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DEVICE FOR MIXING, STIRRING, EMULSIFYING, AND
PUMPING, AND THE ACCELERATION OF CHEMICAL
AND PHYSICAL REACTIONS BY VIBRATION
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Fig. 1.

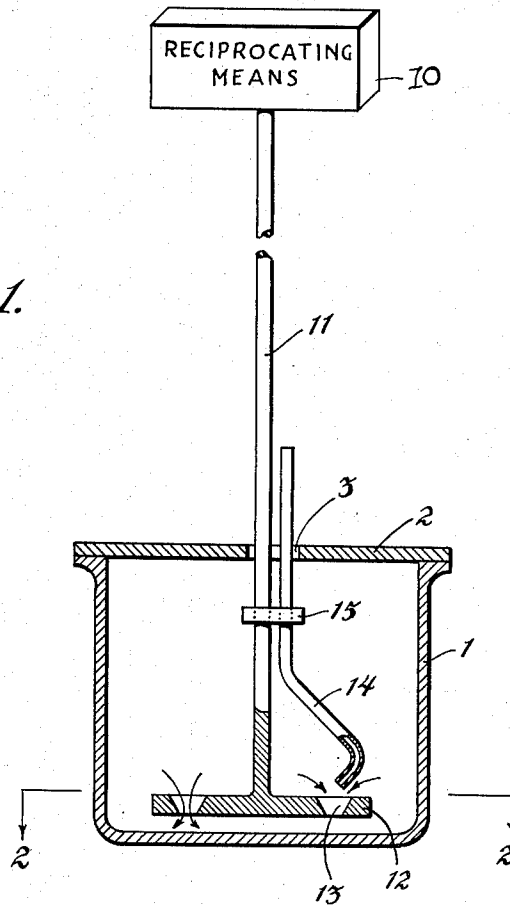
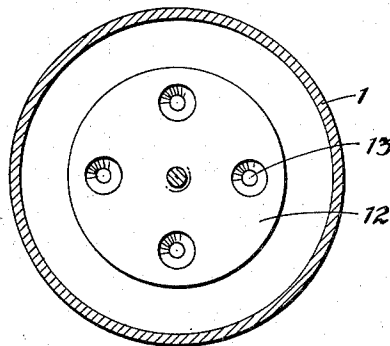


Fig. 2.



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DEVICE FOR MIXING, STIRRING, EMULSIFYING, AND PUMPING, AND THE ACCELERATION OF CHEMICAL AND PHYSICAL REACTIONS BY VIBRATION

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3 Claims. (Cl. 259-27)

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This invention relates to a device for mixing, stirring, emulsifying and the accelerating of chemical and physical reactions by vibration. More particularly it relates to such a device in which contact between a liquid and a gas is enhanced and especially for such contact in the presence of a catalyst.

In my co-pending application Serial No. 74,434, filed February 3, 1949, now United States Patent Number 2,615,692 issued October 28, 1952, there is described and claimed a device for mixing, stirring, emulsifying and/or pumping which operates by vibratory means and which ensures the production of sufficient turbulence in a liquid to be mixed or emulsified. In accordance with my Patent Number 2,615,692 there is provided a vibratory mixer having a relatively thin elongated shaft with a transverse mixing member fixedly mounted on the shaft with the shaft adapted to extend into, and the transverse member to be fully submerged by, a liquid. Mechanical or electrical means are connected to the upper end of the shaft causing the shaft and the mixing member to vibrate or oscillate at a relatively high frequency and small amplitude so that upon submerging the mixing member in a liquid the liquid is impelled at a substantial velocity with respect to the mixing member.

The present invention is an improvement upon the device of my co-pending application and is especially useful where a gas and liquid are to be intermixed, such as for example in a reaction involving a liquid and a gas. In accordance with my improvement, I provide a fluid or gas conduit having a discharge outlet adjacent the mixing member in a zone in which the liquid has had imparted to it a substantial velocity by the vibration of the mixing member. In such a zone the velocity of the liquid with respect to the discharge outlet in the fluid conduit causes a suction to be set up in the conduit and thereby causes fluid to pass from a source through the conduit and out of the outlet into the zone of mixing caused by the vibration of the mixing chamber.

For the purpose of illustrating the invention, there are shown in the accompanying drawings a form thereof which is at present preferred, although it is to be understood that the various instrumentalities of which the invention consists can be variously arranged and organized and that

the invention is not limited to the precise arrangements and organizations of the instrumentalities as herein shown and described.

In the accompanying drawings:

Figure 1 is a vertical section of a vibrating mixer provided with my improvement and in which the mixing member is non-resilient.

Figure 2 is a horizontal section taken on line 2-2 of Figure 1.

Referring to the drawings for a preferred embodiment of the present invention, there is shown container 1 provided with a cover 2 with a suitable opening 3 therein for a relatively thin elongated shaft 11 and a fluid conduit 14. Shaft 11 carries on its lower extremity a transversely enlarged relatively inflexible and form-retaining mixing member 12 fixedly mounted on the shaft in fully submerged relationship to the liquid. The mixing member 12 is also provided with tapered liquid passageways 13 extending through the mixing member 12 generally in the direction of the oscillation or vibration of the shaft 11.

The shaft 11 is driven by reciprocating means 10 and oscillates along its axis and when it moves upward the liquid rushes downward through the holes 13 and since the holes taper downward toward the bottom of the container 1 the liquid is forced to converge to a smaller diameter. When the agitator moves downward a small quantity of liquid flows in the opposite direction, i. e. upward, but this quantity is many times smaller than that which flows downward, this cycle manifesting itself in a pronounced downward flow (as a result of the two currents). In this action the liquid trapped in the larger ends of the tapered openings by the on-coming mixing member is compressed and forced out of the smaller trailing ends of the tapered openings and is discharged in the opposite direction at a considerably higher speed than the speed of the mixing member. Circulation is thus established and extends appreciably beyond the mixing member in the direction of the taper. By extension of the vibratory path this circulation can easily be stepped up to a fountain-like spurt of the liquid in the vessel 1. Thus, the liquid circulates through the holes in the direction of the arrows and obtains a substantial velocity which contributes to the emulsifying, mixing, stirring or pumping action of the device.

As shown in Figure 1, the fluid conduit 14 is dis-

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posed in the mixer so that the fluid conduit discharge outlet is adjacent the mixing member 12 at the larger end of the tapered passageway 13 and in a zone in which the liquid has a substantial velocity. The liquid rushing by the discharge outlet of the fluid conduit creates a suction therein and thereby causes fluid to pass through the conduit and to be discharged into the moving liquid. The fluid from the conduit is thus carried with the liquid, beaten up with it by the vibratory action, and is uniformly distributed throughout the liquid. The fluid conduit 14 may be attached to shaft 11 in any suitable manner, such as by coupling 15 which is provided with openings for shaft 11 and conduit 14.

Depending upon the use to which the device is put, a liquid or a gas may pass through the fluid conduit. The device is particularly useful, however, when it is desired to pass a gas through the conduit. The inlet to the conduit may run to any suitable source such as, for example, the gas which is supernatant to the liquid in the container or to a source outside the container. Obviously also the inlet to the conduit may be located in the liquid in the container or in some other source of liquid depending upon the desired mixing.

The device is particularly useful in reactions in which a catalyst in finely divided form, such as a powder, is to be used in a reaction involving a liquid and a gas. By the use of the present improvement in a vibratory mixer, the catalyst is stirred up and at the same time it is brought into intimate contact with the liquid and the gas which are to take part in the reaction. The use of the device permits the acceleration of such processes and reactions many times over.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof, and it is therefore desired that the present embodiment be considered in all respects as illustrative and not restrictive, reference being had to the appended claims rather than to the foregoing description to indicate the scope of the invention.

I claim:

1. A vibratory mixer for agitating the fluid contents of a liquid-retaining vessel comprising an elongated shaft adapted to extend into a body of liquid retained within said vessel, a transversely enlarged relatively inflexible and form-retaining mixing member fixedly mounted on an end of said shaft and adapted to be fully submerged in said liquid, mechanism operatively connected to the opposite end of said shaft for causing said shaft and said mixing member to reciprocate, a fluid conduit for introducing fluid into said vessel fixedly coupled with said shaft for axial reciprocation therewith and having a discharge outlet for introducing fluid into said vessel juxtaposed adjacent the mixing member at a spaced distance therefrom, at least one tapered liquid passageway extending through the mixing member in a direction generally parallel to the direction of reciprocation, the large diameter opening of each such tapered passageway being positioned on the surface of the mixing member facing the discharge outlet of said fluid conduit and said one passageway being in substantial alignment with said fluid conduit discharge outlet so as to receive fluid therefrom and the small diameter opening of each such tapered passageway being positioned on the opposite surface of the mixing member whereby liquid trapped in each said large tapered pasageway

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opening is compressed and forced out of each smaller opening and impelled therefrom at a higher speed than the speed of the mixing member during reciprocation, thereby causing a pronounced circulation of the liquid in the vessel through each said tapered passageway and aspirating fluid through the discharge outlet of said fluid conduit into the body of liquid within said vessel.

2. A vibratory mixer for agitating the fluid contents of a liquid-retaining vessel comprising an elongated shaft adapted to extend into a body of liquid retained within said vessel, a transversely enlarged relatively inflexible and form-retaining mixing member fixedly mounted on an end of said shaft and adapted to be fully submerged in said liquid, mechanism operatively connected to the opposite end of said shaft for causing said shaft and said mixing member to reciprocate, a fluid conduit for introducing fluid into said vessel fixedly coupled with said shaft for axial reciprocation therewith and having a discharge outlet for introducing fluid into said vessel juxtaposed adjacent the mixing member at a spaced distance above the upper face of said mixing member, a plurality of tapered liquid passageways extending through the mixing member in a direction generally parallel to the direction of reciprocation, the large diameter opening of each such tapered passageway being positioned on the upper face of the mixing member with one of said openings being juxtaposed to the discharge outlet of said fluid conduit so as to receive fluid therefrom and the small diameter opening of each such tapered passageway being positioned on the lower face of the mixing member whereby liquid trapped in each said large tapered passageway opening is compressed and forced out of the smaller openings and impelled therefrom at a higher speed than the speed of the mixing member during reciprocation, thereby causing a pronounced circulation of the liquid in the vessel through each of said tapered passageways and aspirating fluid through the discharge outlet of said fluid conduit into the body of liquid within said vessel.

3. A vibratory mixer for agitating a fluid comprising the combination of a liquid-retaining vessel, an elongated shaft having one end extending into said vessel, a transversely enlarged relatively inflexible and form-retaining mixing member fixedly mounted on said end of the shaft for submergence in liquid in said vessel, mechanism operatively connected to the other end of said shaft for causing said shaft and mixing member to reciprocate, a fluid conduit for introducing fluid into said vessel fixedly coupled with said shaft for axial reciprocation therewith and having a discharge outlet for introducing fluid into said vessel juxtaposed adjacent the mixing member at a spaced distance therefrom, at least one tapered liquid passageway extending through the mixing member in a direction generally parallel to the direction of reciprocation, the large diameter opening of each such tapered passageway being positioned on the surface of the mixing member facing the discharge outlet of said fluid conduit and said one passageway being in substantial alignment with said fluid conduit discharge outlet so as to receive fluid therefrom and the small diameter opening of each such tapered passageway being positioned on the opposite surface of the mixing member whereby liquid trapped in each said large tapered passageway opening is compressed

and forced out of each smaller opening and impelled therefrom at a higher speed than the speed of the mixing member during reciprocation, thereby causing a pronounced circulation of the liquid in the vessel through each said tapered passageway and aspirating fluid through the discharge outlet of said fluid conduit into the body of liquid within said vessel.

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