

Aug. 15, 1939

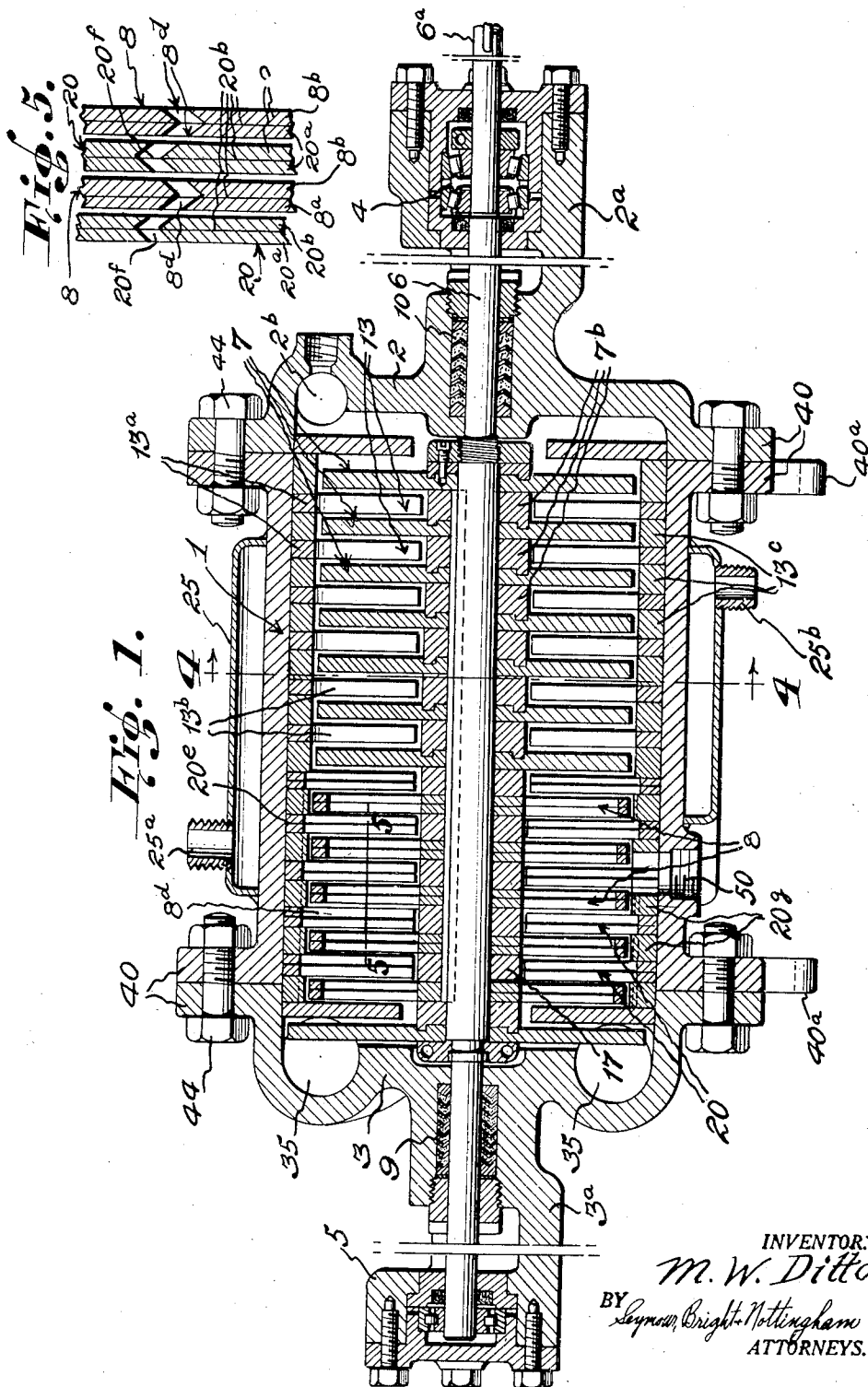
M. W. DITTO

2,169,338

EMULSIFYING MILL

Filed March 18, 1938

4 Sheets-Sheet 1



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2,169,338

EMULSIFYING MILL

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4 Sheets-Sheet 2

Fig. 2.

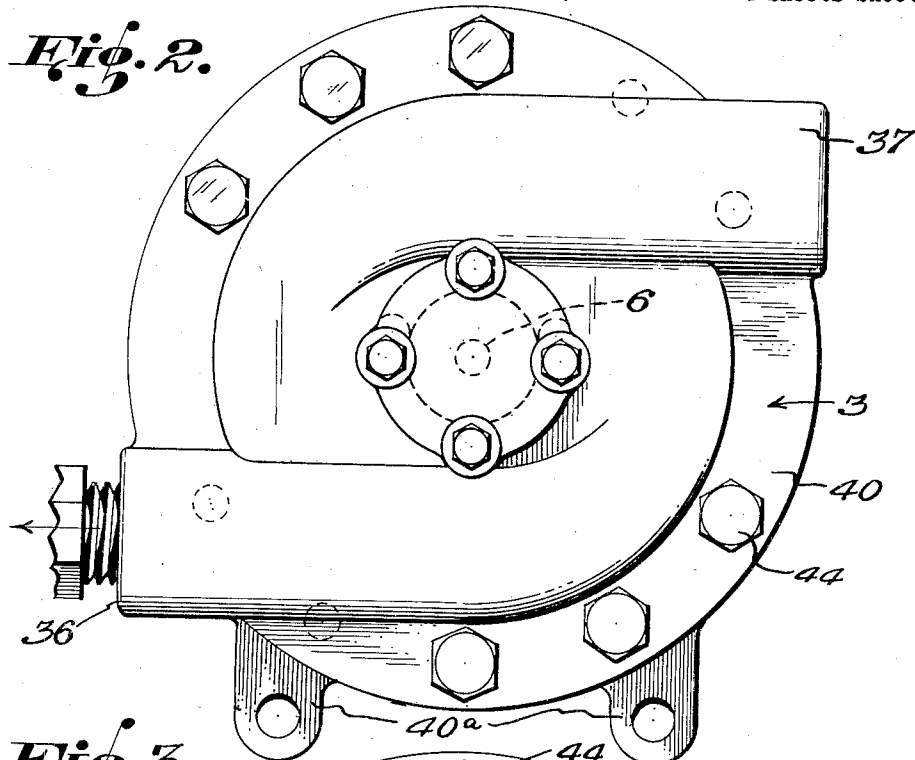
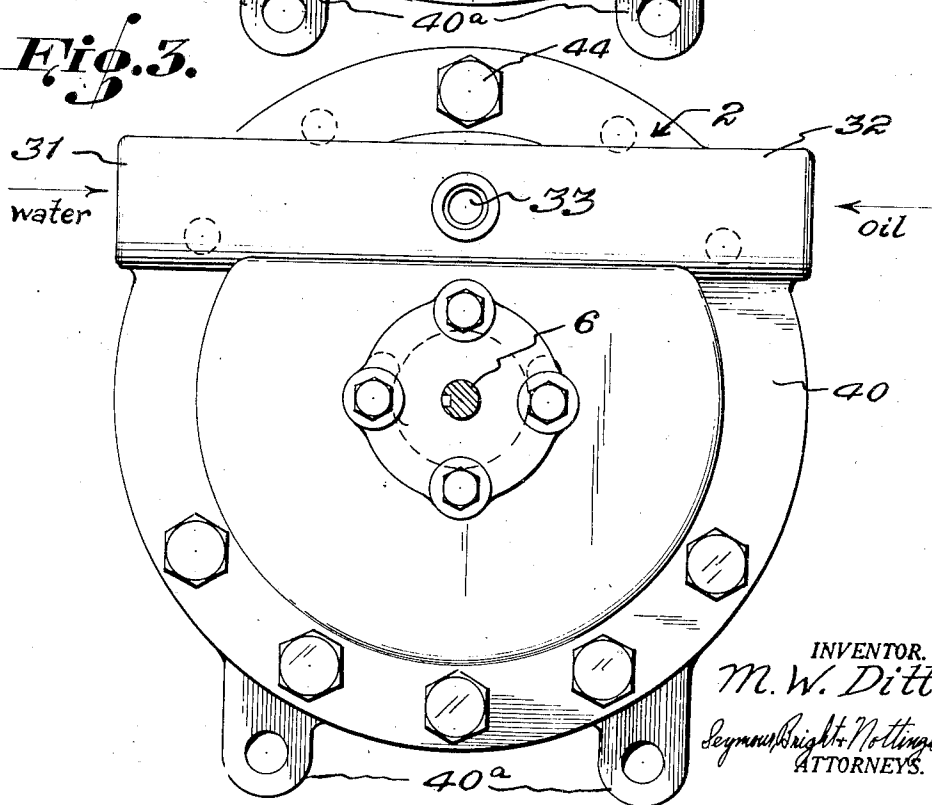


Fig. 3.



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Fig. 4.

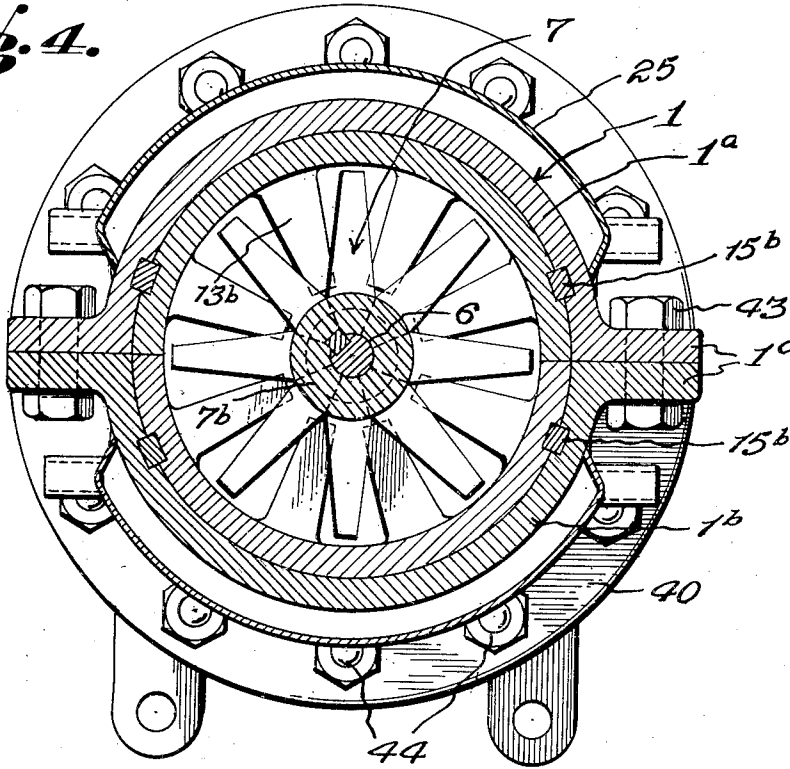


Fig. 6.

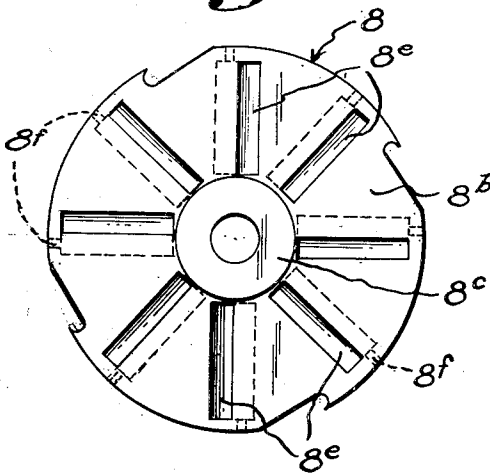
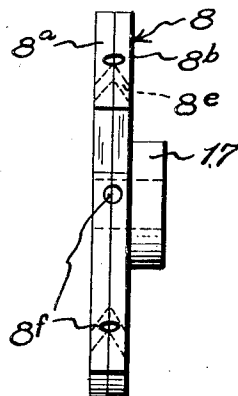


Fig. 7.



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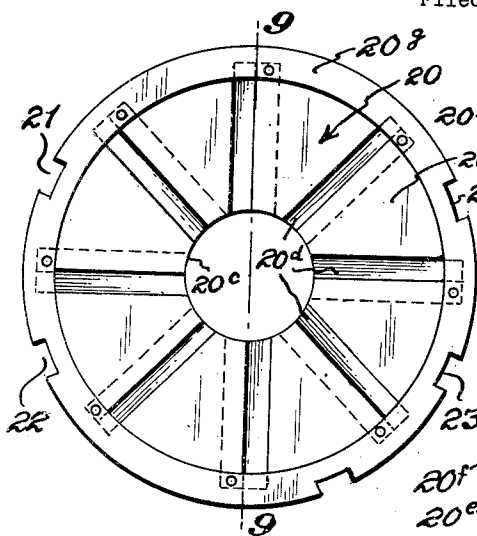


Fig. 8.

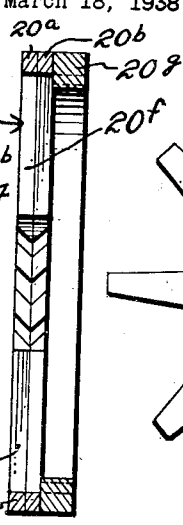


Fig. 9.

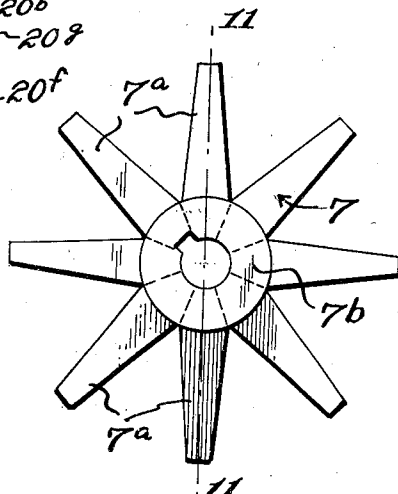


Fig. 10.

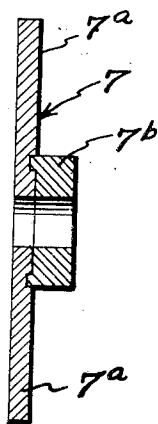


Fig. 11.

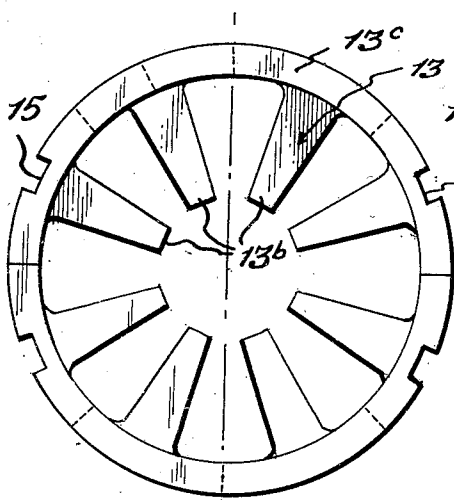


Fig. 12.

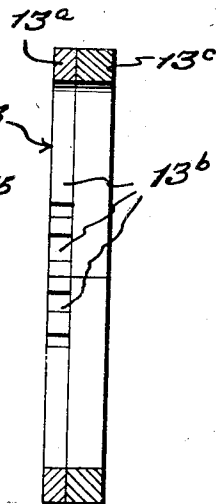


Fig. 13.

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UNITED STATES PATENT OFFICE

2,169,338

EMULSIFYING MILL

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poration of Delaware

Application March 18, 1938, Serial No. 196,780

16 Claims. (Cl. 259—9)

This invention relates to improvements in emulsifying mills and more particularly to a novel emulsifying mill of the rotary type.

The primary purpose of the invention is to provide an emulsifying mill adapted to emulsify various mixtures of liquids to such an extent that the resulting emulsion will resist separation by reaction such as centrifugal force, static settling and freezing.

A further object is to supply a mill capable of making emulsions which to all intents and purposes are permanent in nature.

A further object is to furnish a mill adapted, if oil and water are used in making a compound, to finely disperse the water throughout the oil mass so that it becomes located within the oil and becomes a permanent emulsion due to the fineness of the dispersion.

With the foregoing objects outlined and with other objects in view which will appear as the description proceeds, the invention consists in the novel features hereinafter described in detail, illustrated in the accompanying drawings, and more particularly pointed out in the appended claims.

In the drawings:

Fig. 1 is a diametrical longitudinal sectional view of my improved mill, partly in elevation.

Fig. 2 is an elevation of one end of the same.

Fig. 3 is a similar view of the opposite end of the same.

Fig. 4 is a transverse sectional view taken on the line 4—4 of Fig. 1.

Fig. 5 is a sectional view of a detail on the line 5—5 of Fig. 1.

Fig. 6 is an elevation of one of the rotary amalgamating discs of the mill.

Fig. 7 is a side elevation of the same.

Fig. 8 is an elevation of one of the stationary amalgamating discs of the machine.

Fig. 9 is a diametrical sectional view of the same on the line 9—9 of Fig. 8.

Fig. 10 is an elevation of one of the rotary agitating wheels or elements of the mill.

Fig. 11 is a diametrical sectional view of the same taken on the line 11—11 of Fig. 10.

Fig. 12 is an elevation of one of the stationary agitating discs or elements of the mill.

Fig. 13 is a diametrical sectional view of the same on the line 13—13 of Fig. 12.

Referring to the drawings, 1 designates a cylindrical shell or cylinder, closed at one end by an end member or plate 2, and at the opposite end by an end member or plate 3. The parts 2 and 3 are respectively provided with external exten-

sions 2a and 3a forming supports for anti-friction bearings 4 and 5.

A rotatable shaft 6 extends axially through the chamber formed by the parts 1, 2 and 3, and is journaled in the bearings 4 and 5. The shaft is driven by any suitable prime mover which may be connected to an end 6a of the shaft which projects through the bearing 4.

The plate 2 forms the inlet end of the chamber, and agitating wheels 7 are keyed on the shaft 6 to treat or act upon the entering materials. Each of these wheels, as best shown in Figs. 10 and 11, forms a multiplicity of radiating blades 7a which function to cut and agitate the materials as they travel through the casing into the outlet end member 3 of the same.

The wheels 7 are spaced apart by any suitable means, such as collars 7b and in between the bladed wheels, I arrange stationary agitating wheels or discs 13. As best shown in Figs. 12 and 13, each of these discs consists of a peripheral ring 13a from which a number of spaced stationary blades 13b extend radially inward toward the shaft 6. The rings 13a are notched at the circumferences as shown at 15 to receive splines 15b (Fig. 4) which function to key them to the casing or shell 1.

Spacing rings 13c are arranged in the shell between the rings 13a and serve to space the wheels 13 slightly apart to accommodate the movement of the bladed wheels 7.

A number of spaced rotary amalgamating wheels or elements 8 are also splined on the shafts between the series of bladed wheels 7 and the outlet plate 3, and each of the rotary amalgamating wheels, as best shown in Figs. 1, 5, 6 and 7, preferably consists of a pair of discs 8a and 8b, arranged side by side and in contacting relation. Each disc has a hub portion 8c splined on the shaft 6, and each disc has a series of slots 8d extending therethrough from one of its faces to its opposite face. The slots of each disc extend radially thereof and the walls of the slots of each disc are parallel and inclined relatively to the axis of the shaft 6. The two discs of each amalgamating element have their slots arranged opposite to one another, as best shown in Fig. 7, so as to form V-shaped passageways 8e. I prefer to arrange radial ports 8f at the outer end of each of these passageways and between the ports, I provide the peripheries of each disc with scooping teeth 8g to cause liquid at the circumferences of the discs to be forced by the movement of the teeth through the ports 8f and into the passageways 8e.

The pairs of discs forming the rotary amalgamating elements are spaced apart by collars 17 arranged on the shaft 6, and the intervening spaces are occupied by stationary amalgamating elements 20. Each of these elements (Figs. 8 and 9) consists of a pair of discs 20a and 20b each provided at its center with a hole 20c to accommodate the collars 17. Radially disposed slots 20d are provided in each of the stationary discs and extend from the central hole to a peripheral ring 20e which has peripheral notches 21, 22, 23 and 24 to receive the splines 15b used in securing the stationary discs against movement. The walls of each of the slots 20d are also parallel and arranged at inclinations relatively to the axis of the shaft 6 and the discs forming each pair have their slots opposed to one another in order to provide V-shaped passageways 20f (Fig. 5) extending through each pair of the discs 20a, 20b.

Spacing rings 20g are arranged between the pairs of stationary amalgamating discs to space them properly to accommodate the rotatable amalgamating discs 8.

The plate 2 (Fig. 1) is provided with an inlet passageway 2b which may receive water (Fig. 3) through an intake 31, oil through an intake 32 and a gas, such as air through the intake 33.

While the substances admitted through the plate 2 are passing through the mill and after they have been violently agitated and mixed by means of the members 7 and 13, they may be admixed with any desired fluid which enters the casing through an inlet port 50 (Fig. 1) which may be arranged at an intermediate point in the amalgamating section of the mill.

The emulsion is discharged through passageways 35 in the outlet plate 3 which communicate with outlets 36 and 37 from which the emulsion may be conveyed to any suitable place of storage or use.

Under some circumstances, while the emulsion is being manufactured, it is desirable to heat or cool the same, and in order to provide for this, I arrange a jacket 25 around the shell and furnish it with an intake nipple 25a and an outlet nipple 25b.

The ends of the shell and the end plates are provided with apertured flanges 40 designed to accommodate bolts 44 used in tightly connecting these parts. The flanges of the shell may be provided with apertured ears 40a and 41 to accommodate any suitable means employed in maintaining the mill either vertically or horizontally.

Each end plate is preferably provided with suitable packing means 9, 10 to prevent fluid from discharging along the shaft 6.

In operation the materials treated are fed through the plate 2 under high superatmospheric pressures, and the shaft 6, bladed wheels 7 and amalgamating wheels 8 are rotated at high speeds. As the result of the rotary motion, the members 7 and 13 mix the liquids passing through the machine due to turbulence, or impact, and as the liquids progress further toward the plate 3, they are forced to pass through the amalgamating elements 20 and 8. Due to the high speed of the members 8 rotating between the elements 20; and the slots in the members 8 being disposed in opposite directions to the slots in the members 20, they impart a very high degree of impact and the reaction of sub-division which is regulated and controlled by the number of R. P. M. of shaft 6.

I believe my mill is unique in construction compared to mills now in use for the purpose of producing emulsified mixtures of oil and water or other emulsions or colloidal mixtures, such as paints, lacquers, etc., in that there are no gears or points of friction between the metal surfaces within the casing. All of the members are so disposed that there is clearance between surfaces and the compound for mixing is dependent upon force expended by motion of rotating members between the stationary members. As this type of mill is used primarily for dispersion of one liquid within another, such as two different types of oils, or oil and water, the problem is one of dispersion. The means used in the commonly known colloidal mills depends largely on friction between two surfaces or the rubbing action plus centrifugal force where through-put is small and power concentration high. My mill is able to impart extremely fine dispersion and very high out-put with extremely low power input. Due to the construction, there is a minimum of wear because there is no actual friction between surfaces, and dispersing members are self lubricated due to the fact that they are being rotated within a liquid medium being dispersed by the action imparted by the mill.

The members 7 and 13 act as mixing elements and the members 8 and 20, due to the unique construction of their slots, act as amalgamating elements so that in the instant where oil and water are used, the water is so finely dispersed throughout the oil mass that it is locked within the oil and becomes a permanent emulsion because of the fineness of the dispersion. I have found that mixtures put through a mill of the type disclosed, resist separation by reaction, such as centrifugal force, static settling and freezing. As a matter of fact, the water as a rule, can only be separated by a process of distillation. To all intent and purpose, the emulsions are permanent in nature and permit utilization of emulsions in processes demanding such compounds.

For ease in assembling and maintenance, the casing 1 is preferably formed of two castings 1a and 1b (Fig. 4), each of which has a longitudinally extending apertured flange 1c; these flanges being rigidly secured together by bolts 43 or the like. In reference to the speed of such a mill, it is evident that the shaft 6 can be rotated up to the stress limit of the metals used in the construction, and any speed from 0 to 3000 R. P. M. is possible with this type of construction, the speed being limited only to the capacity of the bearings and the stress of the shaft resulting from centrifugal force at the outer perimeter of the members 7 and 8.

Generally it is found that emulsion takes place more efficiently under pressure above atmospheric, and therefore I do not limit myself to any particular pressure during the emulsifying action. I have found that satisfactory results can be obtained at pressures from 100 to 6000 pounds per square inch, depending upon the type of materials used and the character of the emulsion required.

For convenience in claiming the present invention, I will refer in the claims to the section of the machine which includes the members 7 and 13, as the agitating section, and the portion which includes the members 8 and 20 as the amalgamating section.

The herein described and illustrated embodiment has given satisfactory results and it will be manifest to those skilled in the art, after an

understanding of the invention, that other changes and modifications may be made without departing from the spirit and scope of the invention. It is therefore intended that all matters contained in the above description or illustrated in the drawings shall be interpreted as illustrative and not in a limiting sense.

What I claim and desire to secure by Letters Patent is:

1. An emulsifying mill of the character described, comprising a hollow cylinder having closed ends, a rotatable shaft extending axially through the cylinder, means for introducing materials to be treated into one end of the cylinder, means for discharging an emulsion from the opposite end of the cylinder, said cylinder being provided with an agitating section and an amalgamating section, spaced rotatable agitating elements mounted on the shaft and arranged in the agitating section, stationary agitating elements arranged in the agitating section and having their opposite sides in close proximity to but spaced from the rotatable elements, rotatable amalgamating elements mounted on the shaft and arranged in the amalgamating section between the agitating section and the outlet end of the cylinder, and stationary amalgamating elements arranged in the amalgamating section and positioned between the rotatable amalgamating elements, the amalgamating elements being arranged side by side in close proximity to one another and each amalgamating element having a series of irregular passageways extending therethrough.

2. An emulsifying mill of the character described, comprising a hollow cylinder having closed ends, a rotatable shaft extending axially through the cylinder, means for introducing materials to be treated into one end of the cylinder, means for discharging an emulsion from the opposite end of the cylinder, said cylinder being provided with an agitating section and an amalgamating section, spaced rotatable agitating elements mounted on the shaft and arranged in the agitating section, stationary agitating elements arranged in the agitating section and having their opposite sides in close proximity to but spaced from the rotatable elements, rotatable amalgamating elements mounted on the shaft and arranged in the amalgamating section between the agitating section and the outlet end of the cylinder, stationary amalgamating elements arranged in the amalgamating section and positioned between the rotatable amalgamating elements, the amalgamating elements being arranged side by side in close proximity to one another and each amalgamating element having a series of irregular passageways extending therethrough, and spacing collars mounted on the shaft between the rotatable agitating elements.

3. An emulsifying mill of the character described, comprising a hollow cylinder having closed ends, a rotatable shaft extending axially through the cylinder, means for introducing materials to be treated into one end of the cylinder, means for discharging an emulsion from the opposite end of the cylinder, said cylinder being provided with an agitating section and an amalgamating section, spaced rotatable agitating elements mounted on the shaft and arranged in the agitating section, stationary agitating elements arranged in the agitating section and having their opposite sides in close proximity to but spaced from the rotatable elements, rotatable amalgamating elements mounted on the shaft and arranged in the amalgamating section between

the agitating section and the outlet end of the cylinder, stationary amalgamating elements arranged in the amalgamating section and positioned between the rotatable amalgamating elements, the amalgamating elements being arranged side by side in close proximity to one another and each amalgamating element having a series of irregular passageways extending therethrough, and spacing rings arranged in the cylinder between the stationary agitating elements.

4. An emulsifying mill of the character described, comprising a hollow cylinder having closed ends, a rotatable shaft extending axially through the cylinder, means for introducing materials to be treated into one end of the cylinder, means for discharging an emulsion from the opposite end of the cylinder, said cylinder being provided with an agitating section and an amalgamating section, spaced rotatable agitating elements mounted on the shaft and arranged in the agitating section, stationary agitating elements arranged in the agitating section and having their opposite sides in close proximity to but spaced from the rotatable elements, rotatable amalgamating elements mounted on the shaft and arranged in the amalgamating section between the agitating section and the outlet end of the cylinder, stationary amalgamating elements arranged in the amalgamating section and positioned between the rotatable amalgamating elements, the amalgamating elements being arranged side by side in close proximity to one another and each amalgamating element having a series of irregular passageways extending therethrough, and spacing collars arranged on the shaft between the rotatable amalgamating elements.

5. An emulsifying mill of the character described, comprising a hollow cylinder having closed ends, a rotatable shaft extending axially through the cylinder, means for introducing materials to be treated into one end of the cylinder, means for discharging an emulsion from the opposite end of the cylinder, said cylinder being provided with an agitating section and an amalgamating section, spaced rotatable agitating elements mounted on the shaft and arranged in the agitating section, stationary agitating elements arranged in the agitating section and having their opposite sides in close proximity to but spaced from the rotatable elements, rotatable amalgamating elements mounted on the shaft and arranged in the amalgamating section between the agitating section and the outlet end of the cylinder, stationary amalgamating elements arranged in the amalgamating section and positioned between the rotatable amalgamating elements, the amalgamating elements being arranged side by side in close proximity to one another and each amalgamating element having a series of irregular passageways extending therethrough, and spacing rings arranged in the casing between the stationary amalgamating elements.

6. An emulsifying mill of the character described, comprising a hollow cylinder having closed ends, a rotatable shaft extending axially through the cylinder, means for introducing materials to be treated into one end of the cylinder, means for discharging an emulsion from the opposite end of the cylinder, said cylinder being provided with an agitating section and an amalgamating section, spaced rotatable agitating elements mounted on the shaft and arranged in the agitating section, stationary agitating elements arranged in the agitating section and having their opposite sides in close proximity to but spaced

from the rotatable elements, rotatable amalgamating elements mounted on the shaft and arranged in the amalgamating section between the agitating section and the outlet end of the cylinder, stationary amalgamating elements arranged in the amalgamating section and positioned between the rotatable amalgamating elements, the amalgamating elements being arranged side by side in close proximity to one another and each amalgamating element having a series of irregular passageways extending therethrough, each of said passageways being of V-shape.

7. An emulsifying mill of the character described, comprising a hollow cylinder having closed ends, a rotatable shaft extending axially through the cylinder, means for introducing materials to be treated into one end of the cylinder, means for discharging an emulsion from the opposite end of the cylinder, said cylinder being provided with an agitating section and an amalgamating section, spaced rotatable agitating elements mounted on the shaft and arranged in the agitating section, stationary agitating elements arranged in the agitating section and having their opposite sides in close proximity to but spaced from the rotatable elements, rotatable amalgamating elements mounted on the shaft and arranged in the amalgamating section between the agitating section and the outlet end of the cylinder, and stationary amalgamating elements arranged in the amalgamating section and positioned between the rotatable amalgamating elements, the amalgamating elements being arranged side by side in close proximity to one another and each amalgamating element having a series of irregular passageways extending therethrough, each of said passageways being formed by a radial slot and being of V-shape.

8. An emulsifying mill of the character described, comprising a hollow cylinder having closed ends, a rotatable shaft extending axially through the cylinder, means for introducing materials to be treated into one end of the cylinder, means for discharging an emulsion from the opposite end of the cylinder, said cylinder being provided with an agitating section and an amalgamating section, spaced rotatable agitating elements mounted on the shaft and arranged in the agitating section, stationary agitating elements arranged in the agitating section and having their opposite sides in close proximity to but spaced from the rotatable elements, rotatable amalgamating elements mounted on the shaft and arranged in the amalgamating section between the agitating section and the outlet end of the cylinder, and stationary amalgamating elements arranged in the amalgamating section and positioned between the rotatable amalgamating elements, the amalgamating elements being arranged side by side in close proximity to one another and each amalgamating element having a series of irregular passageways extending therethrough, all of said passageways being of V-shape with the points of the V's in the stationary amalgamating elements extending in opposite direction to the point of the V's in the rotating amalgamating elements.

9. An emulsifying mill of the character described, comprising a hollow cylinder having closed ends, a rotatable shaft extending axially through the cylinder, means for introducing materials to be treated into one end of the cylinder, means for discharging an emulsion from the opposite end of the cylinder, said cylinder be-

ing provided with an agitating section and an amalgamating section, spaced rotatable agitating elements mounted on the shaft and arranged in the agitating section, stationary agitating elements arranged in the agitating section and having their opposite sides in close proximity to but spaced from the rotatable elements, rotatable amalgamating elements mounted on the shaft and arranged in the amalgamating section between the agitating section and the outlet end of the cylinder, and stationary amalgamating elements arranged in the amalgamating section and positioned between the rotatable amalgamating elements, the amalgamating elements being arranged side by side in close proximity to one another and each amalgamating element having a series of irregular passageways extending therethrough, each of the stationary agitating elements consisting of a ring having inwardly extending spaced radially disposed vanes which project toward the shaft.

10. An emulsifying mill of the character described, comprising a hollow cylinder having closed ends, a rotatable shaft extending axially through the cylinder, means for introducing materials to be treated into one end of the cylinder, means for discharging an emulsion from the opposite end of the cylinder, said cylinder being provided with an agitating section and an amalgamating section, spaced rotatable agitating elements mounted on the shaft and arranged in the agitating section, stationary agitating elements arranged in the agitating section and having their opposite sides in close proximity to but spaced from the rotatable elements, rotatable amalgamating elements mounted on the shaft and arranged in the amalgamating section between the agitating section and the outlet end of the cylinder, and stationary amalgamating elements arranged in the amalgamating section and positioned between the rotatable amalgamating elements, the amalgamating elements being arranged side by side in close proximity to one another and each amalgamating element having a series of irregular passageways extending therethrough, each of the rotatable agitating elements consisting of a hub from which projects a series of radially disposed blades.

11. An emulsifying mill of the character described, comprising a hollow cylinder having closed ends, a rotatable shaft extending axially through the cylinder, means for introducing materials to be treated into one end of the cylinder, means for discharging an emulsion from the opposite end of the cylinder, said cylinder being provided with an agitating section and an amalgamating section, spaced rotatable agitating elements mounted on the shaft and arranged in the agitating section, stationary agitating elements arranged in the agitating section and having their opposite sides in close proximity to but spaced from the rotatable elements, rotatable amalgamating elements mounted on the shaft and arranged in the amalgamating section between the agitating section and the outlet end of the cylinder, and stationary amalgamating elements arranged in the amalgamating section and positioned between the rotatable amalgamating elements, the amalgamating elements being arranged side by side in close proximity to one another and each amalgamating element having a series of irregular passageways extending therethrough, each of the stationary amalgamating elements consisting of a pair of discs arranged side by side in contacting relation, each disc

having a series of radially disposed slots, the slots of the discs communicating with one another and forming the passageways in the stationary amalgamating elements, the passageways formed by the slots of each pair of discs being of V-shape.

12. An emulsifying mill of the character described, comprising a hollow cylinder having closed ends, a rotatable shaft extending axially through the cylinder, means for introducing materials to be treated into one end of the cylinder, means for discharging an emulsion from the opposite end of the cylinder, said cylinder being provided with an agitating section and an amalgamating section, spaced rotatable agitating elements mounted on the shaft and arranged in the agitating section, stationary agitating elements arranged in the agitating section and having their opposite sides in close proximity to but spaced from the rotatable elements, rotatable amalgamating elements mounted on the shaft and arranged in the amalgamating section between the agitating section and the outlet end of the cylinder, and stationary amalgamating elements arranged in the amalgamating section and positioned between the rotatable amalgamating elements, the amalgamating elements being arranged side by side in close proximity to one another and each amalgamating element having a series of irregular passageways extending therethrough, each of the rotatable amalgamating elements consisting of a pair of discs arranged side by side in contacting relation and having radially disposed slots forming the passageways in the rotatable amalgamating elements, the passageways being of substantially V-shape.

13. An emulsifying mill of the character described, comprising a hollow cylinder having closed ends, a rotatable shaft extending axially through the cylinder, means for introducing materials to be treated into one end of the cylinder, means for discharging an emulsion from the opposite end of the cylinder, said cylinder being provided with an agitating section and an amalgamating section, spaced rotatable agitating elements mounted on the shaft and arranged in the agitating section, stationary agitating elements arranged in the agitating section and having their opposite sides in close proximity to but spaced from the rotatable elements, rotatable amalgamating elements mounted on the shaft and arranged in the amalgamating section between the agitating section and the outlet end of the cylinder, and stationary amalgamating elements arranged in the amalgamating section and positioned between the rotatable amalgamating elements, the amalgamating elements being arranged side by side in close proximity to one another and each amalgamating element having a series of irregular passageways extending therethrough, each of the rotatable amalgamating elements consisting of a pair of discs arranged side by side in contacting relation and having radially disposed slots forming the passageways in the rotatable amalgamating elements, the passageways being of substantially V-shape, and ports extending from the outer ends of the passageways to the peripheries of the discs.

14. An emulsifying mill of the character described, comprising a hollow cylinder having closed ends, a rotatable shaft extending axially through the cylinder, means for introducing materials to be treated into one end of the cylinder, means for discharging an emulsion from the

opposite end of the cylinder, said cylinder being provided with an agitating section and an amalgamating section, spaced rotatable agitating elements mounted on the shaft and arranged in the agitating section, stationary agitating elements arranged in the agitating section and having their opposite sides in close proximity to but spaced from the rotatable elements, rotatable amalgamating elements mounted on the shaft and arranged in the amalgamating section between the agitating section and the outlet end of the cylinder, and stationary amalgamating elements arranged in the amalgamating section and positioned between the rotatable amalgamating elements, the amalgamating elements being arranged side by side in close proximity to one another and each amalgamating element having a series of irregular passageways extending therethrough, each of the rotatable amalgamating elements consisting of a pair of discs arranged side by side in contacting relation and having radially disposed slots forming the passageways in the rotatable amalgamating elements, the passageways being of substantially V-shape, the peripheries of the discs being provided with teeth.

15. An emulsifying mill of the character described, comprising a hollow cylinder having closed ends, a rotatable shaft extending axially through the cylinder, means for introducing materials to be treated into one end of the cylinder, means for discharging an emulsion from the opposite end of the cylinder, said cylinder being provided with an agitating section and an amalgamating section, spaced rotatable agitating elements mounted on the shaft and arranged in the agitating section, stationary agitating elements arranged in the agitating section and having their opposite sides in close proximity to but spaced from the rotatable elements, rotatable amalgamating elements mounted on the shaft and arranged in the amalgamating section between the agitating section and the outlet end of the cylinder, stationary amalgamating elements arranged in the amalgamating section and positioned between the rotatable amalgamating elements, the amalgamating elements being arranged side by side in close proximity to one another and each amalgamating element having a series of irregular passageways extending therethrough, and an inlet leading into the amalgamating section of the mill.

16. An emulsifying mill comprising a hollow cylinder having an internal chamber and closed ends, a rotatable shaft extending axially through the cylinder, means for introducing liquids to be treated into one end portion of the cylinder, means for discharging an emulsion from the opposite end portion of the cylinder, spaced stationary amalgamating elements arranged in the chamber between the inlet and outlet, each of said elements being of disc-like form and provided with radially disposed slots forming V-shaped passageways therethrough, rotatable amalgamating elements mounted on the shaft in the spaces between the stationary amalgamating elements, each of the rotatable elements being of disc-like form and provided with a series of radially disposed slots forming V-shaped passageways therethrough, the passageways of the stationary and rotatable elements when the latter are not moving, forming zig-zag conduits through said elements.

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