Nov. 11, 1947. R. C. HOPKINS 2,430,768

COLLOIDAL AND HOMOGENIZING MILLS WITH TOOTHED STATOR AND ROTOR

Filed Oct. 7, 1944 2 Sheets-Sheet 1

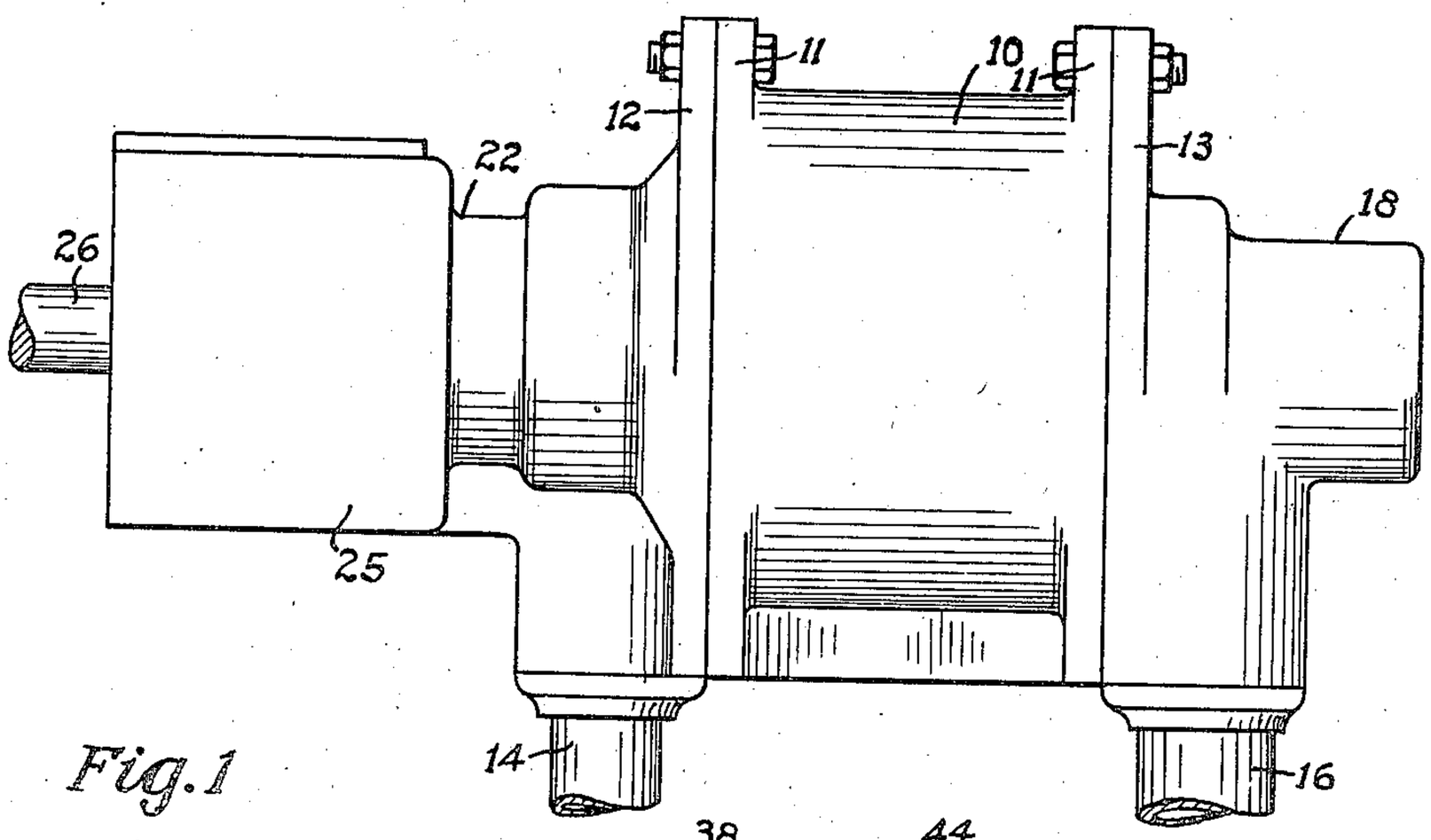

Fig. 1

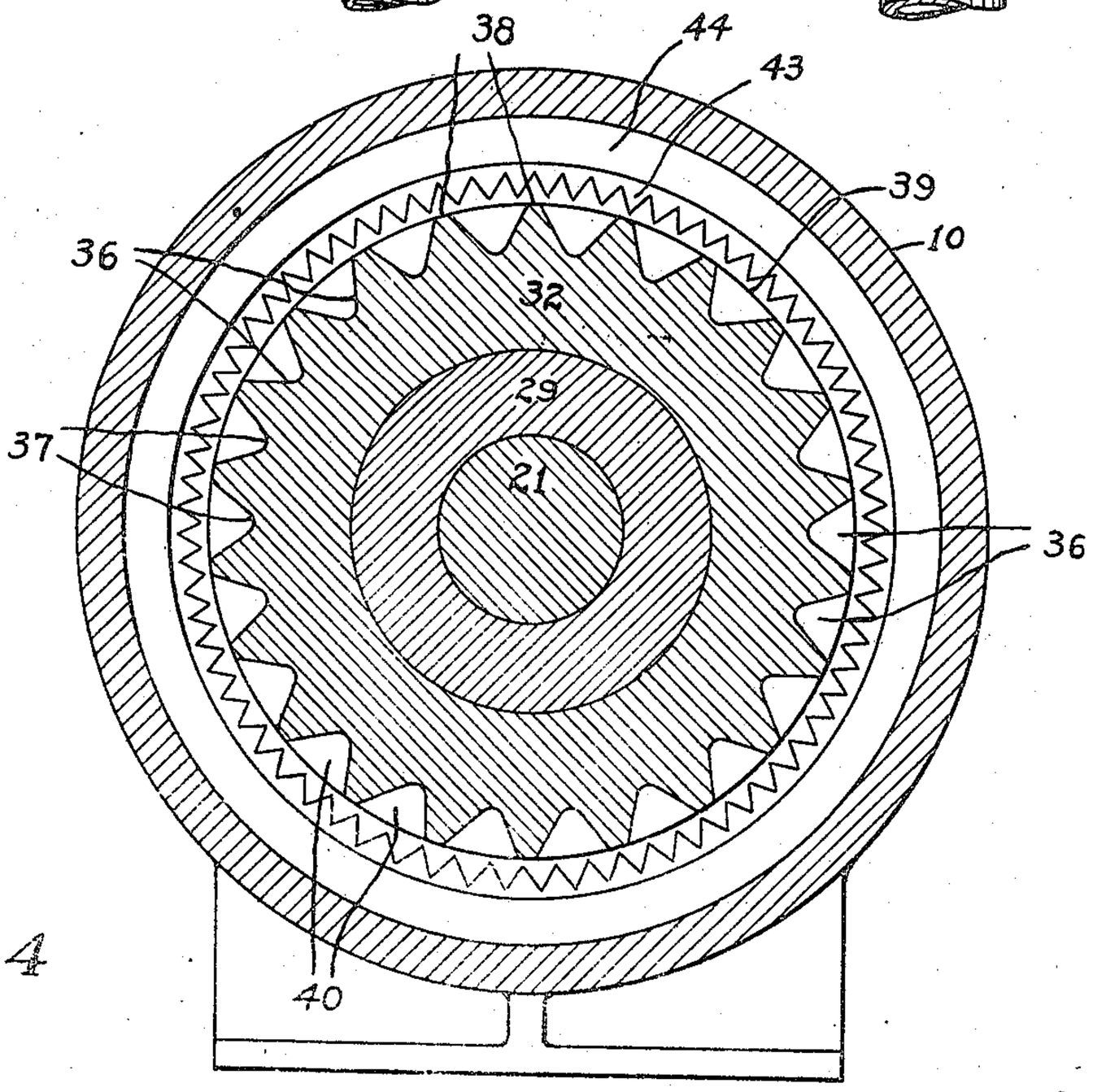

Fig. 4

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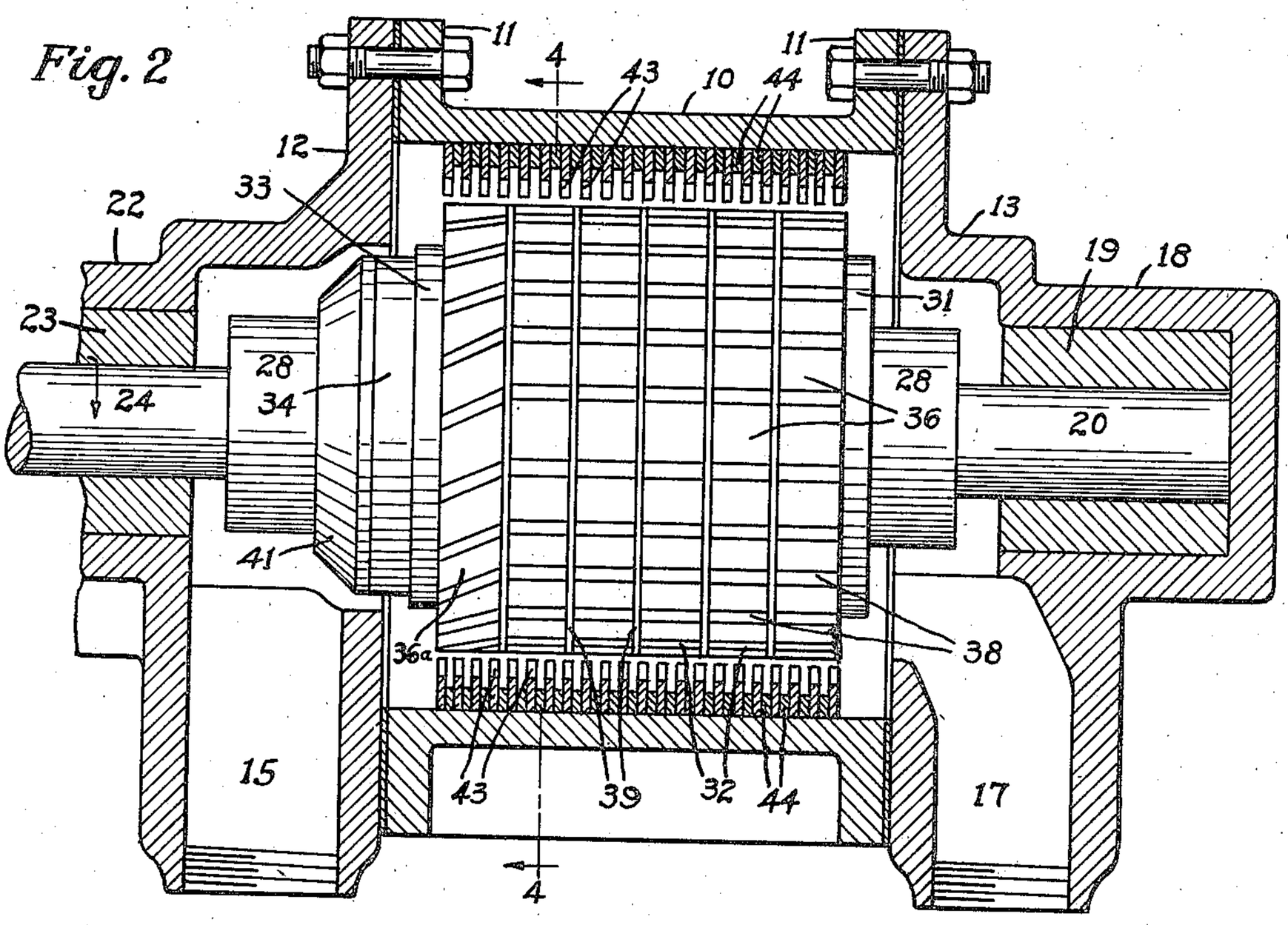
Fig. 2



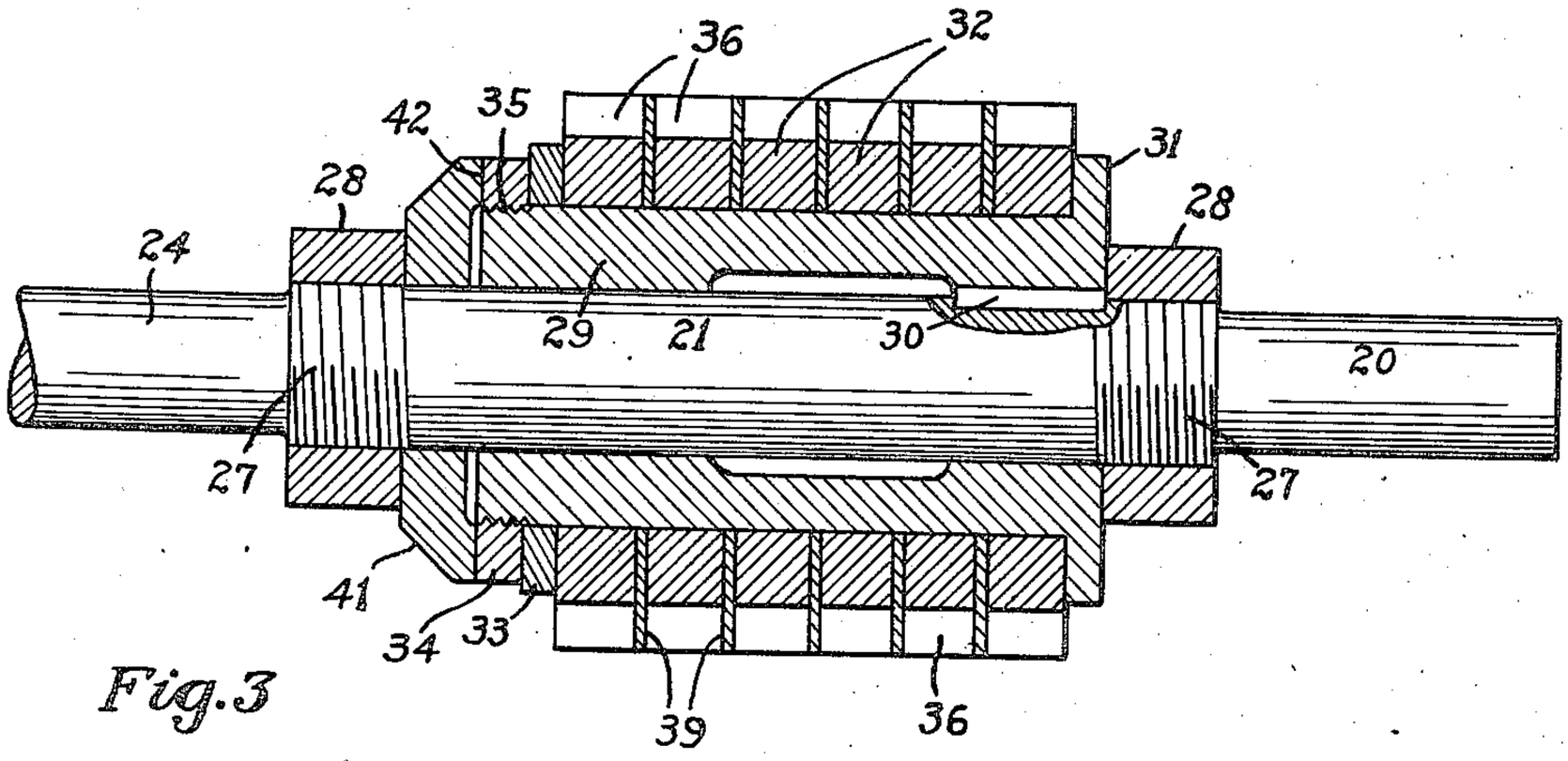


Fig. 3

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COLLOIDAL AND HOMOGENIZING MILL WITH TOOTHED STATOR AND ROTOR

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Application October 7, 1944, Serial No. 557,665

9 Claims. (Cl. 241—160)

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The invention relates to rotary fills for pulverizing, breaking up, mixing, screening, emulsifying and homogenizing the heavy particles of oil or other material, vegetable or animal matter in fluid or semi-fluid state.

It is an object of the present invention to provide a colloidal and homogenizing mill which is constructed and operated on an entirely new principle which is radically different from the construction and operation of mills for this purpose now in use.

A further object of the invention is to provide a mill in which the cutting or milling teeth are stationary and a plurality of rotating mixing and milling chambers are provided, through which the oil or other material to be milled is successively passed.

A still further object is the provision of a mill of the character referred to in which a plurality of stationary saw teeth are mounted around the interior of the mill housing and a plurality of rotating mixing and milling chambers are rotatably mounted within the housing, the material to be milled being passed through said rotating chambers and continuously thrown by centrifugal force against said stationary teeth.

Another object of the invention is to provide a mill comprising a housing having a gang of stationary saw teeth around its interior and a plurality of rotating star wheels of substantial thickness, separated by thin discs of a diameter equal to the overall diameter of the star wheels, thus forming a plurality of rotating mixing and milling chambers around the star wheels and between the separating discs.

Still another object is to provide a mill of this character in which the teeth upon the first star wheel, at the inlet end of the mill, are angularly or spirally arranged so as to set up an effect like a screw propeller, producing a pumping action and overcoming any obstruction to the flow of material pumped through the mill.

A further object is to provide a mill of the character referred to in which the fluid or semi-fluid material is admitted at one end of the rotor, passes successively over the separating discs and through the rotating mixing and milling chambers and is finally discharged at the opposite end of the rotor.

A still further object of the invention is to provide such a mill in which the star wheels and separating discs are assembled upon a mandrel in any combination of two or more star wheels to produce more or less intensive milling and greater or less volume capacity as conditions may require.

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Another object is the provision of a mill of this character in which the particular shape of the rotary mixing and milling chambers sets up a rolling or spinning motion of the material around the inside of the stationary teeth.

Still another object is to provide a mill in which the stationary toothed members are spaced apart a distance approximately equal to the thickness of the toothed members.

It is another object of the invention to produce a mill of this type in which there is a certain pressure effect against the stationary teeth due to the angular shape of the chambers in the rotor and the path of rotation.

Still another object is to provide a construction of mill in which any tendency to clog the rotating chambers is overcome by the flow from one chamber to another over the separating discs, and also by the turbulence set up in each chamber and more particularly due to the washing effect as the material flows over the separating disc into the next chamber.

A further object is the provision of such a mill which may be operated as efficiently in either direction without any change in the inlet or outlet.

A still further object is the provision of a rotary mill in which the inflow of material at the inlet end of the mill has a certain thrust effect which tends to lighten the load on the end thrust bearing.

Another object is to provide a mill in which all of the energy is used up in the milling operation, the transformation of power into heat being an advantage in the case of oil or sludge reduction, the only heat loss being by radiation from the mill housing and accessory parts.

The above objects, together with 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 colloidal and homogenizing mill in the manner illustrated in the accompanying drawings, in which

Figure 1 is a side elevation of the improved mill,

Fig. 2 a longitudinal sectional view through the mill on a slightly larger scale,

Fig. 3 a longitudinal sectional view through the rotor, and,

Fig. 4 a transverse sectional view through the mill, taken as on the line 4—4, Fig. 2.

The mill includes a housing 10, preferably of cylindric form and located in horizontal position,

flanges 11 being formed at opposite ends of the housing for connection of the heads 12 and 13 at the inlet and discharge ends respectively of the mill.

An inlet pipe 14, leading from a pump or other source of fluid or semi-fluid under pressure, communicates with the interior of the housing through the inlet passage 15, in the head 12, and a discharge or outlet pipe 16 communicates with the other end of the housing through the outlet passage 17 in the head 13.

The head 13 has a bearing housing 18 formed thereon and provided with a closed end, any usual and well known form of bearing, as indicated at 19, being located within said bearing housing to receive the journal end 20 of the rotor shaft 21 which is longitudinally, axially disposed through the mill.

A bearing housing 22 is formed upon the head 12 and houses a bearing 23 through which the journal portion 24 of the rotor shaft is located. An extension 25 may be formed beyond the bearing 23 to house a stuffing box or the like, and the journal portion 24 of the shaft is extended therethrough as at 26 and may be operatively connected to a motor or other driving means.

The shaft 21 is provided with screw threaded portions 27 adjacent to each journal end thereof, to receive nuts 28 for mounting the tubular mandrel 29 upon the shaft. The mandrel may be held against rotation relative to the shaft by any suitable means, such as the key 30.

An annular flange 31 is formed upon one end of the mandrel, and a plurality of star wheels 32 is mounted upon the mandrel, butting against said flange at one end and clamped tightly between the flange and the mandrel plate or ring 33 by means of the mandrel nut 34 mounted upon the screw threaded portion 35 at the opposite end of the mandrel.

These star wheels are of substantial thickness as shown in Figs. 2 and 3, and are provided around their peripheries with the substantially V-shape notches 36, each notch being preferably rounded at its apex, as indicated at 37, in order to increase the tendency to produce a rolling or spinning motion of the material as will be later pointed out. The notches 36 may be so spaced as to form narrow, flat surfaces 38 therebetween around the periphery of the star wheel.

Relatively thin separating discs or plates 39 are located upon the mandrel between the star wheels 32, slightly separating the star wheels from each other and forming baffles therebetween, as the separating discs are of a diameter equal to the overall diameter of the star wheels, thus producing a plurality of mixing and milling chambers 40 around the periphery of each star wheel.

In order to regulate the intensity of milling the number of star wheels assembled upon the mandrel may be increased or decreased to suit conditions and requirements. For this purpose the width of the mandrel plate or ring 33 may be varied depending upon the number of star wheels assembled upon the mandrel.

A lock plate or ring 41 may be interposed between one end of the mandrel and the adjacent nut 28, and may be, as shown in Figs. 2 and 3, located between the mandrel nut 34 and the adjacent shaft nut 28, the lock plate or ring being provided with the annular lip 42 contacting the mandrel nut.

With this construction, when the star wheels and separating discs are assembled upon the mandrel in the manner above described and the mandrel nut is tightened against the mandrel plate or ring and the shaft nuts 28 are tightened against the mandrel and lock plate, the entire rotor assembly is rigidly mounted as a unit upon the shaft 21.

As shown in Fig. 2, the notches in the first star wheel may be angularly or spirally located as indicated at 36*a*, so as to set up an effect like a screw propeller and produce a pumping action which will at least overcome any obstruction on resistance to flow of material pumped through the mill.

Where this angular or spiral star wheel is used the rotor must be rotated in the direction of the arrow shown in Fig. 2. Otherwise the rotor may be rotated in either direction and will operate as efficiently and successfully if rotated in one direction as in the other, and without any change of the inlet or outlet.

A gang of internally toothed, saw rings 43 is fixed upon the interior of the housing and spaced by thin annular separator plates 44, the saws and separator plates being of substantially equal thickness and of approximately the same thickness as the separator discs 39 which separate the relatively thick star wheels.

These stationary, internal saws extend the entire length of the rotor, the teeth thereof being in close proximity to, but not in contact with the peripheries of the star wheels, so that the material passing through the chambers of the star wheels will be repeatedly brought into contact with the saw teeth by centrifugal action and thoroughly milled and mixed thereby.

In the operation of the mill, oil or other liquid or semi-liquid material, under pressure, is admitted to the interior of the housing through the inlet passage 15, and passes successively through the V-shape chambers of the star wheels and over the separator discs from the inlet end toward the outlet end of the mill.

The rotating star wheels cause a spinning motion of the material within each of the chambers 40 and the heavier particles of the material are forced against the stationary saw teeth in the housing by centrifugal force, and as this action is repeated as the material successively passes through the chambers of each star wheel a thorough milling, emulsifying and homogenizing of the material is produced.

As the material passes out of the mixing chambers of each star wheel it must pass over the separator discs with enough velocity to wash any material out of the stationary saws, thus preventing any clogging thereof. Furthermore the turbulence set up in each of the mixing chambers will reduce any tendency toward clogging of the saw teeth.

It will be obvious that there will be a dissolving action of the heavy particles of oil or other material due to the generation of heat resulting from the milling and cutting up of heavier particles in the material, thus the transformation of power into heat is a distinct advantage in the case of oil and sludge reduction, and substantially all of the energy is used up in the milling operation.

I claim:

1. A rotary colloidal and homogenizing mill including a housing, a plurality of stationary saws fixed within the interior of the housing and having relatively small saw teeth thereon, a rotor within the housing, a plurality of star wheels upon the rotor having relatively large notches in their peripheries in close proximity to the teeth

of the stationary saws, separator discs between the star wheels extending to the peripheries thereof and forming with said notches a plurality of mixing and milling chambers around the periphery of each star wheel, and means for passing liquid or semiliquid material through the housing and successively through said chambers.

2. A rotary colloidal and homogenizing mill including a housing and having relatively small saw teeth thereon, a plurality of stationary saws fixed within the interior of the housing, a rotor within the housing, a plurality of star wheels upon the rotor having their peripheries in close proximity to the teeth of the stationary saws, each star wheel having a plurality of relatively large substantially V-shape notches around its periphery, separator discs between the star wheels extending to the peripheries thereof and forming with said notches a plurality of V-shaped mixing and milling chambers around the periphery of each star wheel, and means for passing liquid or semi-liquid material through the housing and successively through said chambers.

3. A rotary colloidal and homogenizing mill including a housing, a plurality of stationary saws fixed within the interior of the housing and having relatively small saw teeth thereon, a rotor within the housing, a plurality of star wheels upon the rotor having their peripheries in close proximity to the teeth of the stationary saws, each star wheel having a plurality of relatively large substantially V-shape notches around its periphery, separator discs between the star wheels extending to the peripheries thereof and forming with said notches a plurality of V-shaped mixing and milling chambers around the periphery of each star wheel, and means for passing liquid or semi-liquid material through the housing and successively through said chambers, the notches in the star wheel at the inlet end of the mill being spirally disposed.

4. A rotary colloidal and homogenizing mill including a housing, a plurality of stationary saws fixed within the interior of the housing and having relatively small saw teeth thereon, a rotor within the housing, a plurality of star wheels upon the rotor having relatively large notches in their peripheries in close proximity to the teeth of the stationary saws, separator discs between the star wheels extending to the peripheries thereof and forming with said notches a plurality of mixing and milling chambers around the periphery of each star wheel, and means for passing liquid or semi-liquid material through the housing and successively through said chambers, the star wheels being relatively thick and the separator discs being relatively thin, whereby said mixing and milling chambers cover substantially the entire peripheral area of the rotor.

5. A rotary colloidal and homogenizing mill including a housing, a plurality of stationary saws fixed within the interior of the housing and having relatively small saw teeth thereon, separators between said saws of substantially the same thickness as the saws, a rotor within the housing, a plurality of star wheels upon the rotor having relatively large notches in their peripheries in close proximity to the teeth of the stationary saws, separator discs between the star wheels extending to the peripheries thereof and forming with said notches a plurality of mixing and milling chambers around the periphery of each star wheel, and means for passing liquid or semi-liquid material through the housing and successively through said chambers.

6. A rotary colloidal and homogenizing mill including a housing, a plurality of stationary saws fixed within the interior of the housing and having relatively small saw teeth thereon, separators between said saws of substantially the same thickness as the saws, a rotor within the housing, a plurality of star wheels upon the rotor having relatively large notches in their peripheries in close proximity to the teeth of the stationary saws, separator discs between the star wheels extending to the peripheries thereof and forming with said notches a plurality of mixing and milling chambers around the periphery of each star wheel, and means for passing liquid or semiliquid material through the housing and successively through said chambers, the star wheels being relatively thick and the separator discs being relatively thin, whereby said mixing and milling chambers cover substantially the entire peripheral area of the rotor.

7. A rotary colloidal and homogenizing mill including a housing, a plurality of stationary saws fixed within the interior of the housing and having relatively small saw teeth thereon, a rotor within the housing, a plurality of star wheels upon the rotor having relatively large notches in their peripheries in close proximity to the teeth of the stationary saws, each star wheel having a plurality of relatively large substantially V-shape notches around its periphery, separator discs between the star wheels of a diameter equal to the overall diameter of the star wheels and forming with said notches a plurality of V-shape mixing and milling chambers around the periphery of each star wheel, and means for passing liquid or semi-liquid material through the housing and successively through said chambers.

8. A rotary colloidal and homogenizing mill including a housing, a plurality of stationary saws fixed within the interior of the housing and having relatively small saw teeth thereon, a rotor within the housing, a plurality of star wheels upon the rotor having their peripheries in close proximity to the stationary saws, each star wheel having a plurality of relatively large substantially V-shape notches around its periphery, separator discs between the star wheels extending to the peripheries thereof and forming with said notches a plurality of V-shape mixing and milling chambers around the periphery of each star wheel, and means for passing liquid or semiliquid material through the housing and successively through said chambers, said notches being so shaped as to produce a spinning motion of the material within said chambers.

9. A rotary colloidal and homogenizing mill including a housing, a plurality of stationary saws fixed within the interior of the housing and having relatively small saw teeth thereon, a rotating shaft within the housing, a mandrel fixed upon the shaft, a plurality of relatively thick star wheels detachably mounted upon the mandrel and having relatively V-shape notches in their peripheries in close proximity to the stationary saws, relatively thin separator discs of a diameter equal to the overall diameter of the star wheels located on the mandrel between the star wheels and forming with said V-shape notches a plurality of substantially V-shape mixing and milling chambers around the peripheries of the star wheels, a flange upon one end of the mandrel contacting one endmost star wheel, a mandrel plate detachably mounted upon the mandrel and contacting the other endmost

star wheel, a nut upon the mandrel contacting the mandrel plate for clamping the star wheels and separator discs between the flange and mandrel plate, and means for passing liquid or semi-liquid material through the housing and successively through said chambers.

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Certificate of Correction

Patent No. 2,430,768. November 11, 1947.

ROBERT C. HOPKINS

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Column 5, lines 10 and 11, claim 2, strike out the comma and words ", a plurality of stationary saws fixed within the interior of the housing" and insert the same in line 9, same claim, after "housing"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 24th day of August, A. D. 1948.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.