

A. H. STEVENS.
MIXING AND STIRRING DEVICE.
APPLICATION FILED FEB. 1, 1917.

1,255,944.

Patented Feb. 12, 1918.

2 SHEETS—SHEET 2.

Fig: 2.

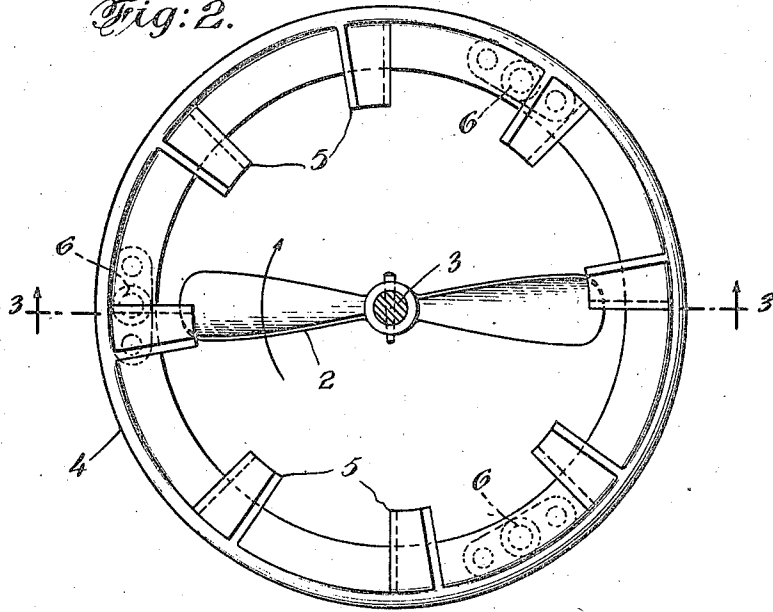
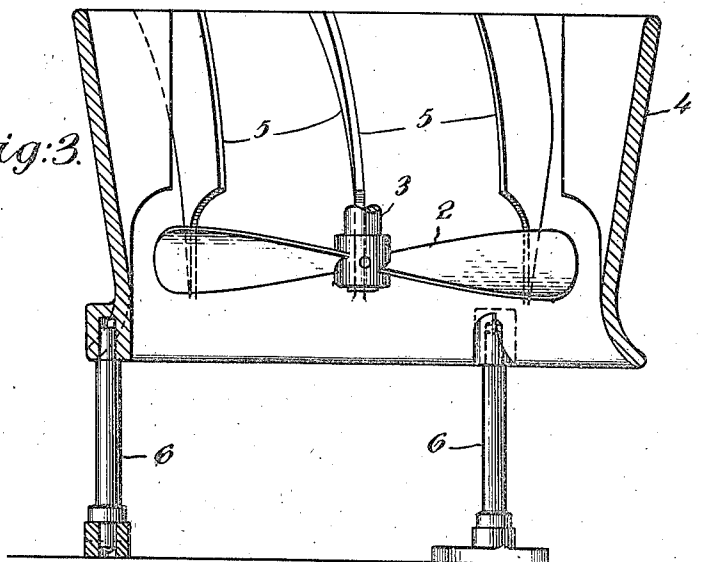


Fig: 3.



Inventor

Alfred H. Stevens

By *h* Attorney

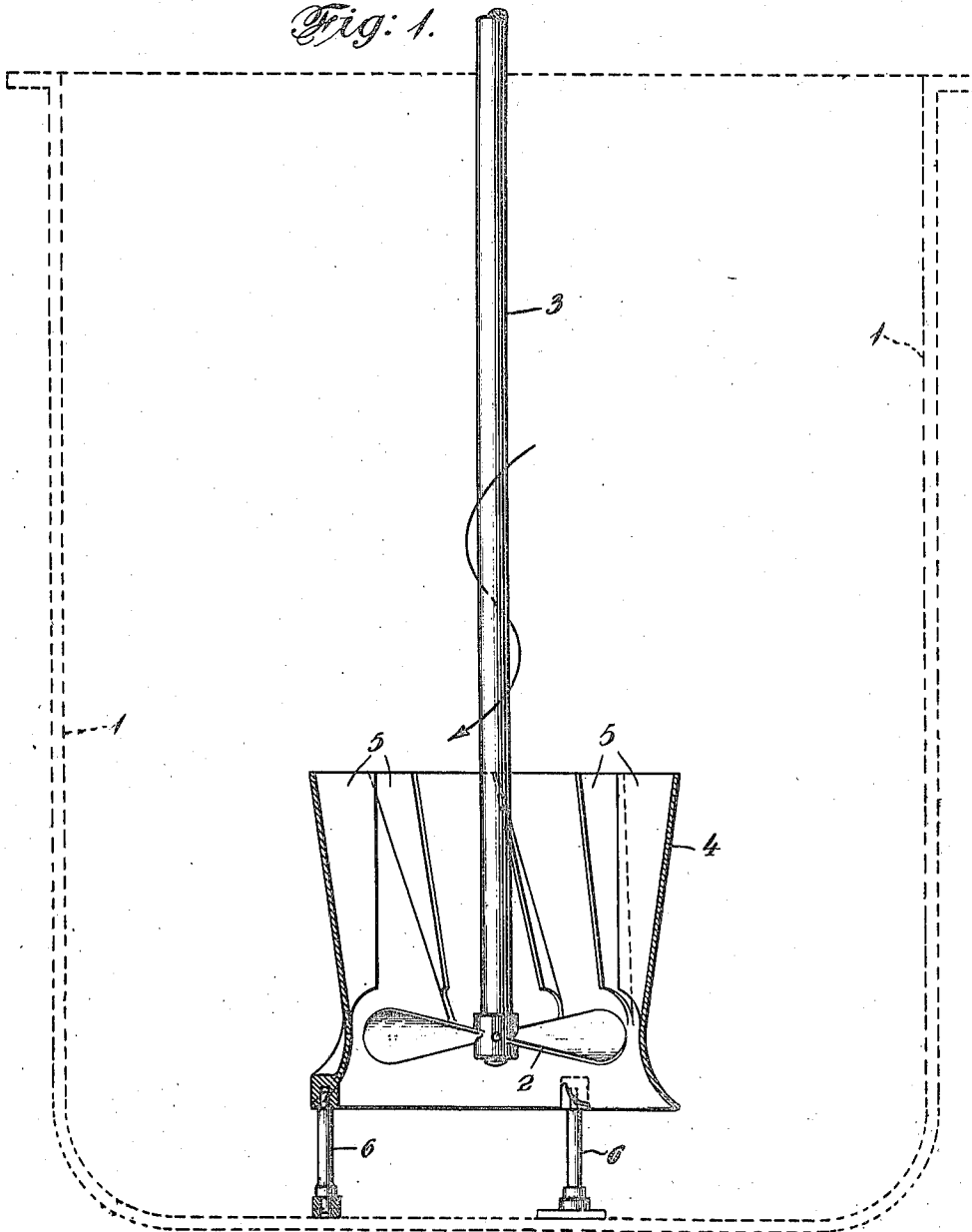
Frederick Becken

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Fig: 1.



Inventor

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UNITED STATES PATENT OFFICE.

ALFRED H. STEVENS, OF BROOKLYN, NEW YORK.

MIXING AND STIRRING DEVICE.

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Specification of Letters Patent.

Patented Feb. 12, 1918.

Application filed February 1, 1917. Serial No. 145,824.

To all whom it may concern:

Be it known that I, ALFRED H. STEVENS, a citizen of the United States, and a resident of the borough of Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Mixing and Stirring Devices, of which the following is a specification.

This invention relates to mixing apparatus and is particularly designed for use in connection with the mixing of liquids having different relative specific gravities although it may be applied and used in any location and for any purpose for which it is adapted.

In the art of mixing and stirring liquids frequent use has heretofore been made of mixing apparatus in which an agitating device of a helical or screw-propeller type has been caused to rotate about a vertical axis in the midst of a mass of material in a container to thereby intermingle the contents of the container. Generally the rotation of the agitating device has been in such a direction as to propel the adjacent material vertically and in either an upward or downward direction, this action being especially effective in mixing liquids having relatively different specific gravities. It has been found that the rotative movement of agitating devices of this type has had a pronounced tendency to set the whole mass of liquid in the container into bodily rotation about a vertical axis coincident with the axis of rotation of the agitating member. This bodily rotation of the liquid mass, which is ordinarily of such velocity that a vortex is formed in the upper surface, interferes to a considerable extent with the movement of the ascending and descending currents, the unobstructed flow of which is essential to the proper mingling of the different liquids.

Not only is the mixing of the material interfered with in the swirling action referred to, but the effective control of the temperature of the batch, which is essential in carrying out many chemical processes, is also restricted. In certain operations it is necessary to raise the temperature of the

batch through the application of externally applied heat by the means of a steam jacket surrounding the container. In other operations the contrary is the case, and it is necessary to lower the temperature of the material by means of a cooling water jacket. In the case where it is desirable to lower the temperature it has been found in actual practice that the liquid at the central part of the mass above the propeller is usually maintained at a higher temperature than that of the liquid adjacent the container walls, while where it is desirable to raise the temperature of the batch, the liquid at the central part adjacent the vortex is at a lower temperature than that near the walls. In either event the difference in temperature between different parts of the same batch of material indicates that the stirring operation is not effective to produce a uniform temperature throughout the batch.

It has also been found that the removal of water from a batch of material, after the washing that follows, for example, a nitration or sulfonation treatment, has been impeded by the time required for the swirling mixture to come to rest and permit the settling and separation of the heavier batch liquid from the lighter water.

The main object of this invention is to provide a mixing and stirring device having means for counteracting the rotating and swirling movement of the material produced by the agitating member.

With this and other objects in view, the invention consists principally in providing a mixing device comprising a container for a mass of agitable material in which a rotatable member, of relatively smaller diameter than that of the container, is disposed causing by its rotation a stream of the material in one direction longitudinally of the axis of the rotatable member and setting up a complementary counter stream longitudinally, in the opposite direction together with means for counteracting the swirling effect upon the material of the rotatable member while maintaining the opposed longitudinal streams.

In the accompanying drawing there is

illustrated a preferred embodiment of the invention, but it is to be understood that the invention may be carried out by other embodiments and by mechanism different from that specifically selected for illustration.

Figure 1 is a vertical sectional view of a device embodying the invention.

Fig. 2 is a plan view of the operating member and a modified form of draft tube used in the device.

Fig. 3 is a vertical section of the agitating member and draft tube taken along the line 3—3 of Fig. 2.

In the particular embodiments of the invention disclosed there is shown a mixing device of the general form in which an agitating member of the screw-propeller type is rotated about a vertical axis near the bottom of a container to thereby intermingle the contents of the container. The propeller employed in the present invention is provided with a draft tube through which the liquid, or other material, is forced by the propeller and, in order to nullify the swirling action of the liquid that is produced by the propeller, the draft tube is provided with stream deflecting vanes set at such an angle as to tend to rotate the ascending stream in a direction counter to that produced in it by the action of the propeller.

In this particular instance a mixing apparatus is shown in which any suitable container, such as 1, is adapted to hold the liquid, or other material, which is to undergo the mixing or stirring operation. A propeller 2, carried by the vertical drive shaft 3, is adapted to be rotated about a vertical axis in the liquid near the bottom of the container, the direction of rotation being such that the liquid immediately surrounding the propeller is forced upwardly through the central portion of the mass.

In actual practice it has been found that the upward flow of liquid in the vicinity of the propeller and the consequent downward flow adjacent the walls of the container, arising from the displacement of liquid by the propeller, is interfered with by the rotative or swirling movement of the entire liquid mass which the revolving propeller tends to produce. This interference with the vertically flowing currents, as will be evident, restricts the mixing action to a considerable extent and, as a consequence, an unnecessarily long interval of time has been needed to produce the required intimacy of mixture in the batches of material.

In order to counteract the swirling action of the liquid mass and to thereby greatly expedite the mixing operation, in the present invention a draft tube 4 provided with inwardly-extending stream directing vanes 5 is mounted adjacent the bottom of the container on standards 6 in such relation to

the propeller 2 that the upwardly flowing stream produced by the propeller is made to flow through the draft tube 4. The vanes 5 are preferably set at an inclination from the vertical and in such a direction that they tend to rotate the stream of liquid passing through the draft tube 4 in a direction opposite that in which the propeller 2 is rotating. That is, if the propeller 2 is rotated in a clockwise direction the vanes 5 are set at such an angle as will tend to rotate the liquid passing through the draft tube in a counter-clockwise direction. By suitably correlating the inclination of the vanes 5, the velocity of rotation of the propeller 2, and the pitch of the propeller blades, it will be obvious that the stream passing through the draft tube can be caused to emerge therefrom with its rotative tendency wholly or largely dissipated, so that no obstruction is presented to the thorough intermingling of the materials in the container either to effect an intimate mechanical mixture or to produce a desired chemical combination.

It will be noted that the draft tube 4, which preferably has the general formation of a Venturi tube, is spaced from the bottom of the container a sufficient distance to provide for the flow of an ample volume of liquid beneath the lower edge of the tube to restore the balance disturbed by the displacement of the liquid through the draft tube. It has been demonstrated by experiment that a draft tube of this particular form produces more efficient results than one that has a cylindrical or other formation. The flaring lower inlet end of the tube not only overcomes the tendency of the entering liquid to form eddy currents but, in addition, the out-spreading lower edge causes the descending streams to pass through the liquid at the angle formed by the junction of the walls with the base of the container and thus insures the agitation of the liquid in this comparatively inaccessible part of the container. The outwardly flaring outlet end of the tube offers less resistance to the stream from the propeller and also affords a more effective distribution of the ascending material into the portions of the material above than can be obtained with a draft tube that is cylindrical in form.

While a preferred form of draft tube having curved vanes 5 and a minimum height which permits the carrying out of the mixing operation on a batch of material that only partially fills the container is shown in Figs. 2 and 3 it will be obvious that not only can a draft tube of greater length and vanes of different form, as in Fig 1, be used but the propeller and draft tube construction is capable of a great

many modifications as will be best suited for operation on a wide range of materials. Suitable means may be provided for varying the inclination of the vanes or for varying the speed of rotation of the propeller as may be required.

It will be seen that a mixing and stirring device has been provided in which the ineffective swirling motion produced in the material by the rotation of an agitator of the screw-propeller type is converted into the vertically and radially moving currents most effective in performing the mixing operation. Not only is the mixing operation more effectively performed by this construction but a better control of temperature is effected when this is desirable. Furthermore the rapid settling and separation which permits of the removal of water from the batch in a very short interval of time following a washing operation, because of the absence of swirling in the liquid mass, materially decreases the time consumed in the washing operation.

While a propeller of a particular type has been described, the invention is intended to be sufficiently comprehensive to include the use of means for preventing swirling in combination with any agitating device which tends to produce a swirling operation. It is also pointed out that, while particular reference has been made to the stirring of liquids having different relative specific gravities to form mechanical mixtures or chemical combinations, the apparatus is capable of mixing liquids of the same specific gravity, or liquids and finely divided solids, or solids alone in granular, pulverulent or other form capable of being intermingled, as may be found desirable.

What is claimed, is:

1. A mixing and stirring device comprising: a container for a mass of agitable material, a rotatable member of relatively smaller diameter than that of the container and disposed within said container causing by its rotation a stream of the material in one direction longitudinally of the axis of the rotatable member and setting up a complementary counter stream longitudinally in the opposite direction and means for counteracting the swirling effect upon the material of the rotatable member while maintaining the opposed longitudinal streams.

2. A mixing and stirring device comprising: a container for a mass of agitable material, a rotatable member of relatively smaller diameter than that of the container and disposed within said container causing by its rotation a stream of the material in one direction longitudinally of the axis of the rotatable member and setting up a com-

plementary counter stream longitudinally in the opposite direction and a draft tube 65 surrounding said rotatable member and in spaced relation to the walls of the container and having provisions for counteracting the swirling effect of the rotatable member upon the material while maintaining the opposed 70 longitudinal streams.

3. A mixing and stirring device comprising: a container for a mass of agitable material, a rotatable member of relatively smaller diameter than that of the container 75 and disposed within said container causing by its rotation a stream of the material in one direction longitudinally of the axis of the rotatable member and setting up a complementary counter stream longitudinally 80 in the opposite direction and a draft tube of substantially Venturi tube formation surrounding said rotatable member in spaced relation from the wall of the container for counteracting the swirling effect of the ro- 85 tatable member upon the material while maintaining the opposed longitudinal streams.

4. A mixing and stirring device comprising: a container for a mass of agitable material, a screw propeller of relatively smaller diameter than that of the container and disposed within said container causing by its rotation a stream of the material in one direction longitudinally of the axis of the 95 screw propeller and setting up a complementary counter stream longitudinally in the opposite direction and means for counteracting the swirling effect upon the material of the screw propeller while main- 100 taining the opposed longitudinal streams.

5. A mixing and stirring device comprising: a container for a mass of agitable material, a screw propeller of relatively smaller diameter than that of the container and disposed within said container causing by its rotation a stream of the material in one direction longitudinally of the axis of the screw propeller and setting up a complementary counter stream longitudinally in 110 the opposite direction and a draft tube surrounding said screw propeller and in spaced relation to the walls of the container and having provisions for counteracting the swirling effect of the screw propeller upon 115 the material while maintaining the opposed longitudinal streams.

6. A mixing and stirring device comprising: a container for a mass of agitable material, a screw propeller of relatively smaller diameter than that of the container and disposed within said container causing by its rotation a stream of the material in one direction longitudinally of the axis of the rotatable member and setting up a comple- 125 mentary counter stream longitudinally in

the opposite direction and a draft tube of substantially Venturi tube formation surrounding said rotatable member in spaced relation from the wall of the container for
5 counteracting the swirling effect of the screw propeller upon the material while maintaining the opposed longitudinal streams.

Signed at New York, in the county of New York and State of New York, this 31 day of Jan., A. D. 1917.

ALFRED H. STEVENS.

Witnesses:

ALBERT O. HARTLEY,
CHARLES J. VOLLMER.