The present invention relates to mixers and more particularly to mixers having a turbine action for the intermixing of liquids and liquids, liquids and gases, or liquids and solids, while circulating the same in a kettle or the like.

The invention seeks to provide a mixer of the type indicated wherein an intimate direct shearing action is obtained in the particles of a mass passing through the mixer.

The invention further contemplates the provision of means for introducing reactants, solvents, etc., into the mass being mixed at the point of mechanical shearing of the particles of said mass and thereby obviating localized over-concentration of the material being introduced.

Another object of the invention is to provide a mixer wherein a greater area of contact between gas and liquid, or liquid and liquid phases are obtained during the aforementioned shearing action.

The invention as herein contemplated, and which will be more fully described in the following specification, is designed to give several advantageous operation phases.

The instant design provides for direct or mechanical shearing in addition to the agitation or indirect shearing obtained by the circulation of the mass of material in a container or kettle. A pumping action of the mixer is afforded by providing a limited inlet to the rotor or impeller of the mixer. This insures a more intimate and longer contact of the mass of materials with the mixer, a feature not obtained in multi-blade paddles as herebefore used. The rotor of the mixer is of such design as to allow for greater linear speeds and hence greater pumping capacities.

"Floating pockets" in the mass are obviated due to the forced flow through a restricted impeller inlet. In this manner a better heat transfer is obtained. The device is designed to provide for the injection or introduction of a gas or liquid at the point of most intense mixing action to make possible continuous mixing in a small container or kettle.

The features outlined in the preceding paragraphs may be obtained with the following principles of operation:

Shearing between rotor blades and stator ridges or ribs provide for the mechanical shearing above-mentioned. A limited or restricted inlet to the impeller insures to each particle of the circulated mass, a uniform movement of travel. The provision of stationary radial elements to tangentially deflect the mass after passing through the mixer, acts to retard the flow of material through the mixer and thus to increase its efficiency. The provision of holes or apertures in the stator portions of the mixer for the introduction therethrough of reactants, blenders, etc., at the points of highest velocity flow, causes a wiping and spatula action of the mass passing through the mixer and past the mentioned apertures. The present design lends itself to being arranged in units positioned one above the other so multi-turbine effects may be obtained. Providing encircling screens or cages around the mixer would serve to hold up the charge in said mixer to increase the amount of shearing of the mass therein.

The apparatus as herein contemplated, may be used as a continuous mixer in sulphonation and nitration. It may be used in flue gas absorption and in the distribution of CO₂ in resin kettles. The mixer may be used for hydrogenation and oxidation at atmospheric or at greater pressures, and in "blowing" of asphalt and the "blowing" of linseed oil and other oils at atmospheric, at greater pressures, and at all temperatures. The device may be used in blending operations, thinning operations, in the manufacture of suspensions, in emulsifications, for gas scrubbing, in the acid treatment of petroleum and lubricating oils, in the continuous NaOH refinement of vegetable oils, etc.

In carrying out the invention it is, of course, too cumbersome to illustrate and describe the various changes and arrangements which may be made in the apparatus for each of the foregoing types of operation. The instant disclosure is intended as exemplary of apparatus for each of the herein mentioned purpose, the following detailed specifications thereof being based on the accompanying drawings, in which exemplary forms of mixers have been illustrated.

In the drawings:

Fig. 1 is a plan view, partly in cross section, of a kettle in which is provided a turbine type mixer as herein contemplated.

Fig. 2 is an elevational view thereof, the kettle being broken away to expose to view a mixer of instant design.

Fig. 3 is an enlarged vertical sectional view, partly broken away, of a mixer such as shown in Fig. 2.

Fig. 4 is a fragmentary plan view of the rotor of the mixer shown in Fig. 3.

Fig. 5 is a similar view of one of the stator members thereof.

Fig. 6 is a front elevational view partly broken away and partly in cross section, of a kettle hav-
ing a mixer therein of alternate design, connec-
tions being shown for introducing material at the shear-
ing points of said mixer.

Fig. 7 is a top plan view, broken in successive
stages, of the mixer shown in Fig. 6.

Fig. 8 is a fragmentary sectional view indicat-
ing the intimate detail of one of the stator mem-
ers of the mixer shown in Figs. 6 and 7.

Fig. 9 is a similar view of an alternate form of
stator.

In that practical embodiment of the invention
illustrated in Figs. 1 to 5 inclusive, the kettle 15
is shown as comprising a cylindrical shell 16 and
dished top and bottom portions respectively 17
and 18a. Vertically disposed in the kettle there
is provided a shaft 19 driven by means such as
the motor 19 through reduction gearing 20 sup-
ported at the top of the kettle.

In the usual manner the kettle may be provided
with a manhole 21, a charging connection 22,
and a reflux connection 23.

The turbine type mixer herein contemplated,
is preferably positioned below the middle of
the kettle and supported in said position as by means
of rods 24 or the like, carried by supports 25
affixed to the inner wall of the kettle. The posi-
tion of the mixer in the kettle may vary, how-
ever, and may be determined by the pumping
capacity of the rotor, the viscosity of the ma-
terial being agitated, and the intermediate changes
in the consistency of the mass.

Referring now more particularly to Figs. 3, 4,
and 5, upon the shaft 19 there is provided a ro-
tor member 28 on both upper and under faces of
which are preferably set the blades 27 and 28
respectively. These blades, as shown in Fig. 4,
are disposed tangentially to a circle of smaller
diameter than the outer periphery of the rotor 26.

The mixer also includes the respective upper
and lower stator rings 29 and 30, each being
formed with ribs or ridges respectively 31 and 32,
directed toward the respective blades 27 and 28.
The ribs 31 and 32 are preferably radially ar-
 ranged as shown in Fig. 5. The stator rings are
so arranged in relation to the rotor 26 as to pro-
vide the gaps 33 and 34 between the respective
blades and ribs. The stator members are prefer-
ably formed as rings to provide central inlet
openings 35 and 36, the outlet of the mixer being
in the present instance, unrestricted.

The aforementioned rods 24 serve to support the
spaced brackets 37, said brackets serving to hold
the stator rings in the aforementioned spaced
relation.

Because of the angular disposition of the blades
27 and 28 in relation to the respective ribs 31 and
32, a direct shearing of material passing between
said blades in the gaps 33 and 34, is obtained.

Fig. 2 shows in a general way, by means of ar-
rows, the type of flow obtained in the mass dur-
ing rotation of the rotor 26. Material is sucked
downwardly through the opening 35 and upward-
ly through the opening 36 and by centrifugal
forces directed past the respective blades of the
rotor and ribs of the stator to be mechanically
sheared and then forced to the outer periphery
of the mixer and into the mass of materials in the
kettle. There is thus established a circula-
tion of the mass of materials wherein in a quite
short time all of the materials within the kettle
are thoroughly intermixed first by the aforemen-
tioned mechanical shearing and second by the
friction among the particles in the mass as said
mass is being agitated.

To further enhance the friction in the mass,
deflector blades such as 38 may be provided on
the inner wall of the kettle to retard swirling of
the mass during agitation thereof.

It is evident from the above that a highly effi-
cient mixer for the purpose previously set forth
has been obtained, that all the parts thereof are
of such design as to be inherently strong; that
the peripheral speed of the rotor has been util-
ized to obtain a highly efficient operation—one
which was not obtainable by the usual type of
paddle or turbine mixer where the material in the
kettle could not maintain uniform contact with the
paddles; and that the confinement of the ro-
tor between superposed stator members guides
the material into such intimate contact with the
blades and ribs that a highly efficient mechanical
shearing of the mass is obtained.

In that form of the invention shown in Figs. 6 to
9, the kettle 40 has mounted therein the vertical
shaft 41 which may be rotated in a manner
as above described. Upon the shaft 41 is carried
a rotor 42 having blades 43 and 44. This rotor is
substantially similar to the one previously de-
scribed.

In this form of the invention the stator mem-
ers 45 and 46 are also ring-shaped and provided
with inlet openings 47 and 48.

The stators 45 and 46 are each shown as having
a respective chamber 49 and 50 and piping con-
nections 51 and 52 to a vertical pipe 53 having
a flange 54 above the top of the kettle for con-
nection to a supply of a gas or a liquid.

Each of the stator rings, at its outer periphery,
serves to support rings 55 between which are dis-
posed a plurality of vertically disposed baffles 56.

In staggered relation to the baffles 56 there are
also arranged another series of baffles 57. The
latter may be termed primary baffles and the
former, secondary baffles.

With particular reference to Figs. 7 and 8, it
will be noted that each of the chambered stator
rings 45 and 46 are provided as at 58 with a
series, or as shown at 59 of Fig. 9, with a plurality
of series, of holes or apertures of relatively small
dimension. These apertures 58 or 59 communi-
cate to the chambers 49 and 50 with the gap or space
between the blades 43 and 44 and the respective
stator members.

As shown in Fig. 8, the hollow stators may also
be provided with ribs for shearing association
50 with the shear blades 43 and 44, the viscosity of
the mass being agitated, determining the desir-
ability of using the ribs and also determining the
height of the ribs and blades.

Thus it may be seen that during the agitation
and mixing of materials and the shearing there-
of, a gas such as air or CO₂ or other gases, or
a suitable liquid or finely divided solid may be
introduced through the pipe 53 and thus into
the chambers 49 and 50 to pass through the aper-
tures 58 into the mentioned area of shearing
between the rotor and the stators. In this man-
ner the material passing through pipe 53 may be
introduced into the mass in small but continu-
ous quantities to insure a uniform distribution
therein.

The primary deflectors 51 and also the second-
ary deflectors 56 serve to minimize swirling of
the mass and also serve to obtain a more intimate
incorporation of the material passing through the
mixer and into the remaining mass of materials
by retarding the flow of material as it leaves
the mixer. The rings 55 serve to confine the ma-
terial flowing from the mixer to enhance the ac-
tion immediately above set forth.
While only two forms of the mixer have been disclosed, it is obvious that the design thereof could be varied to suit the different conditions outlined in the preamble of this specification, and it is intended that the invention as claimed should have a broader basis of interpretation than on the present specific disclosure.

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

1. A mixer comprising a rotor, shear blades on said rotor, a stator member disposed to each side of said rotor and each having a surface in shearing relation with said shear blades, said stator members each having a chamber and each provided with perforations communicating said chamber with the shearing points of the mixer, and means for conducting a fluid to said chambers.

2. A mixer of the character described comprising a rotor having shear blades, a stator at each side of the rotor and each having a surface in shearing relation with said shear blades, each stator being formed with a central inlet opening for the passage therethrough of a fluid mass entering the mixer, and deflector baffles positioned beyond the outer periphery of said rotor for deflecting the fluid mass leaving the mixer, said baffles being carried by said stators and arranged in plural concentric series.

3. A mixer of the character described comprising a rotor having shear blades, a stator at each side of the rotor and each having a surface in shearing relation with said shear blades, each stator being formed with a central inlet opening for the passage therethrough of a fluid mass entering the mixer, and deflector baffles positioned beyond the outer periphery of said rotor for deflecting the fluid mass leaving the mixer, said baffles being fixed and arranged in plural concentric series.

4. A device of the character described comprising a pair of hollow stator members having apertured faces directed towards each other, shear ribs on said faces, a rotor positioned between said stator members and having blades in shearing relation with said shear ribs respectively, and means connected to said stator members for conducting fluid to the hollows therein, said fluid passing through the mentioned apertures directly to the shearing points between said ribs and said blades.

5. In a device of the character described, a pair of hollow stator members, and a rotor positioned therebetween for inducing a flow of a liquid mass between inwardly directed surfaces of said stator members, a set of blades on each side of said rotor, each set of blades being directed towards one of the mentioned stator surfaces to shear the liquid mass passing therebetween, said inwardly directed stator surfaces being apertured for passage therethrough of a fluid circulating in the mentioned hollow stator members, the fluid passing through the apertures being directed at the shear points between each set of rotor blades and its related stator surface.

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