Oct. 4, 1949. J. M. BOYLE 2,483,453

MIXER AND GRINDER

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Fig. 1.

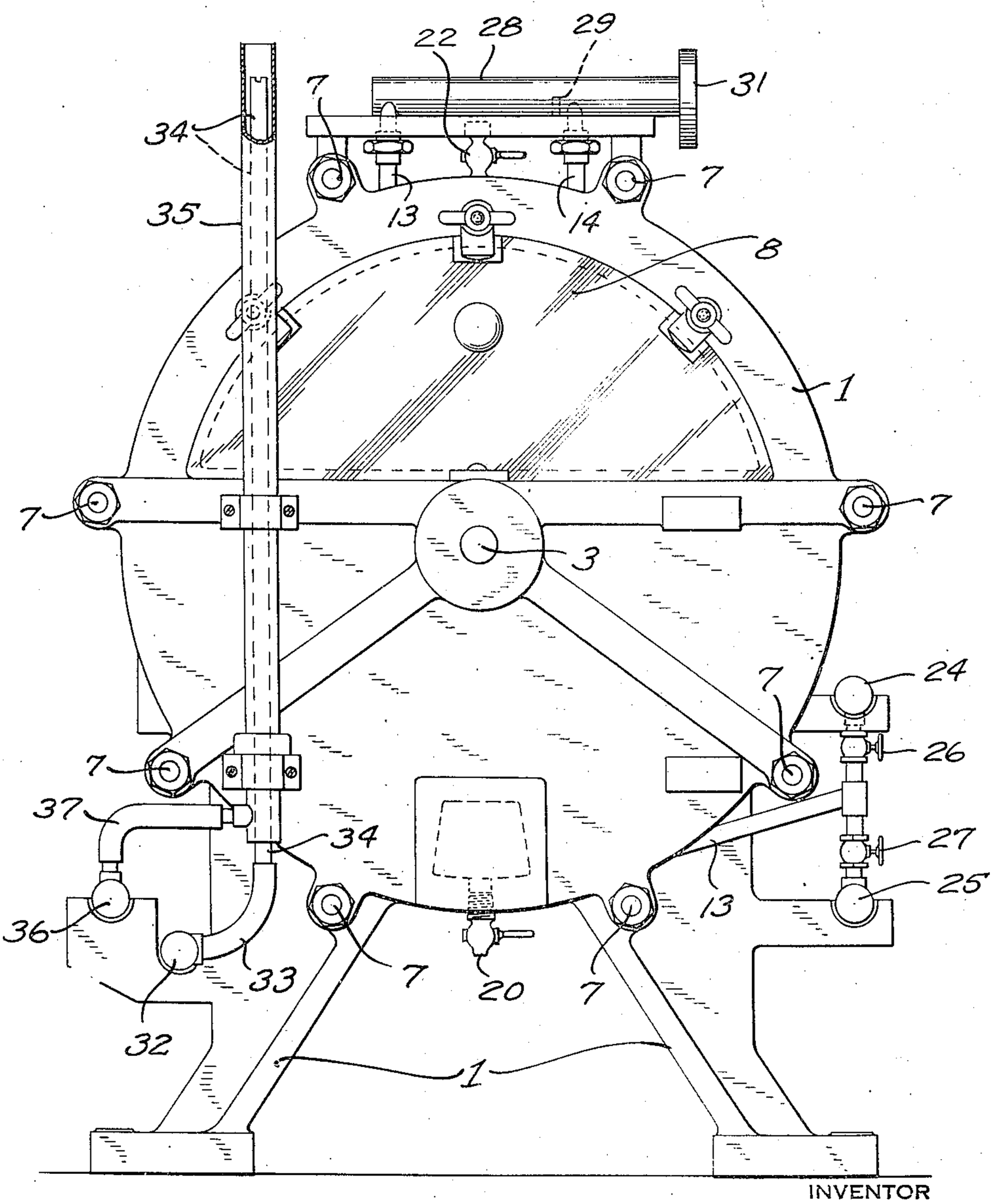

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Fig. 2.

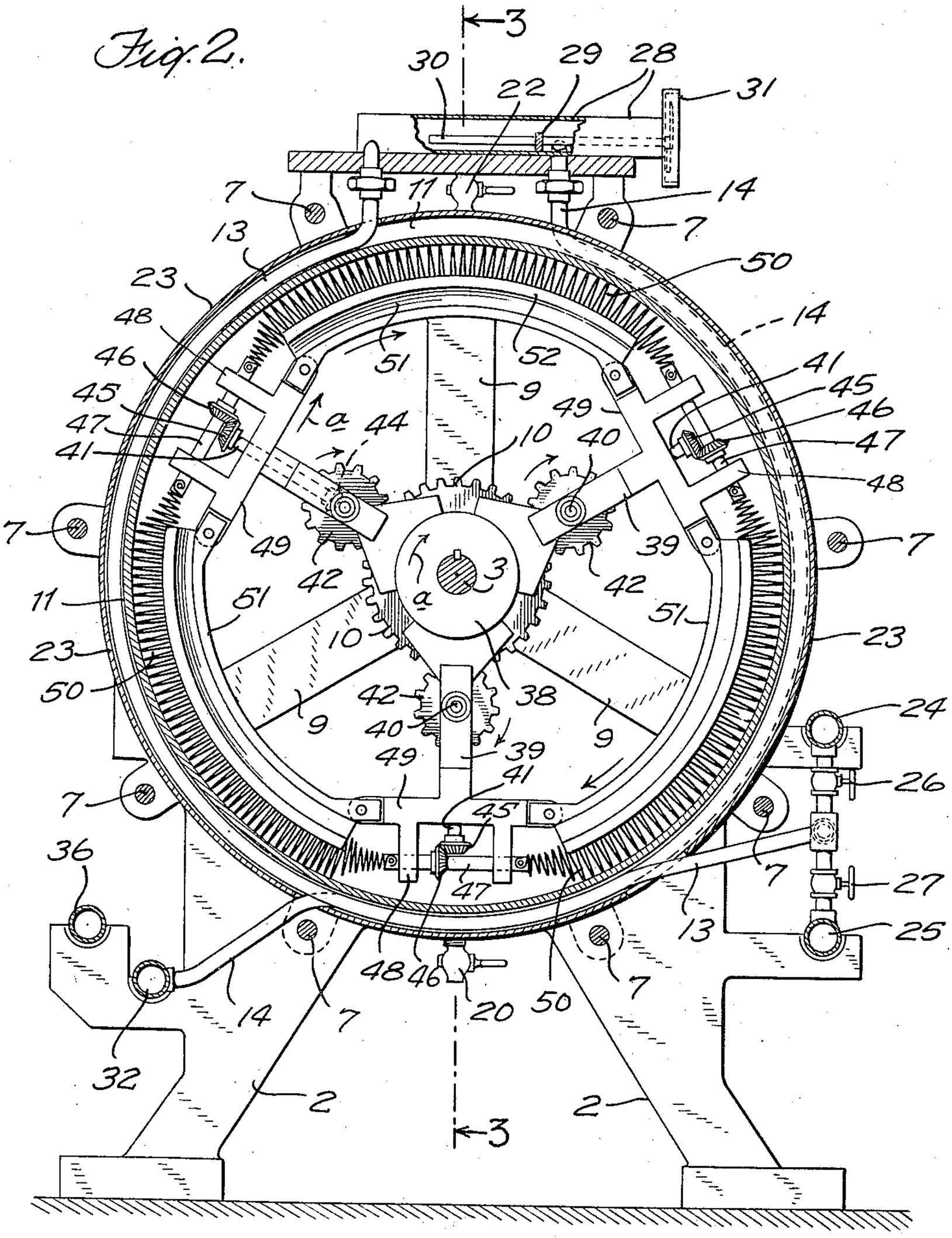

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Fig. 3.

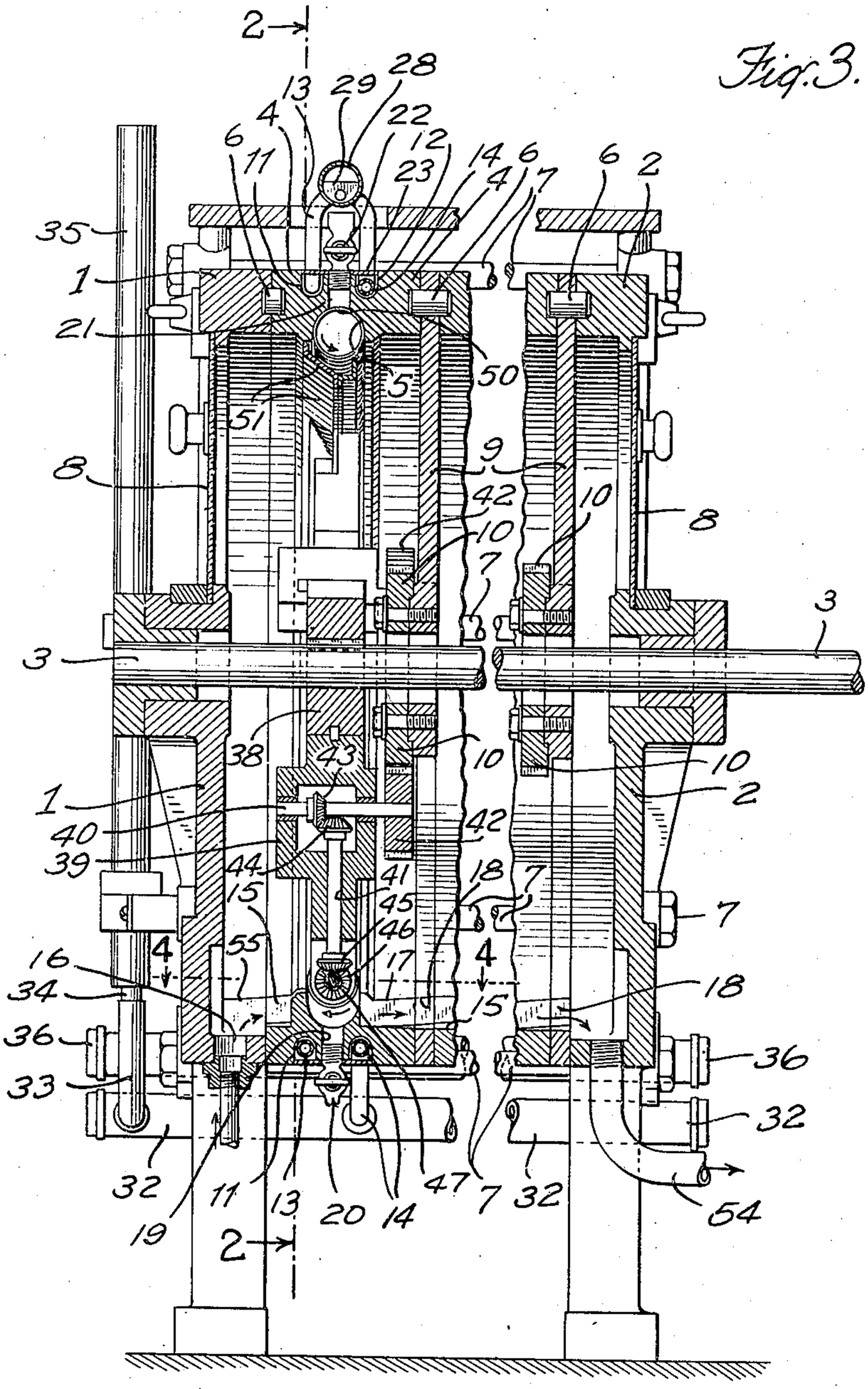

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Fig. 4.

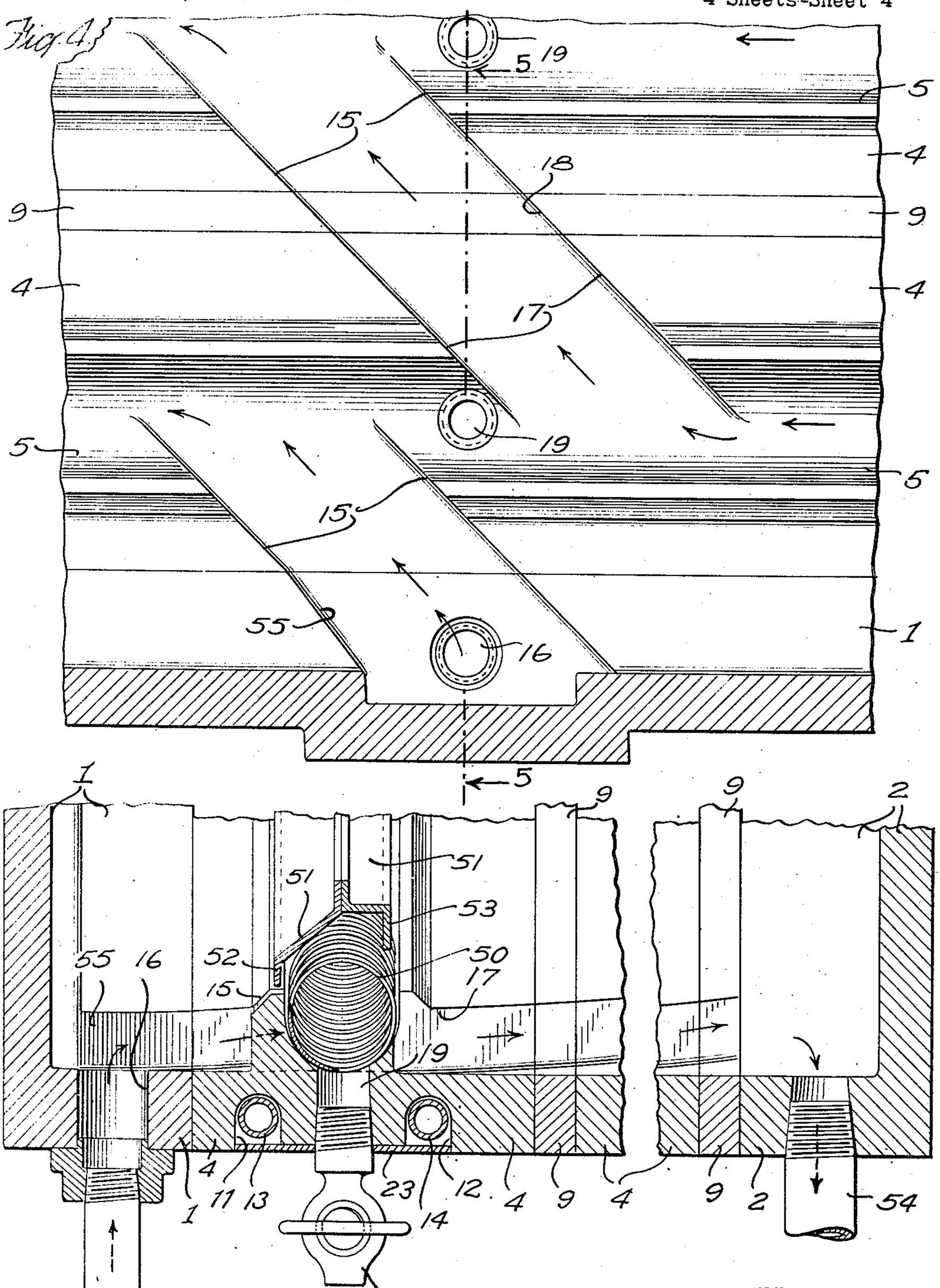

Fig. 5.

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MIXER AND GRINDER

James M. Boyle, New York, N. Y.

Application February 6, 1947, Serial No. 726,875

4 Claims. (Cl. 259—6)

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The present invention relates to an improvement in mixing and grinding machines.

Known types of apparatus for mixing and grinding reveal various defects or inadequacies which in some measure tend to limit their usefulness. In certain wet grinding and mixing operations, for example, continuous throughput has advantages over batch treatment. Known apparatus for this purpose is unduly cumbersome, occupies more space than it should, and lacks flexibility or range in the time or degree of treatment available and in respect to the variety of materials treatable in a given installation.

An object of the present invention has been to provide apparatus for wet grinding and mixing which will have a large throughput capacity in relation to its size and cost and which can be supplied in cooperating units or sections to produce any desired extent or time of treatment. Other advantages and beneficial results in operation of such apparatus will in part be apparent and in part more particularly pointed out in the appended specification and drawings, wherein—

Fig. 1 is an end elevation;

Fig. 2, a transverse vertical section on the line 2—2 of Fig. 3;

Fig. 3, a longitudinal vertical section on the line 3—3 of Fig. 2;

Fig. 4, a fragmentary view on enlarged scale in longitudinal horizontal section on the line 4—4 of Fig. 3; and

Fig. 5, a fragmentary view on enlarged scale in longitudinal vertical section on the line 5—5 of Fig. 4.

Apparatus for treating, as in mixing, dispersing, and/or grinding materials in wet condition according to the present invention comprises in general a set of end pieces, one or more work assemblies or units mounted between said end pieces, means for actuating moving portions of said assemblies, means for feeding in the wet material to be mixed, dispersed and/or ground, and means for withdrawing or discharging the treated material; and may advantageously include devices for controlling temperature of the material in process of treatment, supplemental means for feeding in controlled quantities of substances, as flavoring or coloring matter, for example, and means for taking out samples of the material under treatment without interrupting the treating operation.

As seen more clearly in Fig. 3, an inlet end piece 1 and an outlet end piece 2 are provided with bearings for a main shaft 3 which may be driven by any suitable means. One or more work

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units may be removably and replaceably assembled between said end pieces. One form of such a unit, as shown in Fig. 3, embodies a rotatable assembly and a fixed member comprising a housing or wall, as a ring 4 adapted to provide a material treating or work chamber in the form of a groove 5 having an annular opening and shown as approximately semi-circular in cross-sectional contour, and adapted to receive and cooperate with portions of said rotatable assembly. Sets of dowel pins 6 are arranged with end portions extending into correspondingly shaped opposed recesses located 120° apart in face portions of said end pieces 1 and 2, and of said housings or rings 4. Said end pieces and one or more of said rings 4 and associated parts are held together by tie rods 7. Windows 8 of glass or other suitable transparent material are removably mounted in said end pieces 1 and 2.

Between each two adjacent rings 4, in case two or more work units are combined in a single machine, and between a ring 4 and the outlet end piece 2, a frame 9 of spider form provides support for a fixed gear 10. Said frame 9 is held in assembled position by said pins 6 which extend through holes therein and have their ends projecting into the 120° angularly spaced recesses in face portions of rings 4 previously mentioned.

Each ring 4 is provided with external grooves 11 and 12, or with other suitable conformation, arranged and adapted to receive temperature control fluid conducting pipes, as 13 and 14, respectively.

As shown more clearly in Figs. 4 and 5, the fluid material to be treated is fed through a port 16 initially into a slot 55 formed in a bottom portion of the peripheral flange or inlet end piece 1. An inlet passageway or slot 15 extends diagonally from said slot 55 into work chamber or groove 5 through a portion of the wall of ring 4 at one side of said groove 5. Ring 4 also has a material discharging outlet passageway, as a slot 17, extending diagonally outward from work groove 5 through a portion of the wall at the opposite side thereof and which, when the parts are operatively assembled, registers with a connecting passageway, as a slot 18, in the spider frame 9. Where the machine includes another work unit assembled next in series with the first, and with said interposed frame 9, said connecting slot 18 registers with an inlet slot 15 of ring 4 of said unit following next in the series. Otherwise, fluid material passing through said slot 18 discharges therefrom toward a material discharge port 54. A sampling or drain port 19

opening into work chamber or groove 5 between the adjacent inner ends of the inlet slot 15 and the outlet slot 17 is controlled by a petcock 20. A supplemental material inlet port 21 opening into said work groove 5 through an upper portion of the ring 4 is controlled by a petcock 22. A cover strip 23 encircles mid-peripheral portions of ring 4 in position to close the temperature controlling fluid pipe receiving grooves 11 and 12.

As seen in Figs. 1, 2 and 3, one embodiment of temperature control apparatus whereby heat may conveniently be added to or taken from material in process of treatment in work chamber or groove 5 includes a hot fluid, as water or steam, supply pipe 24 and a cold liquid supply pipe 25, both connected to pipe 13 which lies in groove 11, Fig. 2. Valves 26 and 27 control the amounts of hot and cold fluids, respectively, thus supplied to said pipe 13. The upper end of pipe 13 opens into a chamber 28 at the inlet side of a dam 29 which extends transversely across the interior of said chamber 28 dividing it into an inlet portion and an outlet portion communicating therewith above said dam 29. A thermometer is arranged with its heat sensitive portion 30 exposed in the inlet portion of chamber 28 at a level below the top edge of dam 29 and with its indicating portion, as 31, conveniently visible.

The upper end of pipe 14 opens into said outlet portion of chamber 28. The lower end of said pipe 14 leads into a manifold 32 which in turn is connected by a pipe 33 to the lower end of a vertically adjustable riser tube 34, Fig. 1, the overflow end of which is at a higher level than the upper edge of dam 29. Said riser tube 34 is vertically adjustable in a standpipe 35 which drains into a waste pipe 36 through a connecting pipe 37. It will be understood that the above described circulatory system for temperature controlling fluid, or any suitable modification thereof, may be employed to effect temperature control of any desired number of work units combined in a single machine, either to maintain uniform temperature or to provide different temperature conditions for different units in the group.

As shown in Figs. 2 and 3, the moving portions of each of said work units include a hub 38 secured on main drive shaft 3. Said hub 38 carries equi-spaced brackets or arms each of which has a bifurcated portion 39 which provides bearings for a cross shaft 40, Figure 3, and a radially extending shaft 41. Cross shaft 40 carries at one end a pinion 42 which meshes with and is actuated by said fixed gear 10. Said cross shaft 40 also carries a bevel gear 43 which meshes with and drives a bevel gear 44 secured at the inner end of radial shaft 41. Another bevel gear 45 secured at the outer end of said radial shaft 41, Fig. 2, meshes with and drives a bevel gear 46 secured on a spinner shaft 47 which is journaled in outer end portions of spaced terminal arms 48 extending outwardly from a cross bar 49 and with said outer end portions projecting into said work chamber 5 through the annular opening in the wall thereof.

Each end of each of said spinner shafts 47 is connected to a rotatable agitating element conveniently referred to as a spinner 50, here shown, for example, as a flexible coil of any desired or appropriate metal, it being contemplated that any other suitably flexible element such as a length of chain or the like may be employed, depending on the materials to be treated and the

results desired. Thus, when main shaft 3 is rotated, for example, in the direction of the arrow *a*, or clockwise as seen in Fig. 2, the above described train of gears, pinions and shafts operated from fixed gear 10 serve to rotate the spinners 50 in work chamber or groove 5 in a clockwise direction, as seen at the bottom of Fig. 3 and in Fig. 5, while said spinners are at the same time moved endwise in a circular path through said work chamber or groove 5.

Each end of each of said cross bars 49, Fig. 2, is connected to support an end of a dash plate or trough 51 of generally circular longitudinal sectional contour disposed in an arc and with inner surface portions opposite the greater part of the length of one of said spinners 50, so that operative portions of said spinner are in effect disposed between a wall portion of the chamber or groove 5 and said trough 51.

As shown more clearly in Figs. 3 and 5, the spinners 50 are arranged to operate in the work groove 5 of ring 4; and said troughs 51 are arranged asymmetrically in relation to said work groove 5 and their respective spinners to the extent that the outer edge of flange 52 thereof is disposed close to and overlying a portion of the inner surface of ring 4 adjacent to the annular opening of work groove 5; whereas the outer edge of the other flange 53 of trough 51 overlies portions of said opening and the spinner 50 and is spaced inwardly therefrom.

In operation of the illustrated embodiment, the material or materials in liquid form or carried in a liquid medium may be fed in a continuous stream, if desired, into the work chamber 5 through inlet port 16. The volume thus supplied to said work chamber is preferably such as to be moved freely through the inlet slots or passageways 55 and 15 into the circular path of movement of the agitators or spinners 50 and discharged through the outlet passageway or slot 17 without overflow into adjacent confined spaces. Said spinners operate in said work chambers 5 with a combined liquid advancing effect coupled with an active cross agitation produced by rotation of the spinners about their axes during their endwise or liquid advancing movement.

The speed with which said spinners travel in chamber 5 is determined by the speed of main shaft 3 and, at the minimum, is preferably sufficient to maintain an effective centrifugal effect on the liquid stream of material under treatment. Thus, if due to rotation of a given spinner 50 about its axis, portions of said material are separated from the stream in chamber or groove 5 and thrown against dash plate 51, said portions are forced by said dash plate back into the stream of material moving in a circular path through said chamber.

It is contemplated that where only a single work chamber 5 is employed, the degree or extent of treatment of any given material therein may be varied by varying the speed of rotation of shaft 3, or of the spinner members, or both.

Where the apparatus can be set up to employ two or more work chambers connected in series, the degree or extent of treatment of a given material may be varied by passing it through more or fewer of said work chambers before discharge, as well as by the speed changes first above suggested.

Those skilled in the art will appreciate that physical conditions or characteristics of various materials will in large measure determine whether

such materials can be advantageously treated at all in the apparatus above described and, if so, at what speeds and for how long to produce desired results.

In general, apparatus according to the present invention produces at low labor and power cost, effective intimate mixing or blending of different liquids; suspension or dispersion of certain solids in liquids or of one kind of liquid in another, as water in oil, or vice versa; and reduction in particle size of relatively friable or easily divided solid particles in a liquid medium. These functions indicate usefulness of said apparatus and advantages of its continuous flow mode of operation in the manufacture or processing of products such as pharmaceuticals, candies, cosmetics, foods, cellulose, plastics, paints, chemicals and others wherein known types of mixing, dispersing and grinding devices of the batch type, for example, are inadequate in operation or involve excessive labor and operation costs.

I claim:

1. In apparatus for treating, as in mixing, dispersing and/or grinding materials in wet condition, the combination of a work chamber having an annular opening, a main shaft coaxial with said annular opening, means arranged and adapted to feed material into said chamber, angularly spaced radially extending brackets mounted on said main shaft, a fixed gear mounted coaxially with said main shaft, agitating means supported between said brackets and movable endwise in a circular path through said work chamber with rotation of said main shaft, means mounted on said brackets and cooperating with said fixed gear for rotating said agitating means while the latter is moving endwise in said circular path through said work chamber, and means arranged and adapted to discharge material from said work chamber.

2. Apparatus for treating materials, as in mixing, dispersing and/or grinding in wet condition, the combination of a work chamber, a material inlet thereto, a material outlet therefrom, a main shaft concentric with said work chamber, a material agitator, means for moving said agitator through said work chamber endwise in a circular path concentric with said main shaft, and means for rotating said agitator including a cross shaft and cross shaft actuating means operatively

interposed between said cross shaft and said main shaft.

3. Apparatus for treating materials, as in mixing, dispersing and/or grinding in wet condition, the combination of a work chamber, a material inlet thereto, a material outlet therefrom, a fixed gear, a main shaft concentric with said work chamber, angularly spaced radially extending brackets mounted on said main shaft and having journals at their outer ends, a flexible agitating member having end portions supported in said journals, said member being movable in a circular path and endwise through said chamber with rotation of said main shaft, and means for rotating said member on its own axis simultaneously with said circular movement thereof, including a fixed gear, and driving means operatively connecting said end portions of the flexible agitating member with said fixed gear.

4. Material treating apparatus comprising in combination a casing, a spider mounted therein, a gear secured to said spider and arranged concentrically in the casing, a main shaft concentric with the casing and with said gear, radially extending angularly spaced brackets mounted on said main shaft, pinions journalled on said brackets and engaging said gear, an agitating member having end portions journalled in end portions of said brackets, and means operatively interposed between said end portions of the agitating member and said pinions and arranged and adapted to rotate said agitator member around its longitudinal axis during rotation of said main shaft.

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