Jan. 19, 1965 B. B. CHAPMAN 3,166,303

POWER-DRIVEN MIXING APPARATUS

Filed Aug. 9, 1961 2 Sheets-Sheet 1

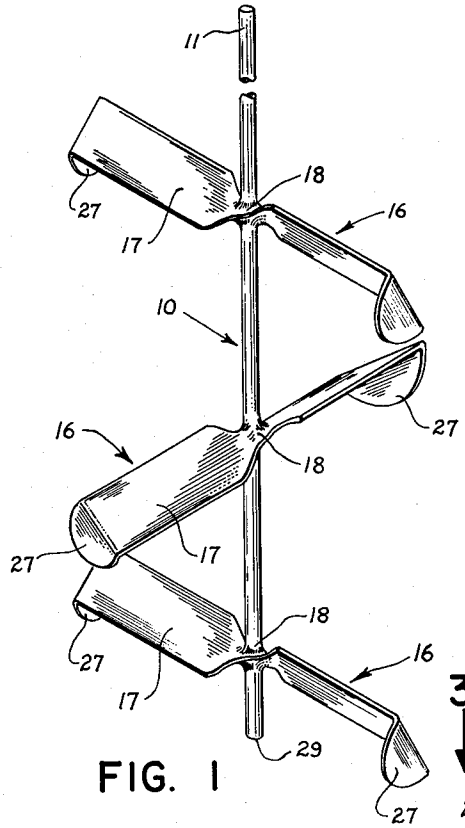

FIG. 1

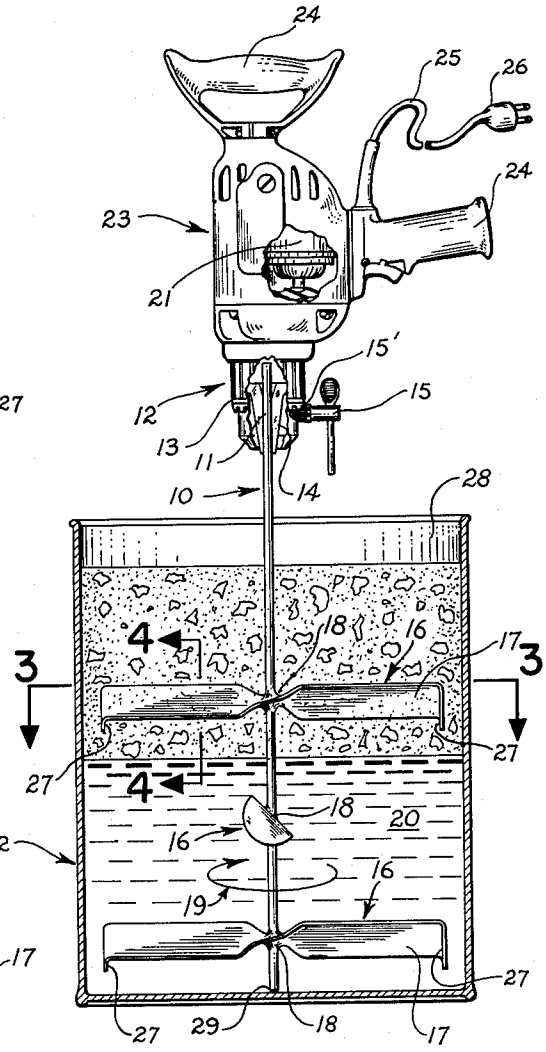

FIG. 2

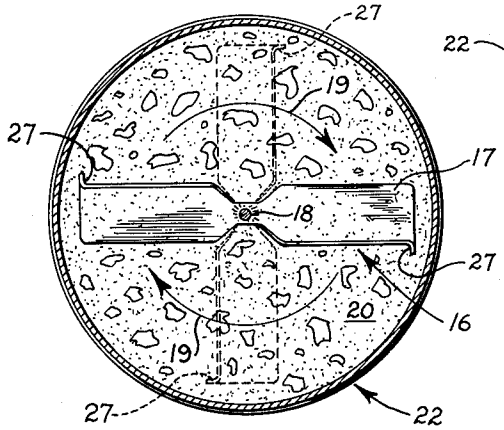

FIG. 3

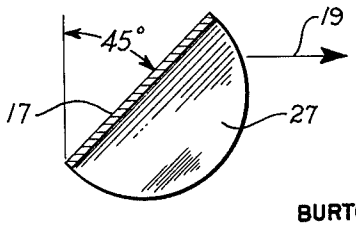

FIG. 4

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POWER-DRIVEN MIXING APPARATUS

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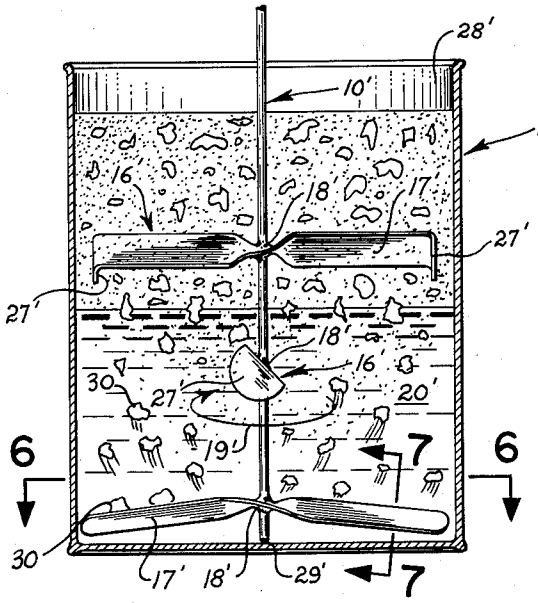

FIG. 5

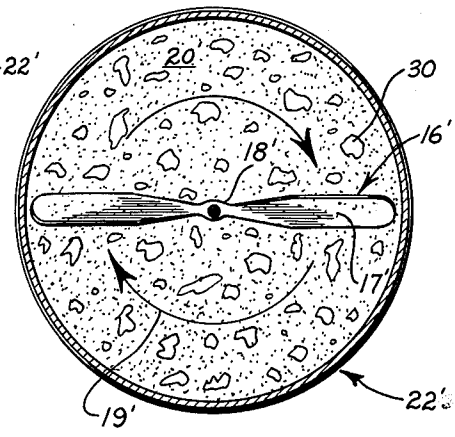

FIG. 6

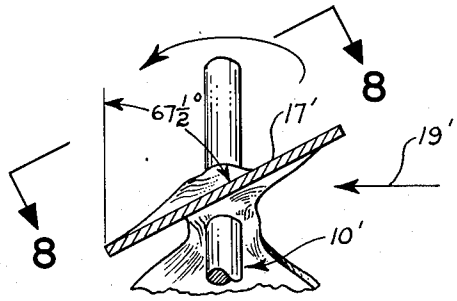

FIG. 7

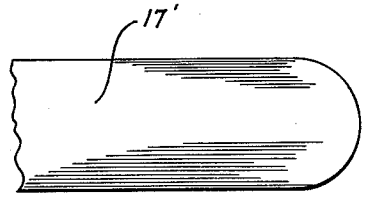

FIG. 8

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United States Patent Office 3,166,303
Patented Jan. 19, 1965

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POWER-DRIVEN MIXING APPARATUS

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Filed Aug. 9, 1961, Ser. No. 130,399
4 Claims. (Cl. 259—135)

Generally speaking, the present invention relates to the mixing apparatus art and, more particularly, pertains to a novel portable power-driven mixer attachment, per se, adapted to be attached to a portable driving motor (which, in certain forms, may be a portable electric drill motor). The invention is also directed to the combination of the mixer attachment and the driving motor.

The portable power-driven mixer apparatus of the present invention is adapted for use in mixing relatively large volumes of liquids which, in certain cases, may contain large quantities of solid material of particulate form with the particle sizes ranging from very finely divided plaster, gypsum, or cement, through intermediate particle sizes such as sand, or the like, to relatively large particle sizes, in certain instances, such as rock or aggregate, although the invention is not specifically so limited.

The liquid carrying the above-mentioned materials may have such a heavy concentration of them as to comprise a relatively thick, pasty, or very viscous slurry.

The apparatus of the present invention is extremely well adapted for mixing plaster, mortar, cement, or concrete in a container such as a cylindrical barrel or drum, although not specifically so limited. Furthermore, the apparatus of the present invention lends itself very well to being fastened to a conventional electric drill, which is generally available on almost any construction job, to comprise the driving unit for the mixer attachment, thus making it unnecessary to purchase a special and completely powered concrete mixer, plaster mixer, or the like, which is a relatively bulky and expensive unit and which is otherwise unusable.

Thus, it can be readily seen that the apparatus of the present invention is not only money-saving but space-saving, since the conventional electric drill usually present on a construction job may be employed for attachment to the mixer unit of the present invention and the cement, mortar, or the like, to be mixed with a quantity of water, may be placed in any suitable drum or barrel for mixing just prior to actual use of the mixed cement or mortar.

It will readily be understood that one prior art problem which has more or less precluded the use of a portable mixer driven by a portable electric drill is the fact that the necessary size of such a unit for mixing a barrel full of cement and water or mortar and water would require that the combined drill and mixer unit weigh approximately 40 lbs. or so. This would necessarily make it quite difficult for a person to use the device for mixing cement or mortar with water in a barrel since this operation would normally require holding the mixing unit for some time and probably moving it up and down within the barrel a number of times to facilitate the mixing operation. This would be extremely tiresome to do in view of the combined weight of the apparatus and would require a very strong man to perform the mixing operation.

However, the novel mixer attachment of the present invention embodies an inventive concept and principle which substantially meets and overcomes the above-mentioned problem and makes a portable mixing unit of the type referred to above a practical, convenient, and easy-to-use device which does not require that the user have strength beyond the ordinary person.

This novel feature arises from the fact that the mixer attachment of the present invention is provided with a

longitudinal shaft which is normally downwardly inserted into the container or barrel carrying the medium which is to be mixed; said shaft being provided with blade means inclined upwardly and forwardly in the direction of rotation thereof whereby to exert a downward force upon the liquid medium to be mixed during rotation of the blade means by the driving motor means, which has the effect of producing an oppositely and upwardly directed reactive force tending to partly support the weight of the entire mixing unit including the driving motor whereby to make it much easier to handle. For example, in one working model of the present invention which weighs approximately 40 lbs. when attached to the driving electric drill motor, the operation of said upwardly and forwardly inclined blade means results in producing a reactive upward acting force equal and opposite to about 30 lbs. of the weight of the unit whereby to leave an effective weight to be supported by the operator of only approximately ten lbs. This makes it possible for the operator to move the entire unit up and down in the medium being mixed within the container or barrel without much effort on the operator's part and also makes it possible for the operator to mix a number of batches of mortar or cement with minimum fatigue. Furthermore, the arrangement of the blade means, in addition to the partial supporting effect which it produces, also produces a very effective churning and mixing of the medium which is to be mixed and does so with a minimum of centrifugal-force-caused outward splashing or displacement of the medium being mixed, by reason of the provision of novel blade tip means carried by the blades which inhibit such outward splashing or displacement of the liquid medium being mixed.

It is an object of the present invention to provide a novel mixing apparatus of the character referred to above which may comprise the combination of a portable driving motor and mixer attachment of the type referred to above or which may comprise the mixer attachment, per se, which is adapted for connection to such a portable driving motor.

It is a further object of the present invention to provide mixing apparatus of the character referred to above wherein the portable driving motor to which the mixer attachment is adapted to be removably engaged or with which the mixer attachment is in combination may comprise a conventional controllably electrically operable portable hand drill including an electric motor and a drill chuck adapted to removably engage the upper end of the longitudinal shaft of the mixer attachment.

It is a further object to provide mixing apparatus of the character referred to above, wherein the blade means comprises a plurality of individual blades transversely carried by the longitudinal shaft means at longitudinally spaced locations therealong.

It is a further object to provide novel mixing apparatus of the character referred to in the preceding object wherein each successive one of said blades along the longitudinal shaft means is differently angularly rotatably related with respect to the axis of the shaft means than the preceding blade.

It is a further object to provide novel mixing apparatus of the character referred to in the second preceding object wherein the bottom blade is downwardly and forwardly inclined in the direction of rotation whereby to throw upwardly larger or heavier particles or elements carried in the liquid medium being mixed by the blade means.

It is a further object to provide novel mixing apparatus of the character referred to above wherein the longitudinal shaft has a second or bottom end adapted to rest upon the bottom of a container (such as a cylin-

drical barrel, or the like, having an open top) adapted to carry the medium which is to be mixed by the blade means.

It is a further object to provide novel mixing apparatus of the character referred to above which is of relatively simple, cheap, foolproof, easy-to-clean and easy-to-use construction such as to be conducive to widespread use thereof.

Further objects are implicit in the detailed description which follows hereinafter (which is to be considered as exemplary of but not specifically limiting the invention) and said objects will be apparent to persons skilled in the art after a careful study of the detailed description which follows.

For the purpose of clarifying the nature of the present invention, several exemplary embodiments are illustrated in the hereinbelow-described figures of the accompanying drawings and are described in detail hereinafter.

FIG. 1 is a perspective partly broken-away view of one exemplary embodiment of the mixer attachment means of the present invention prior to engagement with respect to a portable driving motor such as a portable electric hand drill or the like.

FIG. 2 is a view of the mixer attachment of FIG. 1 after engagement with the chuck of a portable electric drill (including an electric motor) and shows the longitudinal shaft and the blade means in downwardly inserted mixing relationship within a hollow cylindrical container (taking the form of a metal drum or barrel). The barrel is shown in vertical section on the center plane thereof, while the attachment of the present invention and the driving electric drill are shown in partially broken-away elevation.

FIG. 3 is a view of the apparatus of FIG. 2 taken in the direction of the arrows 3—3.

FIG. 4 is an enlarged view of one of the blade tip means taken in the direction of the arrows 4—4 of FIG. 2 and is illustrative of the various other blade tip means, also.

FIG. 5 is a view generally similar to FIG. 2 but illustrates a modified form of the invention wherein the bottom blade is of a reverse pitch type adapted to throw upwardly heavy particles or elements such as large gravel or aggregate when the mixture being mixed is concrete containing such large aggregate or gravel.

FIG. 6 is a view taken in the direction of the arrows 6—6 of FIG. 5.

FIG. 7 is an enlarged fragmentary view taken in the direction of the arrows 7—7 of FIG. 5.

FIG. 8 is an elevational view of the tip of the bottom reverse-pitch blade viewed in the direction of the arrows 8—8 of FIG. 7.

Referring to FIGS. 1–4 for exemplary purposes, one illustrative embodiment of the invention takes a typical exemplary form wherein it comprises a longitudinal shaft, indicated generally at **10**, which is normally vertically directed when in mixing use as shown in FIG. 2 and which has an engaging portion **11**, which in the example illustrated is at the upper end of the shaft **10**, adapted to removably engage a chuck or collet such as the one shown at **12** for exemplary purposes and which, in the form illustrated, comprises a typical split chuck of the type adapted to be opened and closed by rotating the collar **13** so as to cause movement of the tapered engaging fingers **14** in a manner whereby to grip the engaging portion **11** of the shaft **10** as shown in FIG. 2 or whereby to become disengaged from said engaging portion **11** of the shaft **10** as a result of oppositely directed rotation of the collar **13**. In the specific example illustrated, rotation of the collar **13** is adapted to be accomplished by a splined or toothed tapered key means, such as that shown at **15**, which engages the similar splined or gear-toothed portion **15'** of the collar **13**. This structure is well-known in the art and, therefore, will not be described in detail.

The longitudinal shaft **10** is also provided with blade means, indicated generally at **16**, which, in the specific example illustrated, comprises a plurality of individual blades **17**, each being substantially transversely carried by the longitudinal shaft means **10** at longitudinally spaced locations therealong in a fixedly attached manner as indicated at **18**.

In the specific example illustrated, each successive one of the blades **17** along the longitudinal shaft means **10** is differently angularly rotatively related with respect to the axis of the shaft **10** than the preceding blade **17**, although the invention is not specifically so limited in all forms of the invention.

In the specific example illustrated, each of the three blades **17** is inclined upwardly and forwardly in the direction of rotation thereof, as indicated by the arrow **19**, whereby to exert a downward force upon a medium **20** which is adapted to be mixed during rotation of the blade means **16** by the motor means **21** driving the chuck **12**.

This will produce an oppositely and upwardly directed reactive force on the rotating blades **17** tending to partly neutralize and support the weight of the entire unit. This also effectively forces the medium **20** which may consist of liquid and various particulate, finely divided material such as mortar, cement, or the like, initially placed on top of the water, downwardly so that a churning and very efficient mixing action will occur in the interior of the hollow container, indicated generally at **22**.

In the specific example illustrated, the hollow container **22** takes the form of a hollow, cylindrical, upwardly open steel drum of an approximately 30-gallon capacity, or the like, although the invention is not limited to use with this specific type of container but may be used with various different containers.

Also in the specific example illustrated, the driving motor means **21** comprises a portion of a portable electric drill designated generally by the reference numeral **23** and having conventional manually graspable handle means **24** adapted to readily support the entire unit during a mixing operation—particularly in view of the effectively reduced weight of the entire unit produced by the upward reactive force exerted by the medium **20** on the upwardly and forwardly inclined blades **17** as a result of driving rotation of said blades forwardly by the motor **21**.

Also, the electric drill **23** is provided with an electric power supply cord **25** and plug means **26** for connection to any suitable electric outlet for energizing the electric motor means **21**.

It should be noted that each of the blades **17** is provided with a substantially downwardly directed blade tip means **27** (although the bottom blade may not have them in certain forms of the invention) which act to effectively restrict centrifugal-force-caused outward splashing or displacement of the solid-particle-carrying liquid medium **20** which would normally occur as a result of the high-speed rotation of the blade means **16**, particularly adjacent the open top **28** of the container **22**. This type of splashing out of the open top **28** of the container **22** is virtually entirely prevented by the blade tip means **27**.

The shaft **10** has a second or bottom end **29** which is adapted to rest upon the bottom of the container or barrel **22** when the mixing apparatus is fully inserted into the container **22**. This will support the apparatus whenever the operator desires to place it in this position. However, this leaves the apparatus completely free to be vertically reciprocated through the medium **20** to facilitate mixing whenever the operator so desires.

FIGS. 5–8 illustrate a modified form of the invention which is generally similar to the first form illustrated in FIGS. 1–4 and which, therefore, has similar parts designated by similar reference numerals, primed, however. In this modification, the major difference from the first form of the invention shown in FIGS. 1–4 is the fact that the bottom blade **17'** is of different configuration from the bottom blade **17** of the first form of the invention and

has a reverse pitch such that the blade is inclined downwardly and forwardly in the direction of rotation of the shaft **10'** whereby to throw upwardly relatively large or heavy solid particles being mixed in the medium **20'**, such as the aggregate particles **30** shown in FIG. 5 comprising a part of the medium **20'** being mixed which, in this example, might comprise concrete, or the like. This type of reverse pitch bottom blade is only necessary where relatively large or heavy particles comprise a part of the medium being mixed.

It should be noted that the engageable portion **11** or **11'** of the shaft **10** or **10'** may not be round in all forms of the invention but, in certain versions of the invention, may be square, splined, or otherwise keyed for positive locking with respect to a driving motor means. Furthermore, it should be noted that the portable driving motor means is not specifically limited to a portable electric hand drill but may comprise any suitable substantial equivalent thereto.

Furthermore, it should be noted that the number of the blades may be modified, as may the spacing and/or pitch in accordance with the volume and/or depth of the material to be mixed and/or the thickness or consistency of the material to be mixed. These can be so arranged as to provide an optimum load on the motor, while providing maximum mixing efficiency of the blades in a particular medium to be mixed. Additionally, it should be noted that the blade means may be provided with means for controllably adjusting the pitch thereof in certain forms of the invention, thus making the invention universally adaptable for mixing virtually any consistency of liquid medium or solid-particle-carrying liquid medium, or the like.

It should also be noted that the cross-sectional, plan view, and/or elevational configuration of the blades and/or the blade tip means may be modified substantially within the basic spirit and/or scope of the present invention. Also, it should be noted that in certain forms of the invention where the mixing operation will take place virtually completely laterally confined, the blade tip means may be eliminated, since virtually no splashing is possible under such conditions of operation.

It should be understood that the figures and the specific description thereof set forth in this application are for the purpose of illustrating the present invention and are not to be construed as limiting the present invention to the precise and detailed specific structure shown in the figures and specifically described hereinbefore. Rather, the real invention is intended to include substantially equivalent constructions embodying the basic teachings and inventive concept of the present invention.

I claim:

1. Power-driven mixing apparatus comprising a longitudinal shaft means, normally vertically directed when in use, having an upper portion adapted to be rotatively driven by a driving motor means, said longitudinal shaft means being provided with projecting blade means including a first portion thereof comprising a plurality of individual blades each being substantially transversely carried by said longitudinal shaft means at longitudinally spaced locations therealong with said individual blades being provided at opposite ends thereof with downwardly and forwardly directed blade tip means for restricting centrifugal-force-caused outward splashing of a liquid medium adapted to be mixed by the blade means when rotated within a container, each of said plurality of individual blades comprising said first portion of said blade means being inclined upwardly and forwardly in the direction of rotation thereof and having an upwardly and forwardly inclined bottom surface whereby to exert a downward force upon a liquid medium to be mixed during rotation of said blade means by said driving motor means, said projecting blade means also including a second portion comprising a bottom blade substantially transversely carried by the longitudinal shaft means below said plurality of individual blades comprising said first portion of said blade means and being downwardly and forwardly inclined in the direction of rotation of said longitudinal shaft means and having a downwardly and forwardly inclined upper surface whereby to throw upwardly heavy constituents of the liquid medium being mixed by said blade means and to exert an upward force thereupon, the total area of said upwardly and forwardly inclined bottom surfaces of said plurality of individual blades comprising said first portion of said blade means being substantially greater than the total area of said downwardly and forwardly inclined upper surface of said bottom blade comprising said second portion of said blade means whereby to exert a net differential downward force upon the liquid medium to be mixed during rotation of said blade means by said driving motor means and whereby to produce an oppositely and upwardly directed net differential reactive force tending to partly neutralize the weight of the driving motor means, the longitudinal shaft means, and the blade means, and whereby to positively produce vertical circulation of the liquid medium which is to be mixed by reason of said unbalanced vertical forces produced thereon by said first and second portions of said blade means.

2. Apparatus as defined in claim 1 wherein each successive one of said blades along the longitudinal shaft means is differently angularly rotatively positioned than the preceding blade.

3. Apparatus as defined in claim 1 wherein said longitudinal shaft means has a lower portion adapted to rotatively rest upon the bottom of a container adapted to carry the liquid medium which is to be mixed by the longitudinal shaft means and blade means.

4. A portable power-driven mixer attachment comprising a longitudinal shaft means, normally vertically directed when in use, having an upper engaging end adapted to removably engage a chuck rotatably connected to, and adapted to be driven by, the shaft of a controllably energizable electric motor of a portable hand-operated electric drill, said longitudinal shaft means being provided with outwardly projecting blade means including a first portion thereof comprising a plurality of individual blades each having substantially transversely carried by said longitudinal shaft means at longitudinally spaced locations therealong with each successive one of said blades along the longitudinal shaft means being differently angularly rotatively positioned than the preceding blade relative to the longitudinal axis of rotation of said longitudinal shaft means and extending substantially equal distances on each side thereof, said individual blades being provided at opposite ends with downwardly and forwardly directed blade tip means for restricting centrifugal-force-caused outward splashing of a liquid medium adapted to be mixed by the blade means when rotated within a container by said driving electric motor of said electric drill, each of said plurality of individual blades comprising said first portion of said blade means being inclined upwardly and forwardly in the direction of rotation thereof and having an upwardly and forwardly inclined bottom surface whereby to exert a downward force upon a liquid medium to be mixed during rotation of said blade means by said electric motor of said electric drill, said projecting blade means also including a second portion comprising a bottom blade substantially transversely carried by the longitudinal shaft means below said plurality of individual blades comprising said first portion of said blade means and being downwardly and forwardly inclined in the direction of rotation of said longitudinal shaft means and having a downwardly and forwardly inclined upper surface whereby to throw upwardly heavy constituents of the liquid medium being mixed by said blade means and to exert an upward force thereupon, the total area of said upwardly and forwardly inclined bottom surfaces of said plurality of individual blades comprising said first portion of said blade

means being substantially greater than the total area of said downwardly and forwardly inclined upper surface of said bottom blade comprising said second portion of said blade means whereby to exert a net differential downward force upon the liquid medium to be mixed during rotation of said blade means by said driving motor means, and whereby to produce an oppositely and upwardly directed net differential reactivation force tending to neutralize substantially more than two thirds of the weight of the electric motor of said electric drill, the longitudinal shaft means, and the blade means, and whereby to positively produce vertical circulation of the liquid medium which is to be mixed by reason of said unbalanced vertical forces produced thereon by said first and second portions of said blade means; said longitudinal shaft means having a bottom end adapted to rotatively rest upon the bottom of a container adapted to carry the liquid medium which is to be mixed by the longitudinal shaft means and the blade means.

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