws mounted upon the shaft within the mill housing, a packing box surrounding the shaft at the upper end of the housing, a platform surrounding the shaft at a point spaced above said packing box, means upon the top of the housing supporting the platform in spaced relation above said packing box, an upright cylindrical bearing chamber mounted upon said platform and surrounding the shaft, spaced ball bearings in opposite ends of the bearing chamber, the shaft being journalled in said ball bearings, a stuffing box at each end of the bearing chamber and means for maintaining the bearing chamber filled with oil under

pressure, and means for admitting oil under pressure to the packing box.

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