

Aug. 27, 1968

D. V. LIVESEY ET AL

3,398,935

MIXING MEANS

Filed March 25, 1964

MEANS POSITIONING  
MIXING MEANS & SUPPLYING  
PRESSURIZED GAS

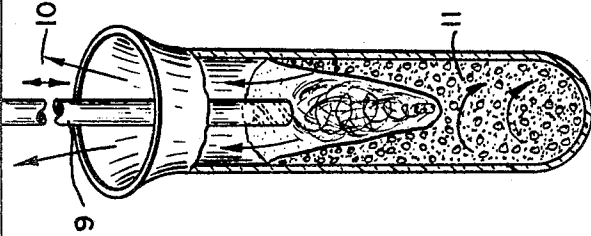


FIG. 3

MEANS POSITIONING  
MIXING MEANS & SUPPLYING  
PRESSURIZED GAS

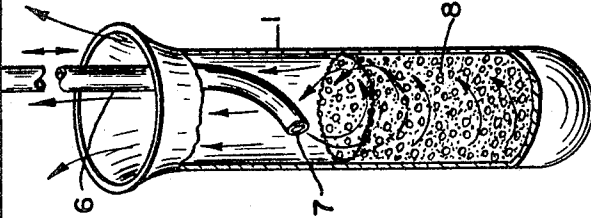


FIG. 2

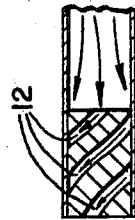


FIG. 4

MEANS SUPPLYING  
CONSTITUENTS TO  
BE MIXED

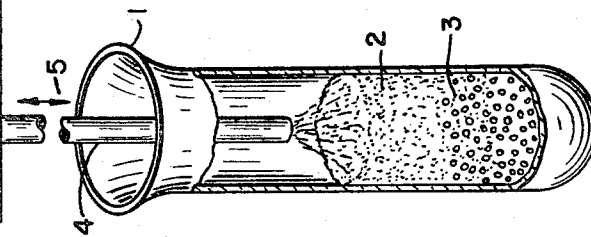


FIG. 1

DONALD V. LIVESEY  
KENNETH A. SNOW  
INVENTORS

BY *Arthur H. Mellon*  
*Frank C. Parker*

ATTORNEYS

1

2

3,398,935

MIXING MEANS

Donald V. Livesey, Irondequoit, and Kenneth A. Snow, Greece, N.Y., assignors to Bausch & Lomb Incorporated, Rochester, N.Y., a corporation of New York

Filed Mar. 25, 1964, Ser. No. 354,686

3 Claims. (Cl. 259-18)

This invention relates to a means and a method of mixing materials and more specifically mixing without introducing a foreign element into a mixture.

The mixing of constituents for chemical reactions, chemical analysis, or mixtures in general has been accomplished by using a stirring element to uniformly distribute the constituents.

This manner of mixing may contaminate the mixture and create a false indication in analysis, or a variable rate in the chemical reaction or some other undesirable result. Accordingly it is desirable to provide a mixing means whereby no foreign element is introduced into the mixture and the mixing is accomplished by inducing movement of the fluids through fluid friction thereby providing an even more rapid mixing means.

It is an object of this invention to provide a mixing by inducing friction between the constituents and causing a rotary or random movement in the mixture.

It is another object of this invention to provide a mixing of the constituents by inducing the fluid friction to the mixture by a whirling mass of pressurized gas.

It is a further object of this invention to create a vortex of a gas to induce a vortex of liquid and through fluid friction provide a rapid and thorough mixing of constituents.

The objects of this invention are accomplished by providing a container for a number of constituents preferably including a liquid of low viscosity. The constituents are placed in the container and a whirling mass of pressurized gas is then directed on the surface of the liquid. The whirling mass of gas induces the whirling rotation of the liquid in the container causing a vortex in the liquid and a thorough and rapid mixing of the constituents. The vortex of gas may be created by a tangential positioned gas jet, or helical orifice means centrally located in the container to create a vortex mixing operation.

The preferred embodiments of this invention are described in the following paragraphs and illustrated in the attached drawings.

FIG. 1 illustrates a container and means for supplying the constituents to be mixed.

FIG. 2 illustrates a tangential gas jet inducing fluid friction in the mixture.

FIG. 3 illustrates helical orifices inducing the gas vortex and through fluid friction creating a liquid vortex for mixing.

FIG. 4 illustrates a sectional view of a helical orifice means.

Referring to FIG. 1 the container 1 is positioned for reception of a mixture of constituents 2 and 3. The number of constituents is immaterial, a means is illustrated for supplying a mixture to the container which may be introduced through the conduit 4 or other conduits which may be reciprocated in and out of the container 1 as indicated by the arrow 5. When the desired amount of constituents are placed in the container 1 the conduit 4 or others are withdrawn from the container.

FIG. 2 illustrates the container 1 containing the constituents. A tube 6 connected to a source of pressurized gas is introduced into the container adjacent the upper surface of the mixture. The mixture preferably includes a liquid of low viscosity which is capable of movement when a gas is directed in a circulating manner on the upper surface of the liquid. The jet 7 creates a whirling mass of gas on the upper surface of the mixture which drags the surface of the liquid with the circular motion and thus induces by fluid friction a vortex in the mixture 8.

FIG. 3 illustrates a tube 9 which may be reciprocated in and out of the container in the manner indicated by the arrow 10 to introduce pressurized gas. The pressurized gas is directed downwardly against the upper surface of the liquid 11. The gas forms a vortex which also induces a vortex as illustrated in the liquid 11. The variable rate of circulation of the various layers in the liquid 11 is created by the rotating vortex axially within the tube and a stationary condition of the container walls on the peripheral engaging portion of the liquid 11. The vortex created in the liquid 11 rapidly mixes the constituents.

FIG. 4 illustrates a section view of the end portion of the hollow tube 9. A plurality of helical orifices 12 passing through a solid cylindrical portion impart a whirling axial motion to the gas as it leaves the orifices. This whirling motion creates a vortex of gas which induces through fluid friction a vortex in the liquid.

The device as illustrated operates in the following described manner. The constituents of a mixture are introduced in FIG. 1 within the container 1. The tube 6 or 9 is then introduced into the open end of the container and creates a whirling mass of gas which engages the fluid surface causing the gas to drag the surface of the liquid in a circular motion. The greater the pressure the greater the rate of motion and the more rapid the mixing of the liquid. The liquid within the container rotates to form a vortex. The various layers intermediate the gas contacting surface and the liquid contacting the peripheral walls of the container are rotated at varying rates to create a thorough mixing throughout the liquid.

The methods set forth are substantially the same whereby the constituents are introduced into the container and then the vortex of gas is formed within the container and a vortex within the liquid is then induced through fluid friction between the gas and the liquid.

The preferred embodiments of this invention are illustrated and described and it is understood that other embodiments might be devised which would fall within the scope of this invention which is defined by the attached claims.

We claim:

1. Apparatus for mixing a sample containing at least one low viscosity liquid material comprising in combination:

- open top container means for holding a sample to be mixed;
- conduit means for introducing separate sample constituents to be mixed into the container means;
- a mixing tube connected to a source of mixing gas, said mixing tube including helical passage means for the mixing gas;
- means for positioning the mixing tube vertically with respect to the sample; and
- means for supplying pressurized mixing gas and flow-

3

ing mixing gas from the helical passage means onto the sample surface in a vortex flow pattern to induce mixing of the sample constituents.

2. The apparatus of claim 1 wherein the mixing tube comprises a substantially solid cylinder portion having multiple helix-shaped passages of uniform flow area, and a hollow tube member surrounding the cylinder portion and connected to the supply means for pressurized mixing gas to the cylinder portion.

3. The apparatus of claim 1 wherein the conduit means may be reciprocated through the open top container means.

4

## References Cited

## UNITED STATES PATENTS

2,653,801	9/1953	Fontein et al. ....	259—4
2,795,403	6/1957	Mead .....	259—4
2,831,754	4/1958	Manka .....	259—4 X
3,212,757	10/1965	Martin et al. ....	259—4
2,208,673	7/1940	Hopkins .....	261—119 X
3,015,554	1/1962	Rummel.	

10 WALTER A. SCHEEL, *Primary Examiner.*

J. M. BELL, *Assistant Examiner.*