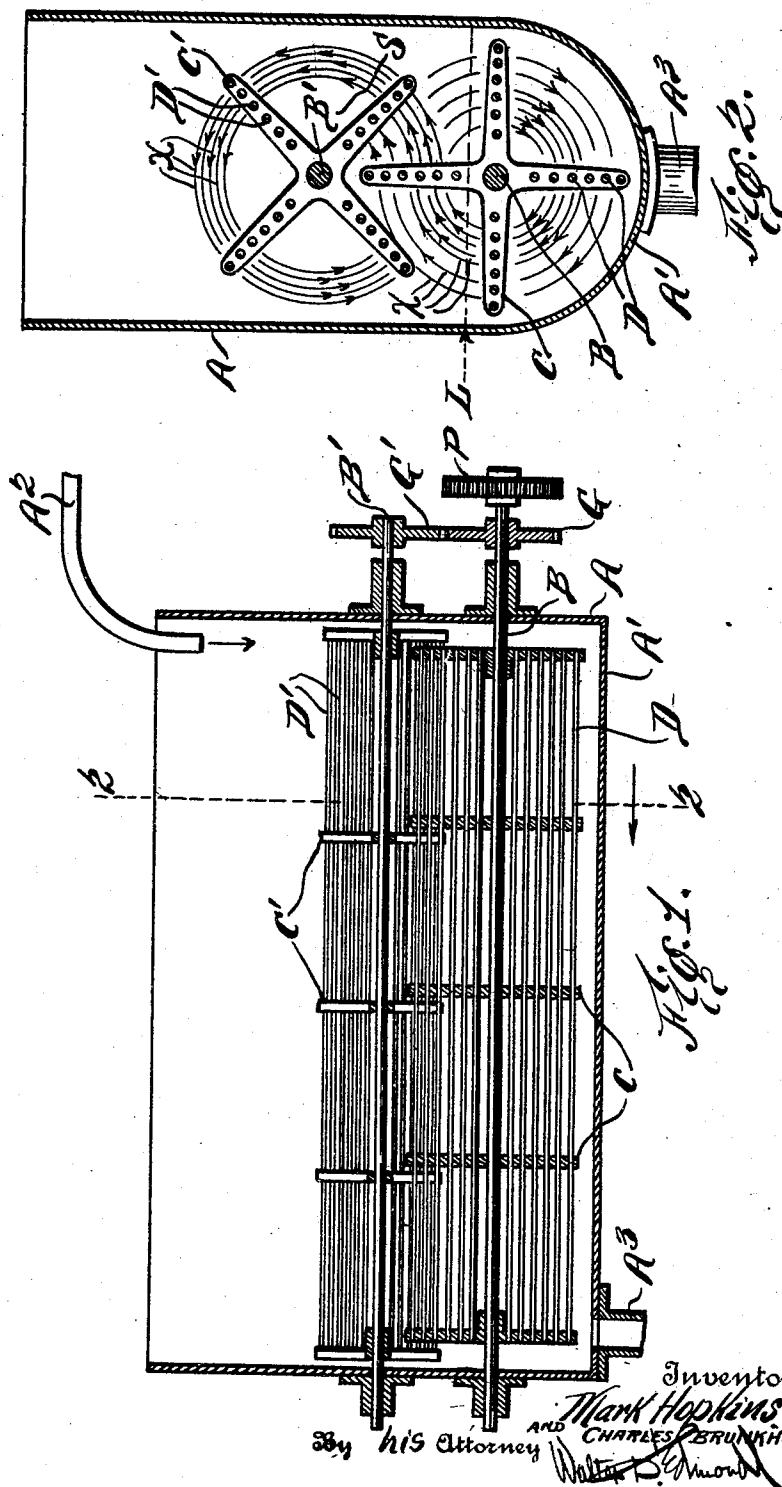


1,308,904.

Patented July 8, 1919.



UNITED STATES PATENT OFFICE.

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ASSIGNORS TO BORDEN'S CONDENSED MILK COMPANY, OF NEW YORK, N. Y.,
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METHOD OF AERATING LIQUESCENT MATERIAL AND MACHINE FOR THE PURPOSE.

1,308,904.

Specification of Letters Patent.

Patented July 8, 1919.

Application filed August 30, 1918. Serial No. 252,031.

To all whom it may concern:

Be it known that we, MARK HOPKINS and CHARLES BRUNKHURST, both citizens of the United States, and residents of Middletown, in the county of Orange and State of New York, have invented certain new and useful Improvements in Methods of Aerating Liquescent Materials and in Machines for the Purpose, of which the following is a specification.

Our invention relates to a method and apparatus for incorporating air or other gas, and minutely subdividing the resulting occlusions thereof, in semi-liquid more or less viscid material, such for example as concentrated milk, one type of such apparatus being, for example, that shown in U. S. Letters Patent No. 1,233,446 dated July 17, 1917, and the objects of our invention comprise provision of means whereby the air is more effectively and economically incorporated and a more minute subdivision of the occlusions effected, more quickly, with less expenditure of energy, and with less risk of undesirably affecting the liquescent materials, such particularly as concentrated milk.

We attain these objects and work our method by aid of the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a vertical longitudinal central section of our apparatus.

Fig. 2 is, on enlarged scale, a transverse section on line 2—2 of Fig. 1, and indicating the directions of movement of the liquescent substance during operation.

A is a suitably supported tank, preferably longitudinally extended, *i. e.* of oblong rectangular horizontal cross section, as shown, and having an inwardly concavely curved bottom A'. Thereinto vents a pipe A² for charging the tank and therefrom leads a pipe A³ affording a discharge orifice for the product and controlled, as usual, by valves, etc., not shown. B is a rotary shaft concentric with and relatively proximate to said bottom; B is liquid-tightly journaled in the tank and rotatable, as usual, by aid of pulley P from a source of power not shown. B carries a plurality of therefrom equidistantly radially projecting alike members, or arms, C, a plurality of which spaced-apart from, and in alinement with, each other are reduplicated along the shaft.

Each such plurality carries a group of spaced-apart alike rods D, extended in parallelism with the shaft. The rods are, preferably, as shown in the drawings, equally spaced apart, parallel with the shaft, cylindrical, and relative-attenuated, there being rods in each group which are equidistant from the axis of the shaft. B' is another rotary shaft similarly journaled in the tank, disposed above, in parallelism with shaft B and carrying similar radially projecting members, or arms, C' carrying groups of similarly extended similar rods D'.

The rods are, as shown by the drawings, relatively attenuated and preferably cylindrical, *i. e.*, of circular cross-section, *i. e.*, having curved exterior surfaces. This size and shape of the rods is important as it enables them, as stated in said patent, to "continuously slice or cut smoothly and evenly in a multitude of planes the viscid concentrate through which the air is being upwardly and relatively gently forced and thus produce the desired impregnation with the least possible ebullition from the surface" (see the referred to patent p. 5, 1. 70), whereas with rods of rectangular cross-section, the desired results are comparatively unattainable, or certainly not so economically, or uninjurious to the material treated, such, for example, as milk.

G is a gear carried by shaft B and intermeshing with a similar gear G' carried by shaft B' whereby when shaft B is rotated shaft B' is caused to synchronously rotate in the opposite direction.

The relative dispositions and proportions of each shaft and of the elements thereby carried, as aforesaid, is such that the arms and rods of the one move rotatively in interspaces between the arms and rods of the other, in the present instance, as shown in the drawings, the shafts being so spaced-apart as to permit clearance thereof by the rods and paths of the rods carried by the lower shaft to be, below the upper shaft, intersected by paths of the rods thereby carried.

It will also be noted that, as shown in Fig. 2, the shaft B' is so superdisposed relatively to the shaft B that the rods carried by the former clear the surface of the material when at normal level.

Method: The liquescent material to be

treated is charged into the tank, up to say the level of the dotted line L located as shown above the shaft B and below the path of the rod C'. Power is then applied and the shafts rotated until the desired extent of aeration and subdivision of occluded air is attained, after which the charge, thereby converted into an aerated, plastic, coherent, adhesive mass such as described in the above referred to patent, is discharged and ready for other treatment such as drying, etc. It will be noted that our method and apparatus dispense with the formerly relied on means for injecting or forcing compressed air, or gas, into the material treated. This is because our method and apparatus are such as to produce by aid of centrifugal action, in, or under, a constantly circularly advancing superelevated part or belt of the mass of material treated, an air space S cylindrical, as shown, and concentric with and extending longitudinally around the shaft B'. From each relatively open end of this space there is constantly sucked, or indrawn, a current of air which passes diffusedly, or in constantly being subdivided bubbles, by levitation, upwardly into said longitudinally extended superdisposed or supernatant moving belt of the concentrate thus separated from the remainder thereof, and is entrained thereby and thus carried back into the tank, to be there further subdivided by the rods and so on indefinitely, as indicated approximately by the arrow-headed lines X illustrating the directions of movement of the charge, shown in Fig. 2. An important feature is that, contemporaneously with the progressive aeration of the heavier portions of the charge in the lower portions of the tank, there is constantly being temporarily separated therefrom and further progressively aerated more aerated, and consequently supernatant, portions of the concentrate. The air occlusions are thus by aid of our apparatus more minutely subdivided and homogeneously distributed, and in less time and with less expenditure of energy, or undesirable effects on the material such as concentrated milk treated, than by any other method for similar purposes with which we are acquainted.

We are aware that in the Patent No. 185754 to Joseph, for improvement in rotary churns, is disclosed a pair of relatively superimposed interlocking "dasher wheels", and in the Patent No. 875384 to Quack, for kneading and mixing machine, a pair of superimposed interlocking agitators, or scrapers; nor do we claim as any part of our present invention any of the constructions so disclosed, these being, so shaped, relatively positioned, or environed, as to be incompetent to produce our above described air space and therefore unavailable for the practice of our method of aeration.

Having now described our invention what we claim as new and desire to secure by Letters Patent is the following, viz:

1. In an apparatus for aerating semi-liquid material, a tank, and within said tank a rotatory shaft carrying a plurality of therefrom transversely projecting arms each carrying a group of therefrom transversely extending relatively attenuated rods, in combination with another similar shaft similarly carrying similar arms and rods, the one shaft being superdisposed relatively to the other shaft, and the said shafts being so spaced apart as to permit clearance thereof by said rods and the paths of rods carried by the one shaft to be intersected by paths of rods carried by the other shaft, and means to synchronously rotate said shafts in opposite directions.

2. In an apparatus for aerating semi-liquid material, a tank, and within said tank a horizontal rotatory shaft carrying a plurality of therefrom radially projecting arms each carrying a group of therefrom horizontally extending relatively attenuated rods, in combination with another therewith parallel similar shaft similarly carrying similar arms and rods, the one shaft being superdisposed relatively to the other shaft, and the said shafts being so spaced apart as to permit clearance thereof by said rods and the paths of rods carried by the one shaft to be intersected by paths of rods carried by the other shaft, and means to synchronously rotate said shafts in opposite directions.

3. In an apparatus for aerating semi-liquid material, a tank, and within said tank a rotatory shaft carrying a plurality of therefrom equidistantly, radially, projecting alike arms each carrying a group of equally spaced-apart, relatively attenuated, rods therefrom extending in parallelism with the shaft, in combination with another similar shaft similarly carrying similar arms and rods, the one shaft being superdisposed relatively to the other shaft, and the said shafts being so spaced apart as to permit clearance thereof by said rods and the paths of rods carried by the one shaft to be intersected by paths of rods carried by the other shaft, and means to synchronously rotate said shafts in opposite directions.

4. In an apparatus for aerating semi-liquid material, a tank, and within said tank a rotatory shaft carrying a plurality of therefrom equidistantly, radially, projecting alike arms each carrying a group of equally spaced-apart relatively attenuated, alike, cylindrical rods therefrom extending in parallelism with, and there being rods in each group equidistant from, the shaft, in combination with another similar shaft similarly carrying similar arms and rods, the one shaft being superdisposed relatively to the other shaft, and the said shafts being

so spaced apart as to permit clearance there-
of by said rods and the paths of rods carried
by the one shaft to be intersected by paths
of rods carried by the other shaft, and means
5 to synchronously rotate said shafts in oppo-
site directions.

5. In an apparatus for aerating semi-
liquid material, a tank, having an inwardly
concavely curved bottom, a shaft rotatable
10 in said tank having its axis concentric with
said bottom and carrying therefrom trans-
versely projecting arms each carrying a plu-
rality of therefrom transversely extending
rods, in combination with another similar
15 shaft similarly carrying similar arms and
rods, said last mentioned shaft being super-
disposed relatively to the first mentioned
shaft, the said shafts being so spaced-apart
as to permit clearance of their axes by said
20 rods and paths of the rods carried by the
lower shaft to be, below the upper shaft,
intersected by paths of the rods thereby
carried, and means to rotate said shafts in
opposite directions.

25 6. In an apparatus for aerating semi-
liquid material, a tank, having an inwardly
concavely curved bottom, a shaft rotatable
in said tank having its axis concentric with
said bottom and carrying therefrom trans-
30 versely projecting arms each carrying a
plurality of therefrom transversely extend-
ing rods of circular cross-section, in combi-
nation with another similar shaft similarly
carrying similar arms and rods, said last
35 mentioned shaft being superdisposed rela-
tively to the first mentioned shaft, the said
shafts being so spaced-apart as to permit
clearance of their axes by said rods, and paths
of the rods carried by the lower shaft to be,
40 below the upper shaft, intersected by paths
of the rods thereby carried, and means to
rotate said shafts in opposite directions.

7. In an apparatus for aerating semi-
liquid material, a tank, having an inwardly
45 concavely curved bottom, a shaft rotatable
in said tank having its axis concentric with
said bottom and carrying therefrom trans-
versely projecting arms each carrying a
plurality of therefrom transversely extend-
50 ing relatively attenuated rods of circular
cross-section, in combination with another
similar shaft similarly carrying similar arms
and rods, said last mentioned shaft being
superdisposed relatively to the first men-
55 tioned shaft, the said shafts being so spaced-
apart as to permit clearance of their axes
by said rods and paths of the rods carried by
the lower shaft to be, below the upper shaft,
intersected by paths of the rods thereby car-
60 ried, and means to rotate said shafts in op-
posite directions.

8. The method of treating semi-liquid
material to aerate it, which comprises charg-
ing it into a tank of oblong horizontal cross
65 section and imparting to superelevated

parts of the charge constantly advancing
circularly by directed movement such as to
shape them temporarily into a superdis-
posed, or supernatant, circularly moving
belt, and thus produce and maintain, in said 70
parts of the charge, by aid of centrifugal
action, a longitudinally-extending cylindri-
cal air space intervening between said belt
and the remainder of the charge the cen-
tral longitudinal axis of which air space is 75
in parallelism with the major axis of the
tank.

9. The method of treating semi-liquid
material to aerate it, which comprises charg-
ing it into a tank of oblong horizontal cross 80
section, imparting to superelevated parts of
the charge constantly advancing circularly
directed movement such as to shape them tem-
porarily into a superdisposed, or superna-
tant, circularly moving belt, and thus produce 85
and maintain in said parts of the charge, by
aid of centrifugal action, a longitudinally-
extending cylindrical air space intervening
between said belt and the remainder of the
charge the longitudinal axis of which air 90
space is in parallelism with the major axis
of the tank, and meanwhile imparting to
parts of the charge in the lower portions of
the tank constantly advancing movement in
directions contrary to said first mentioned 95
movement.

10. The method of treating semi-liquid
material to aerate it, which comprises the
step of producing and maintaining in super-
elevated parts thereof a thereunder longi- 100
tudinally extending air space from the ends
of which air is indrawn and passes by levi-
tation upwardly into superdisposed parts
of the material.

11. The method of treating semi-liquid 105
material to aerate it, which comprises the
step of, by aid of centrifugal action, produc-
ing and maintaining in superelevated parts
thereof a thereunder longitudinally extend-
ing air space from the ends of which air is 110
indrawn and passes by levitation upwardly
into superdisposed parts of the material.

12. The method of treating semi-liquid
material to aerate it, which comprises the
step of producing and maintaining in super- 115
elevated parts thereof a thereunder longi-
tudinally extending air space from the ends
of which air is indrawn and passes by levi-
tation upwardly into superdisposed parts
of the material, and meanwhile imparting 120
to said parts constantly circularly advanc-
ing movement.

13. The method of treating semi-liquid
material to aerate it, which comprises the
step of producing and maintaining in super- 125
elevated parts thereof a thereunder longi-
tudinally extending air space from the ends
of which air is indrawn and passes by levi-
tation upwardly into superdisposed parts
of the material, and meanwhile imparting 130

to said parts constantly circularly advancing movement, and subdividing the air thus incorporated in the material.

14. The method of treating milk to convert it into an aerated, plastic, coherent, adhesive mass which comprises first concentrating it, and then producing and maintaining in superelevated parts of the resulting concentrate a thereunder longitudinally

extending air space from the ends of which air is indrawn and passes by levitation upwardly into superdisposed parts of the concentric.

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Witnesses:

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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."