July 3, 1951 C. W. SMITH 2,559,518

RECIRCULATING TANK MIXING SYSTEM

Filed March 26, 1948

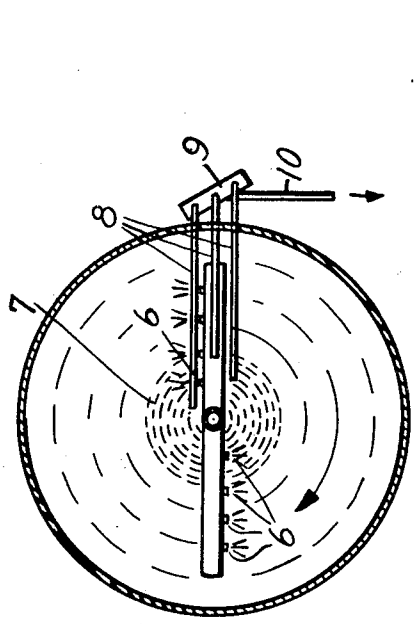



FIG.-2

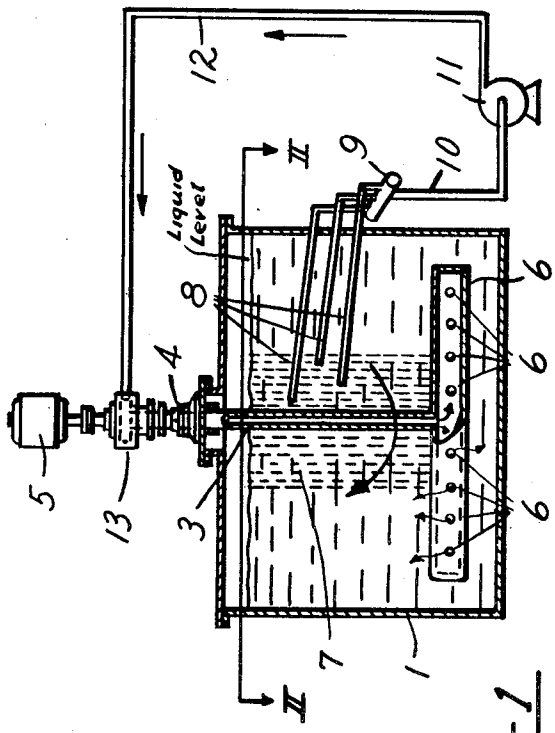



FIG.-1

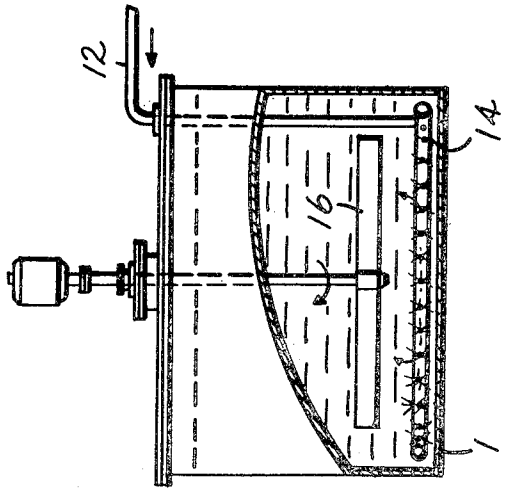



FIG.-3

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Patented July 3, 1951

2,559,518

# UNITED STATES PATENT OFFICE

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## RECIRCULATING TANK MIXING SYSTEM

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Application March 26, 1948, Serial No. 17,145

3 Claims. (Cl. 259—95)

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The present invention relates to a tank mixing system and particularly to a method and apparatus for preparing mixtures such as are employed in grease making, acid and caustic treating operations, in dissolving solids in liquid materials or making slurries thereof, and operations of a similar nature. It is an object of the invention to provide a method and means for improving the efficiency of mixing by mechanical agitation, and to reduce the mixing time required under any given circumstance.

It has been found that in operations involving the mixing of two or more materials, particularly in such operations where a body of such materials is mechanically agitated by paddles or propeller mechanisms in a tank or similar container that there is formed a central core of material above the agitator blades in which the materials are mixed at a much slower rate than in the zone or area in the immediate vicinity of the agitator blades. To overcome such a condition, it is now proposed that provision be made for withdrawing materials from the low turbulence central core above the agitator blades for recirculation and discharge into the high turbulence zone in the immediate vicinity of the agitator blades.

The invention and its objects may be more readily understood from the following description when read in conjunction with the accompanying drawing in which

Figure 1 is a diagrammatic showing of the apparatus in vertical section,

Figure 2 is a cross sectional view along the line II—II of Figure 1, and

Figure 3 is an alternate form of apparatus according to the invention.

In the drawings, the numeral 1 indicates a tank or other container for a batch of two or more materials to be mixed, either or both of which may be a liquid. As indicated, the method and apparatus may also be utilized for the production of solutions of solid materials in a liquid or for producing slurries of solid materials in liquids. As shown, the tank or container is provided with means for agitating a body of materials to be mixed therein. Preferably such means is a hollow, agitator-impeller member 2, supported within the container as by means of a hollow shaft 3. Suitable bearing means such as shown at 4 may be provided to support the shaft and facilitate rotation as by a motor 5 attached to the shaft at its upper end, or by other means. The hollow impeller member 2 illustrated in Figures 1 and 2 of the drawings, is provided with a plurality of jet passageways 6 opening outwardly therefrom through the trailing

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edge portions of the impeller, and is in direct communication interiorly with the hollow shaft 3.

In a conventional system, in which the mixing operation is accomplished by use of a generally comparable impeller mechanism, a zone of low turbulence usually occurs in the area immediately above the impeller member, substantially within the rotation radius thereof. This zone of low turbulence may have the form of a substantially cylindrical core immediately above the impeller. This core or low turbulence zone is indicated by the numeral 7, and by light parallel vertical lines in Figure 1 and light circular lines in Figure 2. To overcome the stagnation effect of such a central zone or core, one or more conduits 8 are extended into the container 1 opening at the inner end within the area immediately above the impeller 2, and within the rotation radius of the impeller blades. The conduits 8 communicate, as through a header or manifold 9, with the suction line 10 of pump 11. Material which is withdrawn from the low turbulence zone 7 in the container 1, by way of lines 8, 9, and 10, is returned by pump 11 through discharge line 12 to the high turbulence zone in the vicinity of the impeller 2. As illustrated in Figures 1 and 2, the discharge line 12 is suitably connected to the hollow shaft 3, as by a collar 13, and the returned material is discharged through the trailing edge portions of the impeller 2 by way of passageways 6.

In operation, the pump 10 continuously withdraws a portion of the materials being mixed from the low turbulence zone 7 through conduits or lines 8, 9, and 10, and returns it to the container through line 12, hollow shaft 3, and is discharged into the high turbulence zone in the immediate vicinity of the impeller 2, by way of jet passageways 6. If sufficient pressure is provided by the pump 11, the jetted discharge from the passageways 6 may be utilized to drive the agitator-impeller 2, or to supplement the action of driving means such as the motor 5.

In the apparatus as shown in Figure 3, the line 12 is connected to an annular conduit member 14 disposed peripherally within the container at a level intermediate that of the impeller and the container bottom, within the high turbulence zone adjacent the impeller. The material may be discharged into this area from line 14 by passageways or jets 15 opening through the walls of the line or conduit 14. In this form of the apparatus, as illustrated, the agitator-impeller and shaft need not be hollow, and a simple paddle wheel 16 and solid shaft may be utilized.

Although the invention has been set forth with

reference to specific embodiments thereof, for the purpose of illustration, it is not intended to be limited thereby, but only by the appended claims.

What is claimed is:

1. A mixing apparatus comprising a container for a fluid body of materials to be mixed, said container having a bottom wall, rotatable agitator-impeller means disposed in said container closely spaced in vertical relation to the bottom wall thereof, rotatable shaft means extended into said container and connected to said agitator-impeller for rotation thereof, a plurality of conduit elements, for withdrawal therefrom of portions of a fluid body of materials in said container, extended into said container, each having an inner end terminating and opening in radially and vertically spaced relation to one another and to said shaft means and agitator-impeller respectively, and within the radius of rotation of said agitator-impeller, and an outer end exteriorly of said container, pump means connected to the outer ends of said conduit elements for withdrawing portions of the body of materials contained therein, and means for returning the material portions withdrawn to the container adjacent said agitator-impeller.

2. A mixing apparatus according to claim 1, in which said agitator-impeller means is a hollow



member having a plurality of passageways opening outwardly through trailing edge portions thereof, and said rotatable shaft means is a hollow shaft opening at one end into said agitator-impeller, and at the other end communicating with said pump means.

3. A mixing apparatus according to claim 1, in which said means for returning the material portions withdrawn to said container comprises a perforated annular conduit member disposed in said container between the bottom wall thereof and said agitator-impeller, and conduit means communicating between said member and said pump means.

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